Georgia Institute of Technology

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GENERAL CATALOG

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Georgia Institute of Technology

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General Catalog 2005 - 2006
Georgia Institute of Technology
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This version of the Georgia Tech *General Catalog* was current as of the date of printing in May 2005. For the most up-to-date version of the *General Catalog*, visit **www.catalog.gatech.edu**. In addition, this is the final printed version of the *General Catalog*. Beginning in May 2006, the *General Catalog* will be available online only.

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Georgia Tech Vision and Mission Statements

Our vision is bold: "Georgia Tech will define the technological research university of the 21st century and educate the leaders of a technologically driven world." Our mission is clear: "to provide the state of Georgia with the scientific and technological knowledge base, innovation, and workforce it needs to shape a prosperous and sustainable future and quality of life for its citizens." It is achieved through educational excellence, innovative research, and outreach in selected areas of endeavor. Georgia Tech's mission in education and research will provide a setting for students to engage in multiple intellectual pursuits in an interdisciplinary fashion. Because of our distinction for providing a broad but rigorous education in the multiple aspects of technology, Georgia Tech seeks students with extraordinary motivation and ability and prepares them for lifelong learning, leadership, and service. As an institution with an exceptional faculty, an outstanding student body, a rigorous curriculum, and facilities that enable achievement, we are an intellectual community for all who seek to become leaders in society. Georgia Tech values its position as a leading public research university in the United States and understands full well its responsibility to advance society toward a proper, fair, and sustainable future. By seeking to develop beneficial partnerships within public and private sectors in education, research, and technology, Georgia Tech ensures relevance in all that it does and assures that the benefits of its discoveries are widely disseminated and used in society. Georgia Tech pursues its mission by giving the highest respect to the personal and intellectual rights of everyone in our community. In return, we expect that all members of our community will conduct themselves with the highest ethical principles.

Human Relations Statement

Georgia Tech is a diverse community, composed of individuals and groups with a variety of religious, racial, national, cultural, sexual, and educational identities. The continuing need to deal constructively with this diversity is one of the great challenges facing us over the next two decades.

The challenge is both professional and personal. Professionally, we increase the opportunities in our lives if we are able to constructively manage and guide such diversity with tolerance. The challenge is also personal because each of us has a legacy of religious, racial, national, cultural, sexual, and educational prejudices that influences our lives.

Each member of our community must be committed to the creation of a harmonious climate because one cannot be neutral to this challenge. Those who are committed to it strengthen Georgia Tech and themselves. Individuals who choose not to commit to the challenge, via acts of intolerance, jeopardize their continued affiliation with the Institute. Those acts may be defined as attempts to injure, harm, malign, or harass a person because of race, religious belief, color, sexual orientation, national origin, disability, age, or gender.

To belong to a global society, Georgia Tech must be a pluralistic institution. Only by embracing diversity, multiformity, and variety can we gain stature, strength, and influence in that global society.

The Institute is committed to maintaining academic and working environments free of objectionable conduct and communication that would be construed as sexual harassment. The determination of what constitutes sexual harassment will vary with particular circumstances, but it can be described as unwanted sexual behavior, such as physical contact or verbal comments that adversely affect the environment of an individual.

Important Web Sites at Georgia Tech

The following Web addresses will help you find the information you need about Georgia Tech:

Georgia Tech Web Site
www.gatech.edu

Admissions (undergraduate)
www.admission.gatech.edu

Admissions (graduate)
www.grad.gatech.edu/admissions

Athletic Association
www.ramblinwreck.com

Bursar's Office (payment/refund policies)
www.bursar.gatech.edu

Buzzport (campus portal)
www.buzzport.gatech.edu

Campus Organizations
www.cyberbuzz.gatech.edu

Career Services
www.career.gatech.edu

Dean of Students Office
www.deanofstudents.gatech.edu

Dining Services
www.gatechdining.com

Disabled Assistance Program
www.adapts.gatech.edu

Financial Aid
www.finaid.gatech.edu

Freshman Experience Program
www.freshmanexperience.gatech.edu

Health Services
www.health.gatech.edu

Honor Advisory Council
www.honor.gatech.edu

Housing Department
www.housing.gatech.edu

Identification/Meal Plan/Debit Card
www.buzzcard.gatech.edu

International Student Services
www.oie.gatech.edu

OMED (Office of Minority Education Development)
www.omed.gatech.edu

Orientation (new students)
www.faset.gatech.edu

Parking and Transportation (vehicle registration, campus shuttles)
www.parking.gatech.edu

Police (campus)
www.police.gatech.edu

President's Scholarship Program
www.psp.gatech.edu

Professional Practice Division
www.profpractice.gatech.edu

Registrar's Office
www.registrar.gatech.edu

Registration, Student Access System
https://oscar.gatech.edu

Academic Calendar

For an up-to-date Georgia Tech academic calendar, visit **www.registrar.gatech.edu**.

GEORGIA TECH: ON YOUR TERMS

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Choosing the right university is a big decision. And making that choice means defining your terms. Which elements of the college experience are most meaningful to you? How do you envision your future? At Georgia Tech, you'll enjoy top-ranked, technology-focused academics, big-time college athletics, motivated students, a world-renowned faculty, nationally recognized research, study abroad opportunities, and a park-like campus in an international city. What's more, you can customize your college experience to meet your unique goals through a variety of programs, including cooperative education, internships, pre-professional programs, career building activities, and more. Whatever your choices, Tech wants you to succeed in school and after graduation. It's up to you!

That's Georgia Tech…on your terms.

Academic Excellence

The core purposes of a university education are to help students stretch their intellectual muscles, conquer new academic territory, and acquire the kind of learning that not only matters now, but will also matter for a lifetime. Georgia Tech provides that kind of learning through its thirty-five undergraduate programs, forty-five master's programs, and twenty-nine Ph.D. programs.

Georgia Tech is ranked among the top ten public universities in the country by *U.S. News & World Report*, which also routinely lists many of Tech's undergraduate and graduate programs in the top 10.

Georgia Tech is also renowned for providing a highly diverse educational environment. The Institute consistently ranks among the top universities in the country in the number of engineering, computer science, and mathematics degrees awarded to women, African Americans, and all underrepresented minorities. Each year the number of minority and female students continues to grow, ensuring that Tech's students will be ready to thrive in the multicultural workforce.

Tech's high-quality faculty is another key contributor to the Institute's educational environment. More than 90 percent of the faculty hold Ph.D.s, and Tech's prominent faculty are recognized worldwide for their excellent research and teaching skills. In 2004, thirteen young faculty won National Science Foundation CAREER Awards, bringing Tech's cumulative total to ninety-six, and the second in the nation. Faculty entrepreneurship is another vital element of the Tech philosophy. During the first six months of 2004, Tech's Economic Development Institute helped Georgia companies with $336 million in government contracts.

Both faculty and administrators help to ensure that the Georgia Tech curriculum reaches far beyond the scope of traditional major classes with programs that provide a competitive career advantage. Many forward-thinking students choose to participate in the Cooperative Plan, an alternating work/study program that is one of the largest voluntary programs of its kind in the United States. More than 3,000 students participate in this program, which provides not only valuable work experience, but also income to offset college expenses.

For students who want a more flexible program, internships are available with a wide variety of employers. Regardless of whether students choose a co-op or internship position, or pursue a pre-professional program to prepare for graduate or professional school, Tech helps students lay the groundwork for a successful future.

In addition, many students study and/or work abroad, providing invaluable academic and industry experience. One of Georgia Tech's primary strategic goals is to have at least 50 percent of its undergraduates participate in an international experience before they graduate.

Research Leadership

From its beginnings more than a century ago, the Georgia Institute of Technology has established a tradition of excellence in technological research as well as education. The Institute is well known for its high academic standards and stands among the top ranks of U.S. research universities with a clear vision for leadership in providing a cutting-edge, technological education for the twenty-first century.

Georgia Tech is one of the South's largest industrial and engineering research agencies. Research is conducted for industry and government by the Georgia Tech Research Institute, various academic schools and departments, and more than eighty interdisciplinary research units on and off campus. In 2004, the Institute's new research award funding reached $370 million, representing more than 2,100 funded research proposals. The Georgia Center for Advanced Telecommunications Technology (GCATT) building houses several Georgia Tech research centers as well as research centers from other universities, high-tech business incubators, and established telecommunications businesses. The GCATT partnership of academia, industry, and government is helping propel Georgia's telecommunications industry to world prominence.

Georgia Tech is also a key player in the state's leading economic development initiative, whose goal is to make Georgia a world leader in the design of broadband (high-speed) communications systems, devices, and chips – the next-generation of hardware/software infrastructure – thus creating in Georgia both high-paying design jobs and many more support and supply-chain jobs.

By insisting the Institute's major interdisciplinary research centers – focusing on topics from architectural conservation to biotechnology, microelectronics, and transportation research – also develop distinct undergraduate and graduate educational programs, the Georgia Tech administration aims to keep its educational programs on the leading edge of discovery and development.

Campus Atmosphere

Life on the Tech campus and in the exciting city of Atlanta provides students with lots of new people and adventures that truly transform them, making students even better prepared for the next leg of their journey. Tech students meet countless motivated classmates, interact with supportive faculty and staff, find multiple opportunities to lead within the hundreds of student activities and organizations available, and become part of a family committed to making the world better. At the newly renovated, $45 million Campus Recreation Center, students can enjoy the state-of-the-art aquatic center and a variety of fitness and recreational venues. And Technology Square, opened in 2003, extends the campus into the heart of Midtown Atlanta's business community with the new Georgia Tech Hotel, Management building, the Global Learning and Conference Center, and a variety of retail outlets that serve both the campus and Midtown residents. When they venture into the city of Atlanta, students discover a global community with incredible cultural, recreational, and sports offerings.

Many students cite the interactive learning atmosphere at Georgia Tech as one of the primary benefits of attending the Institute. Through hands-on learning experiences such as labs, field studies, and team projects, Tech students are prepared for the real world. Continued recruitment and job placement of high-quality students is also an advantage of attending Tech. The Career Services Office is one of the nation's most successful and innovative. Upon graduation, approximately 70 percent of Tech students have already accepted a job or been accepted to graduate school.

Tech's administration and staff emphasize student services as well as academics. Centralized student services, the Student Success Center, and renovated and new residence halls are some of the efforts to further enhance the quality of life on campus. The strong work ethic at Tech is balanced by a collegiate atmosphere incorporating both intercollegiate and intramural sports, campus traditions, and 350 student organizations. Along side their academic achievements, Tech students are also active in the community, earning a well-rounded education through community service activities.

There's no doubt that Georgia Tech stands out as a distinctively different kind of university, one that is eagerly encouraging and developing the revolutionary technologies of the twenty-first century. Equipped with the extremely rich resources of an outstanding student body and faculty; strong partnerships with business, industry, and government; and support from alumni and friends, the Georgia Institute of Technology is poised to fulfill its goals, as well as meet and exceed the challenges of the future.

Academic Offerings

Through the Colleges of Architecture, Computing, Engineering, Management, Sciences, and the Ivan Allen College of Liberal Arts, Georgia Tech offers curricula leading to degrees in thirty-five undergraduate majors, six undesignated bachelor of science degrees, forty-five master's programs, and thirty doctoral programs as well as preparatory programs for law, dental, medical, and veterinary schools. The "Information for Undergraduate Students" and the "Information for Graduate Students" sections of this book contain general information about these degree programs.

Accreditation

The Georgia Institute of Technology is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools (SACS) to award bachelor's, master's, and doctoral degrees.

Inquiries to SACS concerning alleged failures by the Georgia Institute of Technology to comply with or maintain accreditation should be forwarded to:

Southern Association of Colleges and Schools
1866 Southern Lane
Decatur, Georgia 30033-4097
Telephone number: 404.679.4501

In addition, many Institute programs are specifically accredited by appropriate professional certifying agencies.

The Engineering Accreditation Committee (EAC) of the Accreditation Board for Engineering and Technology Inc. (ABET) has accredited the curricula leading to bachelor's degrees in the following fields: aerospace engineering, chemical and biomolecular engineering, civil engineering, computer engineering, electrical engineering, industrial engineering, materials science and engineering, mechanical engineering, nuclear and radiological engineering, and polymer and fiber engineering. The EAC of ABET has accredited the advanced program leading to the master's degree in environmental engineering.

The American Chemical Society has certified the curriculum leading to the bachelor's degree in chemistry; the Computing Accreditation Commission (CAC) of ABET Inc. has accredited the curriculum leading to the bachelor's degree in computer science; the Association to Advance Collegiate Schools of Business has accredited the curriculum for all degrees awarded by the College of Management; the Human Factors and Ergonomics Society has accredited the curriculum leading to the Ph.D. in Engineering Psychology; the National Architectural Accrediting Board has certified the curriculum leading to the Master of Architecture; the American Council for Construction Education has accredited the curriculum leading to the Bachelor of Science in Building Construction; and the Planning Accreditation Board has accredited the curriculum leading to the Master of City and Regional Planning.

The Counseling Center is accredited by the International Association of Counseling Services.

Student Life

Numerous extracurricular activities are available for students. For complete information concerning these services, see the *Student Handbook*, available at the Division of Student Affairs office.

Office of the Dean of Students

The Office of the Dean of Students, a unit of the Division of Student Affairs, strives to create an environment in which student leadership occurs, tradition and diversity are respected, and learning is enhanced. The dean's office recognizes the importance of each individual student, nurtures personal growth, and supports academic pursuits through advocacy, services, and programs.

Students of nontraditional age (over twenty-five) who would like information regarding campus resources, such as housing and other specific services, may call the dean's office for assistance.

Information on other areas within the Office of the Dean of Students can be found in various sections of this catalog. The office is located in 210 Student Services Building. Students may drop in or call 404.894.6367 to schedule an appointment.

Community Services

Georgia Tech applies its resources through community services to the needs of the community and provides an outlet for creative individual responses to social problems. The MOVE (Mobilizing Opportunities for Volunteer Experience) Office places individuals and groups with community agencies and organizes volunteer outings on a regular basis.

Counseling Center

The Counseling Center has a staff of psychologists and counselors who provide individual and group counseling on academic, career, and personal concerns whenever students request counseling services. The Center's career counseling helps students examine and work toward resolving personal and interpersonal issues related to selecting a major or career. The Center's library provides a program of computer-assisted study skills instruction (CASSI-GT) and information about careers through reference books; videos; a computer-assisted decision-making program (Kuder Career Planning System); catalogs from other colleges, business, and graduate schools; and a number of inventories and tests for determining occupational interests, abilities, and personality traits. More information is available at **www.counseling.gatech.edu**.

Career Services

Career Services offers a variety of services to help students explore, select, and pursue a meaningful career – from helping them choose a major to finding internship and full-time positions. The office provides career counseling and testing; career planning; seminars on job-search-related topics; mock interviews; resume critiques; externships; internship, part-time, and full-time job listings; salary surveys; recruiting company information; resume referral services; and graduate school information. The Career Library contains information on various career fields, career planning, graduate school, and job-search-related topics.

Career Services sponsors Career Focus in September, the Georgia Tech Majors Fair in November, and other events throughout the year. All seminars and events are listed on Career Services' Web site at **www.career.gatech.edu**.

Campus recruiting for internship and full-time positions takes place during the fall and spring semesters. Approximately 800 employers, representing a substantial number of Fortune 500 corporations, recruit on campus annually.

Visit Career Services in the Student Success Center or online at **www.career.gatech.edu**.

Diversity Issues and Programs/Women's Resource Center

The Office of Diversity Issues and Programs is responsible for fostering a vision of diversity appreciation reflective of the Institute's strategic plan, which enables students from all backgrounds and cultures to thrive and succeed at Tech. The Office provides an institutionalized approach for meeting the co-curricular needs of students by coordinating and planning educational opportunities that enhance interaction and learning across groups. Through intentional programming and training, the Office assists the campus to understanding, appreciating, and celebrating Tech's rich cultural diversity. For additional information, call 404.894.2561 or visit **www.diversity.gatech.edu**.

The Women's Resource Center enhances the performance and personal development of women at Georgia Tech by striving to create a more inclusive and supportive campus environment for women, and by promoting understanding among Georgia Tech's diverse community of women and men. Services and programs provide opportunities to involve female students in all phases of campus life. For additional information, call 404.385.0230 or visit **www.womenscenter.gatech.edu**.

Student Organizations

Georgia Tech has more than 350 chartered student organizations that offer a variety of activities for student involvement. These organizations are classified in the following categories: honor societies, governing boards, professional/departmental, service, educational, political, cultural/diversity, sport clubs, religious/spiritual, student media, performance, recreation, and Greeks.

Fraternities and Sororities

Georgia Tech's forty-two social fraternities and sororities are coordinated by Student Affairs. The groups offer a variety of activities, opportunities, and services to the Georgia Tech community.

Student Publications and Media

The student publications and radio communications boards oversee the budgeting and operation of the *Technique*, the official student newspaper; the *Blueprint*, the student yearbook; and other

student publications, in addition to the operation of the student radio station, WREK 91.1 FM.

Other student publications include the *North Avenue Review*, an open forum magazine, and *Erato*, the student literary magazine.

Department of Housing

The Department of Housing oversees the assignment, operation, and maintenance of on-campus rooms for 6,300 single students and 300 married students. Amenities include local telephone service, cable TV, high-speed Internet connectivity, learning centers, tutoring, laundry facilities, and fitness areas. In January 2005, the Department of Housing opened 394 new family apartments in the Tenth&Home family housing facility, which includes a mix of one- and two-bedroom luxury apartments designed to ensure a family's comfort, convenience, and success.

The residence hall community at Georgia Tech is an integral part of a student's total Tech experience. The Residence Life program within the Department of Housing is responsible for all residence hall matters, including student well-being, staffing, programs, policy formulation and residence hall government advising. In addition, our team includes Community Offices, ResNet computer networking and the GTCN cable television network. The Department of Housing is committed to providing a comfortable environment that promotes the growth and development of residents and supports the educational mission of the Institute. For more information, refer to the *Residential Living on the Georgia Tech Campus* brochure available at the Housing Office, or visit **www.housing.gatech.edu**.

Health Services

The Primary Care Center's Hours
(Appointment required except in cases of emergency)

Monday-Friday ..... 8:00 a.m.-6:00 p.m.
..... Full Staff
Sunday ..... 2:00 p.m.-5:00 p.m.
..... Clinic with limited staff for urgent care

The Wellness Center's Hours
Monday-Friday ..... 9:00 a.m.-5:00 p.m.

Health Services Telephone Number
404.894.1420 for appointments

Web site
www.health.gatech.edu

Health Services is an ambulatory health care clinic that provides medical care and health education for eligible students and spouses.

The Primary Care Center staff consists of general practice, family practice, and internal medicine physicians, as well as nurse practitioners, registered nurses, medical and radiological technologists, pharmacists, and health educators.

Specialists in gynecology, psychiatry, and radiology, as well as a registered dietician, are available for consultation for a nominal fee. Two Women's Health nurse practitioners are available for gynecological problems and preventive care, such as Pap smears. Contraceptive counseling and information on sexually transmitted disease are also available.

The Wellness Center is available to all Tech students and offers computer-assisted health and nutrition assessments, wellness seminars and events, an information resources center, and personal consultations.

Medical Entrance Form
Students will receive a Medical Entrance Form with their letter of acceptance. All students, graduate and undergraduate, should complete the form and mail it to Health Services before registration. In addition to the Medical Entrance Form, students must provide evidence of an updated immunization certificate and tuberculosis screening. Completed forms must be mailed to:

Health Services
Georgia Institute of Technology
740 First Drive
Atlanta, Georgia 30332-0470
Attention: Medical Records Dept.

Tuberculosis (TB) Screening
All matriculating students must provide documentation of TB screening prior to registration. Failure to do so will prevent registration. For information on required documentation, consult your admissions packet.

Immunizations
All Georgia Tech students must provide documentation of immunization for measles, mumps, and rubella (MMR) prior to attending class. Proof of immunization or immunity must be documented on a Certificate of Immunization by a medical practitioner. Students born before December 31, 1956, need only provide documentation of rubella immunity.

Eligibility for Treatment
Students enrolled in classes, co-op students, spouses of students enrolled in classes or the co-op program (if both the student and spouse have paid their health fees), cross-enrolled students who have paid their health fee for the semester, and continuing students with a current student I.D. are eligible for treatment, provided the health fee has been paid.

Terms of Eligibility
Once the health fee has been paid, students/spouses are eligible for services from the date paid through the end of break week for each semester; new students are eligible for services during the break week that precedes the semester they are entering if they can present proof that the fee was paid. Students who have graduated are no longer eligible for care.

Cost
A semester health fee is automatically assessed to students taking four semester hours or more. All others must pay the health fee at the Health Center or present the Health Center with proof that the health fee has been paid. A $10 late penalty will be assessed if the health fee is paid after the second week of each semester.

Special Health Considerations
It is the responsibility of all students to notify the Health Center, the School of Applied Physiology, and the Office of Disabled Student Services of any disability that would make participation in swimming, competitive sports, and aerobic training hazardous to their well-being. Any student requesting special consideration because of mental or physical disability should have his or her physician write an explanatory letter, giving full details of the disability and consequent limitations on physical activity, to the medical director of Health Services. This letter must accompany the Medical Entrance Form.

Health and Accident Insurance
Supplemental insurance to cover major illnesses and surgeries, specialist consultations, and diagnostic procedures (not available at Health Services) should be purchased by all students who are not included in their parents' or spouse's medical insurance plans. Generally, private hospitals will not admit patients who do not have hospitalization insurance.

Office of International Education

The Office of International Education provides comprehensive support for international education in three broad areas: support to international students and scholars, development of study abroad programs and advice to students about study abroad opportunities, and support to faculty, staff, and students to facilitate the internationalization of Georgia Tech. The office supports the internationalization of the curriculum, advocates for programs of study that prepare students to be globally competent, provides opportunities for faculty to acquire international education experiences, and serves the large population of international students at Georgia Tech.

The Office of International Education currently provides services to more than 2,600 international students from more than 75 countries. These students receive assistance in complying with U.S. immigration law, with cross-cultural adjustment, and in negotiating the academic and social environment of Georgia Tech. International student advisors work closely with student organizations and students themselves in helping them to realize their personal and academic goals.

Students enrolled at Georgia Tech who wish to study abroad may choose from a wide range of summer programs as well as semester-length study abroad programs. Such opportunities exist on every continent and in dozens of countries. Students engage in academic programs that allow them to earn credit that can be applied toward their major and graduation. Financial aid and scholarships can be used on approved study abroad programs. More than 850 students elect to participate in study abroad programs each year.

As a leading research institution, Georgia Tech attracts scholars from all over the world. More than 300 visiting scholars are currently engaged with Georgia Tech faculty in cutting-edge research.

A few of them also teach courses. These collaborative research activities and the contributions made by these visiting scholars help Georgia Tech maintain its national and international prominence as a technological institution.

The Office of International Education provides faculty with information about a variety of international opportunities, including overseas research/teaching fellowships, short-term overseas faculty study seminars, and funding opportunities for international research and for international revisions of the curriculum. The Fulbright Scholar program is housed at the Office of International Education. Faculty are encouraged to take advantage of the hundreds of teaching and research opportunities available worldwide through this distinguished program. Faculty also receive assistance in developing new overseas summer programs, and in designing other initiatives to support the internationalization of academic programs.

Medical requirements/health insurance

A Medical Entrance Form and proof of required immunizations and tuberculosis screening must be on file with the Student Health Center. Failure to provide this information may result in a health hold and delay of registration. All international students (F-1 and J-1 visas) are required to have health insurance coverage. Students may elect to purchase the health insurance made available by the health insurance provider contracted by Georgia Tech or may have their own comparable medical insurance.

NOTE: Figures below the course number and name signify the number of class hours per week, the number of laboratory hours per week, and the semester-hour credit earned for the completed course, in that order.

FOREIGN STUDIES

FS 4000, 6000. Foreign Studies
12-0-12.
Course used by students participating in an exchange program with a foreign university.

FS 4003, -06. Foreign Studies
Class and credit hours equal last digit in course number.
Course used by students participating in an exchange program with a foreign university.

FS 6003, -06. Foreign Studies
Class and credit hours equal last digit in course number.
Course used by students participating in an exchange program with a foreign university.

FASET Orientation (new student orientation)

The student/parent orientation program informs new students and their parents/guests of academic programs and requirements, in addition to familiarizing them with Georgia Tech traditions and the activities and services available on campus. For more information, call 404.894.6897 or visit **www.faset.gatech.edu**.

NOTE: Figures below the course number and name signify the number of class hours per week, the number of laboratory hours per week, and the semester-hour credit earned for the completed course, in that order.

GT 1000. Freshman Seminar
1-0-1.
Discussion of topics related to academic, social and professional success including learning styles, time management, major and career exploration, leadership and teamwork.

OMED: Educational Services

The Office of Minority Education Development (OMED) is an academic service organization charged with the academic retention and performance of African American, Native American, and Latino/Hispanic students at Georgia Tech. OMED runs bridge, transition, peer-mentor, tutorial, parent, corporate, and intervention programs that are targeted to the above groups; however, these programs are open to all Georgia Tech students. OMED programs have received national recognitions and accolades. OMED has served the Georgia Tech community for more than twenty-five years and has helped Georgia Tech become one of the leading producers of engineering degrees awarded to traditionally underrepresented students.

Campus Recreation Center

The newly renovated and expanded Campus Recreation Center (CRC) opened in fall 2004. One of the nation's premier recreation centers, the facility includes six basketball courts, racquetball and squash courts, an indoor hockey rink, a game room, and a 15,000 sq. ft. Fitness Center. The Aquatic Center, home of the 1996 Olympic aquatics events, consists of a fifty-meter competition pool and separate diving well. The new Helen D. and Vernon D. Crawford pool boasts a 185 ft. water slide, current channel, hot tub, six twenty-five-yard lanes, and an outdoor patio. The CRC also houses Tech's intramural program, which includes sports ranging from flag football to kickball to inner tube water polo. Sport clubs offer competition with other schools in more than twenty sports. Non-credit classes are available for a nominal fee and include classes for workout purposes or for learning skills. Outdoor Recreation Georgia Tech (ORGT) members use the CRC's climbing wall. For more information, call 404.385.PLAY or visit **www.crc.gatech.edu**.

Ferst Center for the Arts

The Ferst Center for the Arts serves as a showcase for the presentation of concerts, recitals, lectures, dance, and theater.

Since opening its doors in 1992, the Center has provided a once-in-a-lifetime opportunity for the students of Georgia Tech to experience the finest entertainers in the world at truly affordable prices. Each year, the Ferst Center hosts memorable performances such as violinist Itzhak Perlman, comedic magicians Penn and Teller, the Atlanta Ballet, Soweto Gospel Choir, the Moscow Philharmonic Orchestra, and renowned international opera companies.

The Center not only houses the theater, but also the Richards and Westbrook galleries, located in the foyer of the Center. The galleries feature displays from local and traveling exhibits of fine arts and high technology. The James E. Dull Theatre, which is home to DramaTech, is also located within the Center.

The Center for the Arts is committed to exploring the links between the arts and technology and serves as a prominent example of Georgia Tech's dedication to excellence and outstanding performance – both on campus and in the metro Atlanta community.

DramaTech

DramaTech, Atlanta's oldest theater company, produces at least four plays a year, as well as improvisation and musical theater performances. DramaTech uncovers and nourishes the creative talents of Georgia Tech's future engineers, managers, architects, scientists, and leaders; talents that might otherwise go undeveloped in the world of calculators, computers, designs, and formulas.

DramaTech is both a student organization and a unit of the Ivan Allen College. Although Georgia Tech has no theater department, the director is part of the faculty of the School of Literature, Communication, and Culture. Participation in the theater is open to all students, faculty, staff, and Tech alumni. Students may earn credit for participation in DramaTech through the School of Literature, Communication, and Culture.

For more information, call DramaTech at 404.894.3481.

Student Center

The Fred B. Wenn Student Center and Penny and Roe Stamps Student Center Commons are located in the heart of the Georgia Tech campus and provide many vital services to Tech students. Governed and operated by students, the Student Center Program Council consists of student-run planning committees that organize and coordinate campus-wide activities and events. The Student Center houses the post office, bowling and billiards facilities, video games, a crafts center, a music listening room, a ballroom, a movie theater, several meeting rooms, a credit union, a computer lab, lounge and study areas, and a wide variety of dining options. Vans and audio/visual equipment are available for use by student organizations through the Student Center Administrative Office. Also located in the Student Center is the Center for the Arts Box Office, Student Government Association offices, the Student Organizations Resource Center, WREK radio station, a travel agency, a full-service optical center, a hair salon, and the campus BuzzCard Center.

The hours of operation for many of the Student Center services vary; however, the Student Center building is open twenty-four hours a day, seven days a week, providing students with a place to meet and study.

Student Government

The Georgia Tech Undergraduate and Graduate Student Government Associations (SGA) enable students to maintain responsible and respected self-government and official institutional involvement in academic and nonacademic affairs. For more information, contact the SGA offices in the Student Center Commons at 404.894.2814.

Assistance for Persons with Disabilities

The Access Disabled Assistance Program for Tech Students (ADAPTS) provides accessible programs, services, activities, and reasonable accommodations for students with a disability as defined by section 504 of the Rehabilitation Act of 1973, as amended, and by the Americans with Disabilities Act of 1990. Services are available to ensure that individuals with disabilities have an equal opportunity to pursue education, employment, or other campus programs, activities, or services.

ADAPTS offers self-identified students with permanent or temporary disabilities assistance with registration, accessibility, transportation, parking, housing, counseling, note taking, recorded textbooks, advocacy, test proctoring, referral services, and other needs. ADAPTS promotes disability awareness programs for departmental faculty and staff, as well as the Georgia Tech community.

Students and prospective students who wish to learn more about accommodations for students with disabilities should contact ADAPTS, Student Services Building, Georgia Institute of Technology, Atlanta, Georgia 30332-0285, or call 404.894.2564 (voice) or 404.894.1664 (TDD), or visit **www.adapts.gatech.edu**. Faculty, staff, and visitors should contact Disability Services in the Office of Human Resources at 404.894.3344 (voice) or 404.894.9411 (TDD).

Academic Accommodations for Students with Disabilities

Reasonable accommodations are provided to self-identified students with disabilities who meet the academic and technical standards requisite to admission or participation in the program of study.

Consideration may be given to the substitution or modification of certain course requirements – within the limitations imposed by the accreditation criteria for the degree program in which the student is enrolled – and to the extent that such substitutions or modifications of the course or curriculum do not have a net effect of detracting from the quality of the educational experience implied by the course or curriculum designation. Such substitutions or modifications must be approved by the school chair, department head, or college dean, and the Undergraduate Curriculum Committee and/or the Graduate Committee.

Nontraditional Student Services

For the nontraditional student (undergraduates over age twenty-five, graduate students over age thirty, and financially independent students whose lifestyles vary significantly from those of younger students), the Office of the Dean of Students recognizes the importance of each individual student, encourages personal growth, and supports academic pursuits through advocacy and referral services. For assistance, contact the Office of the Dean of Students at 404.894.6367, or make an appointment to see a dean by visiting **www.deanofstudents.gatech.edu** and fill out an intake form.

Notification of Student Rights under FERPA

The Family Educational Rights and Privacy Act (FERPA) affords students certain rights with respect to their education records. They are:

1. The right to inspect and review the student's education records within forty-five days of the day that the Institute receives the request for access.

   Students should submit to the registrar written requests that identify the record(s) they wish to inspect. The registrar will make arrangements for access and notify the student of the time and place where the records may be inspected.
2. The right to request amendment of the student's education records that the student believes are inaccurate or misleading.

   Students may ask the Institute to amend a record that they believe is inaccurate or misleading. They should write the Office of the Registrar, clearly identifying the part of the record they want changed, and specify why it is inaccurate or misleading.

   If the Institute decides not to amend the record as requested by the student, the Institute will notify the student of the decision and advise the student of his or her right to a hearing regarding the request for amendment. Additional information regarding the hearing procedures will be provided to the student when he or she is notified of the right to a hearing.
3. The right to consent to disclosures of personally identifiable information contained in the student's education records, except to the extent that FERPA authorizes disclosure without consent.

   One exception that permits disclosure without consent is disclosure to school officials with legitimate educational interests. A school official is a person employed by the Institute in an administrative, supervisory, academic, research, or support staff position (including law enforcement unit personnel and health staff); a person or company with whom the Institute has contracted (such as an attorney, auditor, or collection agent); a person serving on the Board of Trustees; or a student serving on an official committee, such as a disciplinary or grievance committee, or assisting another school official in performing his or her tasks.

   A school official has a legitimate educational interest if he or she needs to review an education record in order to fulfill his or her professional responsibility.
4. The right to file a complaint with the U.S. Department of Education concerning alleged failures by the Georgia Institute of Technology to comply with the requirements of FERPA. FERPA is administered by:

Family Policy Compliance Office
U.S. Department of Education
400 Maryland Avenue, S.W.
Washington, D.C. 20202-4605

The address for the registrar is:
Office of the Registrar
Georgia Institute of Technology
Atlanta, Georgia 30332-0315

Parental Notification Policy

Parents of students under the age of twenty-one will be notified when a student is found responsible for violating the "Georgia Tech Student Policy on Alcohol and Other Drugs" when the following occurs:

- When the student endangers himself or herself or others while under the influence of alcohol or other substances (Specific instances include DUI, fighting, alcohol poisoning, and hospitalization.)
- When a hearing officer determines that any future violation of the Institute's policy will most likely result in suspension from Georgia Tech
- When a hearing officer determines that any future violation of the Institute's policy will most likely result in removal from housing

Directory Information

"Directory Information" is information not generally considered harmful or an invasion of privacy if disclosed. The Georgia Institute of Technology considers the following information to be Directory Information:

Name, address, and telephone listing
Level (graduate or undergraduate)
Field of study
Dates of attendance
Degrees, including designation and date awarded

Directory Information cannot include student identification numbers or social security numbers.

Students who wish to discuss the prohibition of release of Directory Information should contact the Registrar's Office for procedural information.

Policy on Sexual Harassment

Sexual harassment of employees or students in the University System is prohibited and shall subject the offender to dismissal or other sanctions after compliance with procedural due process requirements. Unwelcome sexual advances, requests for sexual favors, and other conduct of a sexual nature can constitute sexual harassment. For more information, contact the Dean of Students Office at 404.894.3627 or the director of the Office of Equal Opportunity and Diversity Programs at 404.894.9412.

Student Alcohol Policy

Georgia Tech complies with all federal, state, and local laws and policies, including the policies of the Board of Regents of the University System of Georgia, on the abuse of alcohol and other drugs by its students. The legal drinking age in Georgia is twenty-one. Each member of the Tech community should be involved in the implementation of the Student Alcohol Policy. This policy is distributed via e-mail annually.

In accordance with federal and state laws and because of the potential detriment to the health, well-being, and success of students, all students are prohibited from engaging in the unlawful use or abuse, possession, manufacture, distribution, dispensation, and sale of alcoholic beverages,

controlled substances (including marijuana), and other drugs.

Intellectual Property Policy

The Institute's Intellectual Property Policy, concerning inventions, copyright, and computer software, applies to students as well as to faculty and staff. Adherence thereto is a condition of continued enrollment at the Institute.

Academic Honor Code

A student initiative, the Academic Honor Code became official Institute policy in 1996. Students are required to sign an honor agreement acknowledging their awareness of the Code. All students are strongly encouraged to understand each instructor's Academic Honor expectations. The objective of the Honor Code is to level the academic playing field for all students while strengthening the level of academic integrity and trust within the Georgia Tech community.

Parking and Transportation

Due to limited campus parking availability, permit registration for first-semester freshmen will be restricted to several parking lots on the campus perimeter. Parking registration is conducted online from mid-April through mid-June each year. The registration address is **www.applyparking.gatech.edu**. The Parking and Transportation Web address, **www.parking.gatech.edu**, contains information such as parking policies and procedures, trolley and shuttle services, visitor parking, parking fees, a campus map with parking locations, and other pertinent information.

Questions concerning campus parking and transportation may be directed to **info.parking@parking.gatech.edu** or by phone to 404.385.PARK or 404.385.RIDE.

Required Student Computer Ownership

In an effort to foster equal access to computers and to make the most of the teaching and learning technology available at Georgia Tech, all undergraduate students entering Georgia Tech under this or subsequent catalogs are required to own or lease a computer.

The minimum hardware and software requirements (as well as purchasing and financing options) are sent each spring to students accepted for the summer and fall semesters, and in the fall to students accepted for spring semester.

Because computer ownership is mandatory, an average cost for the minimum hardware and software required can be included in computing a new student's cost of education for the purpose of determining their eligibility for all forms of student financial aid. Students should contact the Office of Student Financial Planning and Services for more information.

Special Support Facilities

Library and Information Center

The Georgia Tech Library and Information Center houses one of the nation's largest collections of scientific and technical literature. Resources include more than 3 million volumes, more than 600,000 government documents, more than 3,000 videotapes, a complete collection of U.S. patents, and approximately 2 million technical reports. The Library receives more than 17,000 current periodicals.

The Library, in cooperation with the Office of Information Technology, provides an Information Commons equipped with 100 high-end computer workstations.

Georgia Tech faculty, students, and staff have access to more than 200 online databases containing citations, abstracts, newspapers, indexes to journals and conference proceedings, and the full text of many periodicals. These databases, as well as the Library's catalog, are accessed through the Georgia Tech Electronic Library (GTEL)(r) and Galileo, a statewide database service. Gateways to a variety of information resources available on the Internet are provided through GTEL(r).

Students, faculty, and staff may use libraries at Emory University, Georgia State University, the University of Georgia, and other local schools via a Georgia Tech ID card.

Copiers are available on several floors of the Library. Students may use facilities for group or individual study. The Library's information consultants provide training classes for all students in the use of GTEL(r), Galileo, and the Internet. Consultants also are available for advice about individual information needs.

Information Technology and Computing Facilities

The Office of Information Technology (OIT) provides technology leadership and support to Georgia Tech students, faculty, staff, and researchers. OIT serves as the primary source of information technology, cable television networking, and telecommunications services for the Institute. Key information technology services include operating the campus computer network, providing access to national research networks, providing technical support for centralized computer accounts and computing systems, and protecting the integrity of Institute data and administrative computing systems.

OIT has built the campus network architecture around centrally administered client/server systems configured with high-end servers on an IP Gigabit Ethernet backbone. OIT is also responsible for the Southern Crossroads network aggregation point that connects universities and colleges in the Southeast. Georgia Tech serves as the anchor in the Southeast for National LambdaRail, a high-speed, optical fiber networking infrastructure designed for advanced research and experimentation.

Centrally managed computer user accounts permit on-campus access to the campus network and Internet, the wireless network, computing labs, and core computing services and resources. Remote access to computing resources is supported for the satellite campuses. Examples of core computing services include e-mail, online software distribution, online library resources, Web course development software, campus Web hosting, the campus Web portal, and associated software for collaboration and communication.

Students living on campus can access the Internet and the campus network from student residences, which are equipped with Internet connection ports and cabling. Students also have access to three general computing labs on campus. The computing lab in the library has more than 100 computer workstations, including workstations equipped for multimedia projects, and a presentation rehearsal studio.

In addition, academic and research units may operate their own computing labs. The Institute's computational science venue initiative operates a high-performance computing cluster and network emulation facility to support classes and start-up research projects. This initiative fosters the acquisition and development of high-performance, parallel, and distributed (grid) computing systems by campus units.

Georgia Tech operates a wireless network for use with laptop computers and other mobile computing devices. The wireless network has wireless access points in and around most campus buildings and walk-up ports in several buildings. Outdoor wireless coverage includes green spaces, pedestrian corridors, and a one-mile corridor along the Tech Trolley route. The wireless network supports guest access through the incorporation of a commercial service.

Technology enhances academic and research activities in more than 250 classrooms, lecture halls, and specialty rooms. These rooms are equipped with desktop computers, video projectors, VCRs, DVD players, document cameras, audio systems, and electric screens. Videoconferencing and streaming media systems are available for teaching and collaboration on the main campus, at satellite campuses, and in distance learning programs.

Georgia Tech administers its own information systems, data repositories, and administrative software systems. The Institute manages information security with campus community education, policy development, technical measures to protect campus resources, and procedures for reacting to events that endanger the Institute's information assets. IT policy development and strategic planning enable Georgia Tech to keep pace with demands for the use and delivery of sustainable services. For more information, visit **www.oit.gatech.edu**.

Georgia Tech Research Institute

The Georgia Tech Research Institute (GTRI) is a client-oriented, not-for-profit research organization that is an integral unit of the Georgia Institute of Technology. GTRI conducts basic and applied research in engineering, science, and economic development for a diversity of customers, including federal, state, and local governmental agencies, industrial firms, and private organizations.

Chartered by the Georgia legislature in 1919 and activated in 1934, the GTRI mission is to plan and conduct focused programs of innovative research and development, education, and economic development that advance the global

competitiveness and security of the state of Georgia, the region, and the nation.

GTRI works closely with Tech's academic colleges, interdisciplinary centers, and Economic Development and Technology Ventures (EDTV) in areas of research, education, and service. GTRI's vision is to be the most respected university-based applied research institute in the nation.

The staff is composed of engineers, scientists, support staff, and students (undergraduate and graduate). Employees work in several laboratories and support groups housed on campus, at the Cobb County Research Facility, and in Huntsville, Alabama. Field offices are maintained in Arlington, Virginia; Dayton, Ohio; Fort Walton Beach, Florida; Quantico, Virginia; Albuquerque, New Mexico; Huntsville, Alabama; Orlando, Florida; and Warner Robins, Georgia.

Research programs at GTRI include acoustics (commercial and defense); aerospace sciences; antennas/electromagnetic environmental effects; commercial product realization; communications/C4ISR; data visualization; database applications; decision support systems; electro-optics; electronic protection; food processing programs; fuel cell technology; human factors; information assurance/warfare; intelligent agents; knowledge management; law enforcement technology; materials science; microelectronics and applications; missile systems; modeling and simulation; navigation; networking; optoelectronics/photonics; radar; safety, health, and environmental technology; signature control and reduction; technology insertion; telecommunications; test and evaluation; and transportation.

One of GTRI's principal missions is to support economic and technological development in Georgia. GTRI promotes economic growth in the state and the Southeast through mutual programs with EDTV. GTRI operates strong technology transfer programs and offers continuing education courses. It is the home of the state's Agricultural Research Technology Program, which conducts research and technology transfer for the poultry industry, one of Georgia's leading employers.

For additional information, contact the Office of the Vice President and Director, GTRI, Centennial Research Building, Atlanta, Georgia 30332-0801, or call 404.894.3400.

Advanced Technology Development Center

The Advanced Technology Development Center (ATDC) is the oldest and most experienced university-affiliated technology incubator in the country. It was formed in 1980 by the governor and General Assembly to increase the technology business base in Georgia. ATDC fulfills this mission by assisting in the formation and growth of advanced technology start-up companies, supporting technology commercialization, and attracting technology companies to the state. In 2004, ATDC received the "Excellence in Technology-led Economic Development" award from the U.S. Department of Commerce.

ATDC is headquartered in Technology Square, and also operates the ATDC Biosciences Center in the Ford Environmental Science and Technology Building. ATDC also has facilities in Columbus, Savannah, and Warner Robins. At these locations, early-stage companies enjoy a strong entrepreneurial working environment, access to professional business consulting, contact with university research faculty, and modern office and laboratory facilities. The ATDC also provides companies with access to facilities, personnel, and students in the University System. **(www.atdc.org.)**

Beyond ATDC, the Georgia Tech VentureLab program helps faculty members and students who wish to commercialize technology developed as part of Georgia Tech's research program. VentureLab helps evaluate the commercial potential of innovations and matches faculty with experienced entrepreneurs who can help form new ventures. In mid-2004, four companies formed in VentureLab received a total of more than $6 million in venture capital investment (see **www.venturelab.gatech.edu** for more information).

ATDC is involved in commercializing technology developed as part of Georgia's new Innovation Centers program. The first such center, the Maritime Logistics Innovation Center, is located in Savannah as a collaboration of the Georgia Department of Economic Development, the Georgia Ports Authority, and the University System of Georgia.

For more information, visit **www.atdc.org**.

Distance Learning and Professional Education

Distance Learning

Graduate-level courses are available throughout the state of Georgia and the nation via the Internet, and on DVD, CD-ROM, or videotape. Selected courses are available at some locations by video teleconferencing and satellite. The courses can be taken with a degree objective or for professional development. Students applying to a graduate program must meet the same admissions criteria as other degree-seeking students. A Master of Science degree can be earned entirely at a distance in:

- Electrical and Computer Engineering
- Environmental Engineering
- Health Physics/Radiological Engineering
- Industrial and Systems Engineering
- Mechanical Engineering
- Medical Physics

Students at remote sites receive class handouts via e-mail, or the Internet, and on CD-ROMs, DVDs, or videotapes of campus sessions via second-day air shipments. They communicate with their instructor via the Internet, telephone, computer, fax, and/or e-mail. For more information, see our Web site at **www.dlpe.gatech.edu**, call 404.894.3378, fax to 404.894.8924, write to Distance Learning and Professional Education, Georgia Institute of Technology, 84 Fifth Street, N.W., Atlanta, Georgia 30308-1031, or e-mail edl@dlpe.gatech.edu.

Some undergraduate courses are offered to Georgia Tech co-op students on work semester. Undergraduate engineering courses are delivered by video teleconferencing to engineering students at Georgia Tech-Savannah and to other units of the University System of Georgia.

Professional Education

Professional Education coordinates the delivery of non-credit short courses and professional development programs to the public and to individual clients. Programs are held on campus and at other selected locations in the United States and other countries. In collaboration with the Center for Distance Learning, professional education programs are also delivered via distance learning technologies including video teleconferencing, online, videotape, and satellite. Professional Education also hosts conferences and trade shows.

Short courses, varying in length from one to five days, are offered throughout the year to assist professionals with acquiring knowledge of different fields and new technologies. Courses are offered on various topics in architecture, engineering and technology, science, management, economic development, and computing. There are thirty-four certificate programs comprised of sequences of short courses offered in the various topics listed above.

For information, please see our Web site at **www.dlpe.gatech.edu**, call 404.385.3502, e-mail pe@dlpe.gatech.edu, fax to 404.894.7398, or write to Distance Learning and Professional Education, Georgia Institute of Technology, Global Learning and Conference Center, 84 Fifth Street N.W., Atlanta, Georgia 30308-1031.

Language Institute

The Language Institute offers intensive English classes to international students and business and professional people. This intensive English program provides seven levels of instruction in English as a second language to participants from around the world. The program also facilitates the assimilation of international students into campus life in the United States through orientation and assistance in the admissions process to American colleges and universities.

For information, please see our Web site at **www.dlpe.gatech.edu**, call 404.894.2425, e-mail eslinfo@esl.gatech.edu, fax to 404.894.8755, or write to the Language Institute, Georgia Institute of Technology, 151 6th Street, N.W. Atlanta, Georgia 30332-0374.

Oak Ridge Associated Universities

Since 1946, students and faculty of the Georgia Institute of Technology have benefited from the Institute's membership in the Oak Ridge Associated Universities (ORAU). ORAU is a consortium of eighty-six colleges and universities and a contractor for the U.S. Department of Energy (DOE) located in Oak Ridge, Tennessee. ORAU works with its member institutions to help their students and faculty gain access to federal research facilities throughout the country; to keep its members informed about opportunities for fellowship,

scholarship, and research appointments; and to organize research alliances among its members.

Through the Oak Ridge Institute for Science and Education, the DOE facility that ORAU operates, undergraduates, graduates, postgradnates, as well as faculty enjoy access to a multitude of opportunities for study and research. Students can participate in programs covering a wide variety of disciplines including business, earth sciences, epidemiology, engineering, physics, geological sciences, pharmacology, ocean sciences, biomedical sciences, nuclear chemistry, and mathematics. Appointment and program length range from one month to four years. Many of these programs are especially designed to increase the numbers of underrepresented minority students pursuing degrees in science- and engineering-related disciplines. A comprehensive listing of these programs and other opportunities, their disciplines, and details on locations and benefits can be found in the *ORISE Catalog of Education and Training Programs*, available at **www.orau.gov/orise/edu/01CatalogEdu.pdf**, or by calling either of the contacts below.

ORAU's Office of Partnership Development seeks opportunities for partnerships and alliances among ORAU's members, private industry, and major federal facilities. Activities include faculty development programs such as the Ralph E. Powe Junior Faculty Enhancement Awards, the Visiting Industrial Scholars Program, and various services to chief research officers.

For more information about ORAU and its programs, contact Charles L. Liotta, vice provost for Research and dean of Graduate Studies, at 404.894.8885 or charles.liotta@carnegie.gatech.edu. Dr. Liotta is the ORAU counselor for Georgia Tech. You may also contact Ms. Monnie E. Champion, ORAU corporate secretary, at 865.576.3306; or visit **www.orau.org**.

Skidaway Institute of Oceanography

Located on Skidaway Island near Savannah, Georgia, the Skidaway Institute of Oceanography provides a complex of coastal- and marine-related educational and research opportunities. School of Biology faculty have facilities at the Institute and participate along with their students in research activities and courses. The Institute maintains small boats and the R/V Blue Fin, a 72-foot vessel for research at distances up to 100 miles offshore. Areas of research expertise at the Institute include chemical, physical, and biological oceanography, marine ecology, and marine geology.

Georgia Tech Lorraine

Located in France in the Metz Technopôle technology park in the Lorraine region, Georgia Tech Lorraine (GTL) serves as the Georgia Institute of Technology campus in Europe. GTL conducts graduate education in engineering and computer science, has ongoing programs of basic and applied research, and offers continuing education courses.

At GTL, students can pursue regular academic programs of Georgia Tech while immersed in the rich culture of Europe. Instructional programs leading to master's degrees and Ph.D.s in electrical and computer engineering, mechanical engineering, and computer science are available to graduate students throughout the year. In addition, double-degree programs that lead to both a Georgia Tech degree and a diploma from a European university have been developed. Undergraduate summer programs in engineering, humanities, management, and social sciences are offered to any qualified student.

All instruction at GTL is in English. French language courses are also available to enhance students' experience as well as to enable students to participate in a double-degree program.

GTL operates in a 50,000-square-foot building that houses classrooms, academic and research laboratories, student lounges, conference rooms, and a library, along with faculty and staff offices. Student housing is available for all GTL students. Many student-oriented facilities are available close to the GTL campus, along with the diverse cultural and entertainment resources of the city of Metz.

For more information, contact GTL at 404.894.0076 or +33 387 20 3939. You may also access GTL at info@georgiatech-metz.fr.

Joint CNRS Research Laboratory

As the result of a strategic alliance between the Georgia Institute of Technology and the French Centre National de la Recherche Scientifique (CNRS), a joint GIT/CNRS research laboratory was established in 1998 at GTL. The laboratory, the Centre GTL-CNRS Telecom, conducts a unique transatlantic collaborative program of research in telecommunications and related areas. Research faculty and graduate students from Georgia Tech, French universities, and other CNRS laboratories work on joint research projects sponsored by industry and by local and national governments.

Initial research programs center on opto-electronic techniques for signal encryption and secure transmission, signal coding for wireless communications, and soliton transmission and wavelength division multiplexing and signal routing in optical fiber transmission links. The program is expanding to include a diversity of research in telecommunications and in the area of integrated sensors and sensor networks.

For more information, contact GTL-CNRS Telecom at +33 387 20 3939 or send e-mail to gtl-cnrs-telecom@georgiatech-metz.fr.

Interdisciplinary Programs

The Office of the Vice Provost for Research and Dean of Graduate Studies oversees interdisciplinary research centers at Georgia Tech not otherwise coordinated through a college. The office currently provides oversight for more than twenty centers. The four programs in bioengineering and bioscience are coordinated through the Parker H. Petit Institute for Bioengineering and Biosciences. The Institute of Sustainable Technology and Development coordinates five additional centers involved with the environment and sustainability. The Georgia Center for Advanced Telecommunications Technology coordinates four other centers with similar research areas. Seven centers report directly to the vice provost for Research and dean of Graduate Studies. Each center is listed below, along with the director's name and telephone number. For more information on each center, call the number provided or call the Office of the Vice Provost for Research and Dean of Graduate Studies at 404.894.8884.

Parker H. Petit Institute for Bioengineering and Bioscience (IBB)

Director: Robert Nerem, 404.894.2768

- Bioengineering Research Center
  Director: Ajit Yoganathan, 404.894.2849
- Bioscience Center (BC)

Director: Sheldon May, 404.894.4052

- Georgia Tech-Emory Biomedical Technology Research Center (EM/GT)
  Director: Ajit Yoganathan, 404.894.2849
- GIT/MCG Biomedical Research and Education Program
  Director: Loren Williams, 404.894.9752

Institute for Sustainable Technology and Development (ISTD)

Director: Bert Bras, 404.894.7895

- Air Resources and Engineering Center (AREC)
  Director: Armistead (Ted) Russell, 404.894.3079
- Environmental Resources Center (ERC)
  Director: Bernd Kahn, 404.894.3776
- Georgia Transportation Institute (GTI)
  Director: Glenn Rix, 404.894.2292 or 404.385.0381
- Georgia Water Resources Institute
  Director: Aris Georgakakos, 404.894.2240
- Specialty Separations Center
  Director: Charles A. Eckert, 404.894.7070

Georgia Center for Advanced Telecommunications Technology (GCATT)

Director: Nikil Jayant, 404.894.7285

Vice Provost for Research and Dean of Graduate Studies

- Interactive Media Technology Center (IMTC)/ Biomedical Interactive Technology Center (BITC)
  Director: Mark Clements, 404.894.4584
  Research Engineer, IMTC: Ed Price, 404.894.4195
  Research Director, BITC: John Peifer, 404.894.7028
- Center for Human Movement Studies
  Director: Robert Gregor, 404.894.1028
- Center for Optical Science and Engineering (COSE)
  Director: William T. Rhodes, 404.894.2929
- Center for Nanoscience and Nanotechnology
  Director: Zhong Lin (Z.L.) Wang, 404.894.8008
- Manufacturing Research Center (MARC)
  Director: Steven Danyluk, 404.894.9687
- Microelectronics Research Center (MIRC)
  Director: James D. Meindl, 404.894.5101
- Polymer Education and Research Center (PERC)
  Director: Vacant

The schools of the Georgia Institute of Technology are authorized to offer graduate degrees, develop and administer their own individual programs, and work closely with one another to provide special study and research opportunities for students who wish to pursue a degree with a wider perspective than that presented by a single discipline. Cooperation between academic units

and various research centers and the development of informal programs based on areas of faculty interest have resulted in the establishment of interdisciplinary programs in a number of areas, such as computer-integrated manufacturing systems, microelectronics, bioscience and bioengineering, and nanotechnology. The College of Engineering lists a number of multidisciplinary programs on page 121 of this catalog. The College of Computing offers an interdisciplinary certificate in cognitive science, detailed on page 101. The role of the College of Management in multidisciplinary programs is discussed on page 330. Multidisciplinary programs in the College of Sciences are discussed on page 348.

Affiliated Organizations

Georgia Tech Athletic Association

Intercollegiate sports are administered by this non-profit corporation through a board of trustees consisting of seven faculty members, three alumni, and three students, with the president of Georgia Tech serving as chair. The Athletic Association is committed to the development, preparation, support, and graduation of student-athletes through its Total Person Program and Academic Center. The Association provides and maintains facilities that allow the participation and enjoyment of a variety of sporting events by members of the Georgia Tech and Atlanta communities. Intercollegiate sports include football, basketball, cross country, indoor/outdoor track, golf, tennis, baseball, volleyball, swimming, and softball. The Athletic Association has made a commitment to excellence and to complement the mission of the Institute.

Georgia Tech Alumni Association

The Georgia Tech Alumni Association was chartered in June 1908 and incorporated in 1947 as a not-for-profit organization with policies, goals, and objectives guided by a board of trustees.

The mission of the Georgia Tech Alumni Association is to serve alumni and promote the Institute. The Association will create relevant and meaningful programs for current and future alumni to foster lifelong participation and philanthropic support. The Association will communicate the achievements of the Institute, maintain its traditions, and strengthen relationships with the campus community. Underlying all the Association does is a belief in the value of education, a commitment to integrity and exceptional customer service, and a pledge to perform in a fiscally responsible manner.

The Association is organized into six departments: Administration, Communications, Event Management/Travel, Human Resources/Clubs, Marketing Research/Campus Relations/Web and Roll Call/Business Development.

The offices of the Alumni Association are located in the L.W. "Chip" Robert Jr. Alumni/ Faculty House at 190 North Ave., Atlanta, Georgia 30313. Inquiries should be directed to 404.894.2391 or 1.800.GTALUMS (phone) or 404.894. 5113 (fax). The Web address is **www.gtalumni.org**.

Georgia Tech Foundation Inc.

The Georgia Tech Foundation Inc. is a not-for-profit, tax-exempt corporation that receives, administers, and invests virtually all private contributions made in support of the academic programs of the Georgia Institute of Technology. The Foundation maintains its support of the Institute through the regular and emeritus members of its board of trustees, who are distinguished by their expertise in financial management and investments and by their devotion to Georgia Tech.

Endowment funds maintained by the Foundation furnish student scholarships and fellowships, faculty assistance, and general support to the academic divisions of the Institute. In addition, gifts and income from undesignated endowments provide unrestricted funds that help meet the most pressing needs of the Institute.

Georgia Tech Research Corporation

Founded in 1937, the Georgia Tech Research Corporation (GTRC) is a state-chartered, not-for-profit corporation serving Georgia Tech as a University System of Georgia-approved cooperative organization. By charter, GTRC "...shall be operated exclusively for scientific, literary, and educational purposes...conduct laboratories, engage in scientific research, and distribute and disseminate information resulting from research..." GTRC is an IRS section 501(c)(3) not-for-profit organization and serves as the contracting agency for all of the sponsored research activities at Georgia Tech. It also licenses all intellectual property (patents, software, trade secrets, etc.) created at Georgia Tech. Additionally, GTRC assists Georgia Tech in obtaining quality research space, enters into long-term leases for specialized research equipment, and conducts other research support programs as requested by the Institute. All funds collected by GTRC are used to support various Georgia Tech research programs requested by the Institute and as approved by the twelve-member board of trustees. GTRC is located on campus at 505 Tenth Street.

Information for Undergraduate Students

This version of the *General Catalog* was current as of the date of printing in May 2005. For the most up-to-date version, visit **www.catalog.gatech.edu**. In addition, this is the final printed version of the *General Catalog*. Beginning in May 2006 it will be available online only.

Degrees

Georgia Tech at present offers curricula leading to the following undergraduate degrees:

College of Architecture
- Bachelor of Science
- Bachelor of Science in Building Construction
- Bachelor of Science in Industrial Design

College of Computing
- Bachelor of Science
- Bachelor of Science in Computational Media
- Bachelor of Science in Computer Science

College of Engineering
- Bachelor of Science
- Bachelor of Science in Aerospace Engineering
- Bachelor of Science in Biomedical Engineering
- Bachelor of Science in Chemical and Biomolecular Engineering
- Bachelor of Science in Civil Engineering
- Bachelor of Science in Computer Engineering
- Bachelor of Science in Electrical Engineering
- Bachelor of Science in Industrial Engineering
- Bachelor of Science in Materials Science and Engineering
- Bachelor of Science in Mechanical Engineering
- Bachelor of Science in Nuclear and Radiological Engineering
- Bachelor of Science in Polymer and Fiber Engineering

Ivan Allen College of Liberal Arts
- Bachelor of Science
- Bachelor of Science in Computational Media
- Bachelor of Science in Economics
- Bachelor of Science in Economics and International Affairs
- Bachelor of Science in Global Economics and Modern Languages
- Bachelor of Science in History, Technology, and Society
- Bachelor of Science in International Affairs
- Bachelor of Science in International Affairs and Modern Languages
- Bachelor of Science in Public Policy
- Bachelor of Science in Science, Technology, and Culture

College of Management
- Bachelor of Science
- Bachelor of Science in Management

College of Sciences
- Bachelor of Science
- Bachelor of Science in Applied Mathematics
- Bachelor of Science in Applied Physics
- Bachelor of Science in Applied Psychology
- Bachelor of Science in Biology
- Bachelor of Science in Chemistry
- Bachelor of Science in Discrete Mathematics
- Bachelor of Science in Earth and Atmospheric Sciences
- Bachelor of Science in Physics

Requirements for each degree are listed in "Suggested Schedules" and "Courses of Instruction" under the school responsible for the program. Students should select a degree program as early as possible, preferably with their request for admission, but may postpone the decision and enter as undecided majors. Students who have selected a degree program receive academic advisement from the appropriate school; undecided students are advised through the respective offices of the deans of the six colleges.

Undergraduates who have completed the required number of work terms through the

Cooperative Plan receive the degree with the designation "Cooperative Plan," or if they have met certain language and international work experience requirements, the designation "International Cooperative Plan" is awarded.

Special Programs

The International Plan
(Available Fall 2005)

The International Plan is a challenging and coherent academic program for undergraduates that develops global competence within the context of a student's major. It is a degree-long program that integrates international studies and experiences into any participating major at Georgia Tech. It helps to prepare Georgia Tech graduates professionally and personally for successful lives in the twenty-first century.

The International Plan is not intended to replace current international programs; it supplements them. Existing study abroad opportunities continue to be offered. It is also not intended to be an add-on to the current degree programs. It is intended to be another curriculum path to earn a degree in which international competence is integrated into the program of study. The plan can be completed within the normal timeframe of four years of undergraduate study.

The overarching model for the International Plan has four components:
- **International Coursework:** Three courses to include one from each of the following categories:
  1) International relations
  2) Global economics
  3) A course about a specific country or region
- **International Experience:** Two terms abroad (not less than twenty-six weeks) engaged in any combination of study abroad, research, or internship.
- **Second Language Proficiency:** All students in the program are expected to reach at least the proficiency level equivalent to two years of college-level language study. Students who use the language to study, conduct research, or participate in an internship during their international experience are expected to attain a higher level of proficiency. Language proficiency is determined by testing (not course credits).
- **Culminating Course:** A capstone course in the major designed to tie the international studies and experiences together with the student's major.

Completion of the International Plan is recognized by a designation on the student's diploma indicating completion of the degree with global competence, e.g., "B.S. in Electrical Engineering: International Plan."

Students should check with their academic advisors to see if their major program of study is participating in the International Plan. For additional information about the International Plan, send e-mail to internationalplan@oie.gatech.edu or visit **www.oie.gatech.edu/internationalplan**.

Division of Professional Practice

Georgia Tech believes that obtaining relevant, academically related experience is an integral part of the educational process. In order to achieve that, the Division of Professional Practice offers two methods to attain such experience: the cooperative education program and the undergraduate professional internship program.

The **Cooperative Plan** has been offered at Georgia Tech since 1912. It is a five-year program for students who wish to integrate practical experience with theory learned in the classroom. More than 3,000 students currently participate, working full time on alternate semesters at more than 650 employers throughout the United States (as well as numerous international assignments). Accredited by the Accreditation Council for Cooperative Education, it is one of the largest totally optional programs in the country and the highest ranked program among public universities.

The Co-op Plan is available for all engineering majors as well those studying biology, chemistry, mathematics, physics, computer science, management, economics, earth and atmospheric sciences, international affairs, industrial design, building construction, and science, technology, and culture. The academic curricula are identical to those offered to regular four-year students, and co-ops remain on the school rolls while on work periods by registering for the appropriate co-op courses.

Co-op offers the student practical experience and insight into human relations, as well as financial assistance. The work experience co-ops receive is a valuable asset to graduates starting out

in their chosen professions. Neither college laboratory experience nor employment during vacations can take the place of organized co-op training. The plan provides, to a substantial degree, the experience most companies require of their employees before promoting them to positions of higher responsibility. Work experience may also assist students who are undecided about their future plans in determining early in their college careers whether they wish to continue in a particular field.

Moreover, daily contact with diverse groups among their fellow employees offers students practical insight into sociology, psychology, economics, and ethics that no textbook can supply. Finally, students receive compensation for their services from the employer. Typically, co-op students can save enough from their earnings to pay for more than half of their school expenses.

Undergraduate professional internships provide practical experience for students who choose not to follow the Co-op Plan. Although internships normally do not provide the depth of co-op, they are an extremely viable way to obtain out-of-classroom experience. Similar to cooperative education, the jobs and the students' performance are monitored by the Division of Professional Practice to ensure maximum benefit by all parties.

Students in all majors may participate in the internship program and may work any term during the school year. Numerous international internships are also available.

For more information on either program, write to Division of Professional Practice, Georgia Institute of Technology, Atlanta, Georgia 30332-0260; e-mail prof.practice@profpractice.gatech.edu; or visit **www.profpractice.gatech.edu**.

Note: Courses with a COOP or INTN designator are used by students participating the Cooperative Plan or Internship Program, respectively.

Undergraduate Academic Common Market

The Academic Common Market (ACM) is an interstate agreement for sharing educational programs and facilities, allowing students to participate in selected programs not offered in their home states without having to pay out-of-state tuition charges. The Southern Regional Education Board (SREB) coordinates the activities of the Academic Common Market for the sixteen participating states, which include Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia.

One of the primary functions of the Academic Common Market is to assist states in offering together what they cannot offer alone. Programs are added to and removed from the Market on an annual basis in order to reflect the changing needs of participating states. The state of Georgia currently makes program changes once annually during the spring.

For a list of undergraduate degree programs non-Georgia residents may study without having to pay out-of-state tuition, as well as the ACM policies and procedures, visit **www.admiss.gatech.edu/acm** or call the Office of Undergraduate Admission at 404.894.4154.

Multidisciplinary and Certificate Programs

Multidisciplinary Programs in the College of Engineering and Certificate Programs in the College of Sciences, the Ivan Allen College of Liberal Arts, and the College of Management offer students in good standing an opportunity to broaden their areas of expertise or acquire skills or information beyond their major degree requirements. Students interested in pursuing these programs should consult with their major school advisor.

For a description of Multidisciplinary and Certificate Programs offered in the College of Engineering, see page 121. For a description of similar programs in the College of Sciences, see page 348; in the Ivan Allen College, see page 244; and in the College of Management, see page 330.

Summer Language Program

The School of Modern Languages offers special summer immersion programs in France, Germany, Japan, Mexico, and Spain. These intensive programs in Languages for Business and Technology (LBAT) consist of six to eight weeks of study abroad in which classroom lessons in business, culture, and technology are combined with field work, cultural events, excursions, and visits to area businesses—all conducted in the target language. The professional visits provide students with firsthand experience of business life, the protocols and strategies of business transactions, and a heightened awareness of the current issues facing the economy of the host country. The LBAT experience offers a unique opportunity for rapid growth in proficiency, to build a deeper appreciation for the cultures and lifestyle patterns of other peoples, and to make lifelong social and professional contacts.

Students will earn nine semester hours at the 3000 level, or twelve hours in Spanish when combining Mexico (six credits) and Spain (six credits). These credits count toward a certificate, a minor, or joint majors offered by Modern Languages with the School of International Affairs or the School of Economics. Program costs vary according to the country visited and the length of the program. In cooperation with Kennesaw State University, Modern Languages offers a similar immersion program in China. The HOPE scholarship applies. See **www.modlangs.gatech.edu** for more information.

ROTC

Georgia Tech offers three voluntary ROTC programs: Army, Navy, and Air Force.

Depending on the student's major, basic and advanced ROTC classes count as a portion of elective credit. (Students may apply a maximum of four hours in basic ROTC courses and six hours in advanced ROTC courses toward meeting the free elective requirements for any degree.) Consult specific colleges to determine the amount of hours that will count toward a degree. After earning a baccalaureate degree and completing the advanced ROTC courses for any of the three services, a student may receive a commission as an officer in either the reserve or active forces.

Students accepted into the program earn more than just money for college and leave with far more than just a college degree. Cadets and midshipmen receive training and experience in the one quality always in great demand: leadership.

Joint Enrollment Program for High School Students

High school students who have completed tenth or eleventh grade and have academic credentials comparable to those of scholastically superior first-year students at Tech may take courses at Georgia Tech. Courses taken at Georgia Tech will normally be at a level beyond those available in the student's high school. Courses completed at Georgia Tech can be used to satisfy high school requirements and will also carry college credit.

Interested students should consult their high school counselor for specific program requirements. Applications for the program are available from the Office of Undergraduate Admission or visit **www.admiss.gatech.edu/jointenrollment**.

Preprofessional Programs

Georgia Tech degree programs offer a well-balanced basic education in addition to outstanding training in the chosen field. As such, they provide an excellent basis for subsequent study of medicine, dentistry, veterinary medicine, or law. These professional programs typically require a limited number of courses in specific areas, which if not required as a part of the student's Georgia Tech degree program may be included as electives. Each academic department has preprofessional advisors who advise students in structuring their program of study to include the necessary courses to qualify for admission to professional school.

Georgia Tech has elected not to have majors designated as premedicine, predentistry, or prelaw. This approach to preprofessional education has two major advantages. First, students who elect not to enter professional school upon graduation are prepared for alternative careers immediately. Second, students who do continue to professional school have backgrounds that often provide them with unique opportunities within their selected profession. Examples include medical research, development of medical devices and apparatus, patent law, or the legal aspects of design and construction.

Professional schools typically admit students with strong academic credentials, a well-balanced education, good communication skills, and a broad range of experiences. With the appropriate selection of elective courses, most majors at Georgia Tech provide suitable preparation for professional school in any area. No specific major offers an obvious competitive advantage in assuring admission to professional schools. The best choice of major is usually the one in which the student has the greatest inherent interest.

Special Academic Services

In an effort to assist its students in realizing their full intellectual potential, Georgia Tech sponsors a variety of voluntary programs designed to help the student overcome academic problems.

For assistance within a specific academic discipline, students should contact the appropriate

college office (see list on page 2). Other academic assistance programs are available through the Division of Student Affairs, the Department of Housing (Freshman Experience Program), OMED (Office of Minority Education Development), and other units of the Institute.

Learning Support

The Office of the Vice Provost for Undergraduate Studies and Academic Affairs (VPUSAA) administers the Learning Support Program. The College of Sciences offers college preparatory courses in mathematics, and the Ivan Allen College of Liberal Arts offers courses in reading and English composition for students who need further preparation before taking credit courses in English, mathematics, and history.

Students who are required by the Institute to take courses in the Learning Support Program will be notified in writing. They must then either test out of the program or register for the required course(s) before they can register for any credit courses that require Learning Support (LS) courses as prerequisites.

Students can test out of taking LS courses by passing the appropriate Georgia Collegiate Placement Exams (GCPEs) administered before the beginning of each semester through the Office of the VPUSAA. Students who do not pass the appropriate examinations prior to their first semester in residence must register for the required LS courses. Students must pass all required LS courses and the appropriate GCPEs within their first three semesters in residence in order to register for any further course work. No more than twenty hours of degree credit work may be earned prior to exiting Learning Support.

In addition to those students who are required by the Institute to take LS courses, any student who desires further preparation may register for one or more courses. LS courses are not prerequisite to credit courses when taken on this elective basis.

LS courses are offered on a pass/fail basis and may not be counted as hours toward graduation. *NOTE: Figures below the course number and name signify the number of class hours per week, the number of laboratory hours per week, and the semester-hour credit earned for the completed course, in that order.*

LEARNING SUPPORT

LS 0198. Reading Skills
3-0-3
Development of reading comprehension and speed, vocabulary, and study skills. Review of grammar and usage.

LS 0298. English Skills
3-0-3
Development of basic skills used in writing the sentence, paragraph, and short essay. Development of reading speed.

LS 0398. Mathematical Skills
3-0-3
Intensive review of arithmetic and algebra skills. Development of mathematics study skills.

Admissions

Freshman Admission

Freshmen may apply only for the summer or fall terms. Following the completion of the junior year of high school, freshman applicants may submit the completed Application for Freshman Admission, nonrefundable application fee, and SAT I and/or ACT scores to the Office of Undergraduate Admission. International students and students who have been home-schooled will be required to submit additional information. Freshman applicants may choose to submit a paper copy of the application or complete one of the options found online at **www.apply.gatech.edu**. The Self-Reported Academic Record (SRAR) must cover the first three years of high school, with the student's senior year schedule indicated by semesters or quarters. The SRAR should show the type of grading system and any honors-level or advanced courses completed by the applicant.

It is the applicant's responsibility to ensure that all required elements, including the application, nonrefundable application fee, and SAT I and/or ACT scores are submitted on time. All elements must be submitted by October 31 (postmarked) to guarantee consideration for the President's Scholarship or by January 15 (postmarked) to guarantee consideration for admission to Georgia Tech.

The Office of Undergraduate Admission will consider all completed applications on file by the stated deadlines provided spaces are available for the particular term or academic year for which the student applies. An application submitted after the deadline may receive consideration, but only at the discretion of the Institute.

COLLEGE BOARD ADVANCED PLACEMENT EXAMS

Subject	Georgia Tech Course	Semester Hours
American Government & Politics	AP Score: 4 or 5 = POL 1101	3
Biology	AP Score: 5 = BIOL 1510	4
Chemistry	AP Score: 5 = CHEM 1310	4
Comparative Politics	AP Score: 4 or 5 = INTA 1200	3
Computer Science (AB)	AP Score: 4 or 5 = CS 1321	3
Economics (Macroeconomics)*	AP Score: 4 or 5 = ECON 2105	3
Economics (Microeconomics)*	AP Score: 4 or 5 = ECON 2106	3
English (Composition & Literature)	AP Score: 4 or 5 = ENGL 1101	3
English (Language & Composition)	AP Score: 4 or 5 = ENGL 1101	3
Environmental Science	AP Score: 5 = EAS 1600	4
French (Language Level III or Literature Level III)	AP Score: 4 or 5 = FREN 2001 & 2002	6
German (Language Level III or Literature Level III)	AP Score: 4 or 5 = GRMN 2001 & 2002	6
History (American)	AP Score: 4 or 5 = HIST 2111	3
History (European)	AP Score: 4 or 5 = HTS 1031	3
History (World)	AP Score: 4 or 5 = HTS LXXX**	3
Mathematics (AB and BC)	AP Score: AB4 or 5 BC3, 4, or 5 = MATH 1501	4
Music (Theory)	AP Score: 3 = MUSI 2600	2
	AP Score: 4 or 5 = MUSI 2600 & 3600	4
Physics C: Part I (Mechanics, Calculus Based)	AP Score: 4 or 5 = PHYS 2211	4
Psychology (General)	AP Score: 4 or 5 = PSYC 1101	3
Spanish (Language Level III or Literature Level III)	AP Score: 4 or 5 = SPAN 2001 & 2002	6

** With a score of 4 or 5 in both macroeconomics and microeconomics, a student could instead elect to receive 3 semester hours of credit for ECON 2100.*
*** HTS LXXX represents a 1000-level elective course.*

For more information regarding freshman admission to the Georgia Institute of Technology, visit **www.admission.gatech.edu**, call 404.894.4154, or write to: Director of Undergraduate Admission, Georgia Institute of Technology, Atlanta, Georgia 30332-0320.

Transfer Admission

Transfer applicants may apply for the summer, fall, or spring terms. Transfer applicants must submit the completed Application for Transfer Admission, nonrefundable application fee, official college transcript(s) from all colleges attended, and, if appropriate, any additional forms related to a special transfer program. Students who apply with fewer than thirty transferable hours at the time of application must submit a final high school transcript. Transfer applicants may choose to submit a paper copy of the application or complete one of the online options at **www.apply.gatech.edu**.

It is the applicant's responsibility to ensure that all required elements, including the application, nonrefundable application fee, and official transcript(s), are submitted on time. All elements must be submitted by February 1 (postmarked) to guarantee consideration for summer or fall semester admission, or October 1 (postmarked) to guarantee consideration for spring semester admission.

The Office of Undergraduate Admission will consider all applications on file by the stated deadlines, provided spaces are available for the particular term or academic year for which the student applies. An application submitted after the deadline may receive consideration, but only at the discretion of the Institute.

SAT II SUBJECT TESTS

Subject	Score	Georgia Tech Course	Semester Hours
Chemistry	720	CHEM 1310	4
English	750	ENGL 1101	3

INTERNATIONAL BACCALAUREATE

Subject	Higher Level Exam Scores	Georgia Tech Credit
Biology	5	4 hours (BIOL 1510)
	6 or higher	8 hours (BIOL 1510 & 1520)
Chemistry	5 or higher	4 hours (CHEM 1310)
Computer Science	5 or higher	3 hours (CS 1321)
Economics	5 or higher	3 hours (ECON 2100)
English	4 or higher	3 hours (ENGL 1101)
European History	4 or higher	3 hours (HTS 2037)
Foreign Language*	5 or higher	6 hours (1001 or 1002)
History of Americas	4 or higher	3 hours (HTS 2XXX**)
Mathematics	4 or higher	4 hours (MATH 1501)
Physics	5 or higher	8 hours (PHYS 2211 & 2212)
Psychology	5 or higher	3 hours (PSYC 1101)

**See Modern Foreign Language Credit on page 27 for details.*
** HTS 2XXX represents a 2000-level elective course.*

For more information regarding transfer admission to the Georgia Institute of Technology or any of the special transfer programs offered, visit **www.transfer.gatech.edu**, call 404.894.4154, or write to: Director of Undergraduate Admission, Georgia Institute of Technology, Atlanta, Georgia 30332-0320.

International Students

International students should access further information regarding application policies and procedures and other basic information helpful to applicants from other countries by visiting **www.admiss.gatech.edu/international.** International students will not receive financial aid or institutional scholarships. For more information, contact the Office of Undergraduate Admission at 404.894.4154.

Advanced Standing

For information, see "Rules and Regulations," Article XII, Section B, "Examinations for Advanced Standing," page 424.

Advanced Placement

Students entering Georgia Tech may receive college credit based upon their scores on the College Board Advanced Placement (AP) Exams taken in conjunction with designated high school advanced placement classes, SAT II Subject Tests, International Baccalaureate Credit, and/or Georgia Tech Departmental Exams.

Once enrolled at Georgia Tech, students are not allowed to take College Board (Advanced Placement and SAT II), International Baccalaureate, or A-Level Examinations for credit. All examinations must be completed prior to the student's enrollment date. Students who offer satisfactory evidence that they are qualified to do so may receive credit for a course by examination at Georgia Tech. Such an examination is called an examination for advanced standing. Please see the Advanced Standing section of this Catalog, "Rules and Regulations," page 424.

College Board Advanced Placement Exams

(See chart above.)

SAT II Subject Tests/ International Baccalaureate

(See charts on page 30.)

Departmental Exams

Advanced Placement in Mathematics

If you've taken a high school calculus course and achieved an SAT I math score of 600 or higher, you may take the School of Mathematics' advanced placement exam in calculus during freshman orientation. This exam is an alternative to College Board Advanced Placement Exams. Pass this and receive credit for MATH 1501. You may also be approved for subsequent course exams.

Modern Foreign Language Credit

You may receive humanities credit for courses numbered 2001-2002 in a language if you submit higher level scores of five or higher from a certified high school International Baccalaureate program. You will not get credit for high school language study if you are a native speaker of that language or if you have taken freshman-level courses at a college and received transfer credit. To have this elective credit entered on your records, you must ask the School of Modern Languages to submit the appropriate document to the registrar. This credit can apply toward the six-hour humanities/fine arts graduation requirement; no grade is attached to it.

Readmission

Georgia Tech students who are not enrolled for two or more consecutive terms must apply for readmission. The Application for Readmission, with all pertinent supporting information, must be submitted to the Registrar's Office before the deadline for the term for which readmission is requested as listed below:

Term	Deadline
Fall	July 1
Spring	December 1
Summer	April 1

Former students on drop or review status should apply at least two months prior to these deadlines in order to ensure sufficient time for the review process. The section "Rules and Regulations" in this catalog contains additional information on readmission.

Students who withdraw from school (receiving all *W*s) will not ordinarily be permitted to enroll the next succeeding term. If an exception is requested due to unusual circumstances, a Petition to the Faculty must be filed.

Academic Advising

The faculty of each school must provide each student enrolled in that school the opportunity to consult with an advisor on the academic program and the selection of courses. Students should regularly seek assistance from their designated faculty advisors during their program of study, particularly when problems occur. Students who do not know the identity of their advisor should consult with the school's academic office. Students who are undecided about their majors should seek advice from staff members in the office of the appropriate college dean.

Students must follow the approved curriculum of the academic school in which they are registered. Students who do not follow the approved curriculum may be denied registration privileges.

Policy on Competitive Admission (Freshman Applicants)

All qualified persons are equally welcome to seek admission to the Georgia Institute of Technology, and all persons may apply for and accept admission confident that the policy and regular practice of the Institute will not discriminate against them on the basis of race, religion, sex, or national origin.

Projections of the number of students to be admitted and enrolled in any year will be determined a) by the capacity of the Institute and b) by approved enrollment levels. If the number of qualified applicants for admission exceeds the number of applicants who can be admitted and enrolled, those to be offered admission will be selected on the basis of a) the Institute's judgment of the applicant's relative qualifications for satisfactory performance in the Institute and b) recognition of the Institute's special responsibilities to the residents of Georgia.

The policy on competitive admission will not prevent the admission of selected applicants who give evidence of possessing special talents for the Institute's programs requiring such special talents. In the application of this policy of competitive admission to nonresident students, preference for admission may be given to nonresident applicants who are legacies of the Institute. The admission of

undergraduate students to pursue programs leading to a baccalaureate degree shall be the responsibility of the Office of Undergraduate Admission, which will apply policies and procedures approved by the Office of the President and the Board of Regents of the University System of Georgia. Preference for admission will be given to qualified residents of Georgia.

The criteria used in determining each applicant's qualifications for admission shall include satisfactory evidence of scholastic promise based upon the applicant's previous academic record, scores on selected tests of aptitude or achievement, and evaluation of the applicant's Personal Statement and Leadership and Activity Record. Applicants who do not satisfy basic admission criteria may, for sufficient reason, be admitted with the approval of the Executive Admissions Committee appointed by the president of the Institute. Appeals concerning individual admission decisions shall be lodged with the director of the Office of Undergraduate Admission.

Policy on Transfer Admission

All qualified persons are equally welcome to seek transfer admission to the Georgia Institute of Technology, and all persons may apply for and accept admission confident that the policy and regular practice of the Institute will not discriminate against them on the basis of race, religion, sex, or national origin.

Projections of the number of transfer students to be admitted and enrolled in any year will be determined by: a) the capacity of the Institute; and b) approved enrollment levels. If the number of qualified applicants for admission exceeds the number of applicants who can be admitted and enrolled, those to be offered admission will be selected on the basis of: a) the Institute's judgment of the applicant's relative qualifications for satisfactory performance in the Institute; and b) recognition of the Institute's special responsibilities to the residents of Georgia.

The policy of admissions set forth above will not prevent the admission of selected applicants who give evidence of possessing special talents for the Institute's programs requiring such special talents. The admission of undergraduate students to pursue programs leading to a bachelor's degree shall be the responsibility of the Office of Undergraduate Admission, which will apply policies and procedures approved by the Office of the President and the Board of Regents of the University System of Georgia. Preference for admission will be given to qualified residents of Georgia.

The criteria used in determining each transfer applicant's qualifications for admission will include satisfactory evidence of scholastic promise based upon the applicant's previous academic transfer record. Under special circumstances, applicants may be admitted by the Executive Admissions Committee appointed by the president of the Institute. Appeals concerning individual admission decisions shall be lodged with the director of the Office of Undergraduate Admission.

Academic Regulations

The "Rules and Regulations" section of this catalog contains detailed information regarding the academic regulations of the Institute. Students who have questions concerning these regulations should consult either their major school or the Registrar's Office, 104 Administration Building.

Grading System

For information on the Georgia Tech grading system, see "Rules and Regulations," Section V.

Graduate Course Option

Students completing both the bachelor's and master's in the same discipline at Georgia Tech may use up to six credit hours of graduate-level course work in the major discipline for both degrees. Recognizing that some master's degree programs do not have a unique undergraduate counterpart program, and that some master's programs are offered by several schools, the term "discipline" in the prior sentence will be broadly interpreted in such cases. To qualify for this option, students must complete the undergraduate degree with a cumulative grade point average of 3.5 or higher and complete the master's degree within a two-year period from the award date of the bachelor's degree. Participating programs are civil and environmental engineering, electrical and computer engineering, engineering science and mechanics, industrial and systems engineering, international affairs, mathematics, mechanical engineering, and polymer, textile, and fiber engineering. For information on five-year B.S.-M.S. programs, see page 42.

Institute Rules for the Pass/Fail System

At the discretion of the major school, a student may receive up to a maximum of nine hours credit toward a bachelor's degree or three hours credit toward a graduate degree for courses taken under the pass/fail system with a grade of satisfactory. Such courses apply toward the degree requirements only if the major school has approved the course, either for all majors or for the individual student. The department or school offering a course determines the criteria for a passing grade and may restrict the pass/fail enrollment in any course it offers. The rules for withdrawal from graded courses apply to pass/fail courses as well.

Faculty will record only a grade of satisfactory or unsatisfactory for any student so designated on the official class roll; students may not change their designation from credit to pass/fail or from pass/fail to credit after the last day to make schedule changes. Neither the professor nor the registrar may change a pass/fail grade to a letter grade, nor may the registrar include courses taken pass/fail in the calculation of grade point averages.

Under certain circumstances, a change in degree requirements may affect a department's position on a course previously approved for degree credit under the pass/fail system. In such cases, the student's major school will decide if a course completed with a grade of pass before the change will fulfill the amended requirements.

Only students who complete ninety-one or more hours toward a degree at Georgia Tech may use the entire maximum of nine hours credit taken on pass/fail toward a bachelor's degree. For transfer students, second undergraduate degree students, and dual degree students, the number of hours completed at Georgia Tech determines the maximum number of pass/fail hours allowed, according to the following schedule:

Hours included in program of study	Hours allowed on pass/fail basis
45 to 70 credit hours	3 credit hours
71 to 90 credit hours	6 credit hours
91 or more credit hours	9 credit hours

Examination and Term Grades

The Institute schedules final examinations during the last week of each term, and term grades are posted on the Student Access System.

Scholastic Average

A student who passes a course receives both the designated number of credit hours and a number of quality points, calculated by multiplying the course credit hours and the numerical equivalent of the letter grade received ($A = 4$, $B = 3$, $C = 2$, $D = 1$). Thus, a student taking a three-hour credit course and earning a grade of *C* receives six quality points. To determine the undergraduate scholastic average, the total number of quality points earned by the student for all courses scheduled as an undergraduate is divided by the total number of credit hours scheduled; for the graduate scholastic average, only those courses scheduled by the student while enrolled in the graduate division are considered. If a student takes the same course more than once, the later grade does not replace the earlier one; rather, the scholastic average includes both grades. Courses taken pass/fail are not included in the calculation of the student's grade point average.

Second Undergraduate Degrees

To be a candidate for a second undergraduate degree, a student must obtain the recommendation of the faculty through the chair of the school concerned. See "Rules and Regulations," Section XIII, E, for detailed information.

Transfer Credit

The basic policy regarding the acceptance of courses by transfer is to allow credit for courses completed with satisfactory grades (*C* or better) in other accredited colleges and universities in the United States and Canada, provided the courses correspond in time and content to courses offered at the Georgia Institute of Technology. Georgia Tech will not accept credit for courses successfully completed at another institution but previously taken at Georgia Tech unless the final grade received at Georgia Tech is a "*W*." The student must request and file an official transcript of transfer courses before the Institute can award credit. Coursework completed at colleges and universities outside the United States and Canada will be evaluated on a case-by-case basis. Transfer credit is not calculated in the Georgia Tech grade point average.

Students may attend another institution as a transient student during terms when not enrolled

at Georgia Tech. Students should discuss their course selection with their academic advisor to ensure transferability and applicability toward their degree program. With the exception of officially sanctioned cross-enrolled programs, students are not to be enrolled at Georgia Tech and another institution during the same term without the specific approval of the appropriate curriculum committee.

Auditors

Officially enrolled students who have obtained approval of their advisors and the department of instruction concerned may audit courses at Tech; however, the student will not receive credit for courses scheduled on an auditing basis. If the student wishes to change to or from auditing status, he or she must follow the procedure for schedule changes during the time allotted for schedule modification in the official calendar.

In order for a successful audit to show on the student's permanent record, the student must comply with all requirements listed by the instructor. If the instructor deems that the student did not successfully audit the course, the grade of *W* will be assigned.

All students registered as auditors must pay tuition at the regular rate. Members of the faculty or staff of the Georgia Institute of Technology may sit in on a course with the permission of the school/college concerned.

Constitution and History Requirements

The Georgia law as amended March 4, 1953, requires that before receiving an undergraduate degree all students pass an examination or a comparable course in United States and Georgia history/constitution. Courses that fulfill the United States and Georgia history/constitution requirement are HIST 2111, 2112; POL 1101; PUBP 3000; or INTA 1200. (Credit not awarded for both POL 1101 and INTA 1200).

Regents' Testing Program

To establish eligibility for an undergraduate degree, every student in the University System of Georgia must pass the Regents' Test, an examination designed to measure proficiency in reading and English composition. Students are invited to take this examination when they have earned ten hours of college credit. Any student accumulating forty-five hours of college credit toward a degree without passing the Regents' Test must schedule remedial English or reading along with other credit coursework. If a student fails in the first attempt, he or she must repeat the test. Alternative tests of competence and remediation are offered to non-native speakers of English. In addition, alternative tests are offered for students with disabilities documented through the Dean of Students' Office. Listed below are test scores that can be used to satisfy the Regents' Test requirements.

The READING portion of the test can be satisfied with:

- SAT Verbal score of 510 or higher
- ACT Reading score of 23 or higher

The ESSAY portion of the test can be satisfied with:

- SAT-I Verbal score of at least 530 and a grade of *A* in English 1101
- SAT-I Verbal score of at least 590 and a grade of *B* in English 1101
- SAT II English Writing score of 650 or higher
- ACT English score of at least 25 and a grade of *A* in English 1101
- ACT English score of at least 26 and a grade of *B* in English 1101
- AP English score of 3 or higher
- International Baccalaureate higher-level English score of 4 or higher

Scores must be from a national administration of the SAT or ACT. Scores from institutional SAT or residual ACT tests will not be acceptable for this purpose.

NOTE: Figures below the course number and name signify the number of class hours per week, the number of laboratory hours per week, and the semester-hour credit earned for the completed course, in that order.

REGENTS' TESTING

RGTR 0198 Regents' Reading Skills
2-0-2.
Special attention given to developing reading skills for students who need additional preparation for the University System Regents' Exam. Cannot be counted for credit toward graduation.

RGTE 0199 Regents' Writing Skills
2-0-2.
Gives special attention to development of basic skills in writing for students who need additional preparation for the University System Regents' Exam. Cannot be counted for credit toward graduation.

ROTC Credit

Students may apply a maximum of four hours in basic ROTC courses and six hours in advanced ROTC courses toward meeting the free elective requirements for any degree. Students should begin taking basic ROTC courses during the first term they are enrolled. For further information, see individual curricula for the schools.

Wellness Requirement

All students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Prerequisite Checking

The registration system will automatically check prerequisites for courses numbered below 6000. Students who do not have the listed prerequisites but believe they have sufficient background work to enroll in the course should contact the school/college of instruction.

Transfer Courses with 'X' Numbers

Transfer courses for which there is no exact Georgia Tech equivalent will be listed with the numbers 1XXX, 2XXX, etc. Courses so numbered can be used as free electives or may be substituted for Georgia Tech courses at the discretion of the academic unit. Transfer courses with an "X" as the third number of the course (e.g., MATH 15X2) are lacking a component of the Georgia Tech course. These courses, in combination with another Tech course, may be considered as equivalent for prerequisite checking and degree requirements. Students should seek advisement from their academic unit regarding the use of these courses toward fulfilling degree requirements.

Core Curriculum

*See **http://www.registrar.gatech.edu** for updates and/or changes.*

Areas A-F

- CORE AREA A – Essential Skills
- CORE AREA B – Institutional Options
- CORE AREA C – Humanities/Fine Arts
- CORE AREA D – Science, Mathematics, and Technology
- CORE AREA E – Social Science
- CORE AREA F – Courses related to degree and major

Core Area A**

Essential Skills, nine* semester hours

Area A is satisfied by completion of the following:

Required of all majors:

Course Number/Name		*Semester Hours*
ENGL 1101	Eng. Comp. I	3
ENGL 1102	Eng. Comp. II	3

Required of all majors in Architecture, Computing, Engineering, and Sciences:

Course Number/Name		*Semester Hours*
MATH 1501	Calculus I	4

Required of all other majors:

Course Number/Name		*Semester Hours*
MATH 1712	Survey of Calculus	4
or MATH 1501	Calculus I	4

**The tenth hour will be used to satisfy Core Area B.*

Core Area B**

Institutional Options, four semester hours

Area B is satisfied by completion of the following:

Course Number/Name	*Semester Hours*
Electives approved by the program	3

Plus 1 hour from Area A

Core Area C**

Humanities/Fine Arts, six semester hours

Area C is satisfied by completion of six semester hours from the following lists. (Undergraduate Research courses numbered 2698, 2699, 4698, and 4699 cannot be used to fulfill requirements for Humanities or Social Science.)

Architecture, City and Regional Planning, Industrial Design, and Music:

ARCH 2111, 2112, 2115, 4109, 4110, 4113, 4114, 4117, 4118, 4119, 4120, 4124, 4128, 4305; COA 2241, 2242, 3115, 3116; CP 4040; ID 2202; MUSI 2600, 3450, 3500, 3600, 3610, 3620, 4450, 4801, 4802, 4803, 4813, 4823, 4833

Literature, Communication, and Culture:

All LCC courses except LCC 2661, 2662, 2698, 2699, 2700, 2710, 2720, 2730, 3400, 3401, 3402, 3404, 3406, 3408, 3410, 3412, 3661, 3662, 3705, 3710, 4100, 4102, 4200, 4400, 4402, 4404, 4406, 4500, 4600, 4602, 4698, 4699, 4720, 4725, 4730, 4731, 4732, 4904, 4906

Modern Languages*:

All CHIN courses beginning with CHIN 1002 CHIN 2698, 2699, 3698, 4699, 4901, 4902

All FREN courses beginning with FREN 1002 except FREN 2698, 2699, 4698, 4699, 4901, 4902

All GRMN courses beginning with GRMN 1002 except GRMN 2698, 2699, 3901, 4698, 4699, 4901, 4902
All JAPN courses beginning with JAPN 1002 except 2698, 2699, 4698, 4699
All LING courses except LING 2698, 2699, 3750, 2760, 4698, 4699, 4901, 4902
All RUSS courses beginning with RUSS 1002 except RUSS 2698, 2699, 4698, 4699, 4901, 4902
All SPAN courses beginning with SPAN 1002 except SPAN 1101, 2698, 2699, 4698, 4699, 4901, 4902

** Humanities credit is awarded for 1001 classes upon completion of corresponding 1002 classes. Humanities credit is awarded for SPAN 1101 upon completion of corresponding SPAN 1102 classes.*

Philosophy, Science, and Technology (PST):
All PST courses except PST 2698, 2699, 3790, 4698, 4699, 4790, 4791, 4792, 4901, 4902, 4903

Core Area D**

Science, Mathematics, and Technology, twelve semester hours

Area D is satisfied by completion of eight semester hours from the science list and four semester hours from the mathematics list.

Science:

Course Number/Name		*Semester Hours*
BIOL 1510	Biol. Principles	4
BIOL 1520	Intro. to Organismal Biol.	4
CHEM 1310	Gen. Chem.	4
CHEM 1311	Inorganic Chem. I	3
CHEM 1312	Inorganic Chem. Lab	1
EAS 1600	Intro. to Environmental Science	4
EAS 1601	Habitable Planet	4
PHYS 2211	Intro. Physics I	4
PHYS 2212	Intro. Physics II	4

Mathematics:
All majors in the Colleges of Architecture, Computing, Engineering, and Sciences will complete Math 1502. All other majors will complete:

Course Number/Name		*Semester Hours*
MATH 1711	Finite Math.	4
or MATH 1502	Calculus II	4

Core Area E**

Social Sciences, twelve semester hours

Area E is satisfied by completion of the U.S./Georgia history and constitution legislative requirement with three semester hours from HIST 2111, 2112; POL 1101; INTA 1200; PUBP 3000; and nine semester hours from the following list. (Undergraduate Research courses numbered 2698, 2699, 4698, and 4699 cannot be used to fulfill requirements for Humanities or Social Science.)

Architecture and City and Regional Planning:
ARCH 4126, 4335, 4770; CP 4010, 4020, 4030

Computer Science:
CS 4752

Economics:
All ECON courses except ECON 2698, 2699, 3110, 3120, 3150, 3160, 3161, 4060, 4170, 4301, 4321, 4345, 4360, 4412, 4698, 4699, 4803, 4901, 4910, 4990

History, Sociology, and History, Technology, and Society (HTS):
All HIST, SOC, and HTS courses except HTS 2698, 2699, 2927, 2928, 2929, 3103, 4698, 4699, 4925, 4926, 4927, 4928, 4929

International Affairs:
All INTA courses except INTA 1001, 1002, 2010, 2698, 2699, 3750, 4400, 4698, 4699, 4901, 4902, 4903

Political Science and Public Policy:
All POL and PUBP courses except PUBP 2698, 2699, 3600, 4113, 4201, 4530, 4532, 4698, 4699, 4756, 4901, 4902, 4903, 4951, 4952

Psychology:
PSYC 1101, 2010, 2020, 2103, 2210, 2220, 2230, 2240, 2270, 2300, 2400, 3060, 4770

Core Area F**

Courses related to degree and major, eighteen semester hours

Area F varies with degree and major.

1. Courses completed at the 3000-4000 level may not satisfy the core curriculum Area C and Area E requirements for students transferring to other units of the University System of Georgia.
2. Any courses completed that were listed in prior catalogs as satisfying the Humanities/Social Science requirement and were completed while that catalog was in effect may also be used to satisfy this requirement.

*** The requirements listed were current as of the printing of this Catalog. For updated requirements, go to* ***www.catalog.gatech.edu.***

This version of the *General Catalog* was current as of the date of printing in May 2005. For the most up-to-date version, visit **www.catalog.gatech.edu**. In addition, this is the final printed version of the *General Catalog*. Beginning in May 2006 it will be available online only.

Information for Graduate Students

General Information

The faculty of the Georgia Institute of Technology grants advanced degrees in engineering, science, management, computing, architecture, city and regional planning, public policy, and other technology-related areas. The goals for graduate studies and research are to establish an educational environment that will strengthen students' personal and professional development, to encourage students and faculty to vigorously pursue the discovery and generation of new knowledge through research, to investigate ways of applying such knowledge innovatively for the benefit of society and humanity, and to foster the development of new tools, objects, and ideas.

Students whose interests and aptitudes lead them beyond the limits of the traditional undergraduate curriculum may broaden their knowledge of a given field and pursue independent inquiry through graduate study. A graduate education is of particular benefit to students interested in careers in research, management development, design, or consulting; to those who aspire to formulate and administer policy; and to those who desire to enter the profession of education.

Degrees and Programs of Study

Master's Programs

Programs of study and research leading to the master's degree are offered in the following disciplines:

Aerospace Engineering
Applied Physics
Architecture
Bioengineering
Bioinformatics
Biology
Biomedical Engineering
Building Construction/Facilities Management
Business Administration
Chemical Engineering
Chemistry
City and Regional Planning
Civil Engineering
Computer Science
Earth and Atmospheric Sciences
Economics
Electrical and Computer Engineering
Engineering Science and Mechanics
Environmental Engineering
Global Executive Master of Business Administration
Health Systems
History and Sociology of Technology and Science
Human-Computer Interaction
Industrial Design
Industrial Engineering
Information Design and Technology
Information Security
International Affairs
International Logistics
Management of Technology (Executive)
Materials Science and Engineering
Mathematics
Mechanical Engineering
Medical Physics
Nuclear Engineering
Operations Research
Paper Science and Engineering
Physics
Polymers
Prosthetics and Orthotics
Psychology
Public Policy
Quantitative and Computational Finance
Statistics
Textile and Fiber Chemistry
Textile and Fiber Engineering
Textile Engineering

Doctoral Programs

Programs of study and research leading to the Doctor of Philosophy are offered in the following disciplines and areas:

Aerospace Engineering
Algorithms, Combinatorics, and Optimization
Applied Physiology
Architecture
Bioengineering
Bioinformatics
Biology
Biomedical Engineering
(joint with Emory University)
Chemical Engineering
Chemistry
Civil Engineering
Computer Science
Digital Media
Earth and Atmospheric Sciences
Electrical and Computer Engineering
Engineering Science and Mechanics
Environmental Engineering
History and Sociology of Technology and Science
Human-Centered Computing
Industrial and Systems Engineering
Management
Materials Science and Engineering
Mathematics
Mechanical Engineering
Nuclear and Radiological Engineering
Paper Science and Engineering
Physics
Polymers
Psychology
Public Policy
Public Policy (joint with Georgia State University)
Textile Engineering

To locate detailed descriptions of these programs and related courses, refer to the index on pages 478-479. Areas of specialization may also be found under each program description.

The Institute may award degrees with or without designation of the field, based upon the recommendation of the school concerned.

Special Programs

Interdisciplinary Programs

The schools of the Georgia Institute of Technology are authorized to offer graduate degrees, develop and administer their own individual programs, and work closely with one another to provide special study and research opportunities for students who wish to pursue a degree with a wider perspective than that presented by a single discipline. Cooperation between academic units and various research centers and the development of informal programs based on areas of faculty interest have resulted in the establishment of interdisciplinary programs in a number of areas, such as computer-integrated manufacturing systems, microelectronics, bioscience and bioengineering, and nanotechnology. The College of Engineering lists a number of multidisciplinary programs on page 121 of this catalog. The College of Computing offers an interdisciplinary certificate in cognitive science, detailed on page 101. The role of the College of Management in multidisciplinary programs is discussed on page 330. Multidisciplinary programs in the College of Sciences are discussed on page 348.

Graduate Cooperative Program

Selected students planning to enroll for graduate study at Georgia Tech have the opportunity to participate in a unique cooperative program leading to advanced degrees in participating schools. Two plans are available. One is designed for Georgia Tech undergraduates who plan to continue as graduate students at Tech and includes study-work periods that span both undergraduate and graduate levels. Eligibility is based on academic achievement at Georgia Tech. The second plan is for graduate students whose undergraduate degrees may be from Tech or other institutions.

Degree requirements under this plan are identical to those for all students enrolled at Georgia Tech. The Graduate Cooperative Plan is designed as an enhancement to the educational programs of students working for advanced degrees and offers the benefits of added facilities and opportunities for external stimulation. In addition, students receive compensation for their services from companies that employ them.

Preliminary screening of students occurs at the school or college level. The participating companies select students on the basis of academic credentials and interest areas correlated with company activities. Many participating companies require U.S. citizenship or permanent residency. For students planning to participate both at the undergraduate and graduate levels, the program requires at least two work semesters at the undergradnate level and at least two work semesters at the graduate level. Students planning to participate only at the graduate level are required to work at least two semesters.

Academic credit for co-op work is available if the student, with approval of the major school, pursues research at the company that can be used to satisfy requirements for the thesis or other research paper.

Students interested in applying for admission to the Graduate Cooperative Plan should write to the Graduate Cooperative Program, Division of Professional Practice, Georgia Institute of Technology, Atlanta, Georgia 30332-0260.

The Academic Common Market

The Institute participates in the Academic Common Market (ACM) Program managed by the Southern Regional Education Board. By interstate agreement, the Market enables southern states to share academic programs. Residents of the participating states who qualify for admission and gain the approval of their state coordinators may enroll on an in-state tuition basis. The Georgia Tech programs currently participating in ACM are graduate programs in building construction and integrated facility management, architecture, city and regional planning, city planning/architecture joint program; as well as undergraduate programs in nuclear and radiological engineering, and polymer and fiber engineering.

Center for the Enhancement of Teaching and Learning (CETL)

The Center for the Enhancement of Teaching and Learning was founded in 1986 with a mission to assist faculty and teaching assistants in becoming more effective instructors and hence to improve the learning of Georgia Tech students. CETL now offers graduate-level courses in Classroom Management, Academic Writing, Academic Professionalism, and English Oral Skills and Instructional Practices for international teaching assistants. In addition, CETL offers training and assistantships associated with its NSF-sponsored Student and Teacher Enhancement Partnership (STEP) program.

All CETL courses may be taken either for audit or pass/fail, and these hours may not be counted toward any degree requirements. No student may take more than two CETL courses in any one semester, and all of these courses require the permission of both the student's home unit and CETL. A non-credit option remains for those students whose home units will not permit the credit version of any of the courses.

All students wishing to enroll in the English Oral Skills course must have a contract signed by their home unit. In addition, these students should schedule a meeting ahead of time with CETL to determine in which version of the course they should register.

The STEP courses are only open to participants in the STEP program, which has its own application process. Interested students should contact CETL directly.

NOTE: Figures below the course number and name signify the number of class hours per week, the number of laboratory hours per week, and the semester-hour credit earned for the completed course, in that order.

CENTER FOR THE ENHANCEMENT OF TEACHING AND LEARNING

CETL 8701. Classroom Management and Policies: Effective Teaching
1-0-1
A course in which students learn about official Georgia Tech policies impacting instruction and develop skills to resolve problems and enhance classroom learning.

CETL 8711. Student and Teacher Enhancement Partnership Summer Training
Credit hours to be arranged.
Participants attend training sessions on pedagogy, classroom management, and educational technology; engage in practice teaching; and design action plans for partnering with local high school teachers.

CETL 8712. STEP Fellows Academic Year Seminar
1-0-1
This is the academic year follow-up course for STEP fellows. It is a forum to share and to continue training as the fellows work in their STEP high schools.

CETL 8721. Academic Writing for Graduate Students and Teaching Assistants
1-0-1
Through examination of writing samples and practice, students learn techniques for enhancing proposal preparation and methods for evaluating writing as future instructors and thesis directors.

CETL 8722. Academic Writing for International Graduate Students
1-0-1
This course aids international graduate students in enhancing their academic writing skills in English through exposure to, and practice of producing examples of academic writing.

CETL 8731. Academic Professionalism
1-0-1
Participants work through numerous exercises and scenarios in order to prepare them professionally and personally for a future career in academics.

CETL 8791. Instructional Practices for International Teaching Assistants
2-0-2
Enhancement of English pronunciation and instructional skills for international teaching assistants. In-class and small-group language practice; discussion of teaching methodology.

CETL 8792. Classroom English and Pedagogy for International Teaching Assistants
2-0-2
Enhancement of English pronunciation and instructional skills for international teaching assistants. In-class and small-group language practice; discussion of teaching methodology; individual tutoring.

CETL 8793. Classroom English for International Graduate Students
2-0-2
Enhancement of English pronunciation skills for international teaching assistants. In-class and small-group language practice; individual tutoring.

CETL 8794. Academic English for International Graduate Students
1-0-1
Enhancement of English pronunciation for international teaching assistants. In-class and small group language practice.

CETL 8801, -02, -03. Special Topics
Credit and class hours equal last digit in course number.

CETL 8997. Student and Teacher Enhancement Partnership Assistantship
Credit hours to be arranged.
This course is for STEP students with an assistantship.

Policies and Regulations

The Graduate Committee, with the approval of the Academic Senate, is responsible for establishing academic policy for the graduate programs; however, final authority rests with the Senate. This committee reserves the right to change requirements for degrees as may be appropriate. Students enrolled at the time such changes appear in the catalog have the privilege of following either the regulations stated in the catalog effective the semester in which they enrolled or the regulations in the Catalog that records the change.

This catalog records the Institute-wide policies and regulations that govern the graduate program. Schools may make additional rules concerning their programs and the pursuit of their degrees, but such rules may not contradict Institute policies and regulations.

Graduate Student Work Loads

Full-time students must be enrolled for at least twelve credit hours on a letter grade or pass/fail basis. As an exception, the advisor and school chair may allow up to three hours out of the minimum twelve to be taken on an audit basis in fall and spring semesters; in summer semesters, the advisor and school chair may allow up to six hours out of the twelve minimum to be taken on an audit basis. Hours in excess of the required twelve may be taken on any basis. Full-time students working exclusively on thesis research should be registered for eighteen or more hours of 7000- or 9000-level courses (Master's or Doctoral Thesis) in fall and spring semesters, and for up to sixteen hours during summer semesters.

The maximum load for graduate students in good standing is twenty-one hours in fall/spring and sixteen hours in summer. The minimum load is three hours except for the semester of graduation. A student may register for only one hour of Master's or Doctoral Thesis (7000 or 9000) during the semester of graduation. This exception may be used once for each degree.

Students with fellowships, assistantships, traineeships, tuition waivers, or student visas and those assigned to the Institute by the armed forces for the purpose of pursuing a degree are required to enroll full time. Part-time doctoral students engaged in research for the Ph.D. should register for the number of 9000-level hours consistent with the time they and their faculty advisors spend on the dissertation research.

Staff Members

No staff member beyond the rank of instructor in a school may work for a master's degree in that school. No new staff member with the rank of assistant professor in a school may work for a doctoral degree in that school.

Admissions Information

Applicants for the master's program should have received a bachelor's degree from a recognized institution and graduated in the upper half of their class. Students must show evidence of preparation in their chosen field sufficient to ensure profitable graduate study.

Ordinarily, the graduate school admits to the doctoral program only those students who have graduated in the upper quarter of their class.

Prospective students may obtain information and apply for admission via the graduate admissions Web page at **www.grad.gatech.edu/admissions**. Unless otherwise instructed by the major school/college under the "Degree Programs" listing at **www.grad.gatech.edu/admissions**, the student must submit the online application, letters of recommendation, and official transcripts of previous academic work to the Graduate Admissions Office by June 1, November 1, or March 1 for fall, spring, or summer terms, respectively. Some programs have earlier deadlines, and some programs admit students for the fall term only. Students are advised to check with the graduate program of interest in the "Degree Programs" listing at **www.grad.gatech.edu/admissions** before applying. It is strongly recommended that international students submit their materials at least six months before the proposed registration date. Students applying for admission with financial assistance for any term are strongly advised to submit their materials by February 1 of the preceding academic year.

Reactivation of Application

Applicants to a Georgia Tech graduate program who do not enter in the term for which they applied and subsequently wish to be considered for a later term must reactivate their applications for the new term by written request to the department to which they originally applied. Since the graduate admissions office keeps files on "never entered" students for one year only, students who delay more than one year in the reactivation request must reapply and provide a new set of application materials. The number of reactivations per applicant is limited.

TOEFL for International Students

All international students from countries in which English is not the primary native language must take the Test of English as a Foreign Language (TOEFL). Since the results of this test constitute part of the material reviewed for admission to graduate study at Georgia Tech, students should arrange to have the Educational Testing Service send their scores to the Graduate Admissions Office as early as possible. The minimum score for graduate admission required by Georgia Tech is 550 (paper-based) or 213 (computer-based). Some academic programs require higher scores.

Students who wish to take the TOEFL may obtain more information and materials at **www.toefl.org**. Applicants may also acquire copies of the *TOEFL Bulletin of Information for Candidates, International Edition*, and the registration form through the offices of the United States Information Service (USIS), American embassies and consulates, and U.S. educational commissions and foundations in a number of cities outside the United States. In addition, several private organizations distribute the TOEFL Bulletin. These groups include the Institute of International Education (IIE); the African American Institute (AAI); the American Mideast Educational and Training Services (AMIDEAST); and the American-Korean Foundation.

Students who cannot obtain a TOEFL Bulletin and registration form locally or via the Web should write well in advance of application to Test of English as a Foreign Language, Box 6151, Princeton, New Jersey, 08541-6151, USA.

Effective September 2005, the make-up of the TOEFL will be changed. As a result, the minimum scores required by the Institute will be reviewed and new minimum scores established. These will be posted on the "Degree Program" pages of the Graduate Admissions Web site as soon as they are available. After September 2005, Georgia Tech will continue to accept either the "old" format scores or "new" format scores as long as they can be reported to the Institute directly from the Educational Testing Service.

Graduate Record Examinations (GRE)

GRE General test scores are generally required by all graduate programs with the exception of the MBA, Global Executive Master of Business

Administration, and the Executive Management of Technology programs, which require Graduate Management Admission Test (GMAT) scores. In addition, GRE subject test scores are required for applicants to the College of Computing and the Schools of Chemistry and Biochemistry and Mathematics.

Information concerning these tests can be obtained from Graduate Record Examinations, Educational Testing Service, Box 6000, Princeton, New Jersey 08541-6000, or **www.gre.org**.

General information on the GMAT is available from Educational Testing Service, Box 966, Princeton, New Jersey 08540, or **www.gmac.com**.

On campus applicants may pick up GRE information from the Graduate Admissions Office and GMAT information from the College of Management.

Types of Standing

Applicants holding a bachelor's degree in an appropriate field from an approved institution will be accorded full graduate standing provided their previous work is of sufficient quality to indicate immediate success in advanced study.

If the work of an applicant holding an approved bachelor's degree is deficient in content or quality so that supplemental study or demonstrated ability is necessary, the applicant may be accorded conditional graduate standing.

Students who do not wish to qualify for an advanced degree at Tech, but demonstrate the potential benefits of their participation in advanced study, may gain admission as special graduate students. Students who are admitted with special standing for failure to submit official transcripts or for other administrative reasons may apply not more than sixteen semester credit hours taken on special standing toward a degree.

Graduate students in good standing at other U.S. universities may enroll at Tech as transient graduate students by filing an application for admission and by providing a letter of verification of good standing status from their registrar. Work undertaken in transient standing will not apply, however, toward a Georgia Tech degree.

The undergraduate school, not the graduate school, will admit students working toward a second bachelor's degree.

In addition to full, conditional, and special graduate standing, graduate students will be classified by academic standing according to their grade point averages: good standing, warning, probation, or drop. For specific information, see "Rules and Regulations," page 415.

The graduate average includes the grades on all courses scheduled by the student after admission to graduate study.

Readmission

Students who interrupt the continuity of their graduate programs by not registering for two or more consecutive terms must seek readmission by filing with the registrar a completed request for readmission form. Individuals who have received a graduate degree from Georgia Tech and who wish to re-enter to receive an additional graduate degree (at the same level or higher) must also request readmission through this process. Readmission forms are available from the registrar's office. For more information, see "Rules and Regulations" on page 415.

Undergraduate Students Taking Graduate Courses

Seniors with a grade point average of at least 2.7 may schedule graduate courses. In order to do so, the student must obtain permission both from the student's advisor and from the chair of the school offering the course. Credit toward the master's degree for up to twelve hours of courses taken as an undergraduate may be received under the following conditions.

1. The student was in residence at Georgia Tech for at least two semesters before registering for the course(s).
2. The student did not apply credit for the course toward the baccalaureate degree. (See page 32, "Graduate Course Option," for special exceptions in certain schools.)

Five-Year B.S.-M.S. Degree Programs

Many schools at Georgia Tech offer five-year B.S.-M.S. degree programs that, like the Graduate Course Option, allow eligible students to use up to six credit hours of graduate-level course work in the major discipline for both degrees. The B.S.-M.S. programs typically include research and mentoring components and have their own GPA requirements. More information is available from participating major schools/colleges.

Registration

During the week preceding first registration, each new student should plan to attend the Institute's orientation session. Information will be posted on the Graduate Admissions Web site. In addition, they should consult with the graduate coordinator of his or her major school to prepare a plan of studies and to receive instructions regarding registration procedures. Complete instructions on how and when to register can be found at **www.registrar.gatech.edu**. Tech also conducts orientation for new fall graduate students just before registration.

Note: All new students must have submitted health forms to Student Health Services before they can register. All new international students must check in with the Office of International Education as soon as they arrive.

Transfer of Credit

A student may not apply for transfer credit until after matriculation at Georgia Tech. The courses to be transferred would typically be those appearing on the approved program of study form for the master's degree. A doctoral student normally does not request transfer credit. The rules relative to and the process for obtaining transfer of credit for graduate-level courses are as follows:

1. A student in a master's degree program requiring fewer than thirty-three semester credit hours may receive up to six hours of transfer credit for graduate-level courses taken at an accredited institution in the United States or Canada, or at a foreign school or university that has a signed partner agreement with Georgia Tech-Lorraine, and not used for credit toward another degree. A student in a master's degree program requiring thirty-three semester credit hours or more may receive up to nine hours of transfer credit for graduate-level courses taken at an accredited institution in the United States or Canada, or at a foreign school or university that has a signed partner agreement with Georgia Tech-Lorraine, and not used for credit toward another degree. The student must supply a current transcript for this evaluation.
2. To obtain transfer of credit, the student must complete the following procedure: a) The student will confer with the graduate advisor to ascertain whether the courses to be transferred are a logical part of the student's graduate program; b) If the courses are appropriate, the student will deliver to the school that teaches such courses a copy of the current transcript, necessary descriptive materials including catalog descriptions, and textbooks used for evaluation. The faculty of the appropriate school will determine the equivalent Georgia Tech course and the number of credit hours accepted. The faculty member who prepares the transfer credit form should have the school chair cosign it. The school should then send the form directly to the registrar with a copy of the student's Approved Program of Study attached; c) If the student wishes to transfer more than the number of hours permitted in paragraph 1), a petition must be submitted to the Institute Graduate Committee including statements of possible justification for the granting of such a petition, transfer credit forms, and the recommendation of the student's school chair.
3. A joint enrollment student may receive graduate credit for up to one-third of the hours required for the degree for graduate courses taken at Emory University or Georgia State University provided that a) Georgia Tech does not offer such courses; b) the student's advisor and school chair approve the courses in writing in advance; and c) the student passes the courses with a grade of *C* or better. "Advance approval" is satisfied when the courses appear on the student's proposed program of study.
4. A student may not receive transfer credit from universities outside the United States and Canada except if the courses were taken at a foreign school or university that has a signed partner agreement with Georgia Tech-Lorraine. In any other case, an international student can obtain credit for courses previously taken but not applied toward another degree by filling out an "Examination for Advanced Standing Authorization Request Form," paying the appropriate fee at the Cashier's Office, and passing the examination for advanced standing. The school or college that normally teaches the equivalent course will administer any necessary examinations.

The Master's Degree

Enrollment Requirements

While students may enroll in the master's degree program upon admission with either full or conditional standing, all conditions must be met and the student's status changed to "full" in order to graduate with the master's degree.

Students enrolled for the master's degree must register for at least one semester per year in order for the original requirements for their degree to remain unchanged. In other cases, the school may re-evaluate the student's credentials and impose additional degree requirements.

Students who have completed all coursework and are planning to submit a thesis in partial fulfillment of the requirements for a master's degree should register for research hours ("MAJR7000") consistent with a realistic appraisal of the amount of remaining thesis work and required faculty involvement. Students are not eligible to receive thesis guidance during any term for which they are not registered.

Students must normally enroll for a minimum of three hours each semester. Thesis students may enroll for one hour of thesis only in the semester of graduation.

The Institute has no residency requirements for the master's degree. See "Requirements for Award of the Master's Degree," item 7, page 45, for more information.

Program of Study

The student, in conference with the faculty advisor, should prepare a program of study for the master's degree as a guide for planning an academic schedule. In some cases, the student's school may require that the proposed program be submitted to the chair of that school for approval.

The program of study must be completed satisfactorily within six consecutive calendar years and must include, at minimum, thirty approved credit hours distributed as follows:

With thesis:

- Minimum course credit hours in major field (a basic field of knowledge, not a department of specialization) 12
- Minimum course credit hours at 6000 to 9000 level 12
- Total course credit hours for degree 18
- Thesis hours (7000) 6
- Total credit hours 30

Without thesis:
(must have approval of school chair)

- Minimum course credit hours in major field (a basic field of knowledge, not a department of specialization) 18
- Minimum course credit hours at 6000 to 9000 level 21
- Total credit hours 30

Some schools require more than the minimum credit hours. Refer to specific academic program descriptions for more detailed information.

Other than thesis hours, the student may use only three hours under the pass/fail designation in the approved program of study (see page 33). As a rule, a course may not be counted toward more than one degree.

Undergraduate courses required for graduation in the discipline (designated degree) or discipline-of-origin (undesignated degree) at Georgia Tech may not be applied toward a master's degree. (See page 32, "Graduate Course Option," for special exceptions in certain schools.)

The Master's Thesis

To complete the requirements for the master's degree, the student must submit a master's thesis unless the school chair determines that additional coursework is of more importance in meeting approved objectives.

Students who meet the requirements for the master's degree by completing a combination of coursework and thesis must register for a minimum of six hours of thesis credit. (See Program of Study.)

A candidate whose program includes a thesis must present a treatise in which the results of an investigation directed by a member of the faculty of the Institute are set forth in clear, articulate form. The purpose of the thesis is to further educational development by requiring the student to plan, conduct, and report an organized and systematic study of importance.

The *Manual for Graduate Theses*, available at **www.grad.gatech.edu/thesis**, specifies the formatting requirements for the thesis. Information regarding electronic thesis/dissertation submission can also be found at this Web site.

Requirements for Award of the Master's Degree

1. **Petition to graduate:** To apply for master's degree candidacy, the student must submit to the registrar, during the semester preceding the anticipated final semester of work, the petition for a degree with the Approved Program of Study attached.
2. **Approved Program of Study** (must accompany petition to graduate): The student's Approved Program of Study must show that course requirements for the master's degree will be satisfied before or during the final semester (see Program of Study).
3. The Approved Program of Study must be successfully completed within a period of no more than six consecutive calendar years.
4. The student must have an overall grade point average of at least 2.7 and satisfy all school academic requirements.
5. The student must have completed satisfactorily any language requirement imposed.
6. The student must have passed any qualifying or comprehensive examinations required by the student's school.
7. The student must be registered for a minimum of three credit hours at all times, except that thesis students may enroll for one hour of MAJR 7000 in the semester of graduation. This reduction may be used only once. Students who have met all requirements for graduation before the last day of registration for the graduation term and who were registered the preceding semester may be eligible for a waiver of enrollment.
8. In addition, the student must have completed any required work outlined at the time of matriculation.

Additional Requirements for Master's Thesis Students

9. The student must submit the thesis topic and committee form to the Graduate Studies office for approval and make satisfactory progress on the thesis.
10. The student must submit the thesis electronically to the Georgia Tech Electronic Thesis and Dissertation Web site at **http://etd.gatech.edu** and receive final acceptance from the Graduate Studies office.

Language Requirement

The student's school may require a reading knowledge of one appropriate language.

The Doctoral Degree

The degree of Doctor of Philosophy recognizes demonstrated proficiency and high achievement in research. After adequate preparation, the candidate must successfully complete both comprehensive examinations in his or her academic field and a searching and authoritative investigation of a special area in the chosen field, culminating in a written dissertation.

Enrollment Requirements

The matriculation requirements are similar to those outlined for the master's degree with the addition of the residency requirement: doctoral students must spend at least two full-time semesters in residence at the Georgia Institute of Technology and ordinarily must complete research for the dissertation while in residence. Under special circumstances, candidates who have met the residency requirement may receive permission to pursue their research in absentia, provided the chair of the appropriate school approves and a faculty member directs the project. In either case, doctoral students working full time on thesis research should be registered for a full course load of "9000" dissertation hours each semester.

While no fixed course requirements apply for the doctoral degree, the student's thesis advisory committee may recommend graduate coursework in both a major and a minor field of study.

Doctoral students must be registered in the semester of graduation. See "Additional Graduation Requirements" in item 3 on page 47 for more information.

Admission to Candidacy

Doctoral students customarily apply for degree candidacy after completing at least three semesters of coursework beyond the bachelor's degree.

To qualify for candidacy, students must:

- complete all course requirements (except the minor);
- achieve a satisfactory scholastic record;
- pass the comprehensive examination; and

- submit for approval to the school chair and the Graduate Studies office (on behalf of the graduate dean) a formal statement naming the dissertation reading committee and delineating the research topic.

Upon satisfactory completion of these requirements, Graduate Studies formally admits the applicant to candidacy for the degree on behalf of the graduate dean.

The Comprehensive Exams

The comprehensive examination assesses both general knowledge of the degree area and specialized knowledge of the student's chosen research field. Each school is responsible for scheduling comprehensive examinations at least once a year, in the fall or spring, and for informing students of their scope. A guidance committee appointed by the chair of the school will advise each student in planning a program of study and preparing for the examination, partly through an initial evaluation of the student's background and interests, partly through periodic consultation to evaluate and aid the student's progress.

Thesis Topic

Prior to the student's admission to candidacy, the candidate will present for the approval of the school chair or college dean and the Graduate Studies office a formal statement naming the student's dissertation advisor and setting forth the topic selected for investigation, the objectives the student hopes to gain, and the steps by which the student proposes to achieve them. The dissertation topic must give promise of being either a genuine addition to the fundamental knowledge of the field or a new and better interpretation of facts already known.

Time Limit for Degree Completion

Students must complete all degree requirements within seven years from the end of the term in which they pass the comprehensive examination.

The Minor Field of Study

In addition to an adequate knowledge of the major field of intended research, the student must demonstrate mastery of some other, smaller body of knowledge – the minor field – preferably outside the student's school. The purpose of the minor is to encourage a wider interest on the part of the student and to provide a broader basis for the evaluation of the student's capabilities.

The minor will normally consist of at least nine semester hours of work in related courses, chosen by the student in consultation with a guidance committee and approved by the Graduate Studies office on behalf of the graduate dean. These courses should be at the 6000 level or above, but the use of certain 4000-level courses may also be approved. Courses taken at other institutions may be included in the minor. Once the student has satisfactorily completed the minor, the school chair sends a confirmation, accompanied by course grades, to the Graduate Studies office for final approval and recording.

Although the student need not complete the minor as a prerequisite for admission to candidacy, the minor must be completed and approved in order to be cleared for graduation.

Language Requirements

The student's school may require a reading knowledge of one or more foreign languages.

The Dissertation

The dissertation must demonstrate that the candidate possesses powers of original thought, talent for research, and ability to organize and present findings. Dissertations must be submitted electronically to the Georgia Tech Electronic Thesis and Dissertation Web site at **http://etd.gatech.edu**.

The format of the dissertation (in general appearance) must meet the criteria published in the *Manual for Graduate Theses*, which is available at **www.grad.gatech.edu/thesis**. For other format or style questions, students should refer to style manuals appropriate to their disciplines.

The Doctoral Examination

If the dissertation advisory committee finds the dissertation satisfactory, it schedules the candidate for an oral examination on the subject matter for the dissertation and the field in which it lies. An examining committee approved by the Graduate Studies office on behalf of the graduate dean will conduct the examination. The candidate's academic unit should forward the announcement of the oral examination, including the names of the examining committee members, to Graduate Studies at least ten working days prior to the exam.

If a candidate should fail to pass the final oral examination, the examining committee may recommend permission for one additional examination. In the case of failure, the registrar does not receive a report of the examination results.

Additional Graduation Requirements

In addition to requirements listed elsewhere, the candidate also must meet the following:

1. Submit a petition for the degree to the Registrar's Office during the term preceding the anticipated final term of work. Petition forms are available from the Registrar's Office.

2. Have an overall grade point average of at least 3.0 in order to graduate.

3. Register for a minimum of one hour of dissertation in the term of graduation. This reduction from the normal minimum course load of three hours may be used only once. If all requirements for graduation, including submission of the final approved dissertation, have been completed prior to the last day of registration, and the student was registered for the preceding term, the student may apply for a waiver of the enrollment requirement.

4. Pay the Institute a fee (currently $55) for archiving and distributing the dissertation through UMI Dissertations Publishing prior to the final submission of the completed dissertation to Graduate Studies via the Electronic Thesis and Dissertation Web site.

If both the dissertation and the examination are satisfactory and the candidate has completed the requirements of residence, minor field, and any additional school requirements, the Graduate Studies office will certify the candidate as qualified to receive the degree of Doctor of Philosophy.

Financial Information

This version of the *General Catalog* was current as of the date of printing in May 2005. For the most up-to-date version, visit **www.catalog.gatech.edu**. In addition, this is the final printed version of the *General Catalog*. Beginning in May 2006 it will be available online only.

Classification of Students for Tuition Purposes

Under the Constitution and laws of Georgia, the Board of Regents of the University System of Georgia was created to govern, control, and manage a system of public institutions providing quality higher education for the benefit of Georgia citizens. The state, in turn, receives substantial benefit from individuals who attend or have attended these institutions through their significant contributions to the civic, political, economic, and social advancement of the citizens of Georgia.

Because the overwhelming proportion of financial support for the operation of the public institutions of higher education in Georgia comes from the citizens through the payment of taxes, the determination of whether a student is classified as a resident or a nonresident of the state for tuition purposes becomes a significant matter. The tuition paid by in-state students covers only about one-fourth of the total cost of their education in the University System. Therefore, Georgia taxpayers are contributing three-fourths of the necessary funds to provide quality education for the citizens of the state.

The practice followed by state colleges and universities of assessing out-of-state students a higher tuition rate is a rational attempt by states to achieve a partial cost equalization between those who have and those who have not recently contributed to the state's economy, even though no precise way exists to determine the degree to which higher tuition charges equalize the cost of educating in-state and out-of-state students.

Courts that have been faced with challenges to residency classification procedures have consistently recognized the right of public institutions of higher education to charge higher rates to out-of-state students and to adopt reasonable criteria for determining the establishment of in-state status.

For the purpose of these regulations, the question to be answered is not primarily whether a student is a resident or nonresident of Georgia, but whether the student should pay University System fees on an in-state basis. The term "resident" is confusing because it may have several definitions as it relates to voter registration, driver's licenses, automobile registration, deeds, contracts, wills, income taxes, and other matters. A student may be a resident of Georgia for some purposes, but not entitled to in-state status for tuition purposes.

The Board of Regents has adopted certain policies governing the classification of students as residents and nonresidents for tuition purposes in keeping with its responsibilities to the citizens of Georgia for an appropriate assessment of fees and reasonable share of the cost of their education. The taxpayers of Georgia are thereby assured that they are not assuming the financial burden of educating persons whose presence in the state is not intended to be permanent.

With these considerations in mind, the Board of Regents has adopted the following policies governing the classification of students for fee payment purposes.

A. 1) If a person is eighteen years of age or older, he or she may register as an in-state student only upon showing that he or she has been a legal resident of Georgia for a period of at least twelve months immediately preceding the date of registration. Exceptions:
   i. A student whose parent, spouse, or court-appointed guardian is a legal resident of the state of Georgia may register as a resident providing the parent, spouse, or guardian can provide proof of legal residency in Georgia at least twelve consecutive months immediately preceding the date of registration.
   ii. A student who previously held residency status in Georgia, but moved from the state then returned to the state within twelve or fewer months.
   iii. Students who are transferred to Georgia by an employer are not subject to the durational residency requirement.

   2) No emancipated minor or other person eighteen years of age or older shall be deemed to have gained or acquired in-state status for tuition purposes while attending any educational institution in this state, in the absence of a clear demonstration that he or she has in fact established legal residence in this state.

   3) If a parent or legal guardian of a student changes his or her legal residence to another state following a period of legal residence in Georgia, the student may retain his or her classification as an in-state student as long as he or she remains continuously enrolled in the University System of Georgia, regardless of the status of his or her parent or legal guardian.

   4) In the event that a legal resident of Georgia is appointed by a court as guardian of a nonresident minor, such minor will be permitted to register as an in-state student providing the guardian can provide proof that he or she has been a resident of Georgia for the twelve months immediately preceding the date of the court appointment.

   5) Aliens shall be classified as nonresident students provided, however, that an alien who is living in this country under an immigration document permitting indefinite or permanent residence shall have the same privilege of qualifying for in-state tuition as a citizen of the United States.

Out-of-State Tuition Waivers

An institution may waive out-of-state tuition and assess in-state tuition for:

A. **Academic Common Market.** Students selected to participate in a program offered through the Academic Common Market;
B. **International Students.** International students selected by the institutional president or an authorized representative, provided the number of such waivers does not exceed 2 percent of the equivalent full-time students enrolled at the institution in the fall term immediately preceding the term for which the out-of-state waiver is to be waived;
C. **University System Employees and Dependents.** Full-time employees of the University System, their spouses, and their dependent children;
D. **Full-time School Employees.** Full-time employees in the public schools of Georgia or of the Department of Technical and Adult Education, their spouses, and their dependent children. Teachers employed full-time on military bases in Georgia shall also qualify for this waiver (BR Minutes, 1988-89, p.43);
E. **Career Consular Officials.** Career consular officers, their spouses, and their dependent children who are citizens of the foreign nation that their Consulate office represents and who are stationed and living in Georgia under orders of their respective governments;
F. **Military Personnel.** Military personnel, their spouses, and their dependent children stationed in or assigned to Georgia and on active duty are eligible to receive a military waiver of non-resident fees;
G. **Nonresident Graduate Students** who hold teaching or research assistantships requiring at least one-third time service at the institution;
H. **National Guard Members.** Full-time members of the Georgia National Guard, their spouses, and their dependent children (BR Minutes, April 1998, pp. 16-17);
I. **Direct Exchange Program Students.** Any international student who enrolls in a University System institution as a participant in a direct exchange program that provides reciprocal benefits to University System students;
J. **Families Moving to Georgia.** A dependent student who, as of the first day of the term of enrollment, can provide documentation supporting that his or her supporting parent or court-appointed guardian has accepted full-time, self-sustaining employment and established domicile in Georgia for reasons other than gaining the benefit of favorable tuition rates may qualify immediately for an out-of-state tuition differential waiver, which will expire twelve months from the date the waiver was granted. An affected student may petition for residency status according to established procedures at the institution; and
K. **Academically Outstanding Graduate Students.** School chairs may recommend a limited number of academically outstanding nonresident, full-time graduate students for a waiver of nonresident tuition.

Students who come to Georgia Tech from another state and work for companies in Georgia remain ineligible for in-state tuition in the absence of compelling evidence of intent to remain in Georgia permanently. Having Georgia voter registration, having employment in any position normally filled by a student (such as co-op, graduate research assistant, or graduate teaching assistant), having a lease of living quarters, having a Georgia automobile registration, and having a Georgia driver's license do not constitute sufficient evidence of domicile to affect classification as an in-state student under the Regents' policy.

For further information concerning residency, students should contact the Residency Office in room 103 of the Administration Building on campus, in writing to Georgia Tech, Residency Office, Atlanta Georgia, 30332-0315, or by phone at 404.894.4150. Information can also be found on the Registrar's Web site at **www.registrar.gatech.edu**. The Residency Office must receive an application for classification as a legal resident for fee payment purposes no later than one month prior to the academic registration date for the term in which the student seeks to pay fees as a resident of Georgia. Requests for tuition waivers must be

Student Tuition Charges*

Degree program of study	Amount per semester	
Georgia Resident	**< 12 Sem. Hours**	**= or >12 Sem. Hours**
Undergraduate	$141/hour	$1,684
Graduate	$169/hour	$2,022
Graduate Assistants	N/A	$25
M.B.A. Graduate	$230/hour	$2,755
M.S. in Building Construction	$331/hour	$3,963
M.S. in Prosthetics & Orthotics	$230/hour	$2,755
M.S. in Quant Comp Fin	$230/hour	$2,755
M.S. in Bioinformatics	$230/hour	$2,755
Master of Industrial Design	$288/hour	$3,446
Ph.D. (joint) in Biomedical Eng	$290/hour	$3,471
Distance Learning	$706/hour	$8,472
Non-Georgia Resident	**< 12 Sem. Hours**	**= or >12 Sem. Hours**
Undergraduate	$694/hour	$8,324
Graduate	$706/hour	$8,470
Graduate Assistants	N/A	$25
M.B.A. Graduate	$919/hour	$11,020
M.S. in Building Construction	$1,019/hour	$12,228
M.S. in Prosthetics & Orthotics	$919/hour	$11,020
M.S. in Quant Comp Fin	$919/hour	$11,020
M.S. in Bioinformatics	$919/hour	$11,020
Master of Industrial Design	$887/hour	$10,634
Ph.D. (joint) in Biomedical Eng	$1,158/hour	$13,885
Distance Learning	$706/hour	$8,472

Mandatory Fees	< 4 Sem. Hours	4 or > Sem. Hours
Student Fees	$53	$455

Semester fees shown in this chart are for the academic year 2004. Final tuition and fee information approved for the 2005 academic year was not available at the time of printing. The most current information on tuition and fees will be available at* ***www.bursar.gatech.edu.*

received by the Registrar's Office no later than one month prior to the last day of registration for the term for which the out-of-state tuition is to be waived.

Tuition

The tuition and fees listed on page 50 are estimated and subject to change. These amounts should be used only as a planning guide for future payments. See **www.bursar.gatech.edu** for the latest information on tuition and fees. Tuition charges can vary based on state residency status and degree program. Residency status will be determined by the Admissions Office at the time of acceptance. Students will either be classified as a resident or non-resident of Georgia for tuition purposes in accordance with the regulations of the Board of Regents of the University System of Georgia.

Students registering for fewer than twelve semester hours will be charged tuition by the hour. When students register for twelve hours, they have reached the tuition charge plateau and will not be charged tuition for any additional hours for which they register. Listed on page 50 are the tuition charges a student can anticipate based on residency status and degree program of study.

Mandatory Student Fees

The student fees listed on page 50 are subject to change and should be considered estimates for use in planning future payments. See **www.bursar.gatech.edu** for the latest information.

All students registered for four or more semester hours are charged the mandatory student fees, which are due at the same time as tuition charges. These mandatory student fees are considered part of the registration process and must be paid in full for the student to be considered enrolled in school. The student activity, athletics, recreation, technology, transportation, and health fees are the mandatory student fees that are used to provide cultural, social, and athletic programs for the entire student body. In addition, these fees provide financial support for student facilities at the Institute, guest speakers and lecturers, student publications, and many special events that are available exclusively for the students of Georgia Tech. These fees also assist in defraying shuttle costs for transporting students around campus. The technology fee supports the infrastructure necessary to provide students with the latest technology in regards to online computing services. Students registering for fewer than four semester hours are only required to pay the transportation fee.

Late Registration Fees

Students who do not meet fee payment deadlines may incur penalty fees. If a student does not pay all required fees by the published fee deadlines, his or her registration may be cancelled. The late payment fee is $75.

Billing Information

The Bursar's Office does not mail invoices to students. A complete Student Invoice Statement is available to students via the Web Student Access System (**https://oscar.gatech.edu**). Any changes that adjust tuition and fees (e.g., adding credit hours or a meal plan, making a payment, or canceling a parking permit) will be updated immediately to show the most current information on the account. The Web invoice also facilitates online payment options for WebCheck payments. For more information, refer to **www.bursar.gatech.edu/student/payment.htm**. It is the student's responsibility to make sure that all requirements of his or her account are satisfied by the deadlines. All questions concerning fees and refunds should be directed only to the Bursar's Office. Verbal misinformation is not grounds for a waiver of a regulation. All tuition charges and other charges are subject to change without notice.

To access a Student Invoice Statement, go to **https://oscar.gatech.edu**. The menu selections are: Secured Access Login (enter student's ID and PIN), Student Services and Financial Aid, Registration, and Student Invoice Statement and Web Payment Options. All notices concerning billing are sent to the student's Georgia Tech e-mail account, which is considered the student's official point of contact.

Fee Payment

All fees are payable by the deadline published on the Official School Calendar (**www.registrar.gatech.edu**) and on the Bursar's Office Web page (**www.bursar.gatech.edu**) for each academic term. Registration is not complete until all fees have been paid. The Institute reserves the right at

any time during the semester to drop any student from classes for failure to pay fees. In no case will a regulation be waived or an exception be granted because a student pleads ignorance of the regulation or asserts that he or she was not informed of it by an advisor or other authority. Students who owe the Institute money and have been placed on "Hold" because of failure to pay may have their accounts placed for collection by a professional collection agency, with the student incurring the full costs of collection. Payment may be made with cash (U.S. dollars); a check payable in U.S. currency and drawn on a financial institution located in the United States (checks must be made payable to Georgia Tech and have the checking account number encoded); or cashier's check. Georgia Tech will not accept credit card payments directly for payment of tuition, fees, and room and board that appear on the student's account summary. Credit card payments can only be made via the Web Student Access System (**https://oscar.gatech.edu**) and will be processed by Georgia Tech's vendor. **You will be charged a service fee of 2.75 percent by the vendor for this service. (No fee will be charged for WebCheck transactions.)**

American Express and MasterCard (credit and debit), and WebChecks will be accepted when payments are made through OSCAR. VISA credit, debit, or check cards will not be accepted. Credit card payments cannot be made by mail, phone, fax, or in person.

Choosing a Payment Option

Check Payments on the Web: The Bursar's Office accepts check payments over the Web. To make a payment to an account, go to **https://oscar.gatech.edu**. The menu selections are: Secured Access Login (enter student ID and PIN), Student Services and Financial Aid, Registration, and Student Invoice Statement and Web Payment Options. The check payment link is at the bottom of the page.

Mail In: Make all checks or money orders payable to the Georgia Institute of Technology. The student's ID number must be clearly printed on all checks or money orders. Payments must be received (not postmarked) by 4:00 p.m. on the fee deadline date. Mail to the following address: Georgia Institute of Technology, Bursar's Office, Lyman Hall, 225 North Avenue, Atlanta, Georgia 30332-0255.

On Campus: Students who pay in person should bring their cash or check to the Bursar's Office Cashier Window, First Floor, Lyman Hall. Payment by check or money order can be deposited in the drop box (entry vestibule to Lyman Hall) at any hour of the day before fee deadline. Do not put cash in the drop box.

Prepayments: Prepayment of fees will be accepted; however, prepayment does not guarantee the student will successfully register for any or all classes needed. It is the student's responsibility to properly register for classes by the registration deadline.

Fee Payment Using Financial Aid: All tuition waivers, financial aid, scholarships, and fellowships awarded will be disbursed to the student's account and applied to any outstanding balances. Financial aid is initially estimated and has not actually been disbursed. The "Balance Due" for a student is reduced by this estimated amount. Actual disbursements begin approximately one week prior to the fee deadline. It is the student's responsibility to ensure that all funds are properly credited by the fee deadline date by reviewing his or her student Web invoice.

If funds are not/will not be disbursed or credited by the fee deadline, the student may be eligible to request a deferment from Student Financial Planning and Services. Deferments must be requested and will be granted only for the lesser of the amount of the financial aid award or the amount due to the Institute.

Disbursement of Financial Aid Checks: Financial aid processed by the Office of Student Financial Planning and Services will be applied directly to the student's account in the Bursar's Office. If a credit balance exists after all charges have been posted, the Bursar's Office will forward a check to the student's campus post office box, or it will be deposited into the student's bank account.

Many financial aid programs (including the HOPE scholarship, Federal Pell Grant, and Stafford Loan) do not require that the student be enrolled full time in order for disbursement to occur. However, because some scholarships and grants do require full-time study, and some aid programs require registration for at least six hours of courses for disbursement, students who are planning to enroll for fewer than twelve hours and who are unsure of the requirements are advised to seek clarification from the Office of Student Financial Planning and Services.

Returned Checks

If a check is returned from the bank (insufficient funds, stop payment, etc.), the student will be required to redeem the returned check with cash or a cashier's check in the Bursar's Office. A returned check fee will be added to the amount of the check. Returned checks remaining unredeemed after a reasonable period of time may be forwarded to a collection agency with the student bearing the additional collections costs. Students who have three checks returned against their Georgia Tech accounts will be denied future check-writing privileges.

Checks returned against a student's fees might subject the student's classes to cancellation. If the student intends to withdraw from Georgia Tech, it remains the student's responsibility to formally withdraw via the Web Student Access System (see "Procedures for Withdrawal").

Cancellation of Registration

Students who register for classes and do not attend must cancel classes online. Failure to do so will result in awarded financial aid being applied to the student's account. Non-attendance then results in the student receiving a grade of *F* in each course.

Refund Policy

The refund amount for students withdrawing from the Institute shall be based on a pro rata percentage determined by dividing the number of calendar days in the semester that the student completed by the total number of calendar days in the semester. The total number of calendar days in a semester is calculated by using the first day of class through the last day of final exams for the Institute and excludes scheduled breaks of five or more consecutive days. Institutional charges will be refunded up to the point in time that the percentage equals 60 percent. Students who withdraw from the Institute when the calculated percentage of completion is greater than 60 percent are not entitled to a refund of any portion of institutional charges.

A full refund (100 percent) will be available to students who fully withdraw from the Institute or to students who drop individual courses by the end of late registration, if they cease to be enrolled at least full time (twelve hours). No further refunds will be given for individual classes dropped after the end of late registration.

Refunds for Students with Financial Aid

A calculation will be made on all financial aid recipients to determine whether a student who completely withdraws during a term has "earned" the monies disbursed. Students "earn" their aid based on the period of time they remain enrolled. During the first 60 percent of the term, a student earns financial aid funds in direct proportion to the length of time the student remains enrolled. Beyond the 60 percent point, all aid is considered earned. The responsibility to repay "unearned" aid is shared by the Institute and the student in proportion to the aid each is assumed to possess. The most current refund schedule (actual dates) can be found at **www.bursar.gatech.edu**.

Undergraduate Financial Assistance

The Office of Student Financial Planning and Services (OSFP&S) is dedicated to helping students and parents obtain the financial aid necessary to pay for a college education at Georgia Tech. The OSFP&S accomplishes this by awarding Institute funds to students and by directing students to other sources of aid. Additionally, the OSFP&S serves as the disbursement and delivery agent for all sources of assistance for undergraduate students, including awards for Georgia Tech students from outside agencies.

Based on the assistance Georgia Tech is able to provide students, no student should fail to consider Georgia Tech due to financial concerns. However, financial aid applicants should be aware that the amount of aid granted seldom meets all educational expenses. Financial assistance offered by Georgia Tech will typically require supplements from the student, the student's family, and outside sources; the primary responsibility for financing an education rests with the student and the

student's family. Students may further defray expenses through summer or part-time jobs, or by participating in the co-op or internship programs.

All entering undergraduate students, including transfer students, who are interested in scholarships, grants, loans, and/or work opportunities for any semester of the academic year beginning in the fall semester must submit the "Georgia Tech Application for Scholarships and Financial Aid" and the "Free Application for Federal Student Aid" (FAFSA). The priority application deadline for entering freshmen is March 1. The deadline for returning undergraduate and transfer students is May 1.

Entering freshmen who meet the March 1 deadline usually receive estimated financial aid awards by April 1. Returning undergraduates and transfers who meet the May 1 deadline receive financial aid awards by June 1.

For additional information, visit **www.finaid.gatech.edu** or contact the Office of Student Financial Planning and Services, Georgia Institute of Technology, Atlanta, Georgia 30332-0460.

President's Scholarship Program

The President's Scholarship is Georgia Tech's premier merit-based scholarship. Recipients are selected from the top applicants for admission to Georgia Tech, based on demonstrated excellence in leadership and academic performance. From the applicant pool, students selected as semifinalists will be asked to be interviewed and to submit teacher recommendations. The top semifinalists will be named finalists and invited with their parents to campus for an interview and information weekend in March. Current Georgia Tech students, transfer students, and international students are not eligible.

Each year approximately sixty incoming freshmen receive President's Scholarships, which are renewable for up to four academic years contingent upon honors-level performance and continued leadership development as evidenced by involvement in campus or community activities. Awards for students who entered in fall 2004 were worth up to a full ride, including tuition, room and board, books, fees, and personal expenses. See the Web page for more information on stipends. Amounts for future years may change.

To be considered, a student must be a U.S. citizen or permanent resident, apply as an incoming freshman, and submit the Georgia Tech Application for Freshman Admission, along with the application fee, with a postmark no later than October 31 of the senior year.

For more information, contact the President's Scholarship Program at 404.894.1615, via e-mail at psp@gatech.edu, or via the Web at **www.psp.gatech.edu**.

Medals and Prizes

Fraternities, academic schools and departments, professional groups, and community organizations award medals and prizes, such as the Phi Kappa Phi Award, and present them at the annual Student Honors Day exercises.

Graduate Financial Assistance

The Institute offers financial aid from a variety of sources to assist students with the pursuit and completion of their degrees as rapidly as circumstances permit. Some of these are briefly described here.

Students should address inquiries for financial assistance to the graduate coordinator of the school in which they plan to study. Graduate school applicants should also investigate national fellowships offered by various foundations, professional organizations, and government agencies. Educational loans are available for qualified applicants through the Office of Student Financial Planning and Services. More information about the Federal Stafford Student Loan program and various alternative loan programs may be found at **www.finaid.gatech.edu**.

President's Fellowships

Each year the Institute awards fellowships to supplement other awards to full-time doctoral matriculants with outstanding academic records and high research potential. The fellowship supplement consists of an annual $5,500 stipend (three semesters). These fellowships are renewable for three additional years, based on the major school's evaluation and recommendation.

Graduate Research Assistantships

Students ordinarily receive these awards on a one-third or half-time basis. In addition to receiving a stipend, full-time students with at least one-third time appointments pay matriculation fees of only $25 per semester (plus student fees), and do not pay nonresident tuition. Student fees are the same for all students. Graduate teaching assistants are also eligible for a partial subsidy of supplementary health insurance.

Graduate Teaching Assistantships

Schools and departments ordinarily offer these awards on a one-third or half-time basis. In addition to receiving a stipend, full-time students with at least one-third time appointments pay matriculation fees of only $25 per semester (plus student fees), and do not pay nonresident tuition. Student fees are the same for all students.

Federal Fellowships and Traineeships

The Institute participates in a number of fellowship and traineeship programs sponsored by agencies of the federal government. In addition, the following traineeships associated with specific training programs are available: water resources planning and management through the Environmental Resources Center, radiation health specialist training program through the School of Mechanical Engineering's Nuclear and Radiological Engineering Program, air quality control through the School of Chemical and Biomolecular Engineering, and minerals and mining through the School of Materials Science and Engineering.

Sponsored Fellowships

The Institute awards a number of fellowships sponsored by various industrial organizations, foundations, and trust funds for the support of outstanding graduate students. These fellowships assist students in pursuing their studies and research full time. Most of these fellowships are restricted to specific areas of study, and interested students should contact the chair of the school in which they plan to study. Fellowships and loans that are not restricted to specific schools include the following.

National Consortium for Graduate Degrees for Minorities in Engineering Fellowship
Candidates for participation in this program are selected from minority groups (African Americans, Puerto Ricans, American Indians, and Chicanos). In addition to the tuition, fees, and a stipend, this program provides an opportunity for summer work experience in one of several off-campus research laboratories. The GEM fellowship supports master's students in engineering and doctoral students in engineering or science. The application deadline is December 1. For further information, write to the College of Engineering, Georgia Institute of Technology, Atlanta, Georgia 30332-0360 or the GEM Center, P.O. Box 537, Notre Dame, Indiana 46556.

National Physical Science Consortium Graduate Fellowship (NPSC)
This Ph.D. fellowship offers up to six years of funding to U.S. citizens in astronomy, chemistry, computer science, geology, materials science, mathematical science, physics, and their subdisciplines. Students receive tuition, fees, a stipend, and two summers of employment with a private or government corporation doing research in the physical sciences and engineering. NPSC is open to all qualified applicants with a special emphasis on the recruitment of minorities and women. The application deadline is mid-November. For more information contact NPSC, c/o University of California, San Diego, 9500 Gilman Drive, La Jolla, California 92093-0516.

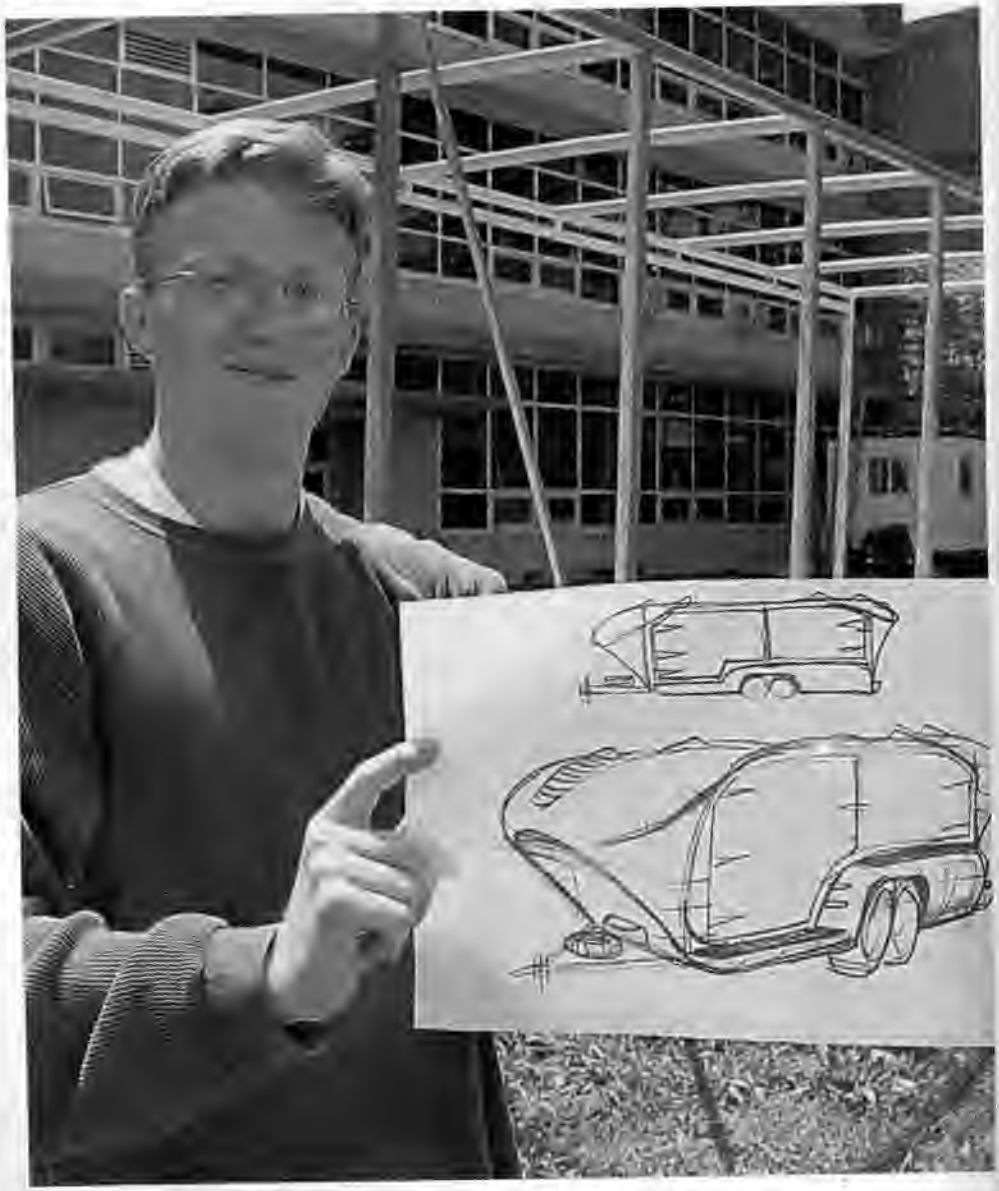
Outside Sponsorships

A student whose tuition and fees are to be paid by a corporation or government sponsor must notify the Bursar's Office of the entity's billing address and the amount to be billed at least sixty days prior to the first fee payment deadline (Phase 1) of each semester. As a courtesy to students, the Bursar's Office will send a billing statement to the entity, but the student remains responsible for payment by the fee payment deadline should the sponsoring entity fail to complete payment by that date.

Veterans Services

Because the Department of Veterans Affairs (VA) must receive certification of enrollment before issuing benefit payments, any student planning to enroll under any of the VA programs should initiate the certification procedure through the Georgia Tech Registrar's Office as early as possible. For further information about the certification procedure, contact the Office of the Registrar, or the Department of Veterans Affairs Atlanta Regional Office, 1700 Clairmont Road, Decatur, Georgia 30033-4032. Veterans information is also available at **www.registrar.gatech.edu**.

Veterans must apply to Georgia Tech through the usual admissions procedure. Eligibility for VA benefits does not guarantee acceptance to the Institute, nor does acceptance to Tech signify eligibility. The Institute serves only as a source of certification and information to the VA; the student must carry out all financial transactions with the Veterans Administration directly.



This version of the *General Catalog* was current as of the date of printing in May 2005. For the most up-to-date version, visit **www.catalog.gatech.edu**. In addition, this is the final printed version of the *General Catalog*. Beginning in May 2006 it will be available online only.

College of Architecture

www.coa.gatech.edu

College established in 1975, School in 1948, Department in 1908
Location: 247 Fourth Street, Atlanta, Georgia 30332-0155
Phone: 404.894.3880
Fax: 404.894.2678

Dean and Professor–Thomas D. Galloway;
Associate Dean and Professor–Douglas C. Allen;
Associate Dean and Associate Professor–Sabir Khan.
Thomas W. Ventulett III Distinguished Chair in Architectural Design–Monica Ponce de Leon.
Harry West Chair of City and Regional Planning–Catherine L. Ross.
Professors–Philip Bryant, Frank Clark, Cheryl K. Contant, Robert M. Craig, Elizabeth M. Dowling, Charles Eastman, Steven P. French, Roozbeh Kangari, Edward L. Keating, Nancey Green Leigh, Ronald B. Lewcock, John Peponis, David S. Sawicki, Craig M. Zimring.
Professors Emeriti–Arnall T. Connel, Thomas N. Debo, Dale Durfee, Rufus Hughes, John Kelly, Roger F. Rupnow, John A. Templer.
Associate Professors–Libero Andreotti, Godfried Augenbroe, Wayne Chung, Richard Dagenhart, Harris H. Dimitropoulos, Michael Dobbins, William J. Drummond, Ellen Dunham-Jones, Athanassios Economou, Michael L. P. Elliott, T. Russell Gentry, Christopher Jarrett, George B. Johnston, Jude LeBlanc, Rita Oberle, Charles Rudolph, Saeid Sadri, Stephen Sprigle, Felix Uhlik, Jerry Ulrich.
Assistant Professors–Sonit Bafna, W. J. Blane, William Caldwell, Ruchi Choudhary, Mark Cottle, Ruth Dusseault, Michael Gamble, Frances Hsu, Ron Mendola, Kevin Reeder, David Ringholz, Kathy Roper, William H. Russell, Tina Simonton, David Sledge, Clifford H. Stern, Andrea Strauss, Linda Thomas-Mobley, Franca Trubiano, Gil Weinberg.
Instructors–Ed Akins, Jack Alhadeff, Marc Bedarida, James Butler, Peter Ciaschini, Jamie Cochran, Mark Collins, Denise Dumais, Lane Duncan, Nickolas Faust, Ann Gerondelis, Carol Gill, Judy O'Buck Gordon, David Green, Paul Gresham, David Haddow, Herman Howard, Timothy Johnson, Gates Kellett, Max Kleinsteuber, David Lackey, Mark Landers, Brian Leary, Leslie Lowe-Brown, John Matthews, Mark McJunkin, Joyce Medina, William Patton, Frederick M. Pearsall, Tim Purdy, Richard Rodgers, Stuart M. Romm, Michael Rowan, Samuel Skelton, Carols Tardio, Anja Valero, Damien Valero, Greg Walker, Maureen Weidner, Tom Whatley, Jordan Williams, Wendell Wilson.
Research Engineers–Scott Haynes, Hector Huacuja-Henry, Anatoliusz Lesniewski, Karen Milchus, Steve Park, Ramachandra Sivakumar, Jonathan Shaw, Yi-Chang James Tsai.
Research Scientists/Associates–Danielle Ayun, Paul Beaty, Karl N. Brohammer, Joanie Chembars, Sarah Endicott, Anthony Giarrusso, John Goldthwaite, Alan Harp, Shelley Kaplan, Ghang Lee, Subrahmanyan Muthukumar, Steve Park, Mahbub Rashid, Robert Roy, Jonathan Shaw, Brenan Stearns, Robert Todd.

General Information

The College of Architecture offers three undergraduate programs – Architecture, Building Construction, Industrial Design – leading to the bachelor of science degree and graduate programs in architecture, building construction, city and regional planning, and industrial design leading to the Master of Architecture, Master of Science in Building Construction and Integrated Facility Management, Master of City and Regional Planning, Master of Industrial Design, Master of Science, and Doctor of Philosophy degrees.

The original mission of the College, established as the Department of Architecture in 1908, was to

prepare students for the professional practice of architecture. During the past ninety years, the mission of the College has expanded, both to provide continued leadership and to respond to changes in the professions and society. From its original focus on the practice of architecture, the College has become a multidisciplinary setting for teaching, research, and service at every scale of the constructed environment ranging from the design and production of the smallest utilitarian object to the planning and design of the city. The undergraduate programs of study and the graduate programs of study and research are fully described in the following sections.

All work executed in the College becomes the property of the College and will be retained or returned at the discretion of the faculty. The faculty also reserves the right to refuse for credit any project executed outside the precincts of the College or otherwise executed without proper coordination with the faculty.

Common First Year

All freshmen enter as undesignated majors within the College of Architecture. All students, including transfer students, must complete a three-course sequence (COA 1060 – Introduction to Design and the Built Environment, COA 1011 – Fundamentals of Design and the Built Environment I, and COA 1012 – Fundamentals of Design and the Built Environment II), in addition to other courses scheduled for the freshman year or appropriate courses for transfer students. During the spring semester of the first year, students enrolled in COA 1012 will prepare a portfolio and application to one of the three undergraduate programs within the College of Architecture: Architecture, Building Construction, or Industrial Design. Admission to one of the three programs will be determined by the student's performance at Georgia Tech, portfolio review, program application information, and other academic information that was used to admit the student to Georgia Tech. Admission to a specific program may be limited by available space and resources needed to accommodate a maximum number of majors in the second-year program courses. Students will be notified concerning their acceptance to a specific program before the end of the spring semester.

Certificate and Minor Programs

The College of Architecture offers certificate programs in Architectural and Design History, City and Regional Planning, and Music, as well as undergraduate minor programs in Architectural History, Music, and a multidisciplinary minor in Design/Arts History. The certificates require a minimum of nine or twelve semester hours of concentration depending on the area. Minor programs require at least eighteen hours of concentration (at least twelve hours taken at the 3000 level or above). Academic advisors in the relevant programs should be consulted for details.

Undergraduate Minor in Multidisciplinary Design/Arts History

The College of Architecture offers a minor for students in all disciplines at Georgia Tech. The minor requires completion of one of three available core survey sequences in the history of design (ARCH 2111 and 2112 [or ARCH 4105 and 4106] or COA 2241 and 2242 or ID 2202) in addition to four courses from at least three lists of courses in: history of architecture, the history of industrial design, the history of the city/landscape/garden, history of art and foreign study, and music history. Architecture and Industrial Design program students must select a core survey sequence outside their major, or select two additional electives from approved lists. Interested students should consult with the associate dean for Undergraduate Studies and Creative Activity for more details.

Undergraduate Programs

Architecture

Phone: 404.894.4885

The undergraduate program in architecture is a four-year, preprofessional program leading to the Bachelor of Science degree. It seeks to provide 1) a general university education in the liberal arts, fine arts, and technology; 2) a multidisciplinary foundation in architectural studies with the design studio as a major focus of the curriculum; and 3) substantial opportunities for students to explore other disciplines, to concentrate studies in certificate programs, cluster electives, or dual degree programs. This Bachelor of Science program prepares students for graduate-level studies in architecture, for graduate study in related fields, or a variety of careers related to

architecture, the building industry, or government service.

In the United States, most state registration boards require a degree from an accredited professional degree program as a prerequisite for licensure. The National Architectural Accrediting Board (NAAB), which is the sole agency authorized to accredit U.S. professional degree programs in architecture, recognizes two types of degrees: the Bachelor of Architecture and the Master of Architecture. A program may be granted a six-year, three-year, or two-year term of accreditation, depending on its degree of conformance with established educational standards.

Master's degree programs may consist of a preprofessional undergraduate degree and a professional graduate degree, which, when earned sequentially, comprise an accredited professional education. However, the preprofessional degree is not, by itself, recognized as an accredited degree.

Grade Requirements

Students must maintain a minimum 2.0 grade point average in each year's grouping of architectural design studio courses (e.g., ARCH 2011, 2012, etc.) in order to enter the next sequence of studio courses. Each sequence of design studio courses must be started in the fall semester. A maximum of nine credit hours may be taken on a pass/fail basis. Only courses taken as free electives within the undergraduate curriculum are eligible for pass/fail credit. See "Information for Undergraduate Students" for Institute regulations regarding pass/fail courses.

Students who complete both the bachelor's and master's degrees in architecture in the College may apply up to six credit hours of graduate coursework for both degrees. In order to qualify for this option, the student must complete the undergraduate degree with a cumulative grade point average of 3.5 or higher and complete the master's degree within a four-year period from the award date of the bachelor's degree.

Certificate Programs

The Architecture Program offers three certificate programs. The History of Architecture and Design Certificate recognizes completion of study in the history of architecture and design from a wide range of designated courses. The American Architectural History Certificate recognizes completion of a general survey of American architecture with designated specialized studies. The European Design History Certificate is especially appropriate for students participating in the Paris Study Abroad Program and/or the Italy Summer Program. Certificates will be granted only to students who, in addition to the certificate program requirements, have satisfied requirements for a Georgia Tech degree. Each requires a minimum of twelve credit hours, at least nine of which are at the 3000 level or higher in the designated area. Courses required by a student's program of study may not be credited by that student toward a certificate. Courses counting toward a certificate must be taken on a letter-grade basis, and a grade of C or better must be received in each course. Interested students should consult **www.coa.gatech.edu/arch** for more details.

Undergraduate Minor in Architectural History

The Architecture Program offers an undergraduate minor in Architectural History for students in all disciplines at Georgia Tech. The minor requires completion of a two-semester core sequence of ARCH 2111 and 2112 or ARCH 4105 and 4106, in addition to four courses (six courses for Architecture Program students) from an approved list. Interested students should consult **www.coa.gatech.edu/arch**.

Bachelor of Science (Suggested Schedule)

First Year – First Semester

Course Number/Name		*Hours*
COA 1011	FUNDAMENTALS OF DESIGN I	5
COA 1060	INTRODUCTION TO DESIGN	3
COMPUTING REQUIREMENT		3
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
TOTAL SEMESTER HOURS		16

First Year – Second Semester

Course Number/Name		Hours
COA 1012	FUNDAMENTALS OF DESIGN II	4
ENGL 1102	ENGLISH COMPOSITION II	3
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
MATH 1502	CALCULUS II	4
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Second Year - First Semester

Course Number/Name	Hours	
ARCH 2011	DESIGN STUDIO I	9
ARCH 2111	HISTORY OF ARCHITECTURE I	3
ARCH 2211	CONSTRUCTION TECH. & DESIGN	3
PHYS 2211	INTRO. PHYSICS I	4
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Second Year - Second Semester

Course Number/Name	Hours	
ARCH 2012	DESIGN STUDIO II	9
ARCH 2112	HISTORY OF ARCHITECTURE II	3
LAB SCIENCE	(BIO, CHEM, EAS, or PHYS)	4
WELLNESS		2
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

Third Year - First Semester

Course Number/Name	Hours	
ARCH 3011	DESIGN STUDIO III	9
ARCH 3241	FUNDAMENTALS OF STRUCTURES	3
COA ELECTIVE(S)		3
FREE ELECTIVE(S)		3
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Third Year - Second Semester

Course Number/Name	Hours	
ARCH 3012	DESIGN STUDIO IV	9
ARCH 3231	ENV. SYSTEMS & DESIGN INTEGRATION I	3
ARCH 4411	INTRO. TO VISUAL ARTS or ARCH 4420 INTRO. TO DESIGN COMPUTING	3
HUMANITIES ELECTIVE(S)		3
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Fourth Year - First Semester

Course Number/Name	Hours	
CLUSTER ELECTIVE(S)		3
COA ELECTIVE(S)		3
FREE ELECTIVE(S)		9
TOTAL SEMESTER HOURS		17

Fourth Year - Second Semester

Course Number/Name	Hours	
CLUSTER ELECTIVE(S)		5
COA ELECTIVE(S)		3
FREE ELECTIVE(S)		6
TOTAL SEMESTER HOURS		14

TOTAL PROGRAM HOURS = 129 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Computing Requirement

Students must complete either CS 1315, CS 1321, or a computer programming course approved as satisfying the general education requirements in computer literacy.

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Electives

Humanities Electives

Twelve credit hours of humanities courses are required. The required ENGL 1101 and 1102, and any other six credit hours of Institute-approved humanities courses, satisfy this requirement. Courses with ARCH prefixes will not satisfy this requirement for ARCH majors.

Social Sciences Electives

Twelve credit hours of approved social sciences courses are required. To satisfy the state requirement regarding coursework in the history and constitutions of the United States and Georgia, students must complete one of the following courses: HIST 2111, HIST 2112, POL 1101, INTA 1200, or PUBP 3000. Either ARCH 4126 or HTS 3011 is also required. Any other six credit hours of Institute-approved social science courses will satisfy the remainder of this requirement.

Science Electives

Eight credit hours of science courses are required. The required PHYS 2211 and any other four credit hours of Institute-approved science courses satisfy this requirement.

COA Electives

Twelve credit hours of approved College of Architecture electives are required, including either ARCH 4411 or ARCH 4420. Courses chosen from the list of required courses for the M.Arch.I degree or any other courses taught in the College and not otherwise required will satisfy this requirement. The selection of any architecture elective should be made in consultation with the student's academic advisor.

Cluster Electives

A minimum of ten credit hours in a concentrated cluster is required for the B.S. degree. Clusters may be made up from courses from within or outside of the College. This requirement may be fulfilled by the senior-year sequence of architectural design (ARCH 4011 and ARCH 4012), by a ten-hour concentration approved by the architecture faculty, or by several existing certificate programs offered on the campus.

Free Electives

Twenty-one credit hours of free electives are included in the curriculum to allow students to pursue architectural studies in additional depth or to pursue other educational interests within or outside the College. Courses chosen from the list of required courses for the M.Arch. degree or any other courses taught in the College or Institute and not otherwise required will satisfy this requirement.

The selection of these courses should be made in consultation with the student's advisor. Military training is an optional program of the Institute. A degree program may include a maximum of four hours of basic ROTC and a maximum of six hours of advanced ROTC. No course covering the same material as other courses may be applied for credit for the B.S. degree.

Senior Year Study Abroad Program

Study in Paris

The College of Architecture conducts an annual Study Abroad Program in Paris, France, in association with the Ecole d'Architecture Paris-LaVillette. This program is designed to give qualified senior students in architecture the opportunity to complete all or part of their senior year in residence in Paris as part of a true cultural exchange. The year-long program offers courses taught by Georgia Tech faculty and native French faculty that parallel those courses taught in Atlanta, while offering an international experience. Group field trips to significant French architectural and cultural sites and a jointly taught Franco-American studio broaden and enhance the program's cultural value. Opportunities also exist for individual study and travel. Due to the importance of communication skills in a successful exchange experience, students planning to participate in the Paris Study Abroad Program are required to complete a minimum of one year of college-level French language courses well in advance of their senior year. Further details of the Paris Study Abroad Program are available in the *Undergraduate Architecture Student Handbook*.

Summer Study in Italy

The College of Architecture offers a summer semester program intended to provide students the opportunity to study the art and architecture of Italy. The primary academic mission of the program is to expand the opportunities for study of the humanities at Georgia Tech. Headquartered in Rome, Florence, and Venice, the program involves a five-week concentrated and intensive study at the buildings, sites, and museums where works by Michelangelo, Uccello, Leonardo, Brunelleschi, and Caravaggio were originally carried out. In addition to painting, sculpture, and architecture, attention is given to the urban context extending from classical antiquity through the Renaissance and late Baroque periods. On-site studies at the Roman Forum, Pompeii, Herculanium, Ostia, Paestum, Hadrian's Villa, Villa D'Este, Villa Giulia, The Vatican Museum, Borghese Museum, Basilica of St. Peter, and other sites provide students with a deeper understanding and appreciation for the role that Italy has played as the artistic, engineering, and political cornerstone of the western world. Twelve credit hours are offered, six of which satisfy Institute undergraduate humanities requirements. The remaining six hours are taken as free electives and involve faculty-directed independent study of topics developed during the Spring term.

Building Construction

Phone: 404.894.4875

The construction industry is among the largest in the United States, employing more than eight million people and contributing eight percent of the U.S. gross national product. The Building Construction (BC) Program at Georgia Tech is one of

the leading programs in building construction in the nation. The program's mission is to educate the leaders of tomorrow's construction industry in partnership with industry.

Employment prospects for BC students are excellent. Students are recruited by general contractors, residential home builders, project management firms, cost value and consulting firms, real estate and property development companies, building material suppliers, and local/state/federal government agencies. The average starting salary for the BC graduate is among the highest on the Georgia Tech campus and ranks at the top of the industry. The degree granted is a Bachelor of Science in Building Construction.

Students in the BC Program learn the basic principles and practices of construction management, real estate development, science, and technology. BC students are educated on how to manage the functions and processes of every aspect of the construction industry. The business climate in Atlanta is vibrant and provides an excellent laboratory opportunity for students to observe various construction sites and activities. The construction companies in the Atlanta area also provide many internships and part-time jobs to students during their study in the BC Program.

Bachelor of Science in Building Construction (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
COA 1011	FUNDAMENTALS OF DESIGN I	3
COA 1060	INTRODUCTION TO DESIGN	3
COMPUTING REQUIREMENT		3
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
TOTAL SEMESTER HOURS		16

First Year - Second Semester

Course Number/Name		*Hours*
COA 1012	FUNDAMENTALS OF DESIGN II	4
ENGL 1102	ENGLISH COMPOSITION II	3
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
MATH 1502	CALCULUS II	4
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Second Year - First Semester

Course Number/Name		*Hours*
BC 2600	CONSTRUCTION CONTRACTING	3
BC 2610	CONSTRUCTION TECHNOLOGY I	3
ACCT 2101	ACCOUNTING I	3
PHYS 2211	INTRO. PHYSICS I	4
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

Second Year - Second Semester

Course Number/Name		*Hours*
BC 2620	CONSTRUCTION TECHNOLOGY II	3
BC 2630	CONSTRUCTION SEMINAR	1
MGT 2200	MGMT. APPLICATIONS OF INFORMATION TECHNOLOGY	3
EAS 2600	EARTH PROCESSES	4
ECON 2100	ECONOMIC ANALYSIS & POLICY PROBLEMS	3
WELLNESS		2
TOTAL SEMESTER HOURS		16

Third Year - First Semester

Course Number/Name		*Hours*
BC 3600	CONSTRUCTION COST MANAGEMENT	3
BC 3640	CONSTRUCTION MECHANICS	3
LCC 2000 or 3000	HUMANITIES (COMMUNICATIONS)	3
MGT 3150	PRINCIPLES OF MANAGEMENT	3
PROFESSIONAL ELECTIVE(S)		3
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		18

Third Year - Second Semester

Course Number/Name		*Hours*
BC 3610	CONSTRUCTION LAW	3
BC 3620	REAL ESTATE & CONSTRUCTION FINANCE & ACCOUNTING	3
BC 4620	STRUCTURAL ANALYSIS	3
MGT 3062	FINANCIAL MANAGEMENT	3
FREE ELECTIVE(S)		3
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		18

Fourth Year - First Semester

Course Number/Name		*Hours*
BC 3630	PROJECT MANAGEMENT I	3
BC 4640	CONSTRUCTION MARKETING	3
BC 4680	PROFESSIONAL INTERNSHIP	3
MGT 3102	MANAGING HUMAN RESOURCES or MGT 3660 INTERNATIONAL BUSINESS	3
BC 4670	CONSTRUCTION INDUSTRY ISSUES	3
TOTAL SEMESTER HOURS		15

Fourth Year - Second Semester

Course Number/Name		*Hours*
BC 4600	PROJECT MANAGEMENT II	3
BC 4610	BUILDING ECONOMICS	3
BC 4630	SENIOR CAPSTONE PROJECT	3
BC 4660	ENTREPRENEURSHIP IN CONSTRUCTION	3
PROFESSIONAL ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

TOTAL PROGRAM HOURS = 129 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Computing Requirement

Students must complete either CS 1315, CS 1321, or a computer programming course approved as satisfying the general education requirements in computer literacy.

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Electives

Free Electives

Six semester hours of free electives are required. Military training is an option allowed by the Institute. If basic ROTC is elected, four credit hours of free electives may be used.

The College of Architecture will accept only the two required hours of physical education (HP 1040, 1062, 1063, or 1064) toward meeting degree requirements.

Professional Electives

Six semester hours of professional electives are required, and these courses should be selected from the list of Recommended Professional Electives provided by the BC Program. The Building Construction professional electives provide students the opportunity to pursue specialized study and develop skills in construction management, construction development, and construction science. Construction management prepares students for managerial systems and practices utilized by constructors to manage the planning and delivery processes of buildings in the contemporary practice of construction.

Managerial areas of study range from internal management systems used by general contractors and builders in office operations and practice to management and systems controls employed by construction managers in the planning, design, and construction phases of complex building projects. Construction development introduces students to entrepreneurial theories and practices used in the development of construction projects ranging from single facilities to multiple building complexes. It focuses on urban economic theories, planning legislation and regulation, and urban development methods applicable in land and real estate investment. Emphasis is on the development and marketing theories of building projects in the context of contemporary planning and urban development issues. Construction science is an analytically and engineering-oriented study designed to encourage students to challenge current methods of building construction and delivery techniques and to seek innovative solutions through study, research, and technical inquiry. Emphasis is on the means and methods of constructing buildings, the intrinsic nature and use of construction materials, the anatomy of building systems and components, and prefabricated building systems and components development and production concepts.

Humanities Electives

Twelve credit hours are required by the Institute. The required English sequence, ENGL 1101-2, and 2000- or 3000-level LCC Communication Intensive courses will satisfy nine hours. The remaining three hours are selected by the student from the approved Catalog list of humanities courses.

Social Sciences Electives

Twelve credit hours of social sciences are required by the Institute. The required three credit hour U.S./Georgia history and constitution legislative course (HIST 2111, 2112; POL 1101; INTA 1200; or PUBP 3000) and ECON 2100 will satisfy six hours. The remaining six hours are selected by the student from the approved Catalog list of social sciences courses.

City and Regional Planning

Phone: 404.894.2350

The City and Regional Planning Program offers no undergraduate degrees. However, a number of undergraduate courses are offered each semester. In addition, three planning courses are available for social sciences credit: CP 4010 – Foundations of Urban and Regional Development; CP 4020 –

Introduction to Urban and Regional Planning; and CP 4030 - The City and Its Technology. CP 4040 – The City in Fiction and Film is available for humanities credit.

An accelerated program is available to Georgia Tech undergraduate students wishing to pursue the master's degree in city planning simultaneously with their undergraduate degree. See details in the graduate section on City and Regional Planning.

Industrial Design

Phone: 404.894.4874

Industrial design is the professional service of creating and developing concepts and specifications that optimize the function, value, and appearance of products and systems for the mutual benefit of both user and manufacturer. An industrial designer's responsibilities include fitting the artifact, system, or service to the person. This includes developing appropriate aesthetics and ergonomics, a practical concern for technical processes, and requirements for manufacture; marketing opportunities and economic constraints; and distribution, sales, and servicing processes.

The industrial designer's work touches all of our lives in the form of home furnishings, transportation, appliances, recreational equipment, and a myriad of other consumer and industrial products and services. While giving form to the efforts of industry, the designer is at the same time a consumer advocate, providing the humanizing link between technology and the consumer.

The Georgia Tech program offers a well rounded course of study with early emphasis on basic design and design skills. Design projects stress realistic design situations. The program encourages students to develop a diverse background in order to expand individual talents and respond to changing opportunities in the field. Most faculty members are practicing designers with extensive experience in the field.

All work executed in the College becomes the property of the College and will be retained or returned at the discretion of the faculty. The faculty also reserves the right to refuse credit for any project executed outside the precincts of the College or otherwise executed without proper coordination with the instructor.

Grade Requirements

All industrial design required studio courses must be completed with a grade of *C* or higher. A student may not enter a more advanced studio design course until this requirement is met; students with such academic deficiencies may be required to delay their studies for one year. Studio design courses must be taken in sequence beginning fall semester. Both transfer students and students already enrolled at Georgia Tech must have a cumulative minimum grade point average of 2.5. Students interested in transferring from another school should contact the Georgia Tech Office of Undergraduate Admission. A maximum of nine credit hours may be taken on a pass/fail basis. Only courses taken as free electives in the undergraduate curriculum must be taken for pass/fail credit. See "Information for Undergraduate Students" for Institute regulations regarding pass/fail courses.

Bachelor of Science in Industrial Design (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
COA 1011	FUNDAMENTALS OF DESIGN I	3
COA 1060	INTRODUCTION TO DESIGN	3
COMPUTING REQUIREMENT		3
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
TOTAL SEMESTER HOURS		16

First Year - Second Semester

Course Number/Name		*Hours*
COA 1012	FUNDAMENTALS OF DESIGN II	4
ENGL 1102	ENGLISH COMPOSITION II	3
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
WELLNESS		2
MATH 1502	CALCULUS II	4
TOTAL SEMESTER HOURS		16

Second Year - First Semester

Course Number/Name		*Hours*
ID 2011	INTRODUCTORY DESIGN I	4
ID 3103	INDUSTRIAL DESIGN COMPUTING I	3
COA 2241	ART HISTORY I	3
SOCIAL SCIENCE ELECTIVE(S)		3
PHYS 2211	INTRODUCTORY PHYSICS I	4
TOTAL SEMESTER HOURS		17

Second Year - Second Semester

Course Number/Name		*Hours*
ID 2012	INTRODUCTORY DESIGN II	4
ID 2202	HIST. OF MODERN INDUSTRIAL DESIGN	3
COA 2242	ART HISTORY II	3
ID 3104	INDUSTRIAL DESIGN COMPUTING II	3
LCC 3401	TECHNICAL COMMUNICATION PRACTICES	2
LAB SCIENCE	(BIO, CHEM, EAS, or PHYSICS)	4
TOTAL SEMESTER HOURS		19

Third Year - First Semester

Course Number/Name		*Hours*
ID 3011	INTERMEDIATE DESIGN I	5
ID 3301	MATERIALS I: RENEWABLES	3
ID 4202	PROFESSIONAL PRACTICE	3
INDUSTRIAL DESIGN ELECTIVE(S)		3
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Third Year - Second Semester

Course Number/Name		*Hours*
ID 3012	INTERMEDIATE DESIGN II	5
ID 3302	MATERIALS & PROCESSES II: NONRENEWABLES	3
ID 4201	DESIGN/RESEARCH METHODS	3
INDUSTRIAL DESIGN ELECTIVE(S)		3
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Fourth Year - First Semester

Course Number/Name		*Hours*
ID 4011	ADVANCED DESIGN I	5
SOCIAL SCIENCE ELECTIVE(S)		3
COA HISTORY ELECTIVE(S)		3
FREE ELECTIVE(S)		5
TOTAL SEMESTER HOURS		16

Fourth Year - Second Semester

Course Number/Name		*Hours*
ID 4012	ADVANCED DESIGN II	5
INDUSTRIAL DESIGN ELECTIVE(S)		3
FREE ELECTIVE(S)		5
TOTAL SEMESTER HOURS		13

TOTAL PROGRAM HOURS = 129 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Computing Requirement

Students must complete either CS 1315, CS 1321, or a computer programming course approved as satisfying the general education requirements in computer literacy.

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Electives

Humanities Electives

Twelve credit hours of humanities courses are required. The required ENGL 1101, 1102, and COA 2241 and 2242 satisfy this requirement. ID 2202 does not count toward this requirement for industrial design majors.

Social Sciences Electives

Twelve credit hours of approved social sciences courses are required. To satisfy the state requirements regarding coursework in the history and constitutions of the United States and Georgia, students must complete one of the following courses: HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200. Any other nine credit hours of Institute-approved social science courses will satisfy the remainder of this requirement.

General and Industrial Design Electives

Fourteen general elective hours are required. The general elective hours may include six hours of credit for ROTC courses. Those enrolling in ROTC must schedule appropriate ROTC courses in the freshman and sophomore years.

Students are encouraged to use general electives to fulfill one of several track elective options. Contact the Industrial Design program office for approved tracks.

Only nine hours of electives taken on a pass/fail basis may be applied toward fulfilling requirements for the B.S.I.D. degree. Nine industrial design elective hours are required.

Graduate Programs

Architecture

Graduate studies in architecture at Georgia Tech are comprised of three distinct degree-granting programs: the Master of Architecture I (M.Arch.I), the Master of Architecture II (M.Arch.II), and the Master of Science (M.S.).

The M.Arch.I Program is the professional program in architecture leading to the NAAB-accredited Master of Architecture degree. This program

accommodates both a two-year curriculum for those students with a four-year, preprofessional degree in architecture and a three-and-a-half-year curriculum for those students without a preprofessional degree in architecture.

The M.Arch.II Program is a one-year, postprofessional program for those students already holding a professional degree in architecture and wishing to pursue advanced studies in architecture with an emphasis upon design.

The M.S. Program is a nonprofessional, research-oriented degree program that requires a minimum of thirty hours of coursework. The Master of Science is administered through the Ph.D. Program.

Together, these programs are linked through a rich array of studios and courses that engage both theoretical discourse and design speculation about architecture. Topical offerings in the areas of design, theory, history, technology, professional and social practice, culture and behavior, visual arts, and design computing comprise the five fields of study available within the graduate program:

1) The program emphasizes the city and its many manifestations as a context for architectural and urban speculation and explores solutions to urban problems through direct engagement with Atlanta and other environs as working design laboratories.
2) The program promotes the knowledge of architectural and urban history as a basis for theoretical discourse and as an impetus for both critical reflection and design speculation upon the social, economic, and political dimensions of a diverse cultural landscape.
3) The program stresses the central engagement of technology as both philosophical framework and constructional means for the generation of culturally responsible form that accommodates and integrates human, functional, and environmental concerns.
4) The program engages the intertwined contexts of both professional and social practice as fertile realms of inquiry across a wide range of issues—from the legal, financial, and business aspects of professional action to the cultural, behavioral, and experiential dimensions of everyday life.
5) The program cultivates the relationship between architecture and art and encourages the critical exploration of representational means in design ranging from traditional techniques to electronic media for purposes of both speculation about and production of architecture.

Master of Architecture (M.Arch.I)

The M.Arch.I Program, leading to the Master of Architecture as the first professional degree, is oriented toward the professional practice of architecture and is fully accredited by the National Architectural Accrediting Board (NAAB). This degree option provides flexibility for students who have an undergraduate degree with a major in architecture as well as those who have a degree in a field other than architecture. The M.Arch.I Program requires a minimum of 60 credit hours and a maximum of 108 credit hours of study, depending upon the applicant's prior education in architecture and the amount of advanced standing credit granted upon admission to the program.

Normally, a student admitted to the program with maximum advanced standing can expect to complete the program within two academic years of full-time study. A student admitted to the program with no advanced standing can expect the program to require three and one-half academic years of full-time study. Graduates from a four-year undergraduate program in architecture similar to that at Georgia Tech can normally expect to complete the program in two academic years, if they have pursued architecturally related elective coursework during their undergraduate years. In all cases, the Master's Project, or the optional Master's Thesis, is required for award of the Master of Architecture degree. Specific information regarding applications for advanced standing and degree requirements is available from the Architecture Program.

The minimum requirements for the M.Arch.I degree, for a student with a previous degree in architecture, are as follows:

Course	Credit Hours
Architectural Design Studios	15
Professional Core Requirements	15
Master's Project/Thesis Option	9
Approved Professional Electives	21
TOTAL (Minimum)	60

Total Minimum Required Credit Hours for M.Arch.I. Program = 60

The maximum requirements for the M.Arch.I degree, for a student with a previous degree in a discipline other than architecture, are as follows:

Course	Credit Hours
Architectural Design Studios	30
Preparatory Requirements	15
Professional Core Requirements	33
Master's Project/Thesis Option	9
Approved Professional Electives	21
TOTAL (Maximum)	108

Total Maximum Required Credit Hours for M.Arch.I Program = 108

Master of Architecture (M.Arch.II)

The M.Arch.II Program is a postprofessional degree in architecture and has the primary purpose of providing advanced studies in architecture and urban design with an emphasis on the studio. A previous professional degree in architecture is required (B.Arch. or M.Arch.) prior to entry into the program. The minimum length of study is one academic year. The minimum requirements are as follows:

Course	Credit Hours
Core Course	6
Architectural Design Studios	10
Professional Electives	14
TOTAL (Minimum)	30

Total Minimum Required Credit Hours for the M.Arch.II Program = 30

Multidisciplinary Study

Multidisciplinary studies are strongly encouraged in all of the master's programs in architecture. These studies may be part of formal dual degree programs, including architecture and city and regional planning, architecture and civil engineering, architecture and management, etc. Other multidisciplinary studies are possible within the College of Architecture, the Institute, and at Emory University, Georgia State University, and the Atlanta College of Art, among other Atlanta area colleges and universities. Coursework outside the Architecture Program frequently includes city and regional planning, public policy, history, philosophy, real estate development, engineering, and studio art.

Foreign Study Programs

Graduate students in architecture are eligible to participate in two College of Architecture foreign study programs. The first is the Summer Program in Europe, which has a primary focus on modern and contemporary architecture in Paris, Berlin, and Holland. The second is the Summer Study in Italy Program, which focuses on architecture, painting, and sculpture at a variety of sites in Italy. For more information, refer to "Summer Study in Italy."

Applications

The deadline for applications is January 15 for the following fall semester. Each applicant must have an outstanding undergraduate record and must submit a portfolio of creative work. The Graduate Record Examination is required for all applicants. A minimum TOEFL score of 600 (paper-based) or 250 (computer-based) is required for all foreign applicants. All applicants should be aware that the Master's Program in Architecture has specific application requirements; therefore, all applicants should request a complete application package and instructions by calling 404.894.4885, faxing to 404.894.0572, or writing to Architecture Program Graduate Admissions, College of Architecture, Georgia Institute of Technology, Atlanta, Georgia 30332-0155.

Master of Science in Building Construction and Integrated Facility Management

The master's degree programs in Building Construction focus on management-based education for industry professionals seeking executive leadership positions in the industry. Our graduate training offers a holistic approach to business processes, integrating coursework, seminars, and hands-on learning to equip today's industry professionals with the resources they need to excel in their professional careers. The graduate program consists of two tracks: 1) Integrated Facility Management, and 2) Integrated Project Delivery Systems, which prepare students for innovative leadership positions within the industry. Students can complete either a thesis or non-thesis option for the degree.

Students in the program come from a variety of backgrounds, often with experience in facility management, construction, architecture, engineering, city planning, management, or business. The

program is tailored to meet the needs of professionals by offering evening classes, giving students the flexibility of continuing to work while taking courses.

The Building Construction program offers two graduate study tracks:

Track 1: Integrated Facility Management
The focus of this graduate study is integrated facility and property management. The program offers a holistic understanding of this complex field and its theoretical concepts, and it focuses on developing and fine-tuning the management skills necessary for success in the facility and property management industry. Courses explore the many facets of integrated facility management including asset management, project management, facility operations and maintenance, energy management, workplace design and consulting, facility technology integration, design and construction, and real estate development.

Track 2: Integrated Project Delivery Systems
The graduate study, focused on integrated project delivery systems, educates students to understand, analyze, select, and manage the most appropriate and effective project delivery systems for constructing a facility. The curriculum emphasizes integrated problem solving through state-of-the-art technical and management techniques. A variety of project delivery systems that can be used independently or integrated are examined. The delivery methods explored include the design-build system, the construction management/agent method, the hybrid bridging and partnering system, the negotiated select team method, as well as the traditional delivery method.

The minimum requirements for a graduate degree in Building Construction are as follows:

Thesis Option: The curriculum for graduate study with the Thesis Option consists of the following thirty-six semester hours:

Courses	Hours
Core courses	18
Approved Professional Electives	6
Master's Thesis	12
Total	36

Non-Thesis Option: The curriculum for graduate study with the Non-Thesis Option substitutes twelve semester hours of coursework for the thesis and consists of the following thirty-six semester hours:

Courses	Hours
Core Courses	18
Approved Professional Electives	18
Total	36

The Graduate Record Exam (GRE) or Graduate Management Admission Test (GMAT) is required for all students. A minimum TOEFL score of 550 (paper-based) or 213 (computer-based) is required of all international applicants. The application can be completed online at **www.grad.gatech.edu/admissions**.

City and Regional Planning

Phone: 404.894.2352

Founded in 1952, Georgia Tech's planning program is one of the oldest professional planning programs in the United States, with nearly 900 alumni. Graduates are employed in both the public and private sectors, at all levels of government, by banks, real estate development companies, public utilities, and private corporations. The program is fully accredited by the Planning Accreditation Board; it is the only accredited planning program in Georgia.

The City and Regional Planning Program offers coursework in seven major areas of urban and regional planning: land development, environmental planning, transportation, economic development, geographic information systems, urban design, and land use policy. Several types of degree programs are available: the professional Master of City and Regional Planning; dual degrees with civil and environmental engineering, architecture, and public policy; and a five-year B.S./M.C.R.P. degree; and the Master of City and Regional Planning concurrent with the Juris Doctor (Law) degree at Georgia State University. Descriptions of each follow.

Master of City and Regional Planning Degree

This program educates the student whose career goal is to be a professional planner. The program requires fifty-five total credit units for graduation. Approximately half of the program consists of required courses, called the core. The core is composed of three substantive streams: planning theory and process, including planning law, institutional analysis, plan implementation, and history and theory of planning; planning methods, including data analysis, computer applications, descriptive and inferential statistics, microeconomic analytic techniques, and planning information systems; and urban and regional theory, which explores the structure and function of urban systems. The core is largely contained within the student's first two semesters. Students must choose one of the seven areas of concentration described above. Each specialization consists of at least four courses.

The two-year curriculum requires, for most students, four semesters of coursework, including a four-credit hour applied research paper. Some students choose to write a ten-credit hour thesis. An approved internship is required for those students with no previous planning work experience.

The Graduate Record Examination is required for all applicants to the Master of City and Regional Planning Program. A minimum TOEFL score of 600 is required for all international applicants. Since the course material is sequential in nature, fall matriculation is strongly recommended. Applications must be completed before March 1 to ensure consideration for financial aid.

For more information about the M.C.R.P. program, contact: Academic Advisor, City and Regional Planning Program, College of Architecture, Georgia Institute of Technology, Atlanta, Georgia 30332-0155.

B.S.-M.C.R.P. Degree

Upper-division undergraduates may work simultaneously on their bachelor's degree and a master's in planning. By enrolling in all required planning classes as electives for the baccalaureate degree, students may obtain both an undergraduate degree as well as complete coursework toward a graduate degree. Students should request and receive permission from the director of the City and Regional Planning Program to begin their program of study in planning no later than fall of their junior year. Students with cumulative GPAs above 3.0 will be considered. In some cases, students can complete the two-year master's program in one year beyond the usual bachelor's degree. The key is to carefully schedule the last year of the undergraduate program. This program may be particularly appropriate for architecture, management, economics, civil and environmental engineering, and earth and atmospheric sciences majors.

The Dual Degree

The City and Regional Planning Program maintains dual degree programs with several other academic units: urban design in the College of Architecture; transportation, environmental engineering, and water resources in the School of Civil and Environmental Engineering; public policy with the School of Public Policy; and law with the Georgia State College of Law. The concept behind these dual degree programs is that a student can structure his or her program so that required courses taken in one program can serve as elective credit in the other, thus allowing the student to receive two degrees in less time than the two would take to complete if pursued separately.

Candidates seeking the dual degree should state their intentions and be officially admitted into City and Regional Planning and simultaneously accepted internally by the second program. In addition to the dual degree programs, the business administration program in real estate at Georgia State University offers a certificate in real estate that some planning students elect to pursue; likewise, the history program at Georgia State University offers a heritage preservation certificate.

Master of Industrial Design (M.I.D.)

An overarching objective of the M.I.D. is to provide an advanced and rigorous education that promotes an understanding of design as a process of identifying, analyzing, and solving design problems of human interface with our physical environment. The degree program will combine core coursework developed for the M.I.D. with coursework from across Georgia Tech in the areas of architecture, engineering, humanities, and social sciences. Students will develop diverse skill sets that provide the graduate-level industrial designer with the knowledge necessary to engage in complex problem solving for a variety of products and production processes with a human-centered focus.

Research emphasis

The M.I.D. graduate program has three core areas of emphasis:

Product development: An emphasis combining expertise of the faculty in research and development with the technologies of advanced computing and rapid prototyping. Students in this area of study work closely with campus Centers such as Advanced Wood Products Lab; Center for Assistive Technology and Environmental Access (CATEA); Graphics, Visualization, and Usability Center (GVU); Georgia Tech Research Institute; and Rapid Prototyping and Materials Institute.

Interface Design: An emphasis in linking the development of graphical user interfaces with the human factors and ergonomics of computer use, software, Internet-related resources, and media development. Students studying in this area work closely with centers such as CATEA, GVU, and Literature, Communication, and Culture labs.

Human-centered design: An area of emphasis utilizing the expertise in assistive technology and environmental accessibility found in the ID program, College of Architecture, CATEA, and GTRI.

Minor Requirements for the Degree

Students who have an undergraduate degree in industrial design from an ID program similar to Georgia Tech's can complete a two-year program consisting of forty-eight graduate credits.

Students who do not have an undergraduate degree in industrial design will need to take an additional thirty-six undergraduate industrial design credits. Students with a non-industrial design education will be admitted conditionally and will be required to successfully complete required undergraduate classes. All graduate students will be reviewed each year for satisfactory progress.

Required Courses for the M.I.D. Degree with ID Undergraduate Degree

Course Number/Name		*Hours*
ID 6100	GRADUATE STUDIES IN ID	3
ID 6101	HUMAN-CENTERED DESIGN	3
ID 6200	GRADUATE STUDIO I	6
ID 6201	GRADUATE STUDIO II	6
GRADUATE ELECTIVES (ALL ELECTIVES MUST BE APPROVED BY THE ID PROGRAM)		18
ID 7000 or ID 6400	THESIS OR NON-THESIS	12
TOTAL MINIMUM REQUIRED CREDIT HOURS		48

Students with a previous degree other than industrial design will be required to complete a minimum of one year of undergraduate industrial design studios. History of Industrial Design, Industrial Design Computing I and II, and Professional ID Practices. These classes are minimum requirements for students with a previous degree other than industrial design before proceeding into the graduate-level studios and coursework.

Master of Science (M.S.)

The M.S. is a nonprofessional degree oriented toward advanced practice, scholarship, and research, requiring a minimum of thirty semester hours of advanced study. Upon application, students must designate an area of study. The areas of specialized study include: a) history and theory of architecture; b) urban design; c) architectural technology and building science; d) architecture, culture, and behavior; and e) computing and information technologies in architecture. Specific requirements for the areas of study may be found at the College of Architecture Web site.

For further details on the program, contact: M.S. Program Advisor, Ph.D. Office, College of Architecture, Georgia Institute of Technology, Atlanta, Georgia 30332-0155.

Ph.D. Program

Phone: 404.894.3476

The program leading to the Doctor of Philosophy degree in the College of Architecture has been developed to enable students of exceptional ability to undertake advanced study and original research in the fields of architecture, construction, and planning. Currently the program includes several fields of study: 1) city and regional planning; 2) architecture, culture, and behavior; 3) architectural history, theory, and criticism; 4) building technology; 5) design computing; 6) building construction; 7) architectural and spatial morphology, and 8) design cognition.

Several areas within city and regional planning studies are available for dissertation research: environmental planning, economic development, transportation planning, land and housing economics, urban and regional development,

information systems, and land use planning. Students in the Architecture, Culture, and Behavior field pursue studies of human responses to the design of buildings and urban space, including morphological studies, studies of environmental perception and cognition, facilities programming, and evaluation. The Architectural History, Theory, and Criticism field addresses architectural history, philosophy, criticism, and practice, including design philosophies, methods, and criticism; it also allows study of preservation and conservation focusing on technical and methodological issues in the preservation of historical and contemporary building components, buildings, and cities.

Studies in Building Technology are concerned with the interface between technology and design construction, including the development and application of advanced knowledge in materials, construction processes, industrial systems, and environmental factors. Design Computing focuses on the development of information technologies in support of creative design and building. Current areas of research include design databases and electronic design environments, building product models, direct fabrication of designs (building CAD/CAM), and parametric modeling. Research in the field of building construction is focused on facility management and the environmental aspects of construction.

Spatial and Architectural Morphology is concerned with the principles that govern layouts, their meaning, functions, and social implications at urban and building scales. It includes analytical studies of spatial form. Design Cognition is concerned with how design information skills and expertise are learned and applied through both traditional and electronic media.

For further details on the program, contact: Ph.D. Program Director, College of Architecture, Georgia Institute of Technology, Atlanta, Georgia 30332-0155.

Master's Certificate Program in Design Computing

Graduate students in the College of Architecture and the College of Computing may sign up to participate in the Certificate Program in Design Computing. This option allows students to enroll in a program jointly administered by the College of Architecture and the College of Computing, providing studies in computing, computer graphics, Web technologies, and other digital technology areas.

Students eligible for this certificate program are master's students in the Colleges of Architecture or Computing. They are admitted through the regular admissions process, but are designated as being also signed up for this certificate option. Students admitted to the certificate program through the College of Architecture may do so through multiple degree programs:

a) **Master of Architecture program:** Students in the M.Arch.1 program may also enroll in this certificate program as part of their professional electives.

b) **Master of Science with a major in architecture in the College of Architecture, Master of Building Construction, and Master of Industrial Design:** Students in these programs may enroll in this certificate program if their interests and background correspond to those of the certificate.

The requirements for the certificate program for College of Architecture students are fifteen units of coursework in computing or design. Students taking the certificate program from the College of Architecture are expected to focus on courses in computer science and design computing within the College. The core courses in design computing are those identified as crucial for base knowledge in the field. Students interested in the certificate program should discuss it with their advisor. For further details on the program, contact: Design Computing Certificate Advisor, Ph.D. Office, College of Architecture, Georgia Institute of Technology, Atlanta, Georgia 30332-0155.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course. This section includes courses in Architecture (ARCH), Building Construction (BC), College of Architecture (COA), City and Regional Planning (CP), and Industrial Design (ID).

ARCHITECTURE

ARCH 2011. Architectural Design Studio I
0-12-4
Prerequisite(s): COA 1012
Elementary design exercises exploring fundamental issues of form and space through analysis of architectural elements and compositions and their use in creative problem solving.

ARCH 2012. Architectural Design Studio II
0-12-4.
Prerequisite(s): ARCH 2011
Elementary design exercises focusing on the compositional integration of building and site through the creative assimilation of programmatic, technical, and contextual requirements.

ARCH 2111. History of Architecture I
3-0-3.
Architectural history from antiquity through the eighteenth century emphasizing buildings in their cultural context as informed by social, technological, and constructive factors and theoretical positions.

ARCH 2112. History of Architecture II
3-0-3.
Architectural history during the nineteenth and twentieth centuries emphasizing buildings in their cultural context as informed by social, technological, and constructive factors and theoretical positions.

ARCH 2115. Modern Architecture and Art in Europe, America and Australia - Nineteenth and Twentieth Centuries
3-0-3.
A brief survey of architecture and art in the nineteenth and twentieth centuries, including a discussion of related influences on developments in those fields.

ARCH 2211. Construction Technology and Design Integration I
3-0-3.
Introduction to building anatomy, technical and expressive characteristics of materials and their organizational assembly.

ARCH 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

ARCH 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

ARCH 3011. Architectural Design Studio III
1-12-5.
Prerequisite(s): ARCH 2012
Intermediate architectural design projects emphasizing the functional priorities and expressive potential of building technologies through studio problems of varying programmatic and contextual complexity.

ARCH 3012. Architectural Design Studio IV
1-12-5.
Prerequisite(s): ARCH 3011
Intermediate architectural design projects exploring the interrelationships of various programmatic models, normative building types, and technological themes within specific physical, urban, and cultural contexts.

ARCH 3231. Environmental Systems and Design Integration I
3-0-3.
Prerequisite(s): ARCH 2211
Human physiology, the occupation of space, and principles of sustainability. Micro-climate, energy consumption, thermal loading, passive solar strategies, daylighting, optics, and acoustics.

ARCH 3241. Fundamentals of Structures
2-3-3.
Prerequisite(s): PHYS 2211
Physics of structure: principles of statics, strengths of materials, and the dynamic forces acting upon them.

ARCH 4011. Architectural Design Studio V
1-12-5.
Prerequisite(s): ARCH 3012
Advanced studies in architectural design emphasizing application of analytical, conceptual, and representational skills within projects that engage and problematize urban context culturally, ecologically, and technologically.

ARCH 4012. Architectural Design Studio VI
1-12-5.
Prerequisite(s): ARCH 4011
Advanced studies in architectural design emphasizing application of analytical, conceptual, and representational skills within projects that engage and problematize context culturally, ecologically, and technologically.

ARCH 4021. Architecture Core Studio I
1-12-5.
Foundation studies in architectural design emphasizing analytical and analogical generative strategies applied to studio problems that engage architectural representation, composition, and fabrication.

ARCH 4022. Architecture Core Studio II
1-12-5.
Prerequisite(s): ARCH 4021
Intermediate studies in architectural design emphasizing integrative design strategies that engage the programmatic, contextual, and constructed dimensions of architecture and its representations.

ARCH 4023. Architecture Core Studio III
1-12-5.
Prerequisite(s): ARCH 4022
Advanced studies in architectural design emphasizing the interrelationship of architectural and urban history, theory, and practice through studio problems that engage all aspects of architectural design.

ARCH 4105. History of Architecture I
3-0-3.
Architectural history from antiquity through the eighteenth century emphasizing buildings in their cultural context as informed by social, technological, and constructive factors and theoretical positions.

ARCH 4106. History of Architecture II
3-0-3.
Architectural history during the nineteenth and twentieth centuries emphasizing buildings in their cultural context as informed by social, technological, and constructive factors and theoretical positions.

ARCH 4109. Architecture and Minimalism
3-0-3.
This course examines the influence of "minimalism," the 1960s art phenomenon, upon architecture culture and production from 1968-present.

ARCH 4110. Public Space: Questions and Configurations
3-0-3.
Prerequisite(s): ARCH 2111 and ARCH 2112
This course addresses questions concerning present-day configurations of public space as a platform for analysis of the contemporary city.

ARCH 4112. Architecture in Georgia
1-6-3.
A field study and archival research on the architecture of the state of Georgia outside of Atlanta.

ARCH 4113. History of Renaissance and Mannerist Architecture
3-0-3.
Investigation of the history and theory of Renaissance and Mannerist architecture with a primary emphasis on Italy.

ARCH 4114. Medieval Architecture
3-0-3.
Investigations of the architecture of Medieval Europe with an emphasis on English and French Romanesque and Gothic, including towns and castles.

ARCH 4115. Introduction to Principles of Classical Design
3-0-3.
An introduction to the principles of Classical and traditional architectural design through readings, discussions, and site visits with Classical architects.

ARCH 4117. Architecture and the Arts and Crafts Movement
3-0-3.
Investigations in the theory, design, and building methods of English and American architects associated with the Arts and Crafts Movement.

ARCH 4118. American Academic Architecture
3-0-3.
Investigations of the history and theory of late nineteenth- and twentieth-century classicism in America.

ARCH 4119. Architecture of Frank Lloyd Wright
3-0-3.
Investigations on the life and work of Frank Lloyd Wright.

ARCH 4120. Atlanta Architecture
3-0-3.
Investigations through lectures, reading, and research of the history of Atlanta architecture and significant architectural firms from the city's founding to the present.

ARCH 4123. European Modernism
3-0-3.
Survey of European architecture from Art Nouveau to LeCorbusier.

ARCH 4124. History of Architecture in the United States
3-0-3.
History investigations of architecture within the continental United States from the colonial period to the present.

ARCH 4125. French Architecture from Ledoux to LeCorbusier
3-0-3.
History of French architecture from Ledoux to LeCorbusier with special emphasis on Paris.

ARCH 4126. Paris Urban History
3-0-3.
The social, cultural, urban, and architectural history of the city of Paris, from its founding until the present. Course offered in Paris only.

ARCH 4127. Introduction to Art and Architecture in Italy
1-0-1.
Reqnired preparation for the COA Summer Program in Italy. The course includes the fundamentals of art and architecture, basic Italian language skills, and library research for required summer program projects.

ARCH 4128. Barcelona: Architecture, Urban Design, Public Space
3-0-3.
Architectural history of the city of Barcelona and its public spaces, with a focus on the major urban and architectural projects since 1850. Offered through the Study Abroad Program.

ARCH 4129. Form and Narrative: Cross Media Analysis
3-0-3.
This theory course will involve an extended comparison between architecture and related art forms, especially painting, film, and writing.

ARCH 4133. Architecture and Discourse of the Everyday
3-0-3.
Prerequisite(s): ARCH 2112
Application of the concept of the everyday to architectural practice from perspectives of European social theory, American cultural landscape studies, and contemporary architectural theory.

ARCH 4151. History of Urban Form
3-0-3.
History of the city as a collective work of architecture with an emphasis on the city's physical form and space.

ARCH 4219. Construction Technology and Design Integration I
3-0-3.
Introduction to building anatomy, technical and expressive characteristics of materials, and their organizational assembly.

ARCH 4220. Construction Technology and Design Integration II
1-6-3.
Prerequisite(s): ARCH 2211 or ARCH 4219
Integration, representation, and constructability of building assemblies and structural systems. Grading, drainage, foundations, structure, and enclosure in relation to building codes and principles of sustainability.

ARCH 4225. Reinvestigating the Detail: The Ornamental and the Everyday
3-0-3.
Explores the role of the detail in contemporary architectural practice.

ARCH 4231. Environmental Systems and Design Integration II
3-0-3.
Prerequisite(s): ARCH 3231
Active building systems design: artificial lighting, mechanical, electrical, communication, transportation systems. Case studies of integrated and sustainable building assemblies.

ARCH 4251. Architectural Structures and Design Integration I
2-3-3.
Prerequisite(s): ARCH 3241
Gravity loads on building structures. Introduction to structural planning. Design of wood and steel structures. Properties of wood and architectural metals. Computer-based analysis of structures.

ARCH 4252. Architectural Structures and Design Integration II
2-3-3.
Prerequisite(s): ARCH 3241
Lateral loads and lateral load resisting systems for building structures. Design and application of Portland cement concrete mixtures. Design of reinforced concrete structures. Building foundations.

ARCH 4253. Advanced Structures Seminar
3-0-3.
Prerequisite(s): ARCH 4252
Fundamentals of steel and concrete design and the computerized design of steel and concrete structural systems for multistory buildings.

ARCH 4303. Programming and Building Evaluation
3-0-3.
Building programming and evaluation of building performance with respect to the aims of organizational users, policy development, and the process of planning and design decisions.

ARCH 4305. Near and Far: Cross-Cultural Practices in Art, Architecture, and Design
3-0-3.
This course will address the material culture of globalization and cultural diffusion,emphasizing the multicultural registers of work produced between and across geographical, cultural, and disciplinary boundaries.

ARCH 4315. Professional Practice of Architecture
3-0-3.
Principles and framework of professional practice including ethics, legal climate, business practices and contracts, project process and management, office organization, and methods of building production.

ARCH 4316. Traditions of Architectural Practice
3-0-3.
Critical examination of architectural practice. Cultural derivation and technological transformation of various conventions of representation, construction, and design; speculation about future paradigms of architectural practice.

ARCH 4330. Understanding Clients and Users: Methods for Programming and Evaluation
3-0-3.
Theories and methods of architectural programming and evaluation.

ARCH 4334. Housing and Culture
3-0-3.
Examination of social, cultural, and behavioral issues as they influence the form of houses and housing.

ARCH 4335. The Social Practice of Architecture
3-0-3.
Introduction to theories and findings about human use and experience of architecture.

ARCH 4411. Introduction to Visual Arts
1-6-3.
Orientation to issues of visual perception and representation of form and space through freehand drawing, composition, color, texture, mixed-media, and journal making.

ARCH 4412. Drawing and the Human Figure
0-9-3.
Studio instruction in figure drawing from the live model with emphasis on the structure and dynamics of the human figure.

ARCH 4413. Collage Making
1-6-3.
Concepts of collage within art, architecture, and culture; manual and electronic approaches to two- and three-dimensional collage making.

ARCH 4414. Representation in Watercolor
1-6-3.
Introductory course in the use of transparent watercolor for field painting and architectural representation. Theory of pigment characteristics in applied painting.

ARCH 4415. Photography I
1-6-3.
Introduction to studio, darkroom, and field photography with emphasis on composition, processing, and printing.

ARCH 4416. Photography II
1-6-3.
Prerequisite(s): ARCH 4415
Advanced techniques in photography. Use of color, filters, four-by-five format cameras with emphasis on architectural photography.

ARCH 4417. Building Furniture and Furnishing Buildings
3-0-3.
A course that focuses on schematic design development of furniture. The emphasis of this course is on conceptual development and material and structural clarity.

ARCH 4420. Introduction to Design Computing
2-3-3.
Survey of computer representations and modeling techniques, including pixel-based images, vector-based drawing systems, and surface and solid modeling; use of applications built upon these systems.

ARCH 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

ARCH 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

ARCH 4770. Psychology and Environmental Design
2-3-3.
Introduction to psychological concepts relevant to environmental design. Survey of selected methods for assessing human-made environments. Crosslisted with PSYC 4770.

ARCH 4801, -02, -03, -04, -05. Special Topics
Class and credit hours equal last digit in course number.

ARCH 4811. Special Topics: Architectural Design
0-3-1.

ARCH 4812. Special Topics: Architectural Design
0-6-2.

ARCH 4813. Special Topics: Architectural Design
0-9-3.

ARCH 4814. Special Topics: Architectural Design
0-12-4.

ARCH 4815. Special Topics: Architectural Design
0-15-5.

ARCH 4821, -22, -23. Special Topics: History, Theory, and Criticism
3-0-3.

ARCH 4831, -32, -33. Special Topics: Architectural Technology
3-0-3.

ARCH 4841, -42, -43. Special Topics: Professional and Social Practice
3-0-3.

ARCH 4851. Special Topics: Visual Arts and Computing
0-3-1.

ARCH 4852. Special Topics: Visual Arts and Computing
0-6-2.

ARCH 4853. Special Topics: Visual Arts and Computing
0-9-3.

ARCH 4863. Special Topics
2-3-3.
Topics of current interest in architecture.

ARCH 4901, -02, -03, -04, -05. Special Problems
Credit hours to be arranged.

ARCH 4911, -12, -13, -14, -15. Special Problems: Architectural Design
Credit hours to be arranged.

ARCH 4921, -22, -23. Special Problems: History, Theory, and Criticism
Credit hours to be arranged.

ARCH 4931, -32, -33. Special Problems: Architectural Technology
Credit hours to be arranged.

ARCH 4941, -42, -43. Special Problems: Professional and Social Practice
Credit hours to be arranged.

ARCH 4951, -52, -53. Special Problems: Visual Arts and Design Computing
Credit hours to be arranged.

ARCH 6031, -32, -33. Architecture Options Studio I, -II, -III
1-12-5.
Advanced studio problems in architecture emphasizing research and application in the areas of history and theory, urban and environmental design, culture and practice, electronic media, and construction technology.

ARCH 6109. Architecture and Minimalism
3-0-3.
This course examines the influence of "minimalism," the 1960s art phenomenon, upon architecture culture and production from 1968-present.

ARCH 6110. Public Space: Questions and Configurations
3-0-3.
Prerequisite(s): ARCH 4105 and ARCH 4106
This course addresses questions concerning present-day configurations of public spaces as a platform for analysis of the contemporary city.

ARCH 6112. Islamic Architecture and Urbanism
3-0-3.
Two-part survey of Asian architecture and urbanism (excluding East Asia). The Islamic world up to the 18th century: the Mughal, Raj, and post-independence periods in Indian subcontinent.

ARCH 6113. History of Renaissance and Mannerist Architecture
3-0-3.
Prerequisite(s): ARCH 4105
Investigation of the history and theory of Renaissance and Mannerist architecture with a primary emphasis on Italy.

ARCH 6114. Architecture and Discourse of the Everyday
3-0-3.
Prerequisite(s): ARCH 4106
Application of the concept of the everyday to architectural practice from perspectives of European social theory, American cultural landscape studies, and contemporary architectural theory.

ARCH 6115. Introduction to Principles of Classical Design
3-0-3.
An introduction to the principles of Classical and traditional architectural design through readings, discussions, and site visits with Classical architects.

ARCH 6117. Architecture of the Arts and Crafts Movement
3-0-3.
Study of the theory, design, and construction of the "artistic" house as embodied in the English and American Arts and Crafts Movement and in related developments elsewhere.

ARCH 6119. Frank Lloyd Wright and His Influence
3-0-3.
Study of the life, work, and influence of Frank Lloyd Wright, including work of his apprentices and followers.

ARCH 6120. History of Atlanta Architecture
3-0-3.
Study of the architecture of the Atlanta metro area.

ARCH 6127. Introduction to Art and Architecture in Italy
1-0-1.
Required preparation for the COA Summer Program in Italy. Includes the fundamentals of art and architecture; basic Italian language skills; library research for required summer program projects.

ARCH 6129. Form and Narrative: Cross Media Analysis
3-0-3.
This theory course will involve an extended comparison between architecture and related art forms, especially painting, film, and writing.

ARCH 6131. Architectural Theory and Criticism I
3-0-3.
Critical study of theoretical writings and architectural production prior to the twentieth century.

ARCH 6132. Architectural Theory and Criticism II
3-0-3.
Critical study of theoretical writings and architectural production of the twentieth century to the present.

ARCH 6135. Architectural Representation
3-0-3.
Systems of architectural representation and codes of thinking, drawing, and reading architecture.

ARCH 6136. Architecture and Ideology
3-0-3.
Architecture and politics in Italy, Germany, and the Soviet Union between the wars.

ARCH 6151. Theories of Urban Design
3-0-3.
Contemporary theories of urban design and their relationship to the contemporary city examined through architects' writings, urban projects, and interdisciplinary criticism.

ARCH 6152. Studies in Landscape Architecture
3-0-3.
History and theory of the designed landscape and garden from the ancient world to the present.

ARCH 6153. History and Theory of the Modern City
3-0-3.
An examination of the evolution of the modern city in the nineteenth and twentieth centuries with particular reference to architectural, city planning, and urban design theories.

ARCH 6154. Introduction to Urban Design
3-0-3.
Introduction of urban design ideas, research, and practice, examining traditional qualities of the American city and their possible applications in the contemporary city.

ARCH 6155. Contemporary Architecture and Urbanism in Europe
2-3-3.
A course on contemporary architecture and urban projects in Europe, including the architect's writings, published criticism, and analysis of the buildings and projects.

ARCH 6206. Studies in Architectural Building Assemblies
3-0-3.
Structural and cladding systems integration, environmental control, and tectonic representation explored through historical and contemporary case studies and applied design solutions.

ARCH 6209. Building Enclosure: A Tectonic Element
3-0-3.
Investigations of enclosure design from three perspectives (technology, form, and culture), analyzing relationships of the four Semperian elements and Alberti's three parts of the enclosure.

ARCH 6210. Architectonics
3-0-3.
The study of architecture of form from both an historical and a mathematical perspective. The formal theory is applied mathematics, group theory, combinatorics, as well as recent studies in the history of mathematics.

ARCH 6215. Contemporary Architecture and Construction Technology
3-0-3.
General exposure to questions pertaining to the production of building systems and assemblies through a series of case study projects by contemporary practicing architects.

ARCH 6216. Eco-Tectonics: Making and Meaning
3-0-3.
Strategies of ecologically sustainable design and construction and the role of the architect in the stewardship of the environment.

ARCH 6218. The Material Logic of Architecture
2-3-3.
Prerequisite(s): ARCH 3241
Introduction to scientific and practical nature of architectural materials: soils, cements, metals, plastics, and glazing materials. Laboratory includes fabrication of, and experiments on, architectural materials.

ARCH 6225. Reinvestigating the Detail: The Ornamental and the Everyday
3-0-3.
Explores the role of the detail in contemporary architectural practice.

ARCH 6226. Green Construction
3-0-3.
Prerequisite(s): ARCH 3231
This course focuses on the means, methods, strategies, and technologies to improve the energy efficiency and performance of buildings, and to reduce the environmental impact of buildings.

ARCH 6305. Near and Far: Cross-Cultural Practices in Art, Architecture, and Design
3-0-3.
This course will address the material culture of globalization and cultural diffusion, emphasizing the multicultural registers of work produced between and across geographical, cultural, and disciplinary boundaries.

ARCH 6312. Ecological Practice: History, Polemics, and Poetics
3-0-3.
An historically and culturally grounded examination of the ecological perspective. Critical and productive engagement with green guidelines, laws, products, design briefs, and procedures.

ARCH 6313. Traditions of Architectural Practice
3-0-3.
Prerequisite(s): ARCH 4106
Critical examination of architectural practice. Cultural derivation and technological transformation of various conventions of representation, construction, and design; speculations about future paradigms of architectural practice.

ARCH 6404. Electronic Media: From Technique to Culture
3-0-3.
The influence of electronic media upon representation and invention in architecture.

ARCH 6417. Building Furniture/Furnishing Buildings
3-0-3.
A course that focuses on schematic design and design development of furniture. The emphasis of this course is on conceptual and material/structural clarity.

ARCH 6426. 3-D Modeling in Architecture
1-6-3.
Prerequisite(s): ARCH 4420
Construction of 3-D computer models of architectural structures. Topics include: geometry creation, light and materials property, rendering, data exchange, and basic animation.

ARCH 6427. Advanced Modeling and Animation in Architecture
1-6-3.
Prerequisite(s): ARCH 6426
Advanced computer modeling of architectural form. Topics include: parametric design, parametric materials, special effects, object libraries, animation, and video production.

ARCH 6428. Formal Systems in Design, Art, and Architecture
3-0-3.
This course will examine generative descriptions of languages of design, art, and architecture and explore various computational approaches to design with a special emphasis on shape grammars.

ARCH 7000. Thesis
Credit hours to be arranged.

ARCH 7042. Urban Design Workshop
0-9-3.
Advanced problems in urban design and development focusing on the Atlanta region. Integration of urban design theory and methods, economic development, political registration, and communication.

ARCH 7043. Urban Design Workshop
0-12-4.
Advanced problems in urban design and development focusing on the Atlanta region. Integration of urban design theory and methods, economic development, political registration, and communication.

ARCH 7044. Urban Design Workshop
0-15-5.
Advanced problems in urban design and development focusing on the Atlanta region. Integration of urban design theory and methods, economic development, political registration, and communication.

ARCH 7045. Urban Design Workshop
0-18-6.
Advanced problems in urban design and development focusing on the Atlanta region. Integration of urban design theory and methods, economic development, political registration, and communication.

ARCH 7060. Critical Positions in Architectural Design
3-0-3.
Prerequisite(s): ARCH 6132
Advanced topics in the theory of architectural production focusing upon contemporary ethical dilemmas and the development of critical positions of design.

ARCH 7090. Master's Project Studio
0-18-6.
Prerequisite(s): ARCH 6033 and ARCH 7060
Comprehensive studio problems emphasizing the integration of disciplinary and professional skills through the formulation of architectural propositions grounded in critical, speculative, and creative research.

ARCH 8801, -02, -03, -04, -05, -06. Special Topics
Class and credit hours equal last digit in course number.

ARCH 8811. Special Topics: Architectural Design
0-3-1.

ARCH 8812. Special Topics: Architectural Design
0-6-2.

ARCH 8813. Special Topics: Architectural Design
0-9-3.

ARCH 8814. Special Topics: Architectural Design
0-12-4.

ARCH 8815. Special Topics: Architectural Design
0-15-5.

ARCH 8821, -22, -23. Special Topics: History, Theory, and Criticism
3-0-3.

ARCH 8831, -32, -33. Special Topics: Architectural Technology
3-0-3.

ARCH 8841, -42, -43. Special Topics: Professional and Social Practice
3-0-3.

ARCH 8851. Special Topics: Visual Arts and Design Computing
0-3-1.

ARCH 8852. Special Topics: Visual Arts and Design Computing
0-6-2.

ARCH 8853. Special Topics: Visual Arts and Design Computing
0-9-3.

ARCH 8863. Special Topics
2-3-3.
Topics of current interest in architecture.

ARCH 8901, -02, -03. Special Problems
Credit hours to be arranged.

ARCH 8911, -12, -13, -14, -15. Special Problems: Architectural Design
Credit hours to be arranged.

ARCH 8921, -22, -23, -24, -25. Special Problems: History, Theory, and Criticism
Credit hours to be arranged.

ARCH 8931, -32, -33. Special Problems: Architectural Technology
Credit hours to be arranged.

ARCH 8941, -42, -43. Special Problems: Professional and Social Practice
Credit hours to be arranged.

ARCH 8951, -52, -53. Special Problems: Visual Arts and Design Computing
Credit hours to be arranged.

ARCH 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding graduate teaching assistantships.

ARCH 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding graduate research assistantships.

BUILDING CONSTRUCTION

BC 2600. Construction Contracting
3-0-3.
The goal of this course is to teach students the basics of construction contracting, business methods, organizational models, bidding, construction insurance, and labor relations.

BC 2610. Construction Technology I
2-3-3.
An introduction to the planning and physical development process for the construction of projects of residential and light construction scale.

BC 2620. Construction Technology II
2-3-3.
Prerequisite(s): BC 2610
A continuation of Construction Technology I with an emphasis on large-scale and high-rise building, i.e., commercial building construction.

BC 2630. Construction Seminar
1-0-1.
Provides an introduction to the construction industry with emphasis on exploring career opportunities in construction.

BC 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

BC 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

BC 3600. Construction Cost Management
2-3-3.
Introduction to cost principles and cost analysis of construction projects, including classification of work, quantity survey techniques, construction operation costs, and bid proposals.

BC 3610. Construction Law
3-0-3.
Prerequisite(s): BC 2600
Legal aspects of construction contracts, bonds, insurance, and bidding. Owner, architect, contractor, and subcontractor relationships.

BC 3620. Real Estate and Construction Finance and Accounting
3-0-3.
Prerequisite(s): BC 2630
General introduction to the financing of construction and real estate development projects. Emphasis on financing requirements, activities, sources, and uses.

BC 3630. Project Management I
2-3-3.
This course will offer construction planning and management techniques for project design and construction with a focus on different scheduling methods and their use.

BC 3640. Construction Mechanics
3-0-3.
Prerequisite(s): PHYS 2211
An introductory course to the evaluation of behavior of buildings, the properties of structural materials, and the behavior of load-resisting members.

BC 4600. Project Management II
3-0-3.
Prerequisite(s): BC 3630
This course covers practical project management, technology, and tools for this approach and the required management skills for successful execution of projects.

BC 4610. Value Engineering and Building Economics
3-0-3.
Prerequisite(s): BC 3600
First part is an introduction to principles and methodology. Second part is an introduction to economic principles and theories and how to apply the concepts and methods of building economics.

BC 4620. Building Structural Analysis
3-0-3.
Prerequisite(s): BC 3640
Emphasis being placed on the practical design and construction of structural elements. The course includes basic design principles with a heavy emphasis on constructability and buildability.

BC 4630. Senior Capstone Project
2-3-3.
Prerequisite(s): BC 3600 and BC 3610 and BC 3620 and BC 3630
A senior construction project that includes redevelopment analysis and feasibility study, project development, and construction.

BC 4640. Construction Marketing
3-0-3.
Prerequisite(s): BC 2630
Methods of construction marketing and business development. Innovative computer applications, verbal skills development, professional strategies, market segmentation, and buyer behavior.

BC 4650. Laboratory for Sustainable Design and Construction
1-3-3.
The goal of the laboratory is to teach students a comprehensive sustainable design and construction information system and a program of real-world, hands-on projects.

BC 4660. Entrepreneurship in Construction
3-0-3.
Prerequisite(s): BC 2630
Basics of construction business risk assessment, looking for construction opportunities, capital investment, computerized construction business, and business failures.

BC 4670. Construction Industry Issues and Initiatives
3-0-3.
Major issues of the construction industry in productivity improvement, constructability, quality improvements, safety, computers, and innovative construction management.

BC 4680. Professional Internship
0-9-3.
Students work for a professional architecture/engineering/construction company in which they learn, first-hand, about the construction industry.

BC 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

BC 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

BC 4700. Construction Management
3-0-3.
An accelerated-pace course designed to provide a basic understanding of fundamental topics including planning, budgeting, estimation, scheduling, and project closeout.

BC 4710. Green Construction
3-0-3.
Prerequisite(s): BC 2620
This course focuses on the means, methods, strategies, and technologies to improve the energy efficiency and performance of buildings, and to reduce the environmental impact of buildings.

BC 4801, -02, -03. Special Topics
Class and credit hours equal last digit in course number.

BC 4900. Special Problems
Credit hours to be arranged.

BC 6100. Professional Trends in Facility Management
3-0-3.
An introductory course covering the organizational, managerial, ethical, and legal principles for the delivery of facility management services. Includes contracts and risk management.

BC 6150. Design-Build Organization and Management
3-0-3.
Introduction to Design-Build (DB) as a project delivery system. Provides information about the organization, the process, and the effects of DB on the industry.

BC 6200. Maintenance Management of Built Assets
3-0-3.
This course covers the processes by which a facility and its systems are serviced and maintained during the facility's life cycle. Includes acquisition, installation, operation, maintenance, and disposal of built assets.

BC 6250. Value Management for Integrated Facility Design and Construction
3-0-3.
Principles and methodology of value management analysis concepts and an examination of future values and worth criteria affecting building design, construction, furnishings, and operations performance.

BC 6300. Safety and Environmental Issues
3-0-3.
This course covers the environmental issues related to the performance of buildings and the health and risk factors for new and existing buildings.

BC 6350. Design and Construction Law
3-0-3.
Overview of construction law and legal issues encountered by the construction manager including U.S. laws, general concepts and definitions, contractor relationships, and relevant case studies.

BC 6400. Facility Planning, Project Management, and Benchmarking
3-0-3.
This course introduces the techniques of planning project management, benchmarking, and their applications to facility management. Includes space forecasting, scheduling and control of projects, and benchmarking studies.

BC 6500. Real Estate Asset and Income Property Management
3-0-3.
This course covers real estate financial management and performance topics from a decision-making and strategic planning orientation for facilities management professionals.

BC 6550. Design and Construction Processes for Integrated Services
3-0-3.
Offers a framework for use and application of design, contract, and performance documents for successful execution of various forms of integrated project delivery systems.

BC 6600. Facilities Management Financial Analysis
3-0-3.
This course covers real property concepts, issues, and topics pertinent to the facility management professional. The topics include site selection, property market analysis, legal documents, and land use control.

BC 6650. Advanced Project Management
3-0-3.
A four-phased coverage of project management including organization, planning and scheduling, control, budgeting, and ending with project testing, evaluation, and termination.

BC 6700. Advanced Facility Management Practices
3-0-3.
Students apply specific methods and procedures from core courses to actual business situations in the facility and property management industry.

BC 6800. Facility and Property Management Capstone
3-0-3.
Designed to integrate the learning from basic topics through the use of actual case studies and situations found within the facility and property management industry.

BC 7000. Master's Thesis
Credit hours to be arranged.

BC 7100. Quantitative Methods for Construction Research
3-0-3.
Introductory course in graduate research in the building construction industry. Covers types of research, sampling methods, and basic analysis and evaluation techniques.

BC 8811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number.
Topics of current interest in building construction.

BC 8823, -33. Special Topics
3-0-3.
Topics of current interest in building construction.

BC 8901, -02, -03. Special Problems
Credit hours to be arranged.

BC 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding graduate teaching assistantship.

BC 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding graduate research assistantship.

COLLEGE OF ARCHITECTURE

COA 1011. Fundamentals of Design and the Built Environment I
0-9-3.
Co-requisite: COA 1060.
Introduction to creative problem-solving and the design realization cycle through project-based design exercises that emphasize the role of representation.

COA 1012. Fundamentals of Design and the Built Environment II
1-9-4.
Prerequisite(s): COA 1011
Introduction to the design of complex problems through an emphasis on integrative and collaborative design strategies, research, critical reflection, and interdisciplinary team work.

COA 1060. Introduction to Design and the Built Environment
3-0-3.
Co-requisite: COA 1011.
Introduction to architecture, building construction, and industrial design through case studies that illuminate past and present practices, as well as future possibilities within the disciplines.

COA 2241, -42. History of Art I, -II
3-0-3.
A survey of artistic manifestations from primitive times to the present. First semester sequence, prehistoric through Renaissance; second semester, Renaissance through contemporary art.

COA 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

COA 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

COA 3115. Art and Architecture in Italy I
3-0-3.
Investigations of the painting, sculpture, and architecture of the Classical, Early Christian, Byzantine, and Medieval periods in Italy with special emphasis on Rome.

COA 3116. Art and Architecture in Italy II
3-0-3.
Investigations of the painting, sculpture, and architecture of the Renaissance and Baroque periods in Italy with special emphasis on works of Rome.

COA 4000. Furniture Workshop: Material Potential and Fabrication Strategies
1-6-3.
Course investigates construction into the design cycle to explore the boundaries between furniture architecture, and sculpture. Exercises introduce furniture production techniques, material properties, and CNC milling.

COA 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

COA 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

COA 4801, -02, -03, -04, -05. Special Topics
Class and credit hours equal last digit in course number.
Topics in design and the built environment.

COA 6115. Art and Architecture in Italy I
3-0-3.
Investigations of the painting, sculpture, and architecture of the Classical, Early Christian, Byzantine, and Medieval periods in Italy with special emphasis on Rome.

COA 6116. Art and Architecture in Italy II
3-0-3.
Investigations of the painting, sculpture, and architecture of the Renaissance and Baroque periods in Italy with special emphasis on the works of Rome.

COA 6763. Design of Design Environments
3-0-3.
Analysis of design processes; analysis of current design tools at both the user interface and functional levels; procedures for developing better design tools. Crosslisted with CS 6763.

COA 6764. Geometric Modeling
3-0-3.
Software development course focusing on 3-D geometric constructions and modeling; emphasizes solid modeling and its role in design. Crosslisted with CS 6764.

COA 8000. Doctoral Seminar
1-0-1.

COA 8510. Research Design in Planning
3-0-3.
Examines the theoretical and practical foundations of research design within the field of city and regional planning.

COA 8520. Advanced Planning Theory
3-0-3.
Advanced seminar on planning theory, including philosophy of sciences, political philosophy, and ethical theory. The course explores the theoretical basis for planning as a social activity.

COA 8600. The Genesis of Architecture
3-0-3.
The nature of architecture illustrated from those of all cultures; determinist theories; its social values and its meanings to the individual-material, physical, anthropological, and cognitive.

COA 8610. Thought and Interpretation in Architecture from the Hellenic Period to the 1830s
3-0-3.
A survey of architectural thought and theory taking account of other fields; paralleled by a review of major critical texts and assessments to the present day.

COA 8612. Thought and Interpretation in Architecture from the 1830s to the Twentieth Century
3-0-3.
A survey of architectural thoughts and theory taking account other fields; paralleled by a review of major critical texts and assessments to the present day.

COA 8620. The Design and Evolution of American Space
3-0-3.
Topical seminar on the development of urban, suburban, and rural American spatial forms, with emphasis on the relationship between public order and vernacular settlement.

COA 8625. Theories of Inquiry in Architecture
3-0-3.
Introduction to research paradigms and their assumptions. The formulation of questions and frameworks of description, representation, analysis, interpretation, and data control.

COA 8630. Theories of Architecture, Space, and Culture
3-0-3.
Accounts of the social functions of architectural space and associated design choices, across a variety of building types and scales of environmental design.

COA 8635. Architecture and Policy: Linking Theory and Practice
3-0-3.
Methods and theories of planning, design, facilities management, and evaluation as they relate to organizational policy and development.

COA 8640. Theories of Psychology for Architecture
3-0-3.
An examination of social and psychological theory as it is applied to the creation and use of space.

COA 8645. Analytical Models of Built Space and Its Functions
3-0-3.
Introduction to analytical ideas and methodologies for the quantitative description of built space, form, building use, and functions. Layouts as configurations: boundaries, accessibility, visibility, extensions.

COA 8650. Formal Descriptions of Designs: Analysis of Space, Shape, and Form
3-0-3.
Introduction to the form and computational description of designs, with an emphasis on spatial patterns. Geometrical constructions, combinatorial approaches, analysis of shape.

COA 8672. Research Seminar in Design Computation
3-0-3.
Seminar review of developments in computing applied to architecture; current major research issues.

COA 8674. Structuring Multimedia Design Knowledge
3-0-3.
Theories and tools for structuring multimedia knowledge for design and designers.

COA 8676. Design and Engineering Databases
3-0-3.
Survey of database use in design and engineering; surveys relational, object-oriented database technology, and ISO-STEP methods of integration.

COA 8680. Performance Aspects of Building Systems Design
3-0-3.
Engineering analysis of building (sub) systems based on a performance ontology. Criteria, metrics, and tools for performance aspect evaluations in different building technology domains.

COA 8685. Computational Building Simulation
3-0-3.
Numerical simulation of performance characteristics of whole buildings. Review of the finite element method for uniform treatment of transport phenomena in different building technology domains.

COA 8690. Integrated Design and Engineering Environments for Buildings
3-0-3.
Surveys of issues for effective integration of heterogeneous design tools for building; previous efforts, current approaches; advanced techniques, including ISO-STEP and IAI.

COA 8811, -12, -13. Special Topics in Architectural/ Planning Studies
Class and credit hours equal last digit in course number.

COA 8821, -22, -23. Special Topics in Architecture and Behavior
Class and credit hours equal last digit in course number.

COA 8831, -32, -33. Special Topics in Design and Technology
Class and credit hours equal last digit in course number.

COA 8841, -42, -43. Special Topics in Design Computing
Class and credit hours equal last digit in course number.

COA 8851, -52, -53. Special Topics in History and Theory
Class and credit hours equal last digit in course number.

COA 8861, -62, -63. Special Topics in History and Theory
Class and credit hours equal last digit in course number.

COA 8901, -02, -03, -04. Special Problems
Credit hours to be arranged.

COA 8996. Qualifying Paper
Credit hours to be arranged.

COA 8997. Teaching Assistantship
Credit hours to be arranged.
For students holding a graduate teaching assistantship.

COA 8998. Research Assistantship
Credit hours to be arranged.
For students holding a graduate research assistantship.

COA 8999. Preparation for Doctoral Dissertation
Credit hours to be arranged.

COA 9000. Doctoral Thesis
Credit hours to be arranged.

CITY AND REGIONAL PLANNING

CP 4010. Foundations of Urban and Regional Development
3-0-3.
The course describes the economic function of cities and the significant factors that shape their growth and development.

CP 4020. Introduction to Urban and Regional Planning
3-0-3.
This course provides an overview of the planning of cities and metropolitan regions. The legal and historical context as well as substantive areas of urban planning are addressed.

CP 4030. The City and Its Technology
3-0-3.
This course places urban infrastructure technology within the larger context of planning and development. The social and economic aspects of these systems are highlighted.

CP 4040. The City in Fiction and Film
3-0-3.
Examines images and perceptions of the urban environment as portrayed in literature and cinema. Explores the social, economic, and cultural contexts that impact on conception of the city.

CP 4050. Negotiation, Facilitation, and Conflict Management
3-0-3.
Theoretical and practical instruction on techniques of negotiation and consensus building using case studies and training exercises.

CP 4210. Environmental Planning and Impact Assessment
3-0-3.
Covers the principles of environmental planning and decision making. Examines the methods and processes, and environmental impact assessment and regulation.

CP 4310. Urban Transportation and Planning
3-0-3.
This course is designed to introduce the fundamentals of urban transportation planning and policy and is applicable to students in a variety of concentrations of study. The purpose of the course will be to acquaint students with transportation planning as a profession and the types of projects that transportation planners are required to conduct.

CP 4510. Fundamentals of Geographic Information Systems
3-0-3.
The course provides a basic understanding of the tools for collecting, storing, and analyzing spatially distributed data. Basic issues of software design and application are covered.

CP 4610. Introduction to Real Estate Investment
3-0-3.
Introduction to real estate analysis and utilization. Subjects include attributes of real property, value determinations, appraisal, investment analysis, market analysis, asset management, and public aspects.

CP 4620. Housing and Real Estate Economics
3-0-3.
Examination of private and public sector approaches to housing. Economic theory of durable goods, demand elasticities, applied market research analysis, and history of public intervention.

CP 4811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number.
Topics of current interest not covered in other courses in the department.

CP 6002. Introduction to Fields of Planning
2-0-2.
Introduction to the various subfields of planning through reading, discussion, and guest lectures by practicing planners. Course also covers professional ethics and career planning and development.

CP 6012. Theory and History of Planning
4-0-4.
Examines theories of planning and the public interest. Considers the roles of planners within the American political system and the historical development of the planning profession.

CP 6016. Growth Management Law and Implementation
3-0-3.
Study of legal framework of planning focusing on managing development to achieve desired outcomes for the economy, society, and the environment.

CP 6019. Quantitative and Computer Methods
3-0-3.
Introduction to computing and quantitative methods in planning. Discusses commonly used data sources, data management, presentation techniques, and planning analytical models.

CP 6023. Advanced Planning Methods
3-0-3.
Prerequisite(s): CP 6019
Analytical methods in planning including inferential statistics, linear regression, and analysis of variance and how they are applied to planning problems. Introduction to research design and the use of qualitative approaches in planning analysis.

CP 6031. Economic Analysis for Planning
3-0-3.
Applications of economic principles to planning, including market theory, public goods, externalities, cost benefit analysis, and project economics.

CP 6032. Urban and Regional Development Theory
3-0-3.
Study of theories in the structure and function of cities and regions. Emphasis on the economic forces shaping urban development.

CP 6034. Demographic and Economic Analysis of Urban Areas
3-0-3.
This course considers the social and economic structure of urban areas from a demographic perspective. Population structure, population change, and migration are explored.

CP 6052. Applied Planning Studio
0-12-4.
Prerequisite(s): CP 6002 and CP 6012 and CP 6023 and CP 6031 and (CP 6032 or CP 6034)
Analysis and preparation of alternatives for an existing neighborhood, community, or region. Emphasis on application of planning skills in a real-world situation.

CP 6112. Introduction to Land Use Planning
3-0-3.
This course introduces students to land use planning. The basic rationale for land use planning and its form in different states is covered.

CP 6122. Land Use Planning Methods
3-0-3.
This course explores the techniques of land use planning and applies them to specific land use types.

CP 6214. Environmental Planning and Impact Assessment
3-0-3.
Examines the principles, processes, and methods of environmental planning. Focuses on environmental science and its use in impact assessment and project evaluation.

CP 6223. Policy Tools for Environmental Management
3-0-3.
The course covers the regulatory, market, and procedural tools used to manage the environment. It examines the strengths and weaknesses of alternative techniques.

CP 6233. Sustainable Urban Development
3-0-3.
Explores the principles and practice of sustainable urban development and the role of planning.

CP 6241. Water Resources Planning
3-0-3.
Fundamentals of water resources planning and watershed management. Emphasis on urban water resources problems, policies, and practices.

CP 6250. Hazardous Waste Planning and Management
3-0-3.
Examines the planning tools and management techniques for the proper use, storage, transport, and disposal of hazardous material and waste products.

CP 6261. Environmental Law
3-0-3.
This course introduces students to the framework of legislation that shapes environmental planning and policy, including NEPA, Clean Air Act, and Clean Water Act.

CP 6311. Introduction to Transportation Planning
3-3-4.
Overview course in transportation planning including basic principles to understanding transportation, current transportation problems, transportation policy, and decision-making processes and methods.

CP 6321. Transportation Planning Methods and Investment Decisions
3-3-4.
Prerequisite(s): CP 6311
Review of transportation methods and how they interface with investment decisions. How transportation planners at the local, regional, state, and federal levels employ methods.

CP 6331. Land Use and Transportation Interaction
3-0-3.
Prerequisite(s): CP 6311
Overview of land use and transportation planning principles, how development impacts transportation, how transportation investments impact development patterns and air quality.

CP 6341. Urban Design and Non-Motorized Accessibility
3-0-3.
Examines role and opportunity to make walking and biking viable travel options in urban environments and how urban environments need to be designed to encourage non-motorized travel.

CP 6351. Transportation and Economic Development
3-0-3.
Impact of transportation infrastructure investments on economic outcomes at a range of geographic scales including neighborhood, municipality, regional, and statewide.

CP 6361. Regional Transportation Planning and Administration
3-0-3.
This course will address the administrative, political, methodological, and social issues underlying the regional transportation planning process.

CP 6412. Foundations of Local Economic Development Planning and Policy
3-0-3
Introduction to local economic development planning, examining theory, process and practice, international and regional factors, public and private roles.

CP 6422. Economic Development Analysis and Practice
3-0-3.
This course focuses on strategy development, methods of analysis, and approaches to practice for urban and regional economic development policy and planning.

CP 6432. Industrial Restructuring and Its Planning Implications
3-0-3.
Examines industrial restructuring trends and theoretical frameworks, develops industry case studies, and considers economic development planning's role in industrial restructuring.

CP 6442. Equity, Social Justice, and Economic Development
3-0-3.
Explores concepts and theories of equity and social justice, analysis of indicators of (in)justice/equity, and economic development planning's role in promoting equity and social justice.

CP 6452. Urban Development Policy
3-0-3.
Introduces elements of urban policy and economic development by examining them historically, nationally, and locally. Approaches to urban development and redevelopment are analyzed.

CP 6514. Introduction to Geographic Information Systems
3-0-3.
This course introduces students to spatial analysis using geographic information systems. Fundamentals of software design and geographic data are covered.

CP 6521. Advanced Geographic Information Systems
2-1-3.
Prerequisite(s): CP 6514
The course provides students with advanced spatial analysis techniques including network analysis, three-dimensional surface modeling, and GIS application development.

CP 6531. Introduction to Remote Sensing
3-0-3.
This course introduces students to the collection and use of satellite imagery and other remote sensing data.

CP 6541. Environmental Analysis Using GIS
3-0-3.
Prerequisite(s): CP 6514
This course focuses on the application of geographic information systems (GIS) to environmental problems. It highlights the types and sources of data appropriate to those applications.

CP 6551. Spatial Analysis of Socioeconomic Data
3-0-3.
Prerequisite(s): CP 6514
This course provides students with an in-depth study of the spatial distribution of human activity, including population, housing, and employment.

CP 6561. Geodemographics: Data Sources and Methods
1-6-3.
Explores important secondary data sources used by planners and analysts working with smaller geographic areas. Experience with hardware and software used to analyze data.

CP 6611. Principles of Real Estate Finance and Development
3-0-3.
Introduction to principles of real estate finance, focusing on the role the public sector plays in making desirable development projects financially feasible.

CP 6621. Real Estate Market Research
3-0-3.
Introduction to real estate market research with particular focus on analysis of housing and office markets.

CP 6630. Government and Housing Markets
3-0-3.
Examination of the operation of local housing markets and national, state, regional, and local housing policies.

CP 6640. Applied Real Estate Development Methods
3-0-3.
Prerequisite(s): (CP 6611 and CP 6621) or (CP 6611 and CP 6630)
Application of the development process, market and financial feasibility analysis, and public policy to large development projects. Extensive use of case studies involving professional developers.

CP 6760. Negotiation and Conflict Management
3-0-3.
Practical and theoretical instruction on techniques of negotiation and consensus building using training exercises and case studies. Emphasizes environmental, policy, planning, and development disputes. Crosslisted with PUBP 6760.

CP 6811. Negotiation, Facilitation, and Conflict Management
3-0-3.
Theoretical and practical instruction on techniques of negotiation and consensus building using case studies and training exercises.

CP 6815. Cinema City
3-0-3.
Explores people's response to cities, augmenting the empirical analysis that is urban studies domain with the subjective perspectives of cinematic artists.

CP 6821. Basic Methods of Policy Analysis and Planning
3-0-3.
Synthesizes elements of the program core's analytic techniques and employs them in a case-study context. Cases address urban policy, planning, and management.

CP 6825. Public Sector Finance and Budgeting
3-0-3.
Theory and practice of public finance. Emphasis on applications in local government revenue collection, budgeting, and expenditure analysis.

CP 6831. Urban Growth and Infrastructure Systems
3-0-3.
This course provides students with a basic understanding of urban infrastructure systems and their role in shaping urban growth and development.

CP 6832. Introduction to Urban Design
3-0-3.
An introduction to the study, research, and practice of urban design examining traditional design principles and their application to the contemporary city.

CP 6834. Urban Design Policy: Analysis and Implementation
3-0-3.
Prerequisite(s): CP 6832
Urban design policy making and its implementation including an analysis of the behavioral basis for policies that promote quality in built form.

CP 7000. Master's Thesis
Credit hours to be arranged.
Provides students with an opportunity to pursue advanced research under the guidance of a faculty committee.

CP 8000. Doctoral Planning Seminar
1-0-1.
This course provides students and faculty an opportunity to present and discuss planning research.

CP 8813. Special Topics in Land Use Planning
3-0-3.
Topics of current interest in land use planning.

CP 8823. Special Topics in Environmental Planning
3-0-3.
Topics of current interest in environmental planning.

CP 8833. Special Topics in Transportation Planning
3-0-3.
Topics of current interest in transportation planning.

CP 8843. Special Topics in Economic Development
3-0-3.
Topics of current interest in economic development.

CP 8853. Special Topics in Geographic Information Systems
3-0-3.
Topics of current interest in geographic information systems.

CP 8863. Special Topics in Land Development
3-0-3.
Topics of current interest in land development.

CP 8873. Special Topics in Urban Design
3-0-3.
Topics of current interest in urban design.

CP 8881, -82, -83. Special Topics in City and Regional Planning
Class and credit hours equal last digit in course number.
Topics of current interest in city and regional planning.

CP 8900, -01, -02. Special Problems
Credit hours to be arranged.
Special problems of current interest.

CP 8990. Applied Research Paper
Credit hours to be arranged.
The applied research paper requires students to demonstrate their ability to organize and execute professional-level work in consultation with a faculty member.

CP 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding graduate teaching assistantships.

CP 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding graduate research assistantships.

INDUSTRIAL DESIGN

ID 2011. Introductory Design I
0-12-4.
Prerequisite(s): COA 1012
Foundation course in visual communications theory and practice, continuing the development of two-dimensional visual literacy. Emphasis on both analog and digital media.

ID 2012. Introductory Design II
0-12-4.
Prerequisite(s): ID 2011
Foundation course in form giving and representing, continuing the development of three-dimensional visual literacy. Emphasis on visual relationships between form and image.

ID 2201. Sustainable Issues for Design
3-0-3.
Co-requisite: ID 2011.
Introduction to the broad environmental issues that face humankind as a participant in the biosphere.

ID 2202. History of Modern Industrial Design
3-0-3.
History and development of industrial design from the beginning of the Industrial Revolution to the present.

ID 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

ID 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

ID 3011. Intermediate Design I
2-9-5.
The systematic design process as applied to industrial design and packaging problems.

ID 3012. Intermediate Design II
2-9-5.
Prerequisite(s): ID 3011
Various dimensions of human factors applied to design, including: aging, disability, normal age change, childhood and adult anthropometrics, and human capability.

ID 3103. Industrial Design Computing I
1-6-3.
Introduction to 2-D computer drawing systems.

ID 3104. Industrial Design Computing II
1-6-3.
Prerequisite(s): ID 3103
Introduction to 3-D modeling systems.

ID 3301. Materials I: Renewables
2-3-3.
This course examines the characteristics, production technologies, histories, and environmental impacts of nine categories of renewable materials familiar to industrial design.

ID 3302. Materials and Processes II: Nonrenewables
2-3-3.
Prerequisite(s): ID 3301
Examination of characteristics, production technologies histories, and environmental impacts of nonrenewable materials used in industrial design.

ID 3803, -13. Special Topics
3-0-3.
Topics of current interest in industrial design.

ID 3901, -02. Special Problems
Credit hours to be arranged.

ID 4011. Advanced Design I
1-12-5.
Prerequisite(s): ID 3012 and ID 3302
Application of the design process to advanced multidisciplinary design problems. Experience in solving real design problems from areas such as consumer products and equipment, transportation and equipment.

ID 4012. Advanced Design II
1-12-5.
Prerequisite(s): ID 4011
Capstone industrial design project of student's own choosing, with consent of instructor, to refine problem-solving and design ability in preparation for professional practice.

ID 4103. Alias Studio I
0-9-3.
Introduction to modeling, rendering, and animation with Alias Studio software.

ID 4104. Alias Studio II
0-9-3.
Prerequisite(s): ID-4103
Introduction to product animation using Alias Studio software.

ID 4201. Design/Research Methods
3-0-3.
Research methods applicable to industrial design including task definition, information gathering, and analysis.

ID 4202. Professional Practice and Preparation
3-0-3.
Principles of consulting and corporate industrial design including preparation of the professional portfolio.

ID 4203. French Society and Culture
3-0-3.
Studies in French society and culture.

ID 4204. Theorizing Design
3-0-3.
Introduction to what designers do and how they undertake their tasks; examples will come from a variety of design disciplines.

ID 4205. French Design and Culture
3-0-3.
Studies in French design and culture.

ID 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

ID 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

ID 4803. Special Topics: Furniture
3-0-3.
Special topics in furniture design not covered in the professional curriculum.

ID 4813. Special Topics: Sustainability
3-0-3.
Special topics in sustainability not included in the professional curriculum.

ID 4823. Special Topics: Information Technology
3-0-3.
Special topics in information technology not included in the professional curriculum.

ID 4833. Special Topics: Collaborative
3-0-3.
Application of the design process to advanced multidisciplinary problems by a team. Projects from a range of interest areas: consumer, industrial products, transportation, furniture.

ID 4843. Special Topics: History and Theory
3-0-3.
Special topics in history and theory not included in the professional curriculum.

ID 4900. Special Problems: Visual Communications
Credit hours to be arranged.
Special problems in communication not covered in the professional curriculum.

ID 4901, -02. Special Problems: Mentor Program
Credit hours to be arranged.
Special problems in teaching pedagogy; mentoring by senior faculty in basic and intermediate design courses.

ID 4903, -04. Special Problems: Research
Credit hours to be arranged.
Special research topics for advanced students not covered in the professional curriculum.

ID 6100. Introduction to Graduate Studies in Industrial Design
3-0-3.
Introduction to the theory and practice of graduate studies in Industrial Design in relation to behavior research and consumer products.

ID 6101. Human Centered Design
3-0-3.
Prerequisite(s): ID 6100
This course examines design artifacts in relation to the human body, aging, disabilities, and environments.

ID 6200. Industrial Design Graduate Studio I
2-12-6.
Graduate application of the design process to advanced multidisciplinary design problems. Experience in solving real design problems for consumer products.

ID 6201. Industrial Design Graduate Studio II
2-12-6.
Prerequisite(s): ID 6200
Graduate-level application of the design process to advanced multidisciplinary problems.

ID 6400. Master's Project
Credit hours to be arranged.
Prerequisite(s): ID 6101
Student produces a product prototype that must meet with instructor's approval.

ID 7000. Master's Thesis
Credit hours to be arranged.
Prerequisite(s): ID 6100
Provides students with the opportunity to pursue advanced research under the guidance of a faculty member.

ID 8900. Special Problems
Credit hours to be arranged.
Prerequisite(s): ID 6101
Special problems in industrial design.

Department of Music

www.music.gatech.edu

Location: Couch Building
Telephone: 404.894.3193
Fax: 404.894.9952
E-mail: fclark@music.gatech.edu

Director and Professor of Music–Frank Clark; *Director of Bands and Director of Symphonic Band*–Andrea Strauss; *Associate Director of Bands and Director of Athletic Bands*–Christopher Moore; *Director of Jazz Ensemble and Director of Orchestra*–Ron Mendola; *Director of Choral Activities*–Jerry Ulrich; *Director of Music Technology*–Gil Weinberg; *Assistant Band Director*–William Bishop.

General Information

Among the oldest traditions of the Institute, the Music Department provides a creative cultural outlet for Tech's many musically minded students. Whether a student's interest is casual or intense, the music faculty is dedicated to providing a quality experience in the theory, history, and practice of music. Students may elect to participate in various classroom courses, and in vocal or instrumental ensembles, enjoying a sense of community, pride, and accomplishment. Institute research also reveals that student retention is 4.5 times greater for students involved in music.

Music activities at Georgia Tech are centered around its major performing groups: Marching Band, Concert Band, Chamber Choir, Chorale, Jazz Ensemble, Symphonic Band, and Orchestra. The Music Department is cognizant of the desires of students who wish to enrich their lives through music, and excellence in the program is clearly demonstrated in the level of student performance and the vitality and rapid growth of the program. Students involved in the program represent every major of the Institute on both undergraduate and graduate levels.

Students earn free elective or humanities credit for all ensembles and classroom courses. Upon completion of thirteen credit hours of coursework within a prescribed curriculum, a Certificate in Music may be awarded. A Minor in Music is also offered, requiring nineteen credit hours, with at least six credit hours at the upper-division level (3000-4000). The minor can be completed in any one of the following areas: woodwinds, brass, strings, percussion, vocal, and jazz. Specific offerings may be checked each semester at **https://oscar.gatech.edu**. The Department plans events with an awareness of the demands placed upon Tech students so that a great amount of musical experience is concentrated into a limited time. Most ensemble classes schedule meetings and rehearsal times during the late afternoon and early evening hours. The Department enjoys a tradition of commitment to campus and community service that contributes greatly to the quality of life at Georgia Tech.

Humanities Credit for Ensemble Participation

Students are permitted to earn four hours of humanities credit for participating in ensembles in the Music Department, provided the selection and concentration criteria are satisfied. Specifically, the selection must satisfy Criterion 1, and the concentration must satisfy either Criterion 2 or Criterion 3.

Criterion 1. The ensemble is chosen from the following list: Percussion Ensemble, Orchestra, Chorale, Concert Band, Jazz Ensemble, Symphonic Band, Vocal Ensemble, and Men's Glee Club.

Criterion 2. The student earns at least four credits in one of the ensembles chosen from the list in Criterion 1.

Criterion 3. The student earns at least four credits in a combination of Symphonic Band and Concert Band.

Music Minor Requirement

A Music Minor can be earned by Georgia Tech students upon completion of nineteen hours of study (twelve hours must be at the 3000 level or higher) in music as approved by the Music Department program coordinator. Students following the guidelines of the Minor Program will be exposed to musical study at considerable depth in areas that include theory, history, and an introduction to the study of music technology. An additional requirement component of the Minor Program involves sustained performance in one of Georgia Tech's instrumental or vocal ensembles chosen from the list below. All courses must be taken on a letter-grade basis with a grade of *C* or better, and must be completed with an overall GPA of 2.0. All other requirements outlined in the Georgia Tech Policy for Undergraduate Minors must be met. Auditions for acceptance into the Music Minor are required and occur each spring.

Required Courses:
- Two hours of Composers and Their Music 1500-1800
- Two hours of Composers and Their Music 1800-Present
- Two hours of Music Theory I
- Two hours of Music Theory II
- Three hours of Survey of Music Technology
- Two hours of Introduction to Computer Music
- Three hours of Individual Applied Instruction

Approved Ensembles Courses:
Three semester hours of participation in one vocal or instrumental ensemble at the 3000 level or above, chosen from the following list:
Concert Band/Symphonic Band/Jazz Ensemble/Orchestra/Chorale/Vocal Ensemble/Men's Glee Club/Percussion Ensemble

Certificate in Fine Arts - Music

A Certificate in Fine Arts - Music can be earned by Georgia Tech students upon completion of thirteen hours of coursework in music as approved by the Music Department director. Students following certificate guidelines will be exposed to an introduction to fine arts, including the development of personal aesthetic and critical skills, and will go on to more in-depth study in music analysis and history. A core component of this program involves sustained performance in one of Georgia Tech's instrumental or vocal ensembles.

At least nine hours must be at the 3000 level or higher. All other Undergraduate Certificate Academic Requirements as they appear in the Undergraduate Certificate Program Guidelines must be met. Courses must be taken on a letter-grade basis, and a grade of *C* or better must be received in order to obtain course credit toward the Certificate. This Certificate Program is designed mainly for students with an interest in gaining an in-depth knowledge of music within the context of a technical undergraduate education. Required and elective courses are as follows:

Required courses (eleven credit hours):

- Three hours of Survey of Music Technology (MUSI 3450)
- Two hours of Composers and Their Music
- Two hours of Music Theory (MUSI 2600, 3600)
- Four hours core from one of the following areas:
  - Band (Concert Band - MUSI 1102-3, 2102-3, 3102-3, 4102-3 and/or Symphonic Band (1112-4, 2112-4, 3112-4, 4112-4)
  - Chamber Ensemble (MUSI 1401-3, 2401-3, 3401-3, 4401-3)
  - Chorale (MUSI 1201-3, 2201-3, 3201-3, 4201-3)
  - Jazz (MUSI 1301-3, 2301-3, 3301-3, 4301-3)
  - Orchestra (MUSI 1601-3, 2601-3, 3601-3, 4601-3)
  - Vocal Ensemble (MUSI 1211-3, 2211-3, 3211-3, 4211-3)

Elective courses (two credit hours):
Two hours of elective music courses with MUSI prefix.

Athletic Bands
The Yellow Jacket Marching Band and Basketball Pep Bands are elements of the Georgia Tech Band Program. The Marching Band and Pep Bands perform at all home games and travel to several out-of-state events, including the ACC Tournament, NCAA Tournament, football games, and bowl appearances. These trips are financed by the Georgia Tech Athletic Association. Tryouts for the auxiliary units are held each spring. There is a mandatory band camp the week before fall classes begin. All members must sign up for the class.

The Georgia Tech Marching Band Handbook provides detailed information about the organization. Contact the Music Department for further information.

Concert Band
The Concert Band is open to experienced wind and percussion players. This is a performing ensemble that covers both traditional and contemporary music. Students can earn humanities credit by participating in a series of Concert Band and/or Symphonic Band courses.

Symphonic Band
An auditioned instrumental ensemble for the more serious student has established a reputation of musical excellence through the performance of challenging band literature. Individual performance time, sectionals, and a high level of musical standards in rehearsals are expected. Repertoire has consisted of the compositions of Grainger, Persichetti, Copland, Bernstein, Hindemith, Giannini, and Holst. Guest clinicians and conductors are frequently invited to enhance performance preparation. Auditions are scheduled by contacting the director before the first day of class.

Orchestra
The Georgia Tech Orchestra was founded in 1993 and has grown to full orchestration including brass, woodwinds, and percussion. The group performs a balance of classical, romantic, contemporary, and popular literature. The Orchestra performs during Parent's Weekend, the Music of the Season concert, and many other community appearances. Auditions are scheduled by appointment during the first two days of class.

Jazz Ensemble
The Jazz Ensemble's repertoire ranges from the concert jazz compositions of Leonard Bernstein, Duke Ellington, and Stan Kenton to the contemporary works of Bob Mintzer and Pat Metheny, and to works commissioned for the band. The group performs at area jazz festivals and has appeared in hundreds of concerts on campus and in the community. Members sharpen their improvisational skills and strive to grow as instrumentalists in various jazz styles. Students rightfully take pride in the group's accomplished level of performance. Professional clinicians, guest artists, and conductors bring additional musical perspective.

Auditions are scheduled by appointment during the first two days of class.

Chamber Ensembles
Small ensembles for experienced instrumentalists are organized prior to the first day of classes. Participation must be pre-approved by a faculty member in the Music Department. Members of these small ensembles must be participating in a large ensemble. Chamber Ensembles include string quartet, brass quintet, woodwind quintet, clarinet quartet, trumpet quartet, saxophone quartet, flute choir, etc. Students receiving class credit for these chamber groups must rehearse at least three hours a week and must be coached by a faculty member. Performances vary depending on the semester and may include appearances at school-related functions.

Percussion Ensemble
The Percussion Ensemble focuses on traditional and contemporary ensemble literature as well as transcriptions of popular music. This ensemble is offered to students with prior percussion background. In the fall, it serves as the marching percussion section of the Marching Yellow Jacket Band.

The Chorale
With approximately 125 singers, the Chorale is Georgia Tech's largest vocal music organization. Students from nearly every school in the Institute are found among its membership. The Chorale specializes in music written for large groups and performs regularly on campus. The Chorale travels extensively during its biennial spring tour.

The Vocal Ensemble
This ensemble of twenty to twenty-four singers is selected through audition each spring and performs as the Georgia Tech Chamber Choir in campus and community concerts. The choir rehearses and performs quality choral music literature written especially for smaller choirs.

The Men's Glee Club
The Men's Glee Club was organized on the Tech campus in 1906 and is the oldest student organization on campus. The Glee Club performs frequently on and off campus. Repertoire includes traditional men's chorus music, contemporary vocal percussion, and original compositions.

Music Technology
"Introduction to Synthesized Computer Music" explores the basic theories of music sequencing and engraving utilizing the computer and integrated synthesizers. "Survey of Music Technology" is a detailed survey of historic and contemporary electronic music systems, providing an overview of the technological, cultural, and aesthetic factors that have shaped developments in the creation and production of modern electronic music.

"Integrating Music into Multimedia" provides students insight and basic proficiency in current techniques that utilize music and digital audio technologies as part of multimedia productions. Also covered are issues in software/hardware integration, data acquisition from various media, and intellectual property considerations. Other classes such as "Music Recording and Mixing," "Music Interface Design," "Multimedia Production and Post-production," and "Music and Sound Design" explore the intersection of music technology and digital media.

Electronic Percussion Ensemble
This ensemble performs a variety of student designed and arranged music. All pieces are performed on student designed and built instruments, as well as the latest in commercial controllers and interfaces. The use of multimedia is also encouraged in each arrangement.

Additional Information
Other courses currently taught in the Music Department include "Composers and Their Music" and "Music Theory." Further information is available from the Music Department at 404.894.3193 or **www.gatech.edu/music**.

Music Department Humanities Credit Information
CORE AREA C:
MUSIC: 2600, 3450, 3500, 3600, 3610, 3620, 4450
Students are permitted to earn four hours of humanities credit for participation in ensembles.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

MUSIC

MUSI 1008, 2008, 3008, 4008. Marching Band
0-6-2.
The Georgia Tech Marching Yellow Jackets perform at all home and some away football games. Students are expected to attend a pre-season camp. All conflicts must be approved by director.

MUSI 1009, 2009, 3009, 4009. Pep Band
0-3-1.
Performance ensemble for men's and women's basketball games.

MUSI 1102, -03; 2102, -03; 3102, -03; 4102, -03. Concert Band
0-3-1.
An instrumental ensemble that performs traditional and contemporary wind literature and is offered to all students with wind, brass, or percussion experience.

MUSI 1112, -13, -14; 2112, -13, -14; 3112, -13, -14; 4112, -13, -14. Symphonic Band
0-3-1.
Audition required prior to the first day of class. An auditioned instrumental ensemble for the more accomplished student interested in band performance; focusing on musical excellence of challenging band literature. Contact director for audition requirements.

MUSI 1201, -02, -03; 2201, -02, -03; 3201, -02, -03; 4201, -02, -03. Chorale – Mixed Singing Group
0-3-1.
A large ensemble focused on rehearsal and performance of high-quality music of all genres. Choral music experience recommended.

MUSI 1211, -12, -13; 2211, -12, -13; 3211, -12, -13; 4211, -12, -13. Vocal Ensemble
0-3-1.
An auditioned vocal ensemble for the more serious student of vocal music; focuses on rehearsal and performance of high-quality music of all genres. Audition and/or consent of instructor required.

MUSI 1221, -22, -23; 2221, -22, -23; 3221, -22, -23; 4221, -22, -23. Men's Glee Club
0-3-1.
An all-male choral ensemble focused on rehearsal and performance of male chorus literature.

MUSI 1301, -02, -03; 2301, -02, -03; 3301, -02, -03; 4301, -02, -03. Jazz Ensemble
0-3-1.
A traditional, twenty-member big band and small ensemble specializing in improvisation. Members learn various jazz styles, performance practices, and history.

MUSI 1401, -02, -03; 2401, -02, -03; 3401, -02, -03; 4401, -02, -03. Chamber Ensemble
0-3-1.
Small instrumental ensembles of various types selected by the director to perform literature for the specific ensemble.

MUSI 1501, -02, -03; 2501, -02, -03; 3501, -02, -03; 4501, -02, -03. Percussion Ensemble
0-3-1.
Percussion ensemble focuses on traditional and contemporary ensemble literature as well as transcriptions of popular music.

MUSI 1601, -02, -03; 2601, -02, -03; 3601, -02, -03; 4601, -02, -03. University Orchestra
0-3-1.
The Georgia Tech Orchestra maintains a full complement of woodwinds, brass, percussion, and strings and performs classical through contemporary literature. Contact director prior to the first day of class to arrange an audition.

MUSI 2521, -22; 3521, -22; 4521, -22. Electronic Percussion Studio/Ensemble
2-3-3.
Applied design construction and programming for performance.

MUSI 2600. Music Theory I
2-0-2.
Fundamentals of music language to include basic notation, scales, key, signatures, and triads. Ability to read music required.

MUSI 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

MUSI 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

MUSI 3450. Survey of Music Technology
2-3-3.
A detailed survey of historic and contemporary electronic music systems and their applications in the creation, production, and reproduction of music.

MUSI 3500. Introduction of Synthesized Computer Music
1-3-2.
Introduction of synthesized computer music familiarizes the student with basic sequencing and music engraving using fundamentals of music theory and composition.

MUSI 3600. Music Theory II
2-0-2.
Prerequisite(s): MUSI 2600
Advanced music theory including Roman numeral analysis, voice leading in four-part harmony, seventh chords, melodic organization, and modulation.

MUSI 3610. Composers and Their Music: 1500-1800
2-0-2.
The history of western music from the Renaissance to the period of classicism.

MUSI 3620. Composers and Their Music: 1800 to Present
2-0-2.
The history of western music from the period of classicism to present day.

MUSI 3710, -20, -30. Individual Applied Instruction
1-0-1.
Private instruction for vocal, wind, and percussion students admitted into the Minor of Music program.

MUSI 3801. Special Topics
0-3-1.
Special ad hoc courses or projects not included in regular course offerings.

MUSI 3802. Special Topics
1-3-2.
Special ad hoc courses or projects not included in regular course offerings.

MUSI 3803. Special Topics
2-3-3.
Special ad hoc courses or projects not included in regular course offerings.

MUSI 4450. Intergrating Music into Multimedia
2-3-3.
Techniques for effectively utilizing music and audio in the context of digital multimedia.

MUSI 4630. Music Recording and Mixing
2-3-3.
Overview of concepts, techniques, hardware, and software used in audio production, as well as aesthetic concerns and considerations.

MUSI 4650. Music and Sound Design
2-3-3.
An investigation of principles and practice of audio and music design, in both contemporary digital and traditional analog systems.

MUSI 4670. Music Interface Design
2-3-3.
Theory and practice of designing and prototyping new forms of music interfaces, including percussion, haptic, and augmented traditional constructs.

MUSI 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

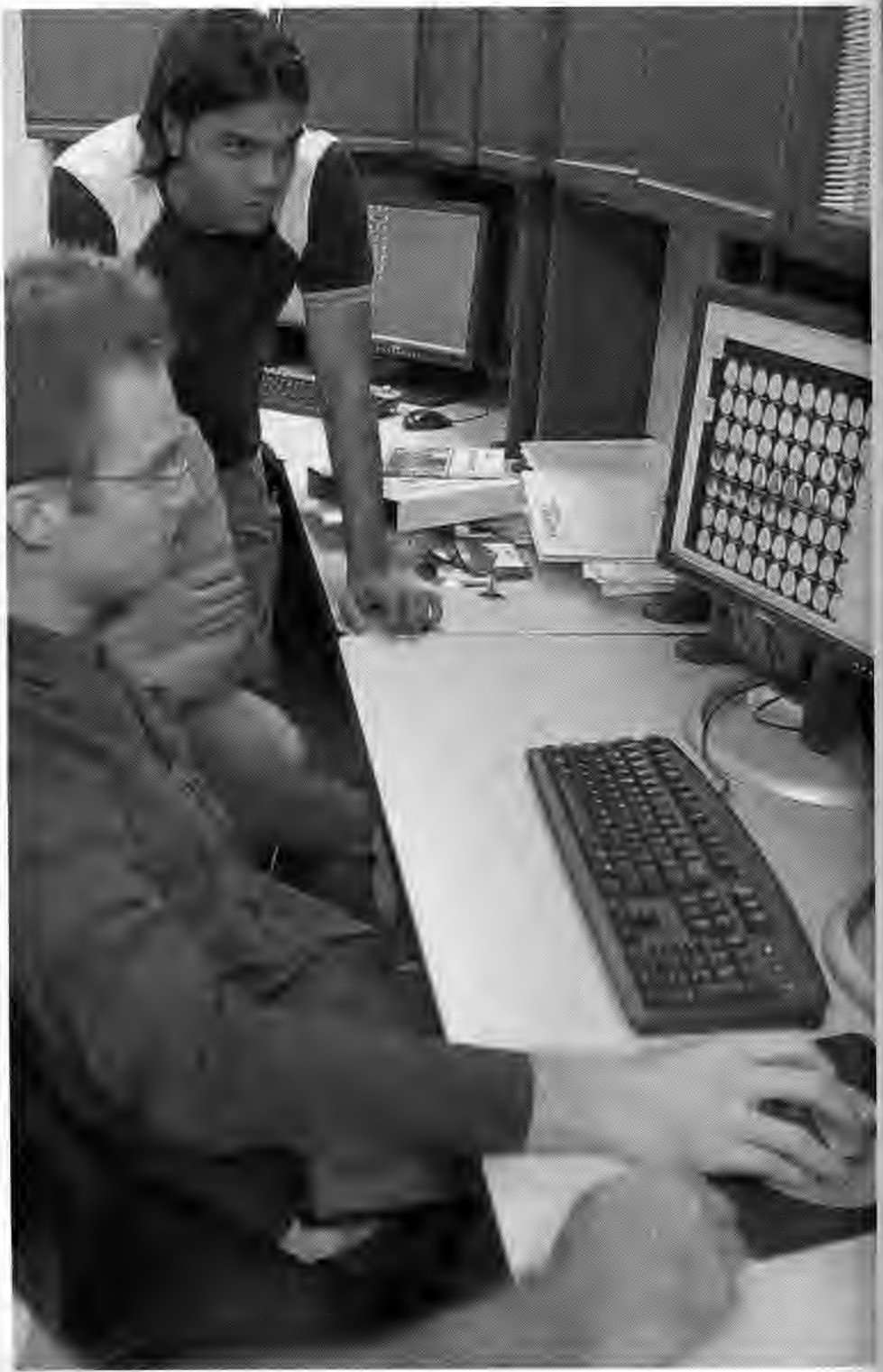
MUSI 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

MUSI 4801. Special Topics
0-3-1.
Special ad hoc courses or projects not included in regular course offerings.

MUSI 4802. Special Topics
1-3-2.
Special ad hoc courses or projects not included in regular course offerings.

MUSI 4803. Special Topics
2-3-3.
Special ad hoc courses or projects not included in regular course offerings.

MUSI 4813, -23, -33. Special Topics
2-3-3.
Special ad hoc courses or projects not included in regular course offerings.



This version of the *General Catalog* was current as of the date of printing in May 2005. For the most up-to-date version, visit **www.catalog.gatech.edu**. In addition, this is the final printed version of the *General Catalog*. Beginning in May 2006 it will be available online only.

College of Computing

www.cc.gatech.edu

Established in 1990
Location: 801 Atlantic Drive
Telephone: 404.894.3152
Fax: 404.894.9846
E-mail: coc-info@cc.gatech.edu

John P. Imlay Dean and Professor–Richard A. DeMillo; *Associate Dean for Undergraduate Education and Faculty Development and Professor*–Merrick Furst; *Associate Dean for Research and Graduate Programs and Professor*–Ellen Witte Zegura; *Associate Dean for Special Programs, Fredrick G. Storey Chair in Computing and Professor*–Richard J. Lipton; *Assistant Dean for Diversity and Special Programs*–Maureen S. Biggers; *Assistant Dean for Continuing Education*–Thomas D. Pilsch; *Stephen Fleming Chair in Telecommunications and Professor*–James D. Foley; *John P. Imlay Jr. Chair in Software and Professor*–Calton Pu.
Regents' Professors–Mostafa H. Ammar, Ronald C. Arkin, Janet L. Kolodner.
Professors– Mustaque Ahamad, Albert N. Badre (emeritus), Aaron Bobick, Lucio Chiaraviglio (emeritus), Charles M. Eastman (joint), Philip H. Enslow Jr. (emeritus), Peter A. Freeman, Richard M. Fujimoto, Seymour E. Goodman (joint), Mary Jean Harrold, Ramesh C. Jain (joint), Richard J. LeBlanc Jr., Ralph Merkle, Raymond E. Miller (emeritus), Shamkant B. Navathe, Nancy J. Nersessian, Krishna V. Palem (joint), Umakishore Ramachandran, Jaroslaw R. Rossignac, Karsten Schwan, Vladimir Slamecka (emeritus), John T. Stasko, Vijay V. Vazirani, Pranas Zunde (emeritus).
Associate Professors–Gregory D. Abowd, Amy S. Bruckman, Keith Edwards, Irfan A. Essa, Ashok K. Goel, Mark Guzdial, Ling Liu, Leo Mark, Milena Mihail, Elizabeth D. Mynatt, Edward R. Omiecinski, Santosh Pande, Colin Potts, Ashwin Ram, Dana Randall, James M. Rehg, Olin Shivers, Prasad Tetali (joint), Gregory Turk, H. Venkateswaran, Eric Vigoda.
Assistant Professors–Tucker R. Balch, Suagata Basu (joint), Alexandra Boldyreva, Brian Cooper, Frank Dellaert, Yan Z. Ding, Andre L. M. Dos Santos, Constantinos Dovrolis, Ronald W. Ferguson, Charles L. Isbell Jr., Subhash Khot, Wenke Lee, Gabriel Loh, Blair MacIntyre, Panagiotis Manolios, Michael Mateas (joint), Michael Niemier, Alessandro Orso, Jeffrey S. Pierce, Yannis Smaragdakis, Thad E. Starner, Andrzej Szymczak, Bruce N. Walker (joint), Jun Xu.
Academic Professionals–Randy Carpenter, Kalyan Perumalla.
Principal Research Scientists–Amihood Amir, W. Michael McCracken.
Senior Research Scientists–Angus McLean, J. Spencer Rugaber, Christopher D. Shaw.
Lecturers–Daniel W. Colestock, William D. Leahy Jr., David M. Smith, Monica Sweat, Robert L. Waters Jr.
Adjunct Faculty–Douglas M. Blough, Jay D. Bolter, Mark Borodovsky, Richard Catrambone, Alexander C. Kirlik, Sung-Kyu Lim, Christine Mitchell, Vincent J. Mooney, Melody Moore, Wendy C. Newstetter, David Prince, Mani M. Subramanian, Craig A. Tovey, Linda M. Wills, Sudhakar Yalamanchili.

General Information

The founding of the College in 1990 as a focal point for the interdisciplinary advancement of computing caps a history that began in 1963 with the establishment of the School of Information Science. In 1972, this school was succeeded by the School of Information and Computer Science, the immediate predecessor of the current College of Computing. The College is organized around a strong core of computer science that provides the basis for interdisciplinary activities. This approach allows the computing program to build effectively

on the strengths of Georgia Tech, accomplished through synergistic linkages to researchers and educators across campus as well as off campus.

Computer science is an important part of the basis for many activities and is a natural and powerful partner with a variety of other disciplines. The College offers instructional and research programs in many areas, including algorithms and data structures, intelligent systems and robotics, computer architecture, cognitive science, databases, distributed and parallel systems, educational technology, graphics and visualization, human-computer interaction, information security, information systems, networking and telecommunications, operating systems, parallel architectures, programming languages, software engineering, and theories of automata and computation.

The College conducts an increasing number of interdisciplinary research and instructional programs jointly with other campus units and operates three centers of interdisciplinary research for the campus: the Center for Experimental Research in Computer Systems (CERCS); the Graphics, Visualization, and Usability (GVU) Center; and the Georgia Tech Information Security Center (GTISC). The College's operations are housed in parts of five separate buildings on campus, including the College of Computing Building.

The College awards bachelor's degrees in computer science, and bachelor's degrees in computational media jointly with the School of Literature, Communication, and Culture, master's degrees in computer science and in information security, and doctoral degrees in computer science and human-centric computing. The College offers an undergraduate minor and undergraduate and graduate certificates in Cognitive Science jointly with the Schools of Psychology and Industrial and Systems Engineering. The College also offers the M.S. degree in Human-Computer Interaction in collaboration with the School of Literature, Communication, and Culture and the School of Psychology. The College is a sponsor of a multidisciplinary program in Algorithms, Combinatorics, and Optimization (ACO), an approved doctoral degree program at Georgia Tech. Master's and doctoral degrees in bioengineering can be pursued through the College as one of the units participating in the Institute-wide interdisciplinary Bioengineering Program.

Undergraduate Programs

Bachelor of Science in Computer Science

The undergraduate degree in computer science (CS) offered by the College of Computing provides a solid foundation of knowledge and skills for applying digital processes effectively to issues of broad interest in a global society. The curriculum builds on a base of fundamentals in programming, software engineering, system design, and computational theory, and then provides our students the opportunity to explore a wide variety of computing specializations in depth. The CS major includes eighteen semester hours of free electives, which provide the students with the flexibility to explore areas of study outside of computer science or to build more depth within computer science. These free electives offer every CS major the opportunity to create an individualized interdisciplinary program of study. The CS curriculum also offers opportunities in undergraduate research and international study.

In addition to the standard four-year plan, a five-year cooperative plan is offered for students who wish to combine their academic education with industry experience. The undergradnate program requires a total of 124 credit hours for graduation, plus a two-hour wellness course. With the exception of free electives, all Bachelor of Science degree coursework must be taken on a letter-grade basis. Up to six hours of free electives may be taken on a pass/fail basis. See page 33 for additional pass/fail restrictions.

The College of Computing requires that all undergraduates who enter the computer science program earn a grade of *C* or better in all required CS courses, including CS specialization courses and the CS free elective course. A student whose final grade in a required CS course is a *D* or *F* must retake that course in the next semester it is offered and must earn a *C* or better for that course to be used as credit toward graduation.

For more information about the undergraduate program, request a brochure from the Office of Student Services, College of Computing, or visit **www.cc.gatech.edu/academics/undergraduate.html**.

Bachelor of Science in Computer Science (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
CS 1321	INTRO. TO COMPUTING* or	
CS 1316	REPRESENTING STRUCTURE & BEHAVIOR*	3
HIST 2111 or 2112 or POL 1101 or		
PUBP 3000 or INTA 1200		3
WELLNESS		2
TOTAL SEMESTER HOURS		15

First Year - Second Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II	4
HUMANITIES ELECTIVE(S)		3
CS 1050	UNDERSTANDING & CONSTRUCTING PROOFS*	3
CS 1322	OBJECT-ORIENTED PROGRAMMING*	3
TOTAL SEMESTER HOURS		16

Second Year - First Semester

Course Number/Name		*Hours*
LAB SCIENCE REQUIREMENT		4
MATH 2605	CALCULUS III FOR CS	4
CS 2110	COMPUTER ORGANIZATION & PROGRAMMING*	4
CS 2335	SOFTWARE PRACTICUM*	3
TOTAL SEMESTER HOURS		15

Second Year - Second Semester

Course Number/Name		*Hours*
HUMANITIES ELECTIVE(S)		3
MATH 3012	APPLIED COMBINATORICS	3
CS 2340	OBJECTS & DESIGN*	3
CS 2200	COMPUTER SYSTEMS & NETWORKS*	4
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

Third Year - First Semester

Course Number/Name		*Hours*
LAB SCIENCE REQUIREMENT		4
CS 3510	DESIGN & ANALYSIS OF ALGORITHMS*	3
COMPUTER SCIENCE SPECIALIZATION*		3
SOCIAL SCIENCE ELECTIVE(S)		3
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

Third Year - Second Semester

Course Number/Name		*Hours*
LAB SCIENCE REQUIREMENT		4
CS 3240	LANGUAGES & COMPUTATION*	3
COMPUTER SCIENCE SPECIALIZATION*		3
SOCIAL SCIENCE ELECTIVE(S)		3
LCC 3401	TECHNICAL COMMUNICATION PRACTICES	2
MATH 3215	PROBABILITY & STATISTICS	3
TOTAL SEMESTER HOURS		18

Fourth Year - First Semester

Course Number/Name		*Hours*
CS 4001	COMPUTING, SOCIETY, & PROFESSIONALISM*	
or CS 4002	ROBOT & SOCIETY*	3
CS 3901	RESEARCH PROJECT or	
CS 3911	STUDIO PROJECT*	3
COMPUTER SCIENCE SPECIALIZATION*		3
FREE ELECTIVE(S)		6
TOTAL SEMESTER HOURS		15

Fourth Year - Second Semester

Course Number/Name	*Hours*
COMPUTER SCIENCE SPECIALIZATION*	3
COMPUTER SCIENCE ELECTIVE(S)	3
FREE ELECTIVE(S)	9
TOTAL SEMESTER HOURS	15

TOTAL PROGRAM HOURS = 124 SEMESTER HOURS
PLUS WELLNESS (2 HOURS)

* Must earn a *C* or better in each of these courses. Only six hours of Free Electives may be taken on a pass/fail basis. All other courses must be taken on a letter grade basis.

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Electives

Humanities/Social Sciences Electives

ENGL 1101 and 1102 apply toward satisfaction of the twelve-hour humanities requirement. An additional six hours of Institute-approved humanities courses are required to fulfill the twelve-hour humanities requirement. To satisfy the state requirements regarding coursework in the history and constitutions of the United States and Georgia, students must complete one of the following courses: HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200. One of these courses,

combined with an additional nine hours of Institute-approved social science courses, satisfies the twelve-hour social sciences requirement.

Laboratory Science Requirement
Select one of the following options:
- Option 1: Physics 2211 Physics 2212, and one of the currently approved laboratory science courses.
- Option 2: Physics 2211 and a two-semester laboratory course sequence in Biology (1510 and 1520).
- Option 3: Physics 2211 and a two-semester laboratory course sequence in Chemistry (1310 and 1311/12).
- Option 4: Physics 2211 and a two-semester laboratory course sequence in Earth and Atmospheric Science from approved list.

Technical Electives and CS Areas of Specialization
Students are required to complete twelve hours of upper-division computer science technical electives, which include three areas of specialization. Students will be required to complete a major and two minor areas of specialization from the upper-division CS electives in the following list. To complete the major area of specialization, students must complete two of the prescribed courses in one area. To complete the minor areas of specialization, students must complete one course in each of two areas other than the major area of specialization. Additional computer science technical electives may be required to bring the total hours to twelve. Students may petition to define other computer science areas of specialization to satisfy specific career objectives. A capstone design project is also required. Students satisfy this requirement by completing either CS 3901 (Research Project) or CS 3911 (Design Project).

CS Specialization Courses
Each student must take at least two courses in one area and must take at least one course in each of two other areas.

Computer Systems
CS 3210 (2-3-3) Design of Operating Systems
CS 3220 (2-3-3) Computer Structures: Hardware/Software Codesign of a Processor
CS 4210 (3-0-3) Advanced Operating Systems
CS 4220 (2-3-3) Programming Embedded Systems
CS 4230 (2-3-3) Distributed Simulation Systems
CS 4235 (3-0-3) Introduction to Information Security
CS 4240 (3-0-3) Compilers, Interpreters, and Program Analyzers
CS 4290 (3-0-3) Advanced Computer Organization

Data Management Systems
CS 4400 (3-0-3) Introduction to Database Systems
CS 4420 (3-0-3) Database System Implementation
CS 4432 (2-3-3) Information Systems Design
CS 4440 (3-0-3) Emerging Database Technologies and Applications

Educational Technology
CS 3790 (3-0-3) Introduction to Cognitive Science
CS 4660 (3-0-3) Introduction to Educational Technology
CS 4665 (3-0-3) Educational Technology: Design and Evaluation
CS 4670 (3-0-3) Computer-Supported Collaborative Learning

Graphics and Visualization
CS 4451 (3-0-3) Computer Graphics
CS 4455 (3-0-3) Video Game Design and Programming
CS 4480 (3-0-3) Digital Video Special Effects
CS 4495 (3-0-3) Computer Vision
CS 4496 (3-0-3) Computer Animation

Intelligent Systems
CS 3600 (3-0-3) Introduction to Artificial Intelligence
CS 4495 (3-0-3) Computer Vision
CS 4610 (3-0-3) Knowledge Systems
CS 4611 (3-0-3) AI Problem Solving
CS 4612 (3-0-3) AI Planning
CS 4631 (2-3-3) Intelligent Robotics and Perception
CS 4641 (3-0-3) Machine Learning
CS 4650 (3-0-3) Natural Language Understanding
CS 4752 (3-0-3) Philosophical Issues in Computation

Networking and Telecommunications
CS 3251 (3-0-3) Computer Networking I
CS 4235 (3-0-3) Introduction to Information Security
CS 4251 (3-0-3) Computer Networking II
CS 4255 (3-0-3) Introduction to Network Management
CS 4260 (3-0-3) Telecommunications Systems

Software Engineering
CS 3300 (2-3-3) Introduction to Software Engineering
CS 4320 (3-0-3) Introduction to Software Processes
CS 4330 (2-3-3) Software Engineering Applications

Theory
CS 4510 (3-0-3) Automata and Complexity
CS 6505 (3-0-3) Computability, Algorithms, and Complexity
CS 6510 (3-0-3) Automata Theory
CS 6520 (3-0-3) Computational Complexity Theory
CS 6550 (3-0-3) Design and Analysis of Algorithms
CS 7510 (3-0-3) Graph Algorithms
CS 7520 (3-0-3) Approximation Algorithms
CS 7530 (3-0-3) Randomized Algorithms

Usability
CS 4470 (3-0-3) Introduction to User Interface Software
CS 4750 (3-0-3) Human-Computer Interface Design and Evaluation

CS Free Elective
A student may satisfy the three-hour computer science free elective requirement with one or more computer science courses that are not used to fulfill any other specific requirement. Credit hours in excess of three may be used as free elective hours.

Free Electives
Eighteen hours of free elective courses may be taken at any time during the course of study. Four hours of basic ROTC may be used as free elective credit toward the bachelor's degree. No 1000- or 2000-level HPS hours or precalculus hours (currently MATH 1113) may be used as free electives. No course that covers the same material as other courses in a student's plan of study can be used as a free elective.

Bachelor of Science in Computational Media

The B.S. in Computational Media is a collaborative effort by the College of Computing and the School of Literature, Communication, and Culture. The program offers a thorough education in all aspects of the computer as a medium: the technical, the historical-critical, and the applied. Program graduates will have both significant hands-on and theoretical knowledge of computing and an understanding of visual design and the history of media. Graduates will be uniquely positioned to plan, create, and critique new digital media forms for entertainment, education, and business communication.

The program requires thirty-six semester hours of courses in computer science and thirty hours of courses in LCC (in addition to the humanities requirement). A substantial number of required courses in each unit ensures that every student has basic competence in:
- computational principles;
- the representation and manipulation of digital media, including graphics and sound;
- software design;
- visual and interactive design;
- digital arts; and
- media theory and history.

After completing required courses, students specialize in a specific area of media computing. Typical specialty areas include:
- **Interactive games design**: This is one of the fastest growing areas of digital media production and is already a $7 billion industry.
- **Special effects:** As special effects become more complex and focused on computer-generated imagery, employment in this area will increasingly require expertise in both media and computer science.
- **Culturally informed program design**: As programming work is increasingly outsourced to nations offering lower labor costs, programming that adds value through a sophisticated response to the needs of specific corporate and group cultures will offer job security to American programmers.

Depending on their coursework within the B.S. program, students will also be qualified to enter graduate studies in computer science, digital arts, digital media studies, and human-computer interface.

Bachelor of Science in Computational Media (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
LAB SCIENCE	(BIOL, CHEM, EAS, PHYS)	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
CS 1315 or 1321 or 1371		3
TOTAL SEMESTER HOURS		17

First Year - Second Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II	4
CS 1050 or 1316 or 1322		6
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

Second Year - First Semester

Course Number/Name		*Hours*
LCC 2700	INTRO. TO COMPUTATIONAL MEDIA	3
MATH 2605	CALCULUS III FOR CS	4
CS 1050 or 1316 or 1322 or 2260 or 2335 or 2340		3
HUMANITIES ELECTIVE(S)		3
WELLNESS		2
TOTAL SEMESTER HOURS		15

Second Year - Second Semester

Course Number/Name		*Hours*
LCC 2710 or 2720 or 2730		3
LAB SCIENCE (BIOL, CHEM, EAS, PHYS)		4
LCC 2400 or 2500 or 2600		3
CS 2260 or 2335 or 2340 or 4001		3
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

Third Year - First Semester

Course Number/Name		*Hours*
LCC (3254, 3256, 3352) or LCC (2600, 3262, 3362) or LCC (2100, 2116, 3318) or LCC (3202, 3226, 3214)**		3
LCC 2710 or 2720 or 2730 or 3705 or 3710		3
CS 2260 or 2335 or 2340 or 4001		3
LCC ELECTIVE(S)		3
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Third Year - Second Semester

Course Number/Name		*Hours*
LCC 3206	STUDIES IN COMMUNICATION & CULTURE or LCC 3314 TECHNOLOGIES OF REPRESENTATION	3
LCC 2710 or 2720 or 2730 or 3705 or 3710		3
CS 2260 or 2335 or 2340 or 4001		3
SOCIAL SCIENCE ELECTIVE(S)		3
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Fourth Year - First Semester

Course Number/Name		*Hours*
LCC (3254, 3256, 3352) or LCC (2600, 3262, 3362) or LCC (2100, 2116, 3318) or LCC (3202, 3226, 3214)**		3
LCC 4699 or 4720 or 4725 or 4730 or 4731 or 4745		3
CS ELECTIVE(S) (3000 or 4000 Level)*		6
CS 4903 or LCC 4699	SPECIAL PROBLEMS or UNDERGRADUATE RESEARCH*	4
TOTAL SEMESTER HOURS		16

Fourth Year - Second Semester

Course Number/Name		*Hours*
LCC (3254, 3256, 3352) or LCC (2600, 3262, 3362) or LCC (2100, 2116, 3318) or LCC (3202, 3226, 3214)**		3
CS ELECTIVE(S) (3000 or 4000 Level)*		6
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		12

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS
PLUS WELLNESS (2 HOURS)

* Must be approved by an advisor.
** Must complete nine hours in a single area.

Wellness Requirement

Georgia Tech requires students to complete HPS 1040, 1062, 1063, or 1064 to earn an undergraduate degree.

Minor in Computer Science

For those students majoring in other disciplines who wish to gain a deeper understanding of computing and its applications, the College of Computing offers the minor in computer science. The minor in computer science requires at least eighteen semester hours of computer science coursework, of which twelve semester hours must be at the 3000 level or higher. Those courses at the 3000 level or higher must be selected from the approved CS major specialization courses or be a required 3000-level course in the CS major (e.g., CS 3240 or CS 3510).

Certificate and Minor in Cognitive Science

Both a certificate and minor in Cognitive Science are offered by the Cognitive Science Program, drawing on a combined curriculum spanning the College of Computing, the School of Psychology, the School of Industrial and Systems Engineering, and the School of Public Policy. The certificate and minor offer students the chance to expand their understanding of their home disciplines by incorporating the latest theories and models in cognitive psychology, artificial intelligence, human-computer interaction, and other cognitive disciplines.

For a certificate in Cognitive Science, students must complete CS/ISYE/PSYC/PST 3790: Introduction to Cognitive Science, along with nine credit hours of cognitively related coursework. For a minor, students must complete an additional three credit hours of coursework and must either take the seminar in cognitive science or complete an individual or group project with a faculty mentor.

Further information on the certificate and minor requirements is available at **www.cc.gatech.edu/cogsci.**

Graduate Programs

Master of Science in Computer Science

The program for the Master of Science in Computer Science (M.S.C.S.) prepares students for more highly productive careers in industry. Graduates receive the M.S.C.S. for completing one of three options in the program as described in this section. Students may apply to the program if they possess a bachelor's degree in computer science from an accredited institution. Students without a bachelor's degree in computer science are encouraged to apply as well, with the understanding that they will be required to complete remedial coursework appropriate to their background in addition to the requirements of the M.S.C.S. degree. All applicants are evaluated according to their prior academic record, scores on the Graduate Record Examination and the Subject Test in Computer Science, a personal statement, and letters of recommendation. Applicants are selected for fall semester admission only. The application deadline is March 1. However, all applicants are encouraged to apply as early as possible because the selection process may begin well before the deadline.

The College's master's degree requirements supplement the Institute's master's requirements listed in this Catalog. Students must achieve a grade point average of at least 3.0 to graduate, and no course grades below *C* will count toward graduation. Undergraduate courses required for the B.S.C.S. degree may not be used toward the M.S.C.S. degree. In addition, no graduate credit will be given for 3000-level courses or lower-level courses. Students must take all master's degree coursework on a letter-grade basis. The maximum total credit hours of Special Problems that may be applied toward the M.S.C.S. degree is three.

Students may choose from one of three options in pursuing the M.S.C.S. degree, including:

Course option: This option requires the student to complete thirty-six hours of coursework.

Total Course Credit Hours	36
Minimum Credit Hours in CS	24
Minimum Credit Hours (6000/8000 Level) in CS	18
Minimum Credit Hours (6000/8000 Level)	24

Project option: This option requires the student to complete twenty-seven hours of coursework and a nine-hour project. The project requires approval by a faculty advisor and the M.S. program coordinator in the semester prior to its inception.

Total Credit Hours	36
M.S. Project Hours	9
Total Course Credit Hours	27
Minimum Credit Hours in CS	24*
Minimum Credit Hours (6000/8000 Level) in CS	18*

Thesis option: This option requires the student to complete twenty-four hours of coursework and a twelve-hour thesis. The thesis process is defined elsewhere in this catalog.

Total Credit Hours	36
M.S. Thesis Hours	12
Total Course Credit Hours	24
Minimum Credit Hours in CS	24*
Minimum Credit Hours (6000/8000 Level) in CS	18*

* May not include M.S. project or thesis hours.

All three of these options require students to complete three hours of courses in each of the core areas of Systems and Theory at the graduate level. In addition, students entering the program must demonstrate a core competency in computing equivalent to undergraduate-level courses in the following areas: systems, design and analysis of algorithms, formal languages and automata theory, databases, networking and communications, computer architecture, and human-computer interaction. This requirement can be satisfied by having taken undergraduate courses as a part of an undergraduate degree, taking remedial courses in the M.S.C.S. program, or by examination. Beyond the core requirements, students may specialize in areas of their choice. A specialization is achieved by completing at least two graduate-level courses in the selected area. Every student must complete at least one specialization as a part of his or her degree program. The current eleven specialization areas are: computer architecture, database systems, graphics and visualization, human-computer interaction, information security, intelligent systems, networking and communications, programming languages and compilers, software methodology and engineering, systems, and theoretical computer science.

A student who is enrolled in another graduate program of the Institute may pursue an M.S.C.S. while that student is also pursuing his or her degree in the other major. To be granted permission to pursue the M.S.C.S., a student must submit to the M.S. program coordinator of the College of Computing the material required for admission to the M.S.C.S. program. This includes transcripts, letters of recommendation, and GRE General Test and Computer Science Subject Test scores. If the student is approved by the College to pursue the M.S.C.S., the student will be notified in writing. At no time will a student outside the College be allowed to pursue a concurrent degree without prior permission of the M.S. program coordinator of the College of Computing.

A student enrolled in the M.S. degree program in computer science who wishes to be admitted to the Ph.D. program in computer science should apply via the same process as external students. It is expected that such a student will have at least two letters of recommendation from College of Computing faculty.

For more information about the M.S.C.S. program, visit **www.cc.gatech.edu/masters**.

Master of Science in Human-Computer Interaction

This interdisciplinary, collaborative Master of Science in Human Computer Interaction (HCI) degree program is a cooperative effort of the College of Computing, the School of Psychology, and the School of Literature, Communication, and Culture coordinated through the GVU Center. The program provides students with the practical, interdisciplinary skills and theoretical understanding they will need to become leaders in the design, implementation, and evaluation of the computer interfaces of the future.

Course of Study

The HCI master's degree is a three-semester program consisting of a total of thirty-six semester hours. Each student will be required to complete a set of core courses, a set of area specialization courses, and a multidisciplinary team project.

The core is divided into fixed and flexible sets of courses. Students are required to complete three courses in the fixed core and a subset of courses in the flexible core based upon their academic background. The specific courses for each student will be determined by the HCI program coordinator in consultation with the academic unit. The area specialization courses are determined by the academic unit in which the student resides. Currently, the participating units are:

- College of Computing
- School of Psychology
- School of Literature, Communication, and Culture

Fixed Core (Nine Hours)

The following three courses are required of all students in the HCI program:

CS/PSYC 6750 (3-0-3) Human-Computer Interaction
PSYC 7101 (3-0-3) Engineering Psychology I: Methods
PSYC 6018 (3-0-3) Principles of Research Design

Flexible Core (Twelve Hours)

Four of the following courses will be chosen to satisfy the flexible core area in the HCI program. Course selections will be made under advisement by the HCI program coordinator in an effort to balance the student's academic background. Additional courses may be used to satisfy the flexible core, but must be approved by the HCI program coordinator.

Computing

CS 6010 (2-3-3) Principles of Design
CS 6455 (3-0-3) User Interface Design and Evaluation
CS 6456 (3-0-3) Principles of User Interface Software
CS 6460 (3-0-3) Educational Technology: Conceptual Foundations
CS 6610 (3-0-3) Cognitive Systems
CS 7450 (3-0-3) Information Visualization
CS 7460 (3-0-3) Collaborative Computing

Psychology

PSYC 6011 (3-0-3) Cognitive Psychology
PSYC 6014 (3-0-3) Sensation and Perception
PSYC 6019 (4-3-5) Statistical Analysis of Psychological Data I
PSYC 6020 (4-3-5) Statistical Analysis of Psychological Data II
PSYC 7102 (3-0-3) Engineering Psychology II: Displays, Controls, and Workplace Design
PSYC 7104 (3-0-3) Psychomotor and Cognitive Skill Learning and Performance

Cognitive Science

CS/PSYC/ISYE 6795 (3-0-3) Introduction to Cognitive Science
CS/PSYC/ISYE 7790 (3-0-3) Cognitive Modeling

Literature, Communication, and Culture

LCC 6210 (3-0-3) Studies in Communication and Culture
LCC 6211 (3-0-3) Digital Aesthetics
LCC 6212 (3-0-3) Historical Approaches to New Media
LCC 6213 (3-0-3) Educational Applications of New Media
LCC 6214 (3-0-3) New Media Project Design and Assessment
LCC 6215 (3-0-3) Issues in Media Studies
LCC 6216 (3-0-3) Globalization and New Media
LCC 6217 (3-0-3) Visual Genealogy of New Media Architecture
COA 6763 (3-0-3) Design of Design Environments

Industrial and Systems Engineering

ISYE 6215 (3-0-3) Models in Human-Machine Systems
ISYE 6401 (3-0-3) Statistical Modeling and Design of Experiments

Areas of Specialization (Eleven Hours)

The specialization courses are determined by the student's home unit:

Computing: Students concentrate on interface software and usability issues, choosing courses in the areas of software, design and evaluation/methods, and cognitive modeling.

Psychology: Students choose courses in the areas of statistics, cognitive psychology, engineering psychology, perception, and allied disciplines.

Literature, Communication, and Culture: Students choose courses in the areas of design practice, communication theory, and allied disciplines.

Multidisciplinary Team Project (Four Hours)

Each student must complete a multidisciplinary team project.

The College's master's degree requirements supplement the Institute's master's requirements listed in this catalog. Students must achieve a grade point average of at least 3.0 to graduate, and no course grade below *C* will count toward graduation. For more information about the M.S.-H.C.I. program, request a brochure from the Office of Student Services, College of Computing, or visit **www.cc.gatech.edu/mshci**.

Master of Science in Information Security

The College of Computing in cooperation with the Sam Nunn School of International Affairs has established a Master of Science degree in Information Security. The program operates in conjunction with the Georgia Tech Information Security Center (GTISC), which was named a Center of Excellence in Information Assurance by the National Security Agency. The Information Security program provides students with background and insight into general knowledge issues before concentrating on either technical or policy coverage of key elements of information security. The general knowledge aspects of the program touch on the issues surrounding the impact of information security on our lives, private citizens' concern for privacy, information security risks to business and government, and the impact of laws and public policy. The technical concentration focuses on examining the general dimension of providing security for information processing systems (secure operating systems and applications, network security, cryptography, and security

protocols). The policy concentration focuses on the many non-technical dimensions of information processing and security, including domestic and international policy processes, organizational routines and innovation, risk perception, industry-government relations, and the constitutional framework for governmental actions. These unique, interdisciplinary strengths of computing and policy are at the core of our program.

Course of Study
The Master of Science in Information Security is a three-semester program for a total of thirty-two semester hours. Each student is required to take a set of core courses, a practicum, and one of two concentrations (technology or policy). The core is composed of seven courses, and the concentrations are three courses tailored to the student's needs and desires, but are focused on technology or policy.

Fixed Core Courses (Twenty-three Hours)
CS 4235 (3-0-3) Introduction to Information Security
CS 6238 (3-0-3) Secure Computer Systems
CS 6260 (3-0-3) Applied Cryptography
CS 6262 (3-0-3) Network Security
CS 6265 (0-9-3) Information Security Laboratory
CS 6725 (3-0-3) Information Security Strategies and Policies
CS 8903 (5-0-5) Practicum/Project/Research

Concentration I (Technology Centric: Nine Hours)
Choose three courses from the following:
MATH 4150 (3-0-3) Introduction to Number Theory
CS 4500 (3-0-3) Theory II
CS 6210 (3-0-3) Advanced Operating Systems
CS 6250 (3-0-3) Computer Networks
CS 6269 (3-0-3)Formal Models and Methods for Information Assurance
CS 6300 (3-0-3) Software Development Process
CS 6400 (3-0-3) Database Systems Concepts and Designs
CS 7260 (3-0-3) Internetworking Architecture and Protocols

Concentration II (Policy Centric: Nine Hours)
Choose three courses from the following:
PUBP 4756 (3-0-3) Technology Forecasting and Assessment
PUBP 6401 (3-0-3) Science, Technology, and Public Policy
ECON 6150 (3-0-3) Cost and Benefit Analysis
MGT 6050 (3-0-3) Management Information Systems
MGT 6057 (3-0-3) Business Process Analysis and Design (SAP)
CIS 8680 (3-0-3) Security and Privacy of Information and Information Systems (offered by Georgia State University)

The College's master's degree requirements supplement the Institute's master's requirements listed in this catalog. Students must achieve a grade point average of at least 3.0 to graduate, and no course grade below *C* will count toward graduation. For more information about the M.S.-I.N.F.S. program, visit **www.cc.gatech.edu/msinfs**.

Master of Science in Bioengineering

Students who wish to pursue a master's degree in bioengineering may also do so through the College of Computing. The specific requirements differ from those of the computer science master's program, and while the degree is granted from the College, applications for this program are processed through the Bioengineering Center of the Office of Interdisciplinary Programs. Additional information is available at **www.bme.gatech.edu/academics/grad/bioengineering.html**.

Doctoral Program In Computer Science

The computer science doctoral program begins with research and breadth components. The research component helps students place an early focus on research. Students must complete an "Introduction to Graduate Studies" course (CS 7001) and then take at least three hours of directed research study (CS 8903) under faculty guidance each semester until their qualifying examination. The breadth component is intended to facilitate students' learning about a variety of areas within computing, as well as core computer science areas. Students must take at least twelve courses from the different areas of study within the College. The current twelve areas are computer architecture, database systems, graphics and visualization, human-computer interaction, information security, intelligent systems and robotics, learning sciences and technology, networking and communications, programming languages and compilers, software methodology and engineering, systems (including operating systems, distributed and parallel systems), and theoretical computer science. Students must include courses from the systems and theory areas in those breadth courses.

As students' research progresses, they must select a primary, and possibly secondary, area of focus from the areas listed previously, and then pass a qualifier (comprehensive exam) in that area or areas. The qualifier consists of three parts:
1. A one-day written examination covering the pertinent research area(s)
2. The submission of a high-quality research deliverable, as evidenced by a portfolio consisting of at least an exam committee-reviewed and publishable article, and possibly other work products as approved by the exam committee
3. An oral presentation and examination

After successfully completing the qualifier, a student focuses on research leading toward a dissertation. The topic of the student's research is formalized through a written dissertation proposal followed by an oral presentation. When the student passes his or her proposal, the student is admitted to candidacy and proceeds with dissertation research. This phase is completed with the successful defense and submission of the approved doctoral dissertation.

Students are also required to complete a nine-hour minor outside the College.

For more information about the Computer Science Ph.D. program, visit **www.cc.gatech.edu/phd**. Inquiries should be directed to the Graduate Coordinator, College of Computing.

Doctoral Program in Human-Centered Computing (HCC)

HCC is the interdisciplinary science of designing computational artifacts that better support human endeavors. HCC students examine issues – such as computer-supported collaborative work and learning, human-computer interaction, human-robot interaction, learning sciences and technology, and mobile and ubiquitous computing – that lie at the intersection of human concerns (such as anthropology, cognitive science, human factors, industrial design, media studies, psychology, and sociology) and computing studies (such as artificial intelligence, computational perception, databases, graphics, information security, networks, programming languages, and robotics).

Students must complete a core of the three courses described below. The required courses will help students develop the first two of the four competencies that must be demonstrated; these competency areas are computing concepts and skills, evaluation of HCC systems, written research communication, and oral research communication. In consultation with their advisors, students must also complete at least three elective courses, including at least one outside the area of HCC specialization. Areas of elective study may include, but are not restricted to, artificial intelligence, cognitive science, collaboration, human-computer interaction, information security, learning sciences and technology, software, software engineering, and visualization. Students must also pass a written and oral qualifier (comprehensive examination) and submit and receive approval for a dissertation topic and committee. Students may then be admitted to candidacy.

Students begin to familiarize themselves with HCC concepts and work on HCC projects in their first required course, CS 6451, Introduction to Human-Centered Computing. In the same semester, students who need to develop skills in programming may do so by taking CS 4452, Human-Centered Computing Concepts. This class will prepare students for the second required course, CS 6452, Prototyping Interactive Systems. In their second year, students take the third required course, CS 7455, Issues in Human-Centered Computing, which delves deeply into theoretical, methodological, conceptual, and technical issues.

Concurrently, each student develops a research portfolio under the supervision of a faculty advisor. The submission of a conference- or journal-quality paper, and a conference-style presentation, satisfies the competencies of written and oral research communications.

Students are also required to complete a nine-hour minor outside the College of Computing, in accordance with Institute requirements.

For more information about the HCC program, visit **http://www.cc.gatech.edu/hcc**. Inquiries should be directed to the HCC Program Coordinator (hcc-phd-info@cc.gatech.edu).

Certificate in Cognitive Science

Graduate students desiring to approach their graduate studies from the perspective of cognitive science are encouraged to obtain a Certificate in Cognitive Science in addition to their graduate degree. Interested students will receive their degree from one of the participating units and follow an interdisciplinary curriculum tailored to their specific interests in cognitive science.

Students enter the certificate program after being admitted to a graduate unit. Although graduate students from any unit on campus may receive a Certificate in Cognitive Science, the program is currently tailored to graduate students in the College of Computing, the School of Psychology, and the School of Industrial and Systems Engineering.

To earn the Certificate in Cognitive Science, students must fulfill their graduate requirements in some unit on campus. In addition, they must take CS/PSYC/ISYE 6795: Introduction to Cognitive Science, along with nine semesters hours of courses from the Cognitive Science Program. Information about the graduate certificate is available at **www.cc.gatech.edu/cogsci** or from the Cognitive Science education coordinator.

Doctoral Program in Algorithms, Combinatorics, and Optimization (ACO)

The College of Computing is one of the sponsors of the multidisciplinary program in Algorithms, Combinatorics, and Optimization (ACO), an approved doctoral degree program at Georgia Tech. The other sponsoring units are the School of Industrial and Systems Engineering and the School of Mathematics. The degree program is administered by an oversight committee drawn primarily from the sponsoring units.

The study of discrete structures is a rapidly growing area in computer science, applied mathematics, and operations research, most obviously in the analysis of algorithms, combinatorics, and discrete optimization. Collaborative work among the three traditionally separate disciplines is already common. The doctorate in Algorithms, Combinatorics, and Optimization will prepare students for careers in this exciting and expanding field.

Students are expected to be well prepared in at least one of the three fields represented by the sponsoring units (computer science, mathematics and operations research). Each student in the program is admitted through one of the three sponsoring units, which serves as the home department. Coursework is drawn from all three disciplines. The research advisor may be any member of the ACO program faculty, which is drawn from electrical and computer engineering, management, and other disciplines in addition to the three sponsoring units.

Additional details about the ACO program are available at **www.math.gatech.edu/aco**.

Bioengineering Programs

In response to the increased need for engineers and medical scientists with advanced training in bioengineering, Georgia Tech now offers master's and Ph.D. degrees in bioengineering. The purpose of bioengineering as a research discipline is to develop new and better physical and mathematical concepts and techniques that may be applied to problems in medicine and biology, to the development of new medical technologies, and to the organization and delivery of cost-effective health care. Interdisciplinary graduate programs in bioengineering are offered by the College of Computing in conjunction with the Bioengineering Center (in the Office of Interdisciplinary Programs), the College of Engineering, and the College of Sciences. The student's home unit will be the College of Computing, which, upon completion of the student's requirements, will recommend the degree. This interdisciplinary approach has been approved by the faculty in the Schools of Aerospace Engineering, Chemical and Biomolecular Engineering, Electrical and Computer Engineering, Materials Science and Engineering, Mechanical Engineering, and Polymer, Textile, and Fiber Engineering, and by the deans of the Colleges of Computing, Engineering, and Sciences.

The program is for computer science or engineering graduates who wish to pursue a degree in bioengineering rather than in a traditional field of computing or engineering, or who have done bioengineering research in other disciplines. In addition, those interested students with non-engineering backgrounds (with degrees in such fields as physics, chemistry, biology, or mathematics) who meet the admission requirements will be admitted to the program. Applications from physicians with undergraduate degrees in engineering or the physical sciences will also be considered. All applications will be processed through the Bioengineering Center.

Additional information is available at **www.bme.gatech.edu/academics/grad/bioengineering.html**.

Research Centers in the College of Computing

Center for Experimental Research in Computer Systems (CERCS)

The Center for Experimental Research in Computer Systems (CERCS) is a research center in the College of Computing and the School of Electrical and Computer Engineering. CERCS focuses on the design and evaluation of computer and software systems through experimental methods.

CERCS constitutes one of the largest experimental systems programs in the United States. CERCS has a mission to:

- promote experimental research in computer and software systems;
- produce high-quality students trained in the experimental method of systems research and development;
- foster high-impact and multidisciplinary research efforts using shared personnel and facilities; and
- support researchers and educators at Georgia Tech and its affiliated institutions.

CERCS conducts research in which new technologies are evaluated experimentally, with large-scale applications, and on systems of substantial size or complexity. CERCS research is driven by complex systems and applications that require integration across multiple CS technologies and areas of research. Current research areas include: information technology; software tools and compilers; languages and formal methods; middleware, distributed, and parallel systems; high performance, cluster, and scientific computing; operating, real-time, and embedded systems; reliable/survivable systems, computer security, and communications; wired and wireless networks; computer architecture and design; and bioelectronic systems.

For more information about CERCS, request a CERCS brochure from the Office of Student Services, College of Computing, or visit **www.cercs.gatech.edu**.

Georgia Tech Information Security Center (GTISC)

The Georgia Tech Information Security Center (GTISC) was established in 1998 as a result of the Sam Nunn/Bank of America Information Security Forum. GTISC focuses on research, education, and outreach in the information security community. The National Security Agency has named GTISC one of thirty-six Centers of Academic Excellence in Information Assurance Education.

The Center concentrates on all aspects of information security, including:

- conducting research that will lay the foundation for a discipline of information security that contributes to the development and testing of systems, devices, strategies, policies, practical concepts, and techniques;
- education and training of information security professionals through degree and continuing education programs to ensure that information security awareness is instilled in all Georgia Tech students; and
- assisting industry, non-profit organizations, government, and individuals in solving information security problems through outreach programs and support of groups devoted to information security.

GTISC has gained a competitive advantage in the field of information security by providing undergraduate and graduate curricula, comprehensive research programs, state-of-the-art equipment, access to fully funded scholarships, and powerful industry alliances. Having positioned itself as a leader in the information security arena, GTISC holds a dominant position in this evolving and vital discipline.

For more information about GTISC, request a GTISC brochure from the Office of Student Services, College of Computing, or visit **www.gtisc.gatech.edu**.

Graphics, Visualization, and Usability (GVU) Center

The GVU Center is much more than graphics, visualization, and usability, the initial disciplines that gave rise to its name and first research directions. More than a decade after its launch, GVU is now focused on computing at the interface, where computing touches the outside world. Throughout most of the computing age, computers have been isolated systems, wholly contained within the framework of a dedicated input device, core

processing units, and dedicated display devices. Today's computing systems are no longer monolithic, but rather are injected into almost all emerging technologies. This new model of computer-world interaction is driving a demand for new ideas involving computing interaction. The GVU Center brings together a research community that is dedicated to meeting this demand.

The GVU Center is an interdisciplinary teaching and research center housed in the College of Computing that spans the Georgia Tech campus and includes many outside collaborators. Its faculty and students are drawn from campus units as diverse as Architecture; Computing; Engineering; Psychology; Literature, Communication, and Culture; and others. The Center enables collaborative research that is often difficult to achieve in traditional academic and industrial settings. These unique combinations of research interests are the catalyst for significant insights into the rapidly evolving landscape of people and computation.

The GVU Center leads the forefront of research in relevant areas including human-computer interaction, ubiquitous and extended applications, augmented spaces, active environments, wearable computing, robotics, computer vision, intelligent sensing, cognitively and perceptually appropriate interfaces, and others.

For more information about the GVU Center, contact the Office of Student Services, College of Computing, and request a GVU brochure, or visit **www.gvu.gatech.edu**.

Cooperative Programs

The College participates in the Undergraduate and Graduate Cooperative Programs. Further details of the programs are found in this catalog. See "Information for Undergraduate Students" and "Information for Graduate Students."

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course. An asterisk (*) denotes prerequisite courses that may be taken concurrently.

COMPUTER SCIENCE

CS 1050. Understanding and Constructing Proofs
3-0-3.
Techniques of rigorous argumentation, emphasizing reading and writing of formal and informal proofs. Application of techniques to domains of relevance to computer science.

CS 1171. Introductory Computing in MATLAB
0-3-1.
Prerequisite(s): CS 1321
For students with a solid introductory computing background needing to demonstrate proficiency in the MATLAB language.

CS 1315. Introduction to Media Computation
3-0-3.
Introduction to computation (algorithmic thinking, data structures, data transformation and processing, and programming) in a media and communication context.

CS 1316. Representing Structure and Behavior
3-0-3.
Prerequisite(s): CS 1315
Modeling the structure of media (e.g., music, graphical scenes) using dynamic data structures. Designing objects as encapsulations of structure and behavior. Algorithms for simulating objects.

CS 1321. Introduction to Computing
3-0-3.
Foundations of computing with an emphasis on the design, construction, and analysis of algorithms. Laboratory-based instruction to computers and software tools.

CS 1322. Object-Oriented Programming
3-0-3.
Prerequisite(s): CS 1316 or CS 1321 or CS 1371
Introduction to techniques and practices for implementing algorithms. Emphasis on professional software practices. Projects focus on interactive and computationally intensive programs, including large program management.

CS 1371. Computing for Engineers
3-0-3.
Foundations of computing with an introduction to design and analysis of algorithms and an introduction to design and construction of programs for engineering problem solving.

CS 1801, -02, -03, -04, -05. Special Topics
Class and credit hours equal last digit in course number.
Courses of timely interest to the profession, conducted by resident or visiting faculty.

CS 2110. Computer Organization and Programming
3-3-4.
Prerequisite(s): CS 1322
An introduction to basic computer hardware, machine language, assembly language, and C programming.

CS 2130. Languages and Translation
3-3-4.
Prerequisite(s): CS 1322
Introduces issues of machine translation including tokenizing, parsing, data representation, and run-time environments. Discusses implementation of programming languages. Laboratory exercises cover tools and techniques for writing parsers and translators.

CS 2200. Computer Systems and Networks
3-3-4.
Prerequisite(s): CS 2110
A broad exposure to computer system structure and networking including software abstractions in operating systems for orchestrating the usage of the computing resources.

CS 2260. Media Device Architectures
3-0-3.
Prerequisite(s): CS 1322
Controlling the interface between hardware and software in media devices. Machine-level programming (e.g., in C) to create graphics, generate sound, and support user interaction.

CS 2335. Software Practicum
2-3-3.
Prerequisite(s): CS 2130
Methods for solving large programming problems. Techniques for quality assurance, managing programs, working in teams, analyzing problems, and producing effective solutions.

CS 2340. Objects and Design
3-0-3.
Prerequisite(s): CS 2335
Object-oriented programming methods for dealing with large programs. Focus on quality processes, effective debugging techniques, and testing to assure a quality product.

CS 2600. Knowledge Representation and Processing
3-3-4.
Prerequisite(s): CS 1322
Introduction to the representation and manipulation of complex symbolic and sub-symbolic information.

CS 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

CS 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

CS 2801, -02, -03, -04, -05. Special Topics
Class and credit hours equal last digit in course number.
Courses of timely interest to the profession, conducted by resident or visiting faculty.

CS 3210. Design of Operating Systems
2-3-3.
Prerequisite(s): CS 2200
Operating systems concepts, including multi-threading, scheduling, synchronization, communication, and access control. Projects will cover design and implementation of several operating systems components.

CS 3220. Computer Structures: Hardware/Software Codesign of a Processor
2-3-3.
Prerequisite(s): CS 2200
Principles in pipelined processor design, with emphasis on the need for a close interaction between code generation and architecture.

CS 3240. Languages and Computation
3-0-3.
Prerequisite(s): CS 2200 and CS 2340
Interpreters as abstract machines and the tools used to construct them, such as scanners and parsers. An introduction to models of computation as embodied by different programming languages. Limits of and relationships between these models.

CS 3251. Computer Networking I
3-0-3.
Prerequisite(s): CS 2200
Introduction to problems in computer networking, including error recovery, medium access, routing, flow control, and transport. Emphasis on current best practice. Includes programming of networked applications.

CS 3300. Introduction to Software Engineering
2-3-3.
Prerequisite(s): CS 2340
Team-based project class to introduce and apply software engineering principles and practices.

CS 3351. Studio Project
1-6-3.
Prerequisite(s): CS 3300
A project-oriented laboratory course used to familiarize students with software engineering methods in a realistic environment.

CS 3352. Studio Project
1-6-3.
Prerequisite(s): CS 3351
A project-oriented laboratory course used to familiarize students with software engineering methods in a realistic environment.

CS 3353. Studio Project
1-6-3.
Prerequisite(s): CS 3352
A project-oriented laboratory course used to familiarize students with software engineering methods in a realistic environment.

CS 3500. Theory I
4-0-4.
Prerequisite(s): CS 1050 and CS 1322 and MATH 3012*
Computational machine models and their language classes. Decidability and undecidability. Data structures and efficient algorithms for fundamental computational problems. Tractability and intractability.

CS 3510. Design and Analysis of Algorithms
3-0-3.
Prerequisite(s): CS 1050 and CS 1322 and MATH 3012
Basic techniques of design and analysis of efficient algorithms for standard computational problems. NP-Completeness.

CS 3600. Introduction to Artificial Intelligence
3-0-3.
Prerequisite(s): CS 1322
An introduction to artificial intelligence and machine learning. Topics include intelligent system design methodologies, search and problem solving, supervised and reinforced learning.

CS 3790. Introduction to Cognitive Science
3-0-3.
Multidisciplinary perspectives on cognitive science. Interdisciplinary approaches to issues in cognition, including memory, language, problem solving, learning, perception, and action. Crosslisted with PST, PSYC, and ISYE 3790.

CS 3801, -02, -03, -04, -05. Special Topics
Class and credit hours equal last digit in course number.
Courses of timely interest to the profession, conducted by resident or visiting faculty.

CS 3901. Research Project
Credit hours to be arranged.
Individual investigation of significant areas of computer science. Guided study and research.

CS 3902. Research Project
Prerequisite(s): CS 3901
Credit hours to be arranged.
Individual investigation of significant areas of computer science. Guided study and research.

CS 3903. Research Project
Prerequisite(s): CS 3902
Credit hours to be arranged.
Individual investigation of significant areas of computer science. Guided study and research.

CS 3911. Design Project
Prerequisite(s): CS 2340
Credit hours to be arranged.
Intensive team-based project experience in the specification, design, and implementation of software and/or hardware for subsequent use in research, industry, and teaching.

CS 3912. Design Project
Prerequisite(s): CS 3911
Credit hours to be arranged.
Intensive team-based project experience in the specification, design, and implementation of software and/or hardware for subsequent use in research, industry, or teaching.

CS 3913. Design Project
Prerequisite(s): CS 3912
Credit hours to be arranged.
Intensive team-based project experience in the specification, design, and implementation of software and/or hardware for subsequent use in research, industry, or teaching.

CS 4001. Computing, Society, and Professionalism
3-0-3.
Examines the role and impact of information and communication technology in society, with emphasis on ethical, professional, and public policy issues.

CS 4002. Robots and Society
3-0-3.
Examines the role and impact of robotics, distributed sensing and actuation, ubiquitous computing and related technology in society, emphasizing ethical, professional, and public policy issues.

CS 4010. Introduction to Computer Law
3-0-3.
Provides an introduction to copyrights, patents, trade secrets, trademarks, and commercial law pertaining to computer software and hardware.

CS 4210. Advanced Operating Systems
3-0-3.
Prerequisite(s): CS 2200
Operating system abstractions and their implementations, multi-threading, efficient inter-address communication, high-level synchronization, introduction to multi-processor and distributed operating systems, real-time systems.

CS 4220. Programming Embedded Systems
2-3-3.
Prerequisite(s): CS 2200
Design principles, programming techniques, and case studies of embedded real-time systems. Interface techniques and devices. Representations and reasoning about physical processes.

CS 4230. Distributed Simulation Systems
2-3-3.
Prerequisite(s): CS 2200
Parallel and distributed computing algorithms and systems for distributed simulation applications such as virtual environments and analytic models.

CS 4235. Introduction to Information Security
3-0-3.
Prerequisite(s): CS 1315 or CS 1321 or COE 1361
Terms/concepts, threats, controls; problem definition; comprehensive information security model; security for operating systems, databases, network/distributed systems; administering security; legal/ethical/policy issues.

CS 4240. Compilers, Interpreters, and Program Analyzers
3-0-3.
Prerequisite(s): CS 3240
Study of techniques for the design and implementation of compilers, interpreters, and program analyzers, with consideration of the particular characteristics of widely used programming languages.

CS 4251. Computer Networking II
3-0-3.
Prerequisite(s): CS 3251
Principles of computer networks, including medium access, ARQ protocols, routing, congestion avoidance, and control. Emphasis on design options and tradeoffs. Includes significant network application programming.

CS 4255. Introduction to Network Management
3-0-3.
Prerequisite(s): CS 3251
Introduction to SNMP-based network management. Practical application to network and system management including hands-on lab practice.

CS 4260. Telecommunications Systems
3-0-3.
Prerequisite(s): CS 2200 and (MATH 3215 or MATH 3225)
Study of telecommunication systems emphasizing functional roles of the various portions of the system and how various functional components support and interact with one another.

CS 4270. Data Communications Laboratory
1-6-3.
Prerequisite(s): CS 4260 and CS 4251*
Detailed study of the principles of data transmission systems and their performance, reinforced by laboratory exercises.

CS 4280. Survey of Telecommunications and the Law
3-0-3.
Overview of telecommunication regulation at the federal, state, and judicial levels; review of FCC policies and restrictions on Bell operating companies under the AT&T Consent Agreement.

CS 4290. Advanced Computer Organization
3-0-3.
Prerequisite(s): CS 3220
Topics concerning the hardware design of computer systems. Advanced techniques in high-performance pipelined central processing units. Memory and I/O systems. Parallel processors including shared-memory multiprocessors and cluster computers.

CS 4320. Introduction to Software Processes
3-0-3.
Prerequisite(s): CS 3300
The course will provide students with an overall context in which software systems are developed from the viewpoint of processes that support development. Software engineering is described as the set of activities developers engage in to create high-quality products within schedule and budget constraints.

CS 4330. Software Engineering Applications
2-3-3.
Prerequisite(s): CS 3300
Software engineering methods specific to classes of applications or systems, including information systems and embedded, real-time systems.

CS 4400. Introduction to Database Systems
3-0-3.
Prerequisite(s): CS 1322
Comprehensive coverage of mainstream database concepts such as the entity-relationship model, relational databases, query languages, and database design methodology. Includes a project.

CS 4420. Database System Implementation
3-0-3.
Prerequisite(s): CS 4400
Study of fundamental software components/algorithms of a database system, including the file manager, query engine, lock manager, and recovery manager. Includes a project component.

CS 4432. Information Systems Design
2-3-3.
Prerequisite(s): CS 3300 and CS 4400
The analysis, design, and implementation of information systems. Topics include requirements analysis, design representations, implementation techniques, and evaluation of systems.

CS 4440. Emerging Database Technologies and Applications
3-0-3.
Prerequisite(s): CS 4400
The course will cover current developments including distributed, object-oriented, temporal-spatial, Web-based, mobile, and active database technologies, and data warehousing and mining applications.

CS 4451. Computer Graphics
3-0-3.
Prerequisite(s): MATH 2605 and (CS 2110 or CS 2260)
An introduction to computer graphics, including: graphics hardware, 2-D rendering, 2-D and 3-D transformations, visible surface determination, illumination, modeling, and ray tracing.

CS 4452. Human-Centered Computing Concepts
3-0-3.
Introduction to programming and human-centered principles of computing based on a communications and media computation context. Introduces user interface programming.

CS 4455. Video Game Design and Programming
3-0-3.
Prerequisite(s): CS 1322
Techniques for electronic game design and programming, including graphics game engines, motion generation, behavioral control for autonomous characters, interaction structure, social and interface issues of multi-user play, and the business aspects of game development.

CS 4470. Introduction to User Interface Software
3-0-3.
Prerequisite(s): CS 2340 and (CS 4750 or PSYC 4750)
Concepts, techniques, structures, and strategies for implementation of interactive software.

CS 4480. Digital Video Special Effects
3-0-3.
Prerequisite(s): CS 4451
A study of digital multimedia and the analysis and synthesis of digital video. Special attention paid to techniques for generating video special effects.

CS 4495. Computer Vision
3-0-3.
Prerequisite(s): MATH 2605 and (CS 2110 or CS 2260)
An introduction to computer vision and machine perception. An intensive study of the process of generating a symbolic description of the scene by interpretation of images(s).

CS 4496. Computer Animation
3-0-3.
Prerequisite(s): CS 4451
Motion techniques for computer animation and interactive games (keyframing, procedural methods, motion capture, and simulation) and principles for storytelling, composition, lighting, and interactivity.

CS 4510. Automata and Complexity Theory
3-0-3.
Prerequisite(s): CS 1050 and CS 1322 and MATH 3012
Computational machine models and their language classes. Undecidability. Resource-bounded computations. Central complexity-theoretic concepts such as complexity classes, reducibility and completeness.

CS 4610. Knowledge Systems
3-0-3.
Prerequisite(s): CS 4600
Knowledge-based problem solving and knowledge system engineering. Topics include expert systems, knowledge acquisition, problem solving, and explanation.

CS 4611. Artificial Intelligence Problem Solving
3-0-3.
Prerequisite(s): CS 4600
Basic concepts and methods of AI problem solving, knowledge representation, reasoning, and learning.

CS 4612. Artificial Intelligence Planning
3-0-3.
Prerequisite(s): CS 4600
Symbolic and numerical techniques that allow intelligent systems to decide how they should act in order to achieve their goals, including action and plan representation, plan synthesis and reasoning, analysis of planning algorithms, plan execution and monitoring, plan reuse and learning, and applications.

CS 4631. Intelligent Robotics and Perception
2-3-3.
An introduction to intelligent systems issues in autonomous robot control. Topics include sensing, perception and symbolic, and numeric approaches to autonomous robot control.

CS 4641. Machine Learning
3-0-3.
Prerequisite(s): CS 4600
Machine learning techniques and applications. Topics include foundational issues; inductive, analytical, numerical, and theoretical approaches; and real-world applications.

CS 4650. Natural Language Understanding
3-0-3.
Prerequisite(s): CS 4600
Methodologies for designing systems that comprehend natural language. Topics include lexical analysis, parsing, interpretation of sentences, semantic representation, organization of knowledge, and inference mechanisms.

CS 4660. Introduction to Educational Technology
3-0-3.
Prerequisite(s): CS 2340
Introduction to the theory and practice of educational technology. Covers learning theory applicable to educational technology, explains major research findings.

CS 4665. Educational Technology: Design and Evaluation
3-0-3.
Prerequisite(s): CS 4660
Intensive project class in which students design, implement, and evaluate a piece of educational technology, applying the theory learned in Introduction to Educational Technology.

CS 4670. Computer-Supported Collaborative Learning
3-0-3.
Prerequisite(s): CS 4660
Research and practice in computer-supported collaborative learning. Review of existing systems and research, as well as evaluation and design methods.

CS 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

CS 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

CS 4710. Introduction to Computing Concepts for Bioinformatics
3-3-4.
Introduction to programming concepts and computing tools such as formal models and algorithms with applications from conceptual biology. May not be used by computer science majors for degree credit.

CS 4750. Human-Computer Interface Design and Evaluation
3-0-3.
Human-computer interface is considered in terms of user-system compatibility. Concepts in human factors and interface design are covered in relation to capabilities of both humans and computers. Crosslisted with PSYC 4750.

CS 4752. Philosophical Issues in Computation
3-0-3.
Metaphysical and epistemological issues in the foundations, methods, and implications of computing. Issues include: minds, brains, and machines; representation and language; simulating nature. Crosslisted with PST 4752.

CS 4777. Vector and Parallel Scientific Computing
3-0-3.
Prerequisite(s): MATH 2605
Scientific computational algorithms on vector and parallel computers. Speed-up, algorithmic complexity, interprocesses communication, synchronization, modern algorithms for linear systems, programming techniques, code optimization. Crosslisted with MATH 4777.

CS 4790. Seminar in Cognitive Science
3-0-3.
A seminar-type course in cognitive science focusing on integrating and deepening students' cognitive science knowledge and skills. Topics include memory, language, problem solving, learning, perception, and action. Crosslisted with PST, PSYC, and ISYE 4790.

CS 4791. Integrative Project in Cognitive Science
3-0-3.
An integrative course in cognitive science focusing on the integration and use of concepts and skills from cognitive science. A different integrative project or set of projects will be taken on each semester; students will contribute on the basis of their background and skill. Crosslisted with PST, PSYC, and ISYE 4791.

CS 4792. Design Project in Cognitive Science
3-0-3.
Individual project with a cognitive science faculty member, designed as a supplement to the student's senior design project or thesis in their major area. Crosslisted with PST, PSYC, and ISYE 4792.

CS 4801, -02, -03, -04, -05. Special Topics
Class and credit hours equal last digit in course number.
Courses of timely interest to the profession, conducted by resident or visiting faculty.

CS 4901, -02, -03. Special Problems
Credit hours to be arranged.
An investigation of significant areas of information in computer science. Guided study and research.

CS 6010. Principles of Design
2-3-3.
This is an interactive hands-on course that will teach students the principles of design at the individual level.

CS 6210. Advanced Operating Systems
3-0-3.
Prerequisite(s): CS 3210
Introduction to graduate-level topics in operating systems using research papers, textbook excerpts, and projects. Provides students thorough comprehension of distributed and parallel computer systems.

CS 6230. High-Performance Parallel Computing: Tools and Applications
3-0-3.
Prerequisite(s): CS 3210
Introduction to MIMD parallel computation, using textbook excerpts, research papers, and projects on multiple parallel machines. Emphasizes practical issues in high-performance computing.

CS 6235. Real-Time System Concepts and Implementation
3-0-3.
Prerequisite(s): CS 3210
Principles of real-time systems, as occurring in robotics and manufacturing, interactive, and multimedia applications. Reviews and uses real-time operating systems.

CS 6236. Parallel and Distributed Simulation Systems
3-0-3.
Prerequisite(s): CS 3210
Algorithms and techniques used in parallel/distributed discrete event simulation systems. Synchronization algorithms, data distribution, applications to high-performance analytic simulations and distributed virtual environments.

CS 6238. Secure Computer Systems
3-0-3.
Prerequisite(s): CS 3210 and CS 4235
Design principles of secure systems, authentication, access control and authorization, discretionary and mandatory security policies, secure kernel design, and secure databases.

CS 6241. Design and Implementation of Compilers
3-0-3.
Prerequisite(s): CS 4240
Design and implementation of modern compilers, focusing upon optimization and code generation.

CS 6245. Compiling for Parallelism
3-0-3.
Prerequisite(s): CS 4240
Design and implementation of compilers for parallel and distributed computers, focusing upon optimization and code generation.

CS 6246. Object-Oriented Systems and Languages
3-0-3.
Prerequisite(s): CS 2340
Design and implementation of object-oriented systems. Aspect-oriented programming, type systems, OO language implementation (virtual dispatch, GC), OO language design (genericity, reflection, mixins).

CS 6250. Computer Networks
3-0-3.
Principles and practice of computer networks, including signaling and framing, error control, medium access, routing, congestion control, end-to-end transport, and network APIs.

CS 6255. Principles of Network Management
3-0-3.
Prerequisite(s): CS 6250
Focus on network, system, and applications management. Principles and practice of various network management standards will be presented. Course includes project assignment.

CS 6260. Applied Cryptography
3-0-3.
Prerequisite(s): CS 4235
Cryptographic algorithms, cryptanalysis, symmetric cryptography, public key cryptography, DES, AES, RSA, hash and MAC functions, digital signatures, pseudo-random generators, cryptographic protocols, SSL/TLS, SET.

CS 6262. Network Security
3-0-3.
Prerequisite(s): CS 4235 and CS 4251
Design principles of secure network protocols and systems, authentication, integrity, confidentiality, privacy, information hiding, digital watermarking, access control, firewall, intrusion detection, and case studies.

CS 6265. Information Security Laboratory
0-9-3.
Prerequisite(s): CS 6238 and CS 6262
Computer systems and network vulnerabilities, information warfare, network and operating system security techniques, security analysis tools.

CS 6269. Formal Models and Methods for Information Assurance
3-0-3.
Prerequisite(s): CS 3500 and CS 4235
Logical foundations of high-assurance systems, formal models for access control, authentication, and trust; techniques for constructing high-assurance systems.

CS 6280. Performance Evaluation of Communication Networks
3-0-3.
Prerequisite(s): (MATH 3215 or MATH 3225) and CS 6250
Methods for evaluating the performance of communication networks with emphasis on modeling, mathematical analysis, computer simulation, and measurement.

CS 6290. High-Performance Computer Architecture
3-0-3.
Prerequisite(s): CS 2200
Topics concerning very high-performance computers including techniques exploiting parallelism in single and multiple processor systems. Credit not given for both CS 4290 and 6290.

CS 6300. Software Development Process
3-0-3.
The process of developing software systems. Includes development and assessment of processes, their instantiation in actual product development, and techniques ensuring quality of developed products.

CS 6310. Software Architecture and Design
3-0-3.
Prerequisite(s): CS 6300
Principles and concepts involved in the design and analysis of large software systems.

CS 6320. Software Requirements Analysis and Specification
3-0-3.
Prerequisite(s): CS 6300
Methods and principles for determining, documenting, analyzing, and formally specifying requirements for software systems.

CS 6330. Software Generation, Testing, and Maintenance
3-0-3.
Prerequisite(s): CS 6300
Introduction to methods and principles for programming, testing, and managing the evolution of software systems.

CS 6390. Programming Language Design
3-0-3.
Design, structure, and goals of programming languages. Object-oriented, logic, functional, and traditional languages. Semantic models. Parallel programming languages.

CS 6400. Database Systems Concepts and Design
3-0-3.
Prerequisite(s): CS 4400
Study of fundamental concepts with regard to relational databases. Topics covered include database design, query processing, concurrency control, and recovery. Credit not given for both CS 6400 and CS 6754.

CS 6411. Object-Oriented Database Models and Systems
3-0-3.
Prerequisite(s): CS 6400
Study of advanced database concepts as they apply to object-oriented database systems. Topics include semantic data models, object-oriented query languages, tools, and applications.

CS 6421. Temporal, Spatial, and Active Databases
3-0-3.
Prerequisite(s): CS 6400
Study of advanced database concepts for temporal databases with emphasis on storage structure, processing and query languages, as well as active database concepts and implementation.

CS 6430. Parallel and Distributed Database Systems and Applications
3-0-3.
Prerequisite(s): CS 4420 or CS 6400
Study of algorithms and performance in advanced databases. Systems include parallel, distributed, and client-server databases. Applications include data mining and online analytical processing.

CS 6451. Introduction to Human-Centered Computing
3-0-3.
Introduction to the range of issues across the HCC disciplines, including design and research methodologies: cognitive, social, and cultural theories; assessment and evaluation; ethical issues.

CS 6452. Prototyping Interactive Systems
3-0-3.
Prerequisite(s): CS 4452
Introduction to design, prototyping and implementation of systems for human-centered computing. Focuses on core concepts in computer science and implications for interactive systems.

CS 6455. User Interface Design and Evaluation
3-0-3.
Prerequisite(s): CS 6750 or PSYC 6750
Examines usability in the software development process with an emphasis on usability, requirements, methodology, design, and evaluation.

CS 6456. Principles of User Interface Software
3-0-3.
Prerequisite(s): CS 6750 or PSYC 6750
Considers the architectural and algorithmic principles behind the implementation of interactive software systems and the tools that support them.

CS 6460. Educational Technology: Conceptual Foundations
3-0-3.
Introduction to educational technology, with an emphasis on theoretical foundations. Introduces basic philosophies, approaches, and technologies. Analyzes issues surrounding technology's impact on education.

CS 6470. Design of Online Communities
3-0-3.
Introduction to the design of online communities. Students study an existing community in depth, and then develop a new community design.

CS 6480. Computer Visualization Techniques
3-0-3.
Prerequisite(s): CS 4451
Principles, techniques, and practice in data, information, multivariate, and scientific visualization. Includes visualization methods, data structures, examples, and tools.

CS 6485. Visualization Methods for Science and Engineering
3-0-3.
Algorithms, software, and practical applications of visualization techniques in science, engineering, business, and medicine. Includes data structures, multivariate visualization, interactive visualization, and visual representations and examples. Computer science students cannot receive credit for this course.

CS 6491. Foundations of Computer Graphics
3-0-3.
Prerequisite(s): CS 4451
Mathematical/physical/perceptual principles and modeling/rendering techniques used to create, represent, display, and animate models of 3-D shapes and their properties.

CS 6505. Computability, Algorithms, and Complexity
4-0-3.
Prerequisite(s): CS 3500
Important concepts from computability theory; techniques for designing algorithms for combinatorial, algebraic, and number-theoretic problems; basic concepts such as NP-completeness from computational complexity theory.

CS 6520. Computational Complexity Theory
3-0-3.
Prerequisite(s): CS 3500
Introduction to resource-bounded computations, central complexity-theoretic concepts such as complexity classes, reducibility, completeness, and intractability.

CS 6550. Design and Analysis of Algorithms
3-0-3.
Prerequisite(s): CS 3500
Advanced techniques for designing and analyzing efficient algorithms for combinatorial, algebraic, and number-theoretic problems.

CS 6601. Artificial Intelligence
3-0-3.
Prerequisite(s): CS 2600
Basic concepts and methods of artificial intelligence including both symbolic/conceptual and numerical/probabilistic techniques.

CS 6670. Distributed Control Algorithms
3-0-3.
Prerequisite(s): CS 4600
Algorithms for synchronous, asynchronous, and partially synchronous networks; analysis, control, and implementation of distributed systems such as robot fleets, animal groups.

CS 6705. Applications of Artificial Intelligence
3-0-3.
A study of the principles and practice of artificial intelligence in areas other than computer science, with particular focus on engineering, science, and business applications. Computer science majors cannot receive credit for this course.

CS 6725. Information Security Strategies and Policies
3-0-3.
Prerequisite(s): CS 4235
Information security vulnerabilities and risks; legal, cost, privacy, and technology constraints; derivation of strategies; technical and procedural means of achieving desired ends.

CS 6750. Human-Computer Interaction
3-0-3.
Describes the characteristics of interaction between humans and computers and demonstrates techniques for the evaluation of user-centered systems. Crosslisted with PSYC 6750.

CS 6754. Engineering Database Management Systems
3-0-3.
Modeling and managing engineering information systems, integration of design and manufacturing functions in engineering product development, logical models of engineering product and processes. Credit not given for CS 6400 and CS 6754. Crosslisted with ME 6754.

CS 6763. Design of Design Environments
3-0-3.
Analysis of design processes; analysis of current design tools at both the user interface and functional levels; procedures for developing better design tools. Crosslisted with COA 6763.

CS 6764. Geometric Modeling
3-0-3.
Software development course focusing on 3-D geometric constructions and modeling; emphasizes solid modeling and its role in design. Crosslisted with COA 6764.

CS 6780. Medical Image Processing
3-0-3.
Prerequisite(s): ECE 6786 or BMED 6786
A study of methods for enhancing, analyzing, interpreting, and visualizing information from two- and three-dimensional data obtained from a variety of medical image modalities. Cross-listed with ECE and BMED 6780.

CS 6795. Introduction to Cognitive Science
3-0-3.
Multidisciplinary perspectives on cognitive science. Interdisciplinary approaches to issues in cognition, including memory, language, problem solving, learning, perception, and action. Crosslisted with ISYE and PSYC 6795.

CS 7000. Master's Thesis
Credit hours to be arranged.

CS 7001. Overview of Graduate Studies in Computing
3-6-5.
Research tools including computer systems, as well as fundamental problem-solving skills, are introduced. Lectures on current computing research are presented and projects are required. Credit not allowed in a program of study for a graduate degree.

CS 7110. Parallel Computer Architectures
3-0-3.
Prerequisite(s): CS 6290
Issues in the design, implementation, and programming of parallel machines.

CS 7210. Distributed Computing
3-0-3.
Prerequisite(s): CS 6210
Fundamental concepts in distributed systems, including global states, logical clocks, and failure models. Distributed algorithms and their implementations using advanced distributed programming systems.

CS 7230. Systems Software Design, Implementation, and Evaluation
1-6-3.
Prerequisite(s): CS 4240 and CS 6210
Design, implementation, and evaluation of systems software. Distributed/parallel applications will be constructed and evaluated using the systems support that is developed.

CS 7250. Broadband Networking Systems
3-0-3.
Prerequisite(s): CS 6250
Focus on the data link layer and its relationship to layers below and above. Gigabit Ethernet, SONTET, fibre channel; media including wireless, satellite, xDSL, cable.

CS 7260. Internetworking Architectures and Protocols
3-0-3.
Prerequisite(s): CS 6250
Detailed discussion of the problems and solution techniques that arise in internetworking. Topics include routing addressing, quality of service, and security.

CS 7270. Networked Applications and Services
3-0-3.
Prerequisite(s): CS 6250
End-to-end functional building blocks and their use in adaptive and non-adaptive applications, including multimedia: coding, compression, security, directory services.

CS 7450. Information Visualization
3-0-3.
Prerequisite(s): CS 6750 or PSYC 6750
Study of computer visualization principles, techniques, and tools used for explaining and understanding symbolic, structured, and/or hierarchical information. Includes data and software visualization.

CS 7455. Issues in Human-Centered Computing
3-0-3.
Prerequisite(s): CS 6452
In-depth focus on theoretical, methodological, conceptual, and technical issues across the HCC disciplines associated with humans (cognitive, biological, socio-cultural); design; ethics; and analysis and evaluation.

CS 7460. Collaborative Computing
3-0-3.
Prerequisite(s): CS 6750 or PSYC 6750
Introduction to computer-supported collaborative work, workflow automation, and meeting augmentation. The course deals with models, enabling technology, systems, and applications.

CS 7465. Educational Technology: Design and Evaluation
3-0-3.
Prerequisite(s): CS 6460
Intensive project class in which students design, implement, and evaluate a piece of educational technology, applying the theory learned in Educational Technology: Conceptual Foundations.

CS 7467. Computer-Supported Collaborative Learning
3-0-3.
Prerequisite(s): CS 6460
Computer-supported collaborative learning is the use of internet-based technologies to support learning in social settings. Focus on issues of implementation and evaluation.

CS 7470. Mobile and Ubiquitous Computing
3-0-3.
Prerequisite(s): CS 6750 or PSYC 6750
Investigates the infrastructure required to develop mobile and ubiquitous computing applications and establishes major research themes and experimental practices.

CS 7490. Advanced Image Synthesis
3-0-3.
Advanced techniques in realistic image synthesis based on the physics of light. Anti-aliasing, textures, surface reflectance, distribution ray tracing, volume rendering, radiosity, and image-based rendering.

CS 7491. 3D Complexity Techniques for Graphics, Modeling, and Animation
3-0-3.
Prerequisite(s): CS 6491
Multiresolution, compression, collision, morphing, visibility, and computational geometry techniques for accessing, rendering, and animating complex 3-D models in engineering, scientific, business, or entertainment applications.

CS 7495. Computer Vision
3-0-3.
An introduction to computer vision and machine perception. An intensive study of the process of generating a symbolic description of the scene by interpretation of images(s).

CS 7496. Computer Animation
3-0-3.
Prerequisite(s): CS 4451
Motion techniques for computer animation and interactive games (keyframing, procedural methods, motion capture, and simulation) and principles for storytelling, composition, lighting, and interactivity.

CS 7497. Virtual Environments
3-0-3.
Prerequisite(s): CS 4451
An introduction to virtual reality and virtual environments. Issues covered will include VR technology, software design, 3-D human-computer interaction, and applications for VR.

CS 7510. Graph Algorithms
3-0-3.
Prerequisite(s): CS 6505 or CS 6550
Algorithms for graph problems such as maximum flow, matching, network reliability, and minimum cuts.

CS 7520. Approximation Algorithms
3-0-3.
Prerequisite(s): CS 6505 or CS 6550
Approximation algorithms for NP-hard optimization problems, design and analysis techniques for such algorithms.

CS 7530. Randomized Algorithms
3-0-3.
Prerequisite(s): CS 6505 or CS 6550
Techniques for designing and analyzing randomized algorithms, derandomization techniques.

CS 7610. Modeling and Design
3-0-3.
Prerequisite(s): CS 4600
Information-processing theories of modeling and design; topics include design decision making, problem solving and learning, and knowledge-based modeling and design.

CS 7611. AI Problem Solving
3-0-3.
Prerequisite(s): CS 6601
Basic concepts and methods of AI problem solving, knowledge representation, reasoning, and learning.

CS 7612. Artificial Intelligence Planning
3-0-3.
Prerequisite(s): CS 6601
Symbolic numerical techniques that allow intelligent systems to decide how they should act in order to achieve their goals, including action and plan representation, plan synthesis and reasoning, analysis of planning algorithms, plan execution and monitoring, plan reuse and learning, and applications.

CS 7613. Knowledge Systems Engineering
2-3-3.
Prerequisite(s): CS 6601
Techniques for constructing large knowledge-based systems. Advanced symbolic AI techniques. Constraint systems.

CS 7615. Knowledge Agents
3-0-3.
Knowledge-based interactive systems, knowledge-based autonomous agents, agent architectures, learning and adaptation, agent evolution.

CS 7620. Case-Based Reasoning
3-0-3.
Prerequisite(s): CS 4600
Topics include case representation, indexing and retrieval, adaptation, interpretive CBR, the cognitive model that CBR implies, and its implications for creativity, decision aiding, and education.

CS 7630. Autonomous Robotics
3-0-3.
Prerequisite(s): CS 4600
The principles and practice of autonomous robotics including behavior-based design and architectures, adaptive learning and team behavior, and the role of perception within robotic systems.

CS 7631. Autonomous Multi-Robot Systems
3-0-3.
Prerequisite(s): CS 4631 or CS 7630
In-depth examination of the current research on multi-robot systems. Students develop and critically analyze a multi-robot system.

CS 7636. Computational Perception
3-0-3.
Prerequisite(s): CS 4641 and (CS 4495 or CS 7495)
Study of statistical and algorithmic methods for sensing people using video and audio. Topics include face detection and recognition, figure tracking, and audio-visual sensing.

CS 7640. Learning in Autonomous Agents
3-0-3.
Prerequisite(s): CS 4600 or CS 4641
An in-depth look at agents that learn, including intelligent systems, robots, and humans. Design and implementation of computer models of learning and adaptation in autonomous intelligent agents.

CS 7641. Machine Learning
3-0-3.
Prerequisite(s): CS 6601
Machine learning techniques and applications. Topics include foundational issues; inductive, analytical, numerical, and theoretical approaches; and real-world applications.

CS 7645. Numerical Machine Learning
3-0-3.
Prerequisite(s): CS 4641
This course explores problems in classification/pattern recognition (OCR, speech, vision, fault detection, medical diagnosis), regression/function approximation, robot control, and reinforcement learning.

CS 7695. Philosophy of Cognition
3-0-3.
Examines problems in the foundations of cognition in relation to current issues in cognitive sciences. Topics include meaning, mental imagery, consciousness, and mind/body problem.

CS 7697. Cognitive Models of Science and Technology
3-0-3.
Examines how models of reasoning and representation developed in the cognitive sciences can provide a basis for an enriched understanding of scientific theories and research practices in science and technology.

CS 7790. Cognitive Modeling
2-6-4.
Prerequisite(s): CS 6795 or ISYE 6795 or PSYC 6795
A hands-on course covering a range of cognitive modeling methodologies. It explores the analysis, development, construction, and evaluation of models of cognitive processing. Crosslisted with ISYE and PSYC 7790.

CS 7999. Preparation for Doctoral Qualifying Exams
Credit hours to be arranged.
Consent of the College required.

CS 8001, -02, -03, -04, -05, -06. Seminar
Class and credit hours equal last digit in course number.
Group discussion of advanced topics in information and computer science. May not be used by computer science majors for degree credit.

CS 8030. Software Engineering Seminar
1-0-1.
This seminar provides students with an opportunity to explore contemporary topics in software engineering.

CS 8795. Colloquium in Cognitive Sciences
1-0-1.
Reading of research papers by leading cognitive scientists, attendance at their colloquia and meeting with them to discuss research. Crosslisted with ISYE and PSYC 8795.

CS 8801, -02, -03, -04, -05, -06. Special Topics
Class and credit hours equal last digit in course number.
Special topics of current interest. Treatment of new developments in various areas of computing.

CS 8893. Special Topics in Cognitive Science
3-0-3.
Topics of current interest in cognitive science.

CS 8901, -02, -03. Special Problems
Credit hours to be arranged.
Small-group or individual investigation of advanced topics in computing. Guided study and research.

CS 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding graduate teaching assistantships.

CS 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding graduate research assistantships.

CS 8999. Doctoral Thesis Preparation
Credit hours to be arranged.

CS 9000. Doctoral Thesis
Credit hours to be arranged.

College of Engineering
www.coe.gatech.edu

This version of the *General Catalog* was current as of the date of printing in May 2005. For the most up-to-date version, visit **www.catalog.gatech.edu**.
In addition, this is the final printed version of the *General Catalog*. Beginning in May 2006 it will be available online only.

College established in 1948, first engineering program in 1885
Location: 225 North Avenue
Atlanta, GA 30332-0360
Telephone: 404.894.3350
Fax: 404.894.0168
E-mail: coe@coe.gatech.edu

Dean–Don P. Giddens; *Associate Deans*–J. Nari Davidson, Jane C. Ammons, Francois Sainfort, Raymond P. Vito; *Assistant Dean*–Jane G. Weyant; *Director of Finance*–Pete Dawkins; *Director of Facilities and Capital Planning*–Gregory B. Goolsby; *Director of Human Resources and Administration*–Monique D. Tavares; *Director of Development*–Lee Williams.

General Information

The College of Engineering comprises ten academic units of instruction and research. These units offer programs of study and research leading to bachelor's, master's, and doctoral degrees. Some also offer programs in one or more subdisciplines or subspecialties.

The programs in engineering are designed to provide a fundamental understanding of the engineering sciences (which are based on mathematics and the natural sciences), of the basic concepts of the humanities and social sciences, and an understanding of the manner in which these elements are interwoven in engineering practice. Each curriculum provides enough flexibility through elective course opportunities to permit a certain amount of program individualism while meeting basic requirements.

Transfer Programs in the College of Engineering

To encourage and accommodate students who desire to study engineering, but who for various reasons may prefer to attend another college before coming to Georgia Tech, the College of Engineering offers the opportunity to transfer to Georgia Tech through the Regents' Engineering Transfer Program (RETP) or the Dual Degree Program.

Regents' Engineering Transfer Program

The RETP is a cooperative program between Georgia Tech and fourteen colleges in the University System of Georgia:

Albany State University
Armstrong Atlantic State University
Columbus State University
Dalton State College
Gainesville College
Georgia Perimeter College
Georgia Southern University
Macon State College
Middle Georgia College
North Georgia College and State University
Savannah State University
Southern Polytechnic State University
State University of West Georgia
Valdosta State University

For the first two years, students in this program attend one of the participating institutions, where they take all of the mathematics and science and many of the engineering courses required in the first two years of the Georgia Tech engineering curricula. Upon successful completion of the RETP requirements at the RETP institution, students are admitted to Georgia Tech to work toward completion of a bachelor of science in engineering degree.

By enrolling in RETP, students may attend a college close to home, thereby decreasing the cost of their education and easing the adjustment to college life. At the same time, RETP students enjoy many of the advantages of Tech students: they have equal access to engineering majors at Tech, they can participate in the co-op program, and they are invited to the Tech campus once a year for campus tours, information sessions, and meetings with advisors in their engineering major.

Dual Degree Program

Under the Dual Degree Program, students attend the participating Dual Degree school for three years and then come to Georgia Tech for approximately two years. Students participating in the Dual Degree Program may seek a degree from any undergraduate degree-granting program in the College of Engineering. Upon completion of the program, the student receives a bachelor's degree from the first school and a bachelor's degree in one of the engineering disciplines at Georgia Tech.

Participating in the Dual Degree Program are many of the schools in the University System of Georgia, Morehouse College, Spelman College, Clark Atlanta University, and other traditionally black colleges and predominantly women's colleges in the Southeast.

For additional information on either of these programs, contact the College of Engineering at Georgia Tech or the RETP or Dual Degree coordinator at a participating RETP or Dual Degree institution.

Interdisciplinary Activities and Programs

The College of Engineering encourages cross-unit collaboration within the College and supports the interdisciplinary culture of Georgia Tech and the merging of disciplines that is the trait of modern technology development. Engineering faculty provide leadership for such activities through their involvement in more than thirty research centers and institutes on campus.

The College also provides opportunities for engineering students to participate in interdisciplinary activities by working with faculty in the centers as research assistants, by taking part in interdisciplinary design projects and competitions, and by completing one or more of the College's multidisciplinary certificate programs.

Any student in good academic standing who is pursuing a degree in one of the participating schools of the College of Engineering or a participating school in any of the other colleges may select elective courses and the subjects of special problems to satisfy simultaneously both the requirements of his or her major degree program and those of a specialized multidisciplinary program. Upon graduation, the student receives both the degree in the major field of study and a certificate attesting to successful completion of the particular related multidisciplinary program.

The following table shows available program offerings and the degree levels of the programs.

Multidisciplinary Certificate Programs

Program	*Degree Level*		
Composites Engineering	B	M	Ph.D.
Geohydrology		M	Ph.D.
Manufacturing		M	Ph.D.
Mechanical Properties of Solids			Ph.D.
Polymer Engineering	B	M	Ph.D.
Pulp and Paper Engineering	B		

General Requirements of Undergraduate Multidisciplinary Programs

The specific design of the multidisciplinary program of any participating undergraduate student, while individualized, must meet certain general requirements as well as requirements that are specific to that multidisciplinary area. The general (minimum) undergraduate multidisciplinary requirements are as follows:

1) The program must relate the student's major area to the given multidisciplinary area.
2) Courses must be taken under more than one academic unit.
3) At least twelve credit hours (not required by name and number in the student's major) must be taken in a coherent program.
4) At least nine credit hours must be at the 3000 level or higher.
5) At least three credit hours must be outside the major field (crosslisted courses may be counted outside the student's major).
6) Courses must be taken on a letter-grade basis, and a grade of *C* or better must be earned in each course counting toward a multidisciplinary certificate.

General Requirements of Graduate Multidisciplinary Programs

The specific design of the multidisciplinary program of any participating graduate student, while individualized, must meet certain general requirements as well as requirements that are specific to that multidisciplinary area. The general (minimum) graduate multidisciplinary requirements are the same as those listed previously for the undergraduate programs, with the following exceptions:

1) at least three of the coherent multidisciplinary program courses as well as nine credit hours must be at the 6000 level or higher; and
2) students at the doctoral level must, on an individual basis, meet additional requirements specified by the student's doctoral committee, consistent with a program beyond the master's level whose objective is to develop a doctoral-level multidisciplinary program.

Interested students may obtain detailed information on the various undergraduate-level and graduate-level multidisciplinary programs from the main office of the school in which they are enrolled.

Certificate Procedures

Petitions for multidisciplinary program certificates are processed as follows:

1) During the semester in which the student expects to graduate, the student completes a Petition for Multidisciplinary Certificate form and obtains the signature of the chair of his or her school, as well as the signature of the chair of the certificate program.
2) When complete, the petition is forwarded to the Office of the Dean of Engineering.
3) At the end of the semester in which all graduation requirements have been met, the certificate will be signed by the dean of Engineering and mailed to the student.

Courses of Instruction

Figures entered below the course number and title of the course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course. An asterisk (*) denotes prerequisite courses that may be taken concurrently.

COLLEGE OF ENGINEERING

COE 1361. Computing for Engineers
3-0-3.
Foundations of computing with an emphasis on design and implementation of algorithms that compliment and support engineering problem solving.

COE 2001. Statics
2-0-2.
Prerequisite(s): MATH 1502 or MATH 1512 or (MATH 1X52 and MATH 1522) and PHYS 2211
Elements of statics in two and three dimensions. Free-body diagrams, distributed loads, centroids, and friction.

COE 3001. Mechanics of Deformable Bodies
3-0-3.
Prerequisite(s): COE 2001 and (MATH 2403 or MATH 2413 or MATH 24X3)
Stress and strain analysis applied to beams, vessels, pipes, and combined loading; stress and strain transformations; beam deflection; column buckling.

Undeclared Engineering Students

www.coe.gatech.edu/students/UEC

College of Engineering
Dean's Office
Location: Tech Tower, Third Floor
E-mail: jane.weyant@coe.gatech.edu

First-year students entering the College of Engineering may choose a specific engineering major or remain undeclared until they determine which Georgia Tech major best fits their interests and goals. It is recommended that students select a major by the end of the first year, but the selection must be made before completion of sixty credit hours. Until a student has chosen a major, course schedules should be planned using the following list of courses, which are common to all engineering majors.

Course Name	*Course Number*
Calculus I	MATH 1501
Calculus II	MATH 1502
Calculus III	MATH 2401
Differential Equations	MATH 2403[1]
Introductory Physics I	PHYS 2211
Introductory Physics II	PHYS 2212
General Chemistry	CHEM 1310[2]
At least one additional science course (differs by major)	
Introduction to Computing	CS 1371
English Composition I	ENGL 1101
English Composition II	ENGL 1102
Humanities Electives	Select from List, GT Catalog, p. 35
Social Science Electives	Select from List, GT Catalog, p. 36
US/GA Hist/Const. Req.	Select from List, GT Catalog, p. 36
Economics	ECON 2100, 2105 or 2106
Wellness	HPS 1040

1. IE majors take MATH 2602, Linear and Discrete Math.
2. IE majors take a science elective.

(Suggested Schedule)

First Year – First Semester

Course Number/Name		*Hours*
MATH 1501	CALCULUS I	4
CHEM 1310	GENERAL CHEMISTRY	4
CS 1371	COMPUTING FOR ENGINEERS	3
ENGL 1101	ENGLISH COMPOSITION I	3
GT 1000	FRESHMAN SEMINAR	1
TOTAL SEMESTER HOURS		15

First Year – Second Semester

Course Number/Name		*Hours*
MATH 1502	CALCULUS II	4
PHYS 2211	INTRODUCTORY PHYSICS I	4
ENGL 1102	ENGLISH COMPOSITION II	3
HISTORY/CONSTITUTION REQUIREMENT		3
WELLNESS		2
TOTAL SEMESTER HOURS		16

Georgia Tech Savannah (GTS)

www.gtsav.gatech.edu

Established in 1998
Location: 210 Technology Circle, Savannah, GA 31407
Telephone: 912.966.7922
Fax: 912.966.7836

Director and Professor–J. David Frost.
Professors–Stanley D. Lindsey, Feodor S. Vainstein, A. Rahman Zaghloul.
Associate Professors–Christopher F. Barnes, Rafi L. Muhanna, Ashraf S. Saad, Paul A. Work, P. Douglas Yoder.
Assistant Professors–Randal T. Abler, Ghassan Al-Regib, Hermann M. Fritz, Kevin A. Haas, Joel R. Jackson, Benjamin D. B. Klein, Elliot Moore II, David W. Scott.
Research Engineer–L. Gail Wells.

General Information

Initiated in 1998 with the offering of undergraduate degrees through the Georgia Tech Regional Engineering Program (GTREP), Georgia Tech Savannah was created to unite education, industry, and technology in Georgia's Southeast region. Continuing Georgia Tech's tradition of excellence in academics, research, and community outreach, the Savannah campus also offers robust graduate degree programs and professional education courses. Cutting-edge research facilities house the academic programs as well as the regional office of the Georgia Tech Economic Development Institute (EDI), the Savannah Advanced Technology Development Center (ATDC), and the Maritime Logistics Innovation Center (MLIC).

Undergraduate Programs

Bachelor of Science

The Georgia Tech Regional Engineering Program (GTREP) offers courses leading to the degrees Bachelor of Science in Civil Engineering, Bachelor of Science in Computer Engineering, Bachelor of Science in Electrical Engineering, and Bachelor of Science in Mechanical Engineering. The undergraduate programs are operated under a formal academic collaboration between Georgia Tech and three partner institutions: Armstrong Atlantic State University (AASU) and Savannah State University (SSU) in Savannah, and Georgia Southern University (GSOU) in Statesboro. During the freshman and sophomore years of the undergraduate degree program, students are enrolled at one of the three partner institutions. These universities offer all of the humanities, mathematics, and science courses and some of the engineering courses required in the first two years of the Georgia Tech engineering curricula. Prior to their junior year, students apply for transfer admission to Georgia Tech and complete their degree program as a Georgia Tech student. Students remain physically located in Southeast Georgia, but are taught by both local and Atlanta-based Georgia Tech faculty. The cornerstone of campus activities is the use of technology-enhanced classrooms and studios that allow seamless collaboration between the Savannah and Atlanta campuses of Georgia Tech – from classroom instruction and research projects to guest lectures and student organizations. Students are also offered many opportunities for hands-on

learning while they complete their degree programs, ranging from undergraduate research projects and internships to Georgia Tech's world-renowned Cooperative Program.

The objectives of the undergraduate degree programs are to: a) provide an educational experience that prepares students for the technical challenges of the engineering profession that they will face during their professional careers; b) deliver a diverse educational program that encompasses elements that develop individual and team problem-solving skills for a global marketplace; c) engender an appreciation of the opportunities afforded by technology in the conduct of engineering in the context of multidisciplinary frameworks; and d) integrate an understanding of the application of engineering with the fundamental principles of the discipline through inclusion of elements such as co-op assignments, internships, undergraduate research opportunities, and course projects. The Regional Engineering Program designation is used for all undergraduate degree programs to distinguish them from corresponding programs for students who receive their instruction on campus in Atlanta. In order to receive the Cooperative Plan designation, a student must be admitted to the Division of Professional Practice and complete a minimum of four work sessions, at least two of which must be undertaken during the fall or spring semesters. The Cooperative Plan normally requires an additional year for completion.

The curricula for the GTREP undergraduate programs are the same as those at the corresponding academic unit on the main campus in Atlanta and are presented elsewhere in the Civil and Environmental Engineering; Electrical and Computer Engineering; and Mechanical Engineering sections of this catalog.

Graduate Programs

Master of Science

Five master's degrees are available through Georgia Tech Savannah: Master of Science in Civil Engineering, Master of Science in Environmental Engineering, Master of Science in Electrical and Computer Engineering, Master of Science in Mechanical Engineering, and Undesignated Master of Science. The master's degree programs require thirty semester credit hours beyond the bachelor's degree. Depending on the specific program of study, students may elect to earn six to nine of these hours by writing a thesis, or they may earn all of the credit through coursework.

The criteria for the master's programs offered through the Georgia Tech Savannah campus are the same as those at the corresponding academic unit on the main campus in Atlanta, and are presented elsewhere in the Civil and Environmental Engineering, Electrical and Computer Engineering, and Mechanical Engineering sections of this catalog.

Doctor of Philosophy

The Ph.D. program is offered to students with an excellent academic background and a capacity for independent research. Doctoral students tailor a highly individualized program of study directed toward completion of a dissertation that is expected to make an important contribution in their selected area of study. Doctoral degrees are offered in Civil and Environmental Engineering, Electrical and Computer Engineering, and Mechanical Engineering. Typically, four to five years beyond the bachelor's degree are required to complete the doctoral program.

The criteria for the doctoral programs offered through the Georgia Tech Savannah campus are the same as those at the corresponding academic unit on the main campus in Atlanta, and are presented elsewhere in the Civil and Environmental Engineering, Electrical and Computer Engineering, and Mechanical Engineering sections of this catalog.

Guggenheim School of Aerospace Engineering

www.ae.gatech.edu

Daniel Guggenheim School of Aeronautics, Established in 1930
Location: Montgomery Knight Building
Telephone: 404.894.3000
Fax: 404.894.2760
E-mail: info@ae.gatech.edu

Chair and William R. T. Oakes Professor–Robert G. Loewy; *Associate Chair for Graduate Programs and Research and Professor*–Jechiel I. Jagoda; *Associate Chair for Undergraduate Programs and Regents' Professor*–Lakshmi N. Sankar; *David S. Lewis Professor and Regents' Professor*–Ben T. Zinn; *Langley Professor*–Alan W. Wilhite; *David and Andrew Lewis Associate Professor of Space Technology*–Robert D. Braun; *Boeing Associate Professor of Advanced Aerospace Systems Analysis*–Dimitri Mavris; *Lockheed Martin Assistant Professor of Avionics Integration*–Eric N. Johnson; *Regents' Professors Emeriti*–Robin B. Gray, Edward W. Price.
Professors–K. K. Ahuja (joint, GTRI), Erian A. Armanios, Olivier A. Bauchau, Anthony J. Calise, James I. Craig, Dan Giddens (joint, BME), Wassim M. Haddad, Sathyanarayana V. Hanagud, Dewey H. Hodges, John W. Holmes, George A. Kardomateas, Narayanan M. Komerath, Suresh Menon, J. V. R. Prasad, Daniel P. Schrage.
Professors Emeriti–Robert L. Carlson, James E. Hubbartt, Manohar P. Kamat, David J. McGill (joint, CEE), Howard M. McMahon, G. Alvin Pierce, James C. Wu.
Associate Professors–John R. Olds, Amy R. Pritchett, Stephen M. Ruffin, Jerry M. Seitzman, Marilyn J. Smith, Panagiotis Tsiotras, P. K. Yeung.
Assistant Professors–Timothy C. Lieuwen, Massimo Ruzzene, Mitchell L. R. Walker.
Lecturer–Michael W. M. Jenkins.
Adjunct Professors–David A. Peters, Robert L. Sierakowski.
Adjunct Associate Professor–Carlo Bottasso.
Principal Research Engineers–Yedidia Neumeir, Douglas O. Stanley.
Senior Research Engineers–R. Dale Atkins, Eugene Lubarsky, Andrew V. Makeev, R. Wayne Pickell.
Senior Research Scientist–Bruce A. Fryxell.
Research Engineers II–Byung Ho Ahn, Jou-Young Choi, Russell K. Denney, Elena Garcia, Peter M. Hollingsworth, Jeong Hur, Michelle R. Kirby, Ralph L. Latham, Zhimin Liu, Jan W. Osburg, Bryce A. Roth, David E. Scarborough, Danielle S. Soban, Christopher P. Stone, Jimmy C. Tai, Vitali Volovoi, Neil R. Weston.
Research Scientist II–Oleksandr Bibik.
Research Engineers I–Adam T. Broughton, Cecile M. Burg, Henrik B. Christophersen, Peter B. Hart, Andrew J. Meyers.
Research Scientist I–Christie M. Maldonado.
Systems Analyst III–William Meyer.

General Information

The Guggenheim School of Aerospace Engineering prepares students at the bachelor's, master's, and doctoral levels for a career in vehicle engineering, with primary emphasis on flight vehicles. A combined B.S./M.S. honors program is also offered that prepares students for graduate studies and research (**http://www.ae.gatech.edu/undergraduate/semester/honors/index.html**). In addition, the School offers a minor with six different tracks. The School is housed in five buildings having a floor space of approximately 122,000 square feet, most of which is devoted to instructional and research laboratories. Additional information can be found at **www.ae.gatech.edu**.

Undergraduate Program

The first two years focus on coursework in the areas of chemistry, mathematics, physics, humanities, social sciences, and general engineering sciences. The third and fourth years emphasize aerospace disciplines and vehicle systems integration. The undergraduate curriculum is designed to provide each student with a general background for either employment in industry or government laboratories, or advanced study in graduate school at the end of four years. The program stresses the theoretical, experimental, and design aspects of aerospace engineering. Courses do not have to be taken during the specific semester indicated in the curriculum, but all prerequisites must be satisfied for each course. Advisement by an assigned faculty member is required before registration. Each student is assigned a faculty advisor who remains the same for the full undergraduate program, unless

the student requests a change. A certain degree of specialization is available to undergraduate students through the proper choice of electives, as are opportunities for undergraduate research, depending on the student's abilities and career objectives. Students should consult with academic advisors for the availability of courses and recommended course sequences.

Educational Objectives

The undergraduate aerospace engineering degree program will:

- provide students with a comprehensive education that includes in-depth instruction in aerodynamics, aircraft and spacecraft structures (including structural dynamics and aeroelasticity), flight and orbital mechanics and controls, and design of aerospace systems;
- prepare students for careers in aerospace engineering by emphasizing the aerospace vehicle, analysis, and problem solving, providing methods to deal with open-ended problems and design including costs, manufacturing, and maintenance; fostering teamwork, communication skills, and individual professionalism; and
- provide adequate research and independent study opportunities that cultivate lifelong learning skills and nourish creative talents.

Bachelor of Science in Aerospace Engineering (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
MATH 1501	CALCULUS I	4
ENGL 1101	ENGLISH COMPOSITION I	3
CHEM 1310	GENERAL CHEMISTRY	4
CS 1371	COMPUTING FOR ENGINEERS	3
WELLNESS		2
TOTAL SEMESTER HOURS		16

First Year - Second Semester

Course Number/Name		*Hours*
MATH 1502	CALCULUS II	4
ENGL 1102	ENGLISH COMPOSITION II	3
PHYS 2211	INTRODUCTORY PHYSICS I	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
AE 1350	INTRO. TO AEROSPACE ENGINEERING	2
TOTAL SEMESTER HOURS		16

Second Year - First Semester

Course Number/Name		*Hours*
MATH 2401	CALCULUS III	4
PHYS 2212	INTRODUCTORY PHYSICS II	4
COE 2001	STATICS	2
AE 1770	ENGINEERING GRAPHICS & VISUALIZATION	3
MSE 2001	PRINCIPLES & APPLICATIONS OF ENGINEERING MATERIALS	3
TOTAL SEMESTER HOURS		16

Second Year - Second Semester

Course Number/Name		*Hours*
AE 2020	LOW-SPEED AERODYNAMICS	3
AE 2220	DYNAMICS	3
TECHNICAL ELECTIVE(S)		3
ECON 2100 or 2105 or 2106		3
MATH 2403	DIFFERENTIAL EQUATIONS	4
TOTAL SEMESTER HOURS		16

Third Year - First Semester

Course Number/Name		*Hours*
AE 3515	SYSTEM DYNAMICS & CONTROLS	4
AE 3450	THERMODYNAMICS & COMPRESSIBLE FLOW	3
AE 3310	INTRO. TO AEROSPACE VEHICLE PERFORMANCE	3
COE 3001	DEFORMABLE BODIES	3
LCC 3401	TECHNICAL COMMUNICATION PRACTICES	2
ECE 3710	CIRCUITS & ELECTRONICS	2
TOTAL SEMESTER HOURS		17

Third Year - Second Semester

Course Number/Name		*Hours*
AE 3125	AEROSPACE STRUCTURAL ANALYSIS	4
AE 3521	FLIGHT DYNAMICS	4
HUMANITIES ELECTIVE(S)		3
ECE 3741	INSTRUMENTATION & ELECTRONICS LAB	1
AE 4451	JET & ROCKET PROPULSION	3
AE 3051	EXPERIMENTAL FLUID DYNAMICS	2
TOTAL SEMESTER HOURS		17

Fourth Year - First Semester

Course Number/Name		*Hours*
HUMANITIES ELECTIVE(S)		3
AE 4350	DESIGN PROJECT I or 4356 SPACE SYSTEMS DESIGN PROJECT I	3
AE 3021	HIGH-SPEED AERODYNAMICS	3
AE 3145	STRUCTURES LAB	1
SOCIAL SCIENCE ELECTIVE(S)		3
FREE ELECTIVE(S)		4
TOTAL SEMESTER HOURS		17

Fourth Year - Second Semester

Course Number/Name		*Hours*
AE 4220	AEROELASTICITY	3
AE 4354	DESIGN PROJECT II or AE 4357 SPACE SYSTEMS DESIGN PROJECT II	3
SOCIAL SCIENCE ELECTIVE(S)		3
FREE ELECTIVE(S)		6
AE 4525	CONTROL SYSTEMS DESIGN LAB	2
TOTAL SEMESTER HOURS		17

TOTAL PROGRAM HOURS = 130 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Requirements

A grade of *C* or better is required in each 1000- and 2000-level math and physics course; a course with a *D* or *F* grade must be repeated the next semester the student is in residence. A 2.0 overall average or better is required to schedule AE 2120 or AE 2020. No more than two *D* grades are permitted in AE courses listed by number in the sophomore, junior, and senior years. Courses in which a *D* was earned may be repeated at any time with the approval of an advisor.

Electives

Humanities/Social Sciences Electives

A total of twelve credit hours in humanities and twelve credit hours in social sciences are required for graduation. See pages 35-36 for a list of acceptable courses. The humanities requirements may be satisfied by completing ENGL 1101, ENGL 1102, and two more approved humanities courses. The social science requirement may be satisfied by completing the history and constitution requirement, the economics requirement (ECON 2100, 2105, or 2106), and two more approved social science courses. To satisfy the state requirements regarding coursework in the history and constitution of the United States and Georgia, students must complete one of the following courses: HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200. Courses taken in humanities and social sciences must be scheduled on a letter-grade basis.

Science Elective

The science elective must be chosen from a list of approved courses, including a computer science offering. These are listed at **www.ae.gatech.edu/undergraduate.**

Free Electives

The required ten credit hours of free electives may be taken at any time during the course of study. If ROTC is elected, four credit hours of basic and six hours of advanced ROTC may be applied toward these electives. HPS 1040 cannot be applied toward the free electives. Only the free electives may be taken on a pass/fail basis.

Further details on the undergraduate program are available at **www.ae.gatech.edu/undergraduate**.

Graduate Programs

At the graduate level, the School offers master's and doctoral degrees. In addition, the School offers a distance learning-based master's degree. The master's degree may be earned by completing thirty-three semester hours of coursework, which must include three hours of Special Problems research credit. Alternatively, the candidate may elect to complete twenty-four semester hours of coursework along with nine hours of M.S. thesis. The candidate must propose a thesis topic, complete the thesis, and successfully defend it before being awarded the degree. The Ph.D. degree is a research degree. It requires fifty semester hours of coursework beyond the bachelor's degree; however, the main emphasis is on the research leading to a Ph.D. thesis. The candidate must pass a qualifying examination and present a thesis proposal and a thesis defense. GPAs of 2.7 and 3.25 are required to graduate with M.S. and Ph.D. degrees, respectively. All coursework, including Special Problems, must be taken on a letter-grade basis.

The programs of study for both the master's and doctoral degrees are very flexible and can be tailored, in agreement with the student's advisor, to meet the candidate's professional goals. For further details governing the graduate program, access the *Aerospace Engineering Graduate Handbook* at **www.ae.gatech.edu/graduate**.

Graduate students may specialize in the following areas: aerodynamics and fluid mechanics, aeroelasticity and structural dynamics, flight

mechanics and control, propulsion and combustion, structural mechanics and materials behavior, and system design and optimization. Further information on these areas of specialization and research can be found at **www.ae.gatech.edu/research**.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course. An asterisk (*) denotes prerequisite courses that may be taken concurrently.

AEROSPACE ENGINEERING

AE 1350. Introduction to Aerospace Engineering
2-0-2.
Introduction to the field of aerospace engineering, discussion of basic aerospace systems and disciplines, working vocabulary of the field. Demonstration through examples. Includes a wind tunnel visit.

AE 1355. Aerospace Systems Design Competition I
1-6-3.
Team-oriented aerospace systems design project directed by a faculty advisor. Typically a national student competition in aircraft, rotorcraft, or spacecraft design. Technical role commensurate with freshman standing.

AE 1750. Introduction to Bioengineering
3-0-3.
An introduction to the field of bioengineering, including the application of engineering principles and methods to problems in biology and medicine, the integration of engineering with biology, and the emerging industrial opportunities. Crosslisted with BMED, CHE, ECE, ME, and MSE 1750.

AE 1770. Introduction to Engineering Graphics and Visualization
2-3-3.
Prerequisite(s): MATH 1501* or MATH 15X1 or MATH 1511*
Introduction to engineering graphics and visualization including sketching, line drawing, and solid modeling. Development and interpretation of drawings and specifications for product realization. Crosslisted with CEE 1770 and ME 1770.

AE 2020. Low-Speed Aerodynamics
3-0-3.
Prerequisite(s): (MATH 2401 or MATH 2411 or MATH 24X1) and AE 1350 and PHYS 2211
Basic results, conservation laws, potential, airfoil, and wing analysis. Boundary layers on plates and airfoils. Pressure gradients. Introduction to turbulence and vortex-dominated flows.

AE 2120. Introduction to Mechanics
3-0-3.
Prerequisite(s): (MATH 2401* or MATH 2411* or MATH 24X1) and PHYS 2211
Forces and movements; equilibrium in two and three dimensions; multiforce members; friction; stress and strain; axial loading, torsion, and bending of beams.

AE 2220. Dynamics
3-0-3.
Prerequisite(s): AE 2120 and (MATH 2403* or MATH 2413* or MATH 24X3)
Motion of particles and mass center of bodies, kinematics and kinetics of rigid bodies in plane motion, work-energy and impulse-momentum methods, 3-D dynamics of rigid bodies.

AE 2355. Aerospace Systems Design Competition II
1-6-3.
Team-oriented aerospace systems design project directed by a faculty advisor. Typically a national student competition in aircraft, rotorcraft, or spacecraft design. Technical role commensurate with sophomore standing.

AE 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

AE 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

AE 2801, -02, -03. Special Topics
Class and credit hours equal last digit in course number. Normally taken by sophomores. Course material devoted to special topics in aerospace engineering.

AE 2901, -02, -03. Special Problems
Credit hours to be arranged.
Research topic selected in consultation with advisor. A brief description, endorsed by the faculty advisor, must be approved by the School.

AE 3021. High-Speed Aerodynamics
3-0-3.
Prerequisite(s): AE 2020 and AE 3450
Compressibility effects on airfoil and wing aerodynamics supersonic potential flow: method of characteristics; boundary layer effects on airfoil and wing performance.

AE 3051. Experimental Fluid Dynamics
1-3-2.
Prerequisite(s): AE 2020 and AE 3450*
Experiments in fluid mechanics, aerodynamics, and propulsion with emphasis on data acquisition and analysis, e.g., measurement techniques, laboratory instrumentation, measurement errors/noise, and digital sampling.

AE 3120. Introduction to Structural Analysis
3-0-3.
Prerequisite(s): AE 2120 and (MATH 2403 or MATH 2413 or MATH 24X3).
Euler-Bernoulli beam theory. Deflections due to bending. Bending of beams with unsymmetrical cross-section. Stability of beams and columns. Elements of two-dimensional elasticity.

AE 3122. Aerospace Structural Analysis
3-0-3.
Prerequisite(s): AE 3120
Principles of virtual displacements and virtual forces. Applications to structural analysis. Introduction to energy concepts. Introduction to finite elements. Bending, shear, torsion of thin-walled structures.

AE 3125. Aerospace Structural Analysis
4-0-4.
Prerequisite(s): COE 3001
Principle of virtual displacement. Application to structural analysis. Basic equations of elasticity. Bending, shearing, and torsion of thin-walled structures.

AE 3145. Structures Laboratory
0-3-1
Prerequisite(s): AE 3120
Introduction to mechanical measurements, instrumentation principles and practice, measurement of stress and strain, shear center, column stability, properties of composite structural materials, fracture toughness test.

AE 3510. Introduction to Aerospace Vehicle Performance
3-0-3.
Prerequisite(s): AE 2020 and AE 2220
Introduction to aerospace vehicle performance: VTOL, STOL, CTOL aircraft and spacecraft. Drag estimation, thrust required and available, basic point and path performance, special performance items, maneuvers.

AE 3355. Aerospace Systems Design Competition III
1-6-3.
Team-oriented aerospace systems design project directed by a faculty advisor. Typically a national student competition in aircraft, rotorcraft, or spacecraft design. Technical or leadership role commensurate with junior standing.

AE 3450. Thermodynamics and Compressible Flow
3-0-3.
Prerequisite(s): PHYS 2212 and (MATH 2401 or MATH 2411 or MATH 24X1)
First and second laws of thermodynamics. Thermodynamic properties and state equations. Isentropic flow. Flows with shocks and expansions. Flows with friction and heat transfer.

AE 3515. System Dynamics and Control
4-0-4.
Prerequisite(s): AE 2220 and (MATH 2403 or MATH 2413 or MATH 24X3)
Dynamic modeling and response of systems with mechanical, hydraulic, electrical, and/or thermal elements. Classical methods of feedback control system design and analysis.

AE 3521. Aircraft and Spacecraft Flight Dynamics
4-0-4.
Prerequisite(s): AE 2020 and AE 3515
Three-dimensional rigid body dynamics, aircraft and spacecraft equations of motion, principles of static stability and control, dynamic stability of uncontrolled motion, gyroscopic instruments.

AE 3801, -02, -03. Special Topics
Class and credit hours equal last digit in course number. Normally taken by juniors. Course material devoted to special topics in aerospace engineering.

AE 3901, -02, -03. Special Problems
Credit hours to be arranged.
Research topic selected in consultation with advisor. A brief description, endorsed by the faculty advisor, must be approved by the School.

AE 4040. Computational Fluid Dynamics
3-0-3.
Prerequisite(s): AE 3021
Discretization of PDEs, stability and accuracy considerations, iterative and time/space marching schemes, aerospace applications.

AE 4051. Flow Diagnostics
2-3-3.
Prerequisite(s): AE 3051
Overview of experimental techniques. Flow visualization; statistical methods. Laboratory operation, data acquisition, analysis, interpretation, reporting.

AE 4060. Aeroacoustics
3-0-3.
Prerequisite(s): AE 3450 and AE 3515
Concepts and techniques, noise sources, data acquisition and reduction, aeroacoustic resonances, commonalities in the music of wind instruments and sources of aircraft noise, community impact.

AE 4070. Introduction to Propeller and Rotor Theory
3-0-3.
Prerequisite(s): AE 3021
A study of the theory and equations used in the design of propellers and helicopter rotors.

AE 4080. Aerothermodynamics
3-0-3.
Prerequisite(s): AE 3021
Convective heat transfer and viscous drag in high-temperature and high-speed flowfields. Inviscid hypersonic theory, real gas effects, and wall thermal protection strategies.

AE 4120. Introduction to Aerospace Engineering Composite Structures
3-0-3.
Prerequisite(s): AE 2120 or ME 2211
Introduction to composite systems. Principles of manufacturing, structural mechanics of laminated composites. Aerospace design applications. Damage tolerance.

AE 4131. Introduction to Finite Element Methods
2-3-3.
Prerequisite(s): AE 3122
Finite Element Method and its application to linear structural problems. The basic formulations of various structural elements are discussed.

AE 4170. Structural Integrity and Durability
3-0-3.
Prerequisite(s): AE 3120
Multiaxial stress states, inelasticity in metals and polymers, yield criteria, metal fatigue, fracture, stress intensity factors, fracture toughness, fatigue crack growth, metal creep, and polymer viscoelasticity.

AE 4220. Structural Dynamics and Aeroelasticity
3-0-3.
Prerequisite(s): AE 3122 and AE 3515
Structural dynamics of one-dimensional systems. Analysis of static aeroelastic phenomena, unsteady aerodynamics, and flutter. Equations of motion for complete aeroelastic systems; solution techniques.

AE 4350. Aerospace Engineering Design Project I
2-3-3.
Prerequisite(s): AE 3021 and AE 3310 and AE 3521 and AE 4451
Conceptual design methodology developed and applied incorporating center of gravity, inertias, structural layout, materials, propulsion integration, stability and control, vehicle sizing, performance, and acquisition costs.

AE 4351. Aerospace Engineering Design Project II
2-3-3.
Prerequisite(s): AE 4350
Design methodology further developed and applied. Teams formed to prepare competitive proposals in response to given mission requirements. Designs publicly presented and defended.

AE 4355. Aerospace Systems Design Competition IV
1-6-3.
Team-oriented aerospace systems design project directed by a faculty advisor. Typically a national student competition in aircraft, rotorcraft, or spacecraft design. Technical or leadership role commensurate with senior standing.

AE 4356. Space Systems Design Project I
2-3-3.
Prerequisite(s): AE 3310 and AE 3021* and AE 3521* and AE 4451*
First-semester space-oriented capstone design course. Introduction to design processes for spacecraft and launch vehicle design. Students respond to two mock-proposal requests. Topics may vary.

AE 4357. Space Systems Design Project II
2-3-3.
Prerequisite(s): AE 4356
Second-semester team-oriented space capstone design course. Competing teams of five to six students respond to an instructor-provided mock-RFP for a space system. Topics may vary.

AE 4375. Fundamentals of Computer-Aided Engineering and Design
3-0-3.
Prerequisite(s): CS 1321 and (MATH 2403 or MATH 2413 or MATH 24X3)
Introduction to the principles of geometric modeling; 2-D systems; 3-D wireframe, surface and solid representations; mathematical representations of curves, surfaces, solids; application to aerospace design problems.

AE 4380. Astronautics
3-0-3.
Prerequisite(s): AE 2220
Introduction to the space environment, two-body orbital mechanics, rocket vehicle propulsion, performance, and staging. Interplanetary trajectories, atmospheric entry and heating, spacecraft communications.

AE 4451. Jet and Rocket Propulsion
3-0-3.
Prerequisite(s): AE 3450
Principles of aerospace propulsion systems. Thermodynamic cycles. Thermodynamics of combustion. Turbine engine and rocket performance characteristics. Cycle/component analysis of engines and turbomachinery.

AE 4461. Introduction to Combustion
3-0-3.
Prerequisite(s): AE 3450
Basics of combustion and combustion devices. Chemical thermodynamics, reaction rates, premixed/nonpremixed flames, ignition, stabilization, and pollutants. Applications in turbine, rocket, and internal combustion engines.

AE 4521. Vehicle Guidance and Simulation
3-0-3.
Prerequisite(s): AE 3521
Simulation of aerospace systems. Simulation as an engineering tool. Mathematical modeling. Simulation of aircraft, spacecraft, missiles, and guidance systems. Illustrative case studies.

AE 4525. Control System Design Laboratory
1-3-2.
Prerequisite(s): AE 3521*
Experiments in system dynamics and control with emphasis on vehicle flight control system design.

AE 4580. Introduction to Avionics Integration
3-0-3.
Prerequisite(s): AE 3521 and ECE 3710
Avionics in modern aerospace vehicle systems, including impact on design and performance. Specific case-studies; covers: navigation, GPS, stability augmentation, radar, health monitoring, databases, human factors, and software.

AE 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

AE 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

AE 4757. Biofluid Mechanics
3-0-3.
Prerequisite(s): AE 2020 or ME 3340 or BMED 3300
Introduction to the study of blood flow in the cardiovascular system. Emphasis on modeling and the potential of flow studies for clinical research application. Crosslisted with CHE and ME 4757.

AE 4758. Biosolid Mechanics
3-0-3.
Prerequisite(s): (MATH 2403 or MATH 2413 or MATH 24X3) and (ME 3201 or AE 3120 or BMED 3400)
The mechanics of living tissue, e.g., arteries, skin, heart muscle, ligament, tendon, cartilage, and bone. Constitutive equations and some simple mechanical models. Mechanics of cells. Applications. Crosslisted with CHE and ME 4758.

AE 4760. Engineering Acoustics and Noise Control
3-0-3.
Prerequisite(s): MATH 2403 or MATH 2413 or MATH 24X3
Study of acoustics related to noise and its control; acoustics terminology wave propagation, wave equation solutions, instrumentation, data processing, room acoustics, noise control, noise legislation. Crosslisted with ME 4760.

AE 4791. Mechanical Behavior of Composites
3-0-3.
Prerequisite(s): AE 3120 or ME 3201
Stress-strain behavior of composites, property of matrix and reinforcing materials, mechanics of fiber-reinforced composites, lamina and laminate analysis, and mechanical performance. Crosslisted with CEE, CHE, ME, MSE, and PTFE 4791.

AE 4793. Composite Materials and Processes
3-0-3.
Prerequisite(s): CHEM 1310 and PHYS 2212
Basic principles of selection and design of composite materials and their manufacturing and testing. Cost factors. Laboratory exercises on manufacturing and tests. Crosslisted with CEE, CHE, ME, MSE, and PTFE 4793.

AE 4794. Composite Materials and Manufacturing Testing
3-3-4.
Prerequisite(s): CHEM 1310 and PHYS 2212
Basic principles of selection and sign of composite materials and their manufacturing and testing. Cost factors. Laboratory exercises on manufacturing and tests. Crosslisted with CEE, CHE, ME, MSE, and PTFE 4794.

AE 4801, -02, -03, -04. Special Topics
Class and credit hours equal last digit in course number. Normally taken by seniors. Course material devoted to special topics in aerospace engineering.

AE 4901, -02, -03. Special Problems
Credit hours to be arranged.
Research topic selected in consultation with advisor. A brief description, endorsed by the faculty advisor, must be approved by the School.

AE 6009. Viscous Fluid Flow
3-0-3.
Fundamental conservation laws. Laminar flows, wall-bound and free shear flows. Separation, heat transfer, and compressibility effects. Introduction to flow instability and transition to turbulence.

AE 6012. Turbulent Flows
3-0-3.
Prerequisite(s): AE 6009
Basic characteristics of turbulence. Statistical methods. Reynolds averaging, kinetic energy budget, and scaling issues. Homogeneity and isotrophy. Free- and wall-bounded shear flows. Simulation and modeling.

AE 6020. High-Speed Flow
3-0-3.
Prerequisite(s): AE 3021
Transonic small disturbance theory. Transonic potential flow modeling. Supercritical airfoil design. Physics of hypersonic flow. Newtonian flow. Modeling of hypersonic viscous and inviscid flow.

AE 6030. Unsteady Aerodynamics
3-0-3.
Prerequisite(s): AE 3021
Unsteady potential theory for various speed ranges. Calculation of steady and unsteady aerodynamic loads on airfoils and wings. Vortex flows. Topics of current research interest.

AE 6042. Computational Fluid Dynamics
4-0-4.
Prerequisite(s): AE 3021
Finite-difference, finite volume methods for solution of Navier-Stokes and Euler equations. Classification of equations, stability, grids, boundary conditions, implicit and explicit methods, turbulence modeling.

AE 6050. Gas Dynamics
3-0-3.
Prerequisite(s): AE 6765 or ME 6765
Defining equations for compressible flows, real gas properties and their effect on the behavior of equilibrium and non-equilibrium flows.

AE 6052. Flow Diagnostics and Control
2-3-3.
Prerequisite(s): AE 3021 and AE 3051
Introduction to experimental techniques; flow visualization; statistical methods; pressure, velocity, temperature, density, particle size, reaction rate measurements. Experiment design, data acquisition, and interpretation. Flow control.

AE 6060. Aeroacoustics
3-0-3.
Prerequisite(s): AE 3021
Lighthill's theory of aerodynamic noise and extensions, flow/acoustic interactions, feedback phenomenon, supersonic jet noise, aeroacoustics of ducts, propeller noise, helicopter noise, sonic boom.

AE 6070. Rotary Wing Aerodynamics
3-0-3.
Prerequisite(s): AE 3021
Vortex wake modeling; analytical inflow theories, modern computational methods for rotary wing aerodynamic analysis; aerodynamic noise.

AE 6080. Dynamics of Turbulence
3-0-3.
Prerequisite(s): AE 6012
Fundamental physics of turbulent flows. Vorticity dynamics, Kolmogorov similarity hypotheses and nonlinear interactions. Mixing and dispersion. Direct and large-eddy simulations. Reynolds stress modeling. Advanced topics.

AE 6100. Structural Stability I
3-0-3.
Prerequisite(s): AE 3122
Stability of elastic systems under quasi-static loads. Classical, kinetic, and potential energy approaches through rigid member models. Buckling of elastic bars and frames. Energy methods.

AE 6101. Structural Stability II
3-0-3.
Prerequisite(s): AE 6100
Buckling of beams on elastic foundations, rings and arches; elasticity theory; torsional buckling of shafts, buckling of plates, circular cylindrical shells, rotating beams, nonconservative problems.

AE 6104. Computational Mechanics
3-0-3.
Prerequisite(s): AE 6106
Development of finite element methods for linear, static structural analysis. The basic tools of the finite element method. The formulation of various structural elements.

AE 6106. Analysis of Aerospace Structural Elements
3-0-3.
Prerequisite(s): AE 3122
This course focuses on the analysis of advanced aerospace structures. Beam theory is reviewed, plate theory is introduced. Classical and energy solutions are presented.

AE 6111. Elasticity
3-0-3.
Prerequisite(s): AE 6769 or ME 6769
Stresses and deformations in continuum media. Stress and strain measures used in nonlinear elasticity. Equilibrium equations and energy principles. Nonlinear beam, plate, and shell applications.

AE 6112. Inelastic Response
3-0-3.
Prerequisite(s): AE 6769 or ME 6769
Fundamentals of inelastic response relevant to aerospace and composite structures. Viscoelastic constitutive relations. Isothermal boundary value problems. Foundations of plasticity theory. Solution of plastic-elastic problems.

AE 6123. Design of Fiber-Reinforced Composite Structures
2-3-3.
Prerequisite(s): ME 2211 or AE 2120
Composite material systems, composite structures including anisotropic plate and shell theory, shear deformation, hygrothermal and interlaminar stresses. Finite element modeling. Design case studies and cost-effective applications for thin walled sections.

AE 6161. Theory of Plates
3-0-3.
Prerequisite(s): AE 6106
Development of isotropic and anisotropic plate theories. Classical and energy solutions for various geometrics and loadings. Aerospace applications including elastically coupled composite and sandwich plates.

AE 6162. Shell Structures
3-0-3.
Prerequisite(s): AE 6161
Analysis of stresses and deformation of shells with and without bending, shells forming surfaces of revolution, asympiote methods, buckling of shells, nonlinear theories.

AE 6165. Principles of Fracture and Fatigue
3-0-3.
Prerequisite(s): ME 2211 or AE 2120
Brittle and ductile fracture. Determination of stress intensity factors. Analytics of fracture mechanics. Elastic-plastic fracture. Energy release rate. Mechanics of fatigue. Crack growth. Environmental effects.

AE 6170. Structural Optimization
3-0-3.
Prerequisite(s): AE 3122
Mathematical methods of constrained optimization, sensitivity analysis, approximation concepts, decomposition techniques, shape optimization in the context of structural design.

AE 6200. Aeroelasticity
3-0-3.
Prerequisite(s): AE 6230
Understanding and analysis of aeroelastic phenomena in fixed-wing aircraft, static aeroelasticity, dynamic aeroelasticity, and dynamic response and transient stresses in aircraft structures.

AE 6210. Advanced Dynamics I
3-0-3.
Prerequisite(s): AE 2220
Kinematics of particles and rigid bodies, angular velocity, inertia properties, holonomic and nonholonomic constraints, generalized forces.

AE 6211. Advanced Dynamics II
3-0-3.
Prerequisite(s): AE 6210
A continuation of AE 6210. Equations of motion, Newtonian frames, consistent linearization, energy and momentum integrals, collisions, mathematical representation of finite rotation.

AE 6220. Rotorcraft Structural Dynamics and Aeroelasticity
3-0-3.
Prerequisite(s): AE 6210 and AE 6230
Elementary blade dynamics, flap-lag dynamics, ground resonance, structural dynamics of rotating beams, nonlinear elastic blade analysis, harmonic balance and trim, Floquet theory.

AE 6230. Structural Dynamics
3-0-3.
Prerequisite(s): AE 3120 and AE 3515
Dynamic response of single-degree-of-freedom systems, Lagrange's equations; modal decoupling; vibration of Euler-Bernoulli and Timoshenko beams, membranes, and plates.

AE 6231. System Identification in Structural Dynamics
3-0-3.
Prerequisite(s): AE 6230
System identification by complex exponential methods, poly ref techniques, eigen-realization methods and frequency domain methods. Effects of noise, generalized least squares, and recursive online identification.

AE 6240. Numerical Methods in Structural Dynamics
3-0-3.
Prerequisite(s): AE 6230
Rayleigh quotient, Rayleigh-Ritz and Galerkin methods; extraction of eigenvalues and eigenvectors; analysis of forced harmonic response; direct time integration of large-scale systems.

AE 6251. Experimental Methods in Structural Dynamics
3-3-3.
Prerequisite(s): AE 6230
Experimental methods for measurement of structural vibration, random vibration, analytical methods for analysis of vibration data, applications to single and multi-degree-of-freedom problems.

AE 6252. Smart Structures and Structural Control
3-3-3.
Prerequisite(s): AE 6230
Modeling smart sensors and actuators, development of closed loop models, design of controllers, validation of controllers, application to vibration control, noise control, and shape control.

AE 6263. Flexible Multi-Body Dynamics
3-0-3.
Prerequisite(s): AE 6211 and AE 6230
Nonlinear, flexible multi-body dynamic systems, parametrization of finite rotations, strategies for enforcement of holonomic and non-holonomic constraints, formulation of geometrically nonlinear structural elements, time-integration techniques.

AE 6270. Applied Nonlinear Dynamics
3-0-3.
Prerequisite(s): AE 6230
Nonlinear vibration methods through averaging and multiple scales, bifurcation, periodic and quasi-periodic systems, transition to chaos, characterization of chaotic vibrations, thermodynamics of chaos, chaos control.

AE 6280. Wave Propagation
3-0-3.
Prerequisite(s): AE 6230
Dilational, equivalue mixed waves; Rayleigh and Lamb waves, reflection, refraction, impact problems, plastic waves, N.D.E., vibration control, numerical methods, finite deformation wave propagation, constitutive equations.

AE 6320. Astronautics
3-0-3.
Prerequisite(s): AE 2220
Introduction to the space environment, two-body orbital mechanics, rocket propulsion, performance, and staging. Interplanetary trajectories, atmospheric entry and heating, spacecraft communications. Credit not allowed for both AE 4380 and AE 6320.

AE 6322. Spacecraft Launch and Vehicle Design
2-6-4.
Prerequisite(s): AE 6320
Early design of spacecraft and launch vehicles. Emphasis on preliminary vehicle sizing and performance, effect of new technologies, and disciplinary interactions. Individual design projects.

AE 6333. Rotorcraft Design I
3-0-3.
Prerequisite(s): AE 6372*
System approach to conceptual design of aerospace systems with emphasis on rotorcraft. Comprehensive methodologies for aerospace vehicle synthesis and sizing. Integration of technologies.

AE 6334. Rotorcraft Design II
2-6-4.
Prerequisite(s): AE 6333 and AE 6383
Students work together on this application to complete the preliminary design stage of a specific rotorcraft. Participants are exposed to disciplinary and interdisciplinary issues.

AE 6343. Aircraft Design I
3-0-3.
Prerequisite(s): AE 6372*
Stochastic approach to conceptual design of aerospace systems with emphasis on aircraft and missiles. Comprehensive methodologies for aerospace vehicle synthesis and sizing. Integration of technologies.

AE 6344. Aircraft Design II
2-6-4.
Prerequisite(s): AE 6343 and AE 6383
Students work together on this application to complete the preliminary design stage of a specific aircraft or missile. Participants are exposed to disciplinary and interdisciplinary issues.

AE 6354. Advanced Orbital Mechanics
3-0-3.
Prerequisite(s): AE 6320
Advanced concepts in orbital mechanics including orbit determination, orbital perturbations, time of flight, rendezvous, low-thrust trajectories, and multi-body problems. Taught in alternate years.

AE 6361. Air Breathing Propulsion System Design I
3-0-3.
Prerequisite(s): CS 1321
Air breathing propulsion design with emphasis on multidisciplinary design issues related to system integration, cycle selection, performance, cost, reliability, maintainability, etc.

AE 6362. Safety by Design
3-3-4.
Prerequisite(s): AE 6320 or AE 6331 or AE 6341
Autonomous situational flight model allows students to examine complex behaviors in the "pilot-vehicle-operational conditions" system. Flight certification and airworthiness requirements are mapped into formal scenarios.

AE 6372. Aerospace Systems Engineering
3-0-3.
Introduction to aerospace systems engineering. Systems engineering and quality engineering methods and tools. Top-down design decision support processes, computer integrated environments, Integrated Product/Process Development (IPPD).

AE 6373. Advanced Design Methods I
3-3-4.
Prerequisite(s): MATH 2403
Introduction to modern probabilistic design methods and techniques. Design of experiments, Taguchi methods, response surface equations, robust design, risk and uncertainty, technology assessment and selection.

AE 6374. Advanced Design Methods II
3-0-3.
Prerequisite(s): MATH 2403 and CS 1371
Introduction to modern multidisciplinary design optimization methods and techniques. Numerical optimization with applications, stochastic methods, Genetic Algorithms, multidisciplinary decomposition methods, multi-level optimization strategies.

AE 6380. Fundamentals of Computer-Aided Design and Engineering
3-0-3.
Prerequisite(s): CS 1321 and (MATH 2403 or MATH 2413 or MATH 24X3)
Introduction to the principles of geometric modeling; 2-D systems; 3-D wireframe, surface and solid representations; mathematical representations of curves, surfaces, solids; application to aerospace design problems. Credit not allowed for both AE 4375 and AE 6380.

AE 6381. Software Development for Engineering Applications
2-3-3.
Prerequisite(s): CS 1321
Introduction to the development of engineering analysis and visualization software for UNIX workstations with emphasis on rapid prototyping, information modeling, distributed processing, and client/server architectures.

AE 6382. Computing Systems for Engineering Research Laboratory
0-3-1.
Prerequisite(s): CS 1371
Introduction to computational systems used for engineering research. Basics of Unix and Windows operating systems, survey of the major programming languages, and computing frameworks.

AE 6383. Applied Design Laboratory
0-3-1.
Introduction to computing tools and processes used in subsequent applied design courses in graduate fixed wing, rotary wing, and space systems design tracks.

AE 6410. Combustion Dynamics
3-0-3.
Prerequisite(s): AE 6766 or ME 6766
Acoustic wave propagation in inhomogeneous flows, flame acoustic wave interactions, and control of combustion-driven oscillations.

AE 6412. Turbulent Combustion
3-0-3.
Prerequisite(s): AE 6766 or ME 6766
Fundamentals of interaction between flow turbulence and reactive scalars. Theoretical, numerical, and experimental methods. Physics of premixed, non-premixed, and partially premixed turbulent combustion.

AE 6414. Multi-Phase Combustion
3-0-3.
Prerequisite(s): AE 6766 or ME 6766
Fundamentals of dispersed-phase dynamics of liquid-gas and soot aerosol flows. Fluid-particle-wall interactions. Numerical and experimental methods. Advances in spray combustion.

AE 6440. Turbine Engine Aerothermodynamics
3-0-3.
Prerequisite(s): AE 4451
Analysis and design of gas turbine engine components including axial flow compressors, turbines, inlets, and nozzles. Heat transfer and turbine blade cooling.

AE 6445. Combustor Fundamentals
3-0-3.
Examination of the chemical and aerothermodynamic processes that govern gas turbine combustor performance and design. Also fuel injection, noise, emissions, and testing methodologies.

AE 6450. Rocket Propulsion
3-0-3.
Prerequisite(s): AE 4451
Analysis and design of rocket engines including liquid, solid, hybrid, and advanced propulsion systems.

AE 6503. Helicopter Stability and Control
3-0-3.
Prerequisite(s): AE 3515 and AE 4070
Helicopter general equations of motion, rotor forces and moments, helicopter stability and control characteristics, handling qualities, flight control system design.

AE 6504. Modern Methods in Aircraft Flight Control
3-0-3.
Prerequisite(s): AE 3521
Linear quadratic regulator design. Model following control. Stochastic control. Fixed structure controller design. Applications to aircraft flight control.

AE 6505. Random Processes and Kalman Filtering
3-0-3.
Prerequisite(s): AE 3515
Probability and random variables and processes; correlation; shaping filters; simulation of sensor errors; Wiener filter; random vectors; covariance propagation; recursive least-squares; Kalman filter; extensions.

AE 6506. Aerospace Guidance and Navigation
3-0-3.
Prerequisite(s): AE 3521
Earth's shape and gravity. Introduction to inertial navigation. GPS aiding. Error analysis. Guidance systems. Analysis of the guidance loop. Estimation of guidance variables. Adjoint analysis.

AE 6511. Optimal Guidance and Control
3-0-3.
Prerequisite(s): AE 3515
Euler-Lagrange formulation; Hamilton-Jacobi approach; Pontryagin's minimum principle; systems with quadratic performance index; second variation and neighboring extremals; singular solutions; numerical solution techniques.

AE 6520. Advanced Flight Dynamics
3-0-3.
Prerequisite(s): AE 3515
Reference frames and transformations, general equations of unsteady motion, application to fixed-wing, rotary-wing and space vehicles, stability characteristics, flight in turbulent atmosphere.

AE 6531. Aerospace Robust Control I
3-0-3.
Prerequisite(s): ECE 6550
Robustness issues in controller analysis and design. LQ analysis, H2 norm, LQR, LQG, uncertainty modeling, small gain theorem, H-infinity performance, and the mixed-norm H2/H-infinity problem.

AE 6532. Aerospace Robust Control II
3-0-3.
Prerequisite(s): AE 6531
Advanced treatment of robustness issues. Controller analysis and design for linear and nonlinear systems with structured and non-structured uncertainty. Reduced-order control, stability multipliers, and mixed-mu.

AE 6534. Control of Aerospace Structures
3-0-3.
Prerequisite(s): AE 6230 and AE 6531
Advanced treatment of control of flexible structures. Topics include stability of multi-degree-of-freedom systems, passive and active absorbers and isolation, positive real models, and robust control for flexible structures.

AE 6580. Aerospace Nonlinear Control
3-0-3.
Prerequisite(s): ECE 6550
Advanced treatment of nonlinear robust control. Lyapunov stability theory, absolute stability, dissipativity, feedback linearization, Hamilton-Jacobi-Bellman theory, nonlinear H-infinity, backstepping control, and control Lyapunov functions.

AE 6760. Acoustics I
3-0-3.
Prerequisite(s): MATH 2403 or MATH 2413 or MATH 24X3
Fundamental principles governing the generation, propagation, reflection, and transmission of sound waves in fluids. Crosslisted with ME 6760.

AE 6761. Acoustics II
3-0-3.
Prerequisite(s): AE 6760 or ME 6760
Radiation and scattering of sound waves in fluids, duct acoustics, dissipation phenomena. Crosslisted with ME 6761.

AE 6762. Applied Acoustics
3-0-3.
Prerequisite(s): AE 6760 or ME 6760
Mufflers, resonators, acoustic materials, barriers, industrial noise, room acoustics, active noise control. Crosslisted with ME 6762.

AE 6765. Kinetics and Thermodynamics of Gases
4-0-4.
Prerequisite(s): AE 3450 or ME 3322
Thermodynamics of nonreacting and reacting gas mixtures. Introductory quantum theory, statistical thermodynamics, and gas kinetic theory. Crosslisted with ME 6765.

AE 6766. Combustion
3-0-3.
Prerequisite(s): AE 6765 or ME 6765
Introductory chemical kinetics, detonations and deflagrations, laminar flame propagation in premixed gases, ignition and quenching, laminar diffusion flames and droplet burning, turbulent reacting flows. Crosslisted with ME 6766.

AE 6767. Advanced Topics in Combustion
3-0-3.
Prerequisite(s): AE 6766 or ME 6766
Turbulent combustion, combustion instability and control, solid propellants and explosives, chemical kinetics, pollutant formation and destruction, computational and experimental methods for reacting flows. Crosslisted with ME 6767.

AE 6769. Linear Elasticity
3-0-3.
Governing equations of linear elasticity, plane elasticity, boundary value problems, airy stress function and complex variable methods, simple three-dimensional solutions. Crosslisted with ME 6769.

AE 6770. Energy and Variational Methods in Elasticity and Plasticity
3-0-3.
Prerequisite(s): MATH 2403 and (AE 3120 or ME 3201)
Applications of energy and variational methods in engineering mechanics to elastic, plastic, and dynamical behavior of deformable bodies. Crosslisted with ME 6770.

AE 6779. Dynamic System Simulation and Modeling
3-0-3.
Prerequisite(s): AE 2220
Models of dynamic systems, such as aircraft, ground vehicles and machinery, and manual control. Numerical simulation techniques and applications. Interactive simulators. Student programming project. Crosslisted with ISYE 6779.

AE 7000. Master's Thesis
Credit hours to be arranged.

AE 7764. Acoustic Propagation
3-0-3.
Prerequisite(s): AE 6760 or ME 6760
Propagation of sound in inhomogeneous fluids; ray acoustics, ocean and atmospheric acoustics, nonlinear acoustics. Crosslisted with ME 7764.

AE 7772. Fundamentals of Fracture Mechanics
3-0-3.
Prerequisite(s): MSE 3005 or AE 3120 or ME 3201
Advanced study of failure of structural materials under load, mechanics of fracture, and microscopic and macroscopic aspects of the fracture of engineering materials. Crosslisted with CHE, CEE, ME, and MSE 7772.

AE 7773. Advanced Fracture Mechanics
3-0-3.
Prerequisite(s): AE 7772 or CEE 7772 or CHBE 7772 or ME 7772 or MSE 7772
Nonlinear fracture mechanics including elastic-plastic and time-dependent fracture, advanced test methods, J-integral theory, and extensions. Crosslisted with CEE, CHE, ME, and MSE 7773.

AE 7774. Fatigue of Materials and Structures
3-0-3.
Prerequisite(s): AE 7772 or CEE 7772 or CHBE 7772 or ME 7772 or MSE 7772
Mechanical and microstructural aspects of nucleation and growth of cracks under cyclic loading conditions, notch effects, cumulative damage, multiaxial loading, and fatigue crack propagation. Crosslisted with CEE, CHE, ME, and MSE 7774.

AE 7775. Topics in Fracture and Fatigue of Metallic and Composite Structures
3-0-3.
Prerequisite(s): ME 2211 or AE 2120
Brittle and ductile fracture criteria. Failure prediction in composite structures. Free-edge and internal delamination. Anisotropic cracks. Fatigue behavior of composites and metal. New micromechanical models. Crosslisted with CHE, ME, and MSE 7775.

AE 7791. Damage, Failure, and Durability of Composite Materials
3-0-3.
Prerequisite(s): AE 4791 or CEE 4791 or CHBE 4791 or ME 4791 or MSE 4791
Analysis and failure of fiber-reinforced composite material systems. Mechanisms of toughening, multiple cracking mechanisms. Failure in woven fabric, braided, and special geometry composites. Crosslisted with CHE, CEE, ME, MSE, and PTFE 7791.

AE 7792. Advanced Mechanics of Composites
3-0-3.
Prerequisite(s): AE 7791 or CHBE 7791 or CEE 7791 or ME 7791 or MSE 7791 or PTFE 7791
Anisotropic elasticity, hygrothermal behavior, stress analysis of laminated composites including 3-D effects, stress concentrations, free-edge effects, thick laminates, adhesive and mechanical connections, fracture of composites. Crosslisted with CHE, CEE, ME, MSE, and PTFE 7792.

AE 7793. Manufacturing of Composites
3-0-3.
Prerequisite(s): AE 4794 or CEE 4794 or CHBE 4794 or ME 4794 or MSE 4794 or PTFE 4794
Major manufacturing techniques of metal-ceramic and polymer-matrix composites. Modeling of processes with emphasis on fundamental mechanisms and effects. Crosslisted with CHE, CEE, ME, MSE, and PTFE 7793.

AE 8001. Design Seminar
1-0-1.
Case studies of existing aerospace systems; assessment of design payoffs and risks; industry experts provide case examples and knowledge transfer to course participants; field trips.

AE 8801, -02, -03, -04, -05. Special Topics
Class and credit hours equal last digit in course number.
Special topics of current interest.

AE 8900, -01, -02, -03. Special Problems
Credit hours to be arranged.

AE 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding graduate teaching assistantships.

AE 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding graduate research assistantships.

AE 8999. Preparation for Doctoral Dissertation
Credit hours to be arranged.

AE 9000. Doctoral Thesis
Credit hours to be arranged.

An asterisk (*) denotes prerequisite courses that may be taken concurrently.

Wallace H. Coulter Department of Biomedical Engineering at Georgia Tech and Emory University

www.bme.gatech.edu

Established in 1997
Location: U. A. Whitaker Building
Telephone: 404.385.0124
Fax: 404.894.4243

Wallace H. Coulter Chair and Professor–Larry V. McIntire; *Associate Chair for Research, Wallace H. Coulter Distinguished Faculty Chair, and Regents' Professor*–Ajit P. Yoganathan; *Associate Chair for Graduate Programs and Professor*–Stephen P. DeWeerth; *Associate Chair for Undergraduate Programs and Associate Professor*–Paul J. Benkeser; *Georgia Research Alliance Eminent Scholar in Systems Biology and Professor*–Eberhard O. Voit; *Price Gilbert Jr. Chair in Tissue Engineering, Deputy Director, GTEC, and Professor*–Barbara D. Boyan; *Georgia Research Alliance Eminent Scholar in Imaging and Professor*–Xiaoping Hu; *Julian Hightower Professor (Electrical and Computer Engineering and Biomedical Engineering)*–Allen R. Tannenbaum; *Dean, College of Engineering, and Professor*–Don P. Giddens *[Lawrence L. Gellerstedt Jr. Chair in Bioengineering and Georgia Research Alliance Eminent Scholar]*; *Regents' Professor*–Mark Borodovsky.
Professors–Gang Bao, Richard Nichols, Cheng Zhu *(Joint-Mechanical Engineering)*.
Associate Professors–Ravi Bellamkonda, Hanjoong Jo, Shuming Nie.
Assistant Professors–Julia E. Babensee, Shella Keilholz, Michelle C. LaPlaca, Joseph M. Le Doux, Robert H. Lee, Todd C. McDevitt, Niren Murthy, John Oshinski, Steven Potter, Oskar Skrinjar, Johanna S. Temenoff, Lena Ting, Dongmei "May" Wang, Yadong Wang.
Director, Learning Sciences Research–Wendy L. Newstetter.

General Information

Biomedical engineering is the interdisciplinary field of study combining engineering with life sciences. The role of the biomedical engineer is to provide answers to problems arising from the study of living systems by employing the methodology and principles of engineering. This activity may encompass the spectrum from direct clinical applications to long-range fundamental research.

The Wallace H. Coulter Department of Biomedical Engineering at Georgia Tech and Emory University (the Coulter Department) is a unique partnership between a public institution and a private university. The formation of the Department in 1997 was the culmination of collaborative efforts between the two institutions in the field of biomedical engineering that dated back to the 1980s. In 2000, the Department assumed the name of Wallace H. Coulter, recognized as one of the most influential engineers in the twentieth century through his entrepreneurial efforts in shaping the fields of automated cell analysis and hematology.

The Coulter Department has identified five thrust areas in which to focus research and educational programs: cardiovascular biomechanics and biology, cellular and biomolecular engineering, neuroengineering, biomedical imaging and informatics, and biomaterials and tissue engineering. Research in these biomedical engineering thrust areas can result in major breakthroughs in medicine, basic science, and applied technology.

The true integration of the life sciences and engineering is essential in educating a substantial percentage of the next generation of biomedical engineers in order to benefit from the biological revolution and its applications to medicine. The Coulter Department offers both undergraduate and graduate degree programs that attract outstanding students who wish to have that integration in their education so that they may be equipped with the tools to be the leaders in this field in the twenty-first century.

Undergraduate Program

The Coulter Department offers a B.S. degree conferred by Georgia Tech. The program strives to produce graduates who are expected to demonstrate the following during the first few years after graduation:

- Mathematics, science, and engineering fundamental expertise at the interface of engineering

and the life sciences, which enables them to take leadership roles in the ever-expanding field of biomedical engineering
- An ability to use their multidisciplinary background to foster communication across professional and disciplinary boundaries with the highest professional and ethical standards
- The ability to recognize the limits of their knowledge and initiate self-directed learning opportunities to be able to continue to identify and create professional opportunities for themselves in the field of biomedical engineering

By the time of graduation from the program, the students will have obtained
- an ability to identify, formulate, analyze, model, and solve real-world biomedical engineering problems by integrating and applying basic principles of mathematics, life sciences, and engineering;
- an ability to use modern science and engineering techniques, skills, and computational tools to support biomedical engineering analysis, modeling, problem solving, and design;
- an abillty to meet the desired needs of a client by designing a biomedical engineering system, component, or process;
- an ability to design and conduct experiments as well as to measure, analyze, and interpret experimental data from living systems;
- an ability to communicate effectively in both written reports and oral presentations;
- an ability to function effectively within multidisciplinary teams;
- a broad education necessary for professional practice in biomedical engineering;
- an understanding of how ethical, social, and professional responsibilities impact the practice of biomedical engineering;
- an ability to recognize the limits of their knowledge and engage in self-directed learning;
- a knowledge of contemporary issues and challenges facing biomedical engineers; and
- advanced knowledge in one of four areas within the field – biomechanics, cellular and tissue engineering, neuroengineering, or biomedical imaging.

Bachelor of Science in Biomedical Engineering (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
MATH 1501	CALCULUS I	4
CHEM 1310	GENERAL CHEMISTRY	4
BIOL 1510	BIOLOGICAL PRINCIPLES	4
ENGL 1101	ENGLISH COMPOSITION I	3
WELLNESS		2
TOTAL SEMESTER HOURS		17

First Year - Second Semester

Course Number/Name		*Hours*
MATH 1502	CALCULUS II	4
CHEM 1315	SURVEY OF ORGANIC CHEMISTRY	3
PHYS 2211	INTRODUCTORY PHYSICS I	4
BMED 1300	PROBLEMS IN BME I	3
ENGL 1102	ENGLISH COMPOSITION II	3
TOTAL SEMESTER HOURS		17

Second Year – First Semester

Course Number/Name		*Hours*
MATH 2401	CALCULUS III	4
CHEM 3511	SURVEY OF BIOCHEMISTRY	3
PHYS 2212	INTRODUCTORY PHYSICS II	4
CS 1371	COMPUTING FOR ENGINEERS	3
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		17

Second Year - Second Semester

Course Number/Name		*Hours*
MATH 2403	DIFFERENTIAL EQUATIONS	4
BMED 2210	CONSERVATION PRINCIPLES IN BMED	4
COE 2001	STATICS	2
ECE 3710	CIRCUITS & ELECTRONICS	4
BMED 2300	PROBLEMS IN BME II	3
TOTAL SEMESTER HOURS		15

Third Year - First Semester

Course Number/Name		*Hours*
BMED 3160	SYSTEMS PHYSIOLOGY I	4
BMED 3400	INTRO. TO BIOMECHANICS	4
ECE 2025	INTRO. TO SIGNAL PROCESSING	4
ECE 3741	INSTRUMENTATION & ELECTRONICS LAB	1
CEE/MATH/ISYE 3770	STATISTICS & APPLICATIONS	3
TOTAL SEMESTER HOURS		16

Third Year - Second Semester

Course Number/Name		*Hours*
BMED 3500	BIOMEDICAL SENSORS & INSTRUMENTATION	3
BMED 3161	SYSTEMS PHYSIOLOGY II	4
BMED 3300	BIOTRANSPORT	4
HUMANITIES ELECTIVE(S)		3
LCC 3401	TECHNICAL COMMUNICATION PRACTICES	2
TOTAL SEMESTER HOURS		16

Fourth Year - First Semester

Course Number/Name		*Hours*
MSE 2001	PRINCIPLES & APPLICATIONS OF ENGINEERING MATERIALS	3
BMED 4600	SENIOR DESIGN PROJECT I	2
BME TECHNICAL ELECTIVE(S)		6
HUMANITIES ELECTIVE(S)		3
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Fourth Year - Second Semester

Course Number/Name		*Hours*
BMED 4601	SENIOR DESIGN PROJECT II	3
BME TECHNICAL ELECTIVE(S)		3
ECON 2100 or 2105 or 2106		3
HUMANITIES/SOCIAL SCIENCE ELECTIVE(S)		6
FREE ELECTIVE(S)		2
TOTAL SEMESTER HOURS		17

TOTAL PROGRAM HOURS = 130 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Electives

The biomedical engineering curriculum includes thirty semester hours of electives, subject to the following requirements:

1) Humanities, six hours: refer to pages 35-36 for a list of approved courses.
2) Social sciences, nine hours: must include HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200; refer to pages 35-36 for a list of approved courses to satisfy the remaining hours.
3) Concentration electives, fifteen hours: refer to **www.bme.gatech.edu/academics/electives.html** for a list of approved courses.

Minor in Biomedical Engineering

The minor requires the successful completion of at least eighteen hours of coursework selected from lists of approved biomedical engineering and bioscience courses (refer to **www.bme.gatech.edu/academics/undergrad_minor.html** for the current lists of approved courses). The goal of the minor program is to educate students in how to apply engineering fundamentals to solve problems in biology and medicine. The program should be of particular interest to those students who plan to pursue advanced degrees in biomedical engineering and/or medicine.

Graduate Programs

- Ph.D. Program in Biomedical Engineering
- Ph.D. and M.S. Programs in Bioengineering
- Ph.D. Program in Bioinformatics
- M.D./Ph.D. Program

Ph.D. Program in Biomedical Engineering

The Joint Biomedical Engineering Ph.D. program is offered through the Wallace H. Coulter Department of Biomedical Engineering at Georgia Tech and Emory University. The degree is conferred jointly by both Georgia Tech and Emory. The curriculum is based on an integration of life sciences, engineering, and mathematics. The goal is to enable students to postulate and solve biomedical problems quantitatively and with a systems perspective. Both Georgia Tech and Emory faculty provide an integrative teaching medium for students by "team-teaching" courses. One year of core courses establishes the fundamental principles in both life science and engineering. All students entering the program, regardless of undergraduate major, will be integrated into the same classes and are subject to the same program prerequisites. Problem-based learning in the first year will complement the engineering and life science courses. During the first and second semesters, students will be required to do a minimum of two lab rotations. Other requirements include a bioethics course, a teaching course, a teaching practicum, a minimum of nine hours of technical electives, and a nine-hour minor program of study outside the student's thesis research area.

Upon completion of the lab rotation requirement, students will be assigned a thesis advisor in

the summer of the first year. After successfully passing the qualifying examination, students submit a request for approval of their Thesis Reading Committee. Upon successful completion of all degree requirements, students will be awarded the Ph.D. degree by the graduate schools of Georgia Tech and Emory.

Minimum Prerequisites

B.S. in Engineering or Life Sciences
One year of calculus-based physics
One year of organic chemistry
Calculus up to ordinary differential equations (normally two years)

M.S. and Ph.D. in Bioengineering

This program is interdisciplinary in scope, where advanced courses in engineering specialties, life sciences, and bioengineering are combined with training in biomedical research. Both the M.S. and Ph.D. in bioengineering are being offered by the College of Engineering. Students select a home school within the College of Engineering (Aerospace Engineering, Biomedical Engineering, Chemical and Biomolecular Engineering, Civil Engineering, Materials Science and Engineering, Mechanical Engineering, and/or Polymer, Textile, and Fiber Engineering). Only students selecting biomedical engineering as their home school are reviewed and admitted by the Department of Biomedical Engineering. High-quality students with engineering or non-engineering backgrounds (degrees in computer science, physics, chemistry, biology, or mathematics, or physicians with undergraduate degrees in engineering or the physical sciences) are eligible to apply to the program.

Ph.D. Program in Bioinformatics

See description under School of Biology.

M.D./Ph.D. Program

The Coulter Department of Biomedical Engineering participates with the Emory University School of Medicine and the Medical College of Georgia to offer students an opportunity to combine their M.D. with a Ph.D. in Biomedical Engineering or Bioengineering.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course. An asterisk (*) denotes prerequisite courses that may be taken concurrently.

BIOMEDICAL ENGINEERING

BMED 1300. Problems in Biomedical Engineering I
1-6-3.
Prerequisite(s): MATH 1501 and (BIOL 1510 or BIOL 1511)
Biomedical engineering problems from industrial and clinical applications are addressed and solved in small groups using problem-based learning methodologies.

BMED 1750. Introduction to Bioengineering
3-0-3.
An introduction to the field of bioengineering, including the application of engineering principles and methods to problems in biology and medicine, the integration of engineering with biology, and the emerging industrial opportunities. Crosslisted with AE, CHE, ECE, ME, and MSE 1750.

BMED 1801, -02, -03, -04, -05. Special Topics
Class and credit hours equal last digit in course number.
Courses in special topics of current interest not included in the regular course offerings.

BMED 1811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number.
Courses in special topics of current interest not included in the regular course offerings.

BMED 2210. Conservation Principles in Biomedical Engineering
4-0-4.
Prerequisite(s): BMED 1300 and PHYS 2212 and MATH 2403
A study of material and energy balances applied to problems in biomedical engineering.

BMED 2300. Problems in Biomedical Engineering II
1-6-3.
Prerequisite(s): BMED 1300 and BMED 2210 and COE 2001
Biomedical engineering problems from industrial and clinical applications are addressed and solved in small groups using problem-based learning methods.

BMED 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

BMED 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

BMED 2801, -02, -03, -04, -05. Special Topics
Class and credit hours equal last digit in course number.
Courses in special topics of current interest not included in the regular course offerings.

BMED 2811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number.
Courses in special topics of current interest not included in the regular course offerings.

BMED 3160. Systems Physiology I
4-5-4
Prerequisite(s): (CHEM 3511* or CHEM 4511*) and BIOL 1510
A study of physiologic properties of human cells and tissues, with specific attention focused on organization, membrane-level transport and kinetics, cell signaling, and energy requirements.

BMED 3161. Systems Physiology II
3-5-4.
Prerequisite(s): BMED 2300 and (CEE 3770 or ISYE 3770 or MATH 3770) and BMED 3160
Quantitative model-oriented approaches to the study of major human physiologic functions and integrative analysis of the control of homeostatic processes.

BMED 3300. Biotransport
4-0-4.
Prerequisite(s): BMED 2210
Fundamental principles of fluid, heat, and mass transfer with particular emphasis on physiological and biomedical systems.
01-NOV-2000

BMED 3400. Introduction to Biomechanics
4-0-4.
Prerequisite(s): (MATH 2403 or MATH 2413) and COE 2001
An introduction to the basic concepts and methods in biomechanics, including statistics and the mechanics of biomaterials. The biomedical applications of mechanics will be illustrated.

BMED 3500. Biomedical Sensors and Instrumentation
2-3-3.
Prerequisite(s): ECE 2025 and (ECE 3041 or ECE 3741) and (CEE 3770 or ISYE 3770 or MATH 3770)
A study of basic concepts and design of electronic sensors and instrumentation used in biomedical measurements. Standard clinical measurement techniques will also be examined.

BMED 4500. Cell and Tissue Engineering Laboratory
1-6-3
Prerequisite(s): (BMED 3160 or BIOL 3331) and BMED 3500 and BMED 3400
The principles of cell and tissue engineering will be presented as a laboratory course to give students a hands-on experience. Cell engineering topics include receptor/ligand interactions, cell cycle/metabolism, cell adhesion, cellular mechanics, cell signal transduction, and cell transfection. Tissue engineering topics include applications, biomaterials/scaffolds and cells for reparative medicine, bioreactors and bioprocessing, functional assessment, in vivo issues.

BMED 4600. Senior Design Project I
1-3-2
Prerequisite(s): BMED 3161
Team-oriented major design project in biomedical engineering, incorporating engineering standards and realistic design constraints.

BMED 4601. Senior Design Project II
1-6-3.
Prerequisite(s): BMED 4600
Team-oriented major design project in biomedical engineering, incorporating engineering standards and realistic design constraints.

BMED 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

BMED 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

BMED 4750. Diagnostic Imaging Physics
3-0-3.
Physics and image formation methods for conventional X-ray, digital X-ray CT, nuclear medicine, and magnetic resonance and ultrasound imaging. Crosslisted with MP 4750 and NRE 4750.

BMED 4757. Biofluid Mechanics
3-0-3.
Prerequisite(s): AE 2020 or ME 3340 or BMED 3300
Introduction to the study of blood flow in the cardiovascular system. Emphasis on modeling and the potential of flow studies for clinical research application. Crosslisted with AE, CHE and ME 4757.

BMED 4758. Biosolid Mechanics
3-0-3.
Prerequisite(s): ME 3201 or BMED 3400
The mechanics of living tissue, e.g., arteries, skin, heart muscle, ligament, tendon, cartilage, and bone. Constitutive equations and some simple mechanical models. Mechanics of cells. Applications. Crosslisted with AE, CHE, and ME 4758.

BMED 4782. Biosystems Analysis
3-0-3.
Prerequisite(s): BMED 3500 or CHBE 4400 or ECE 2040 or ME 3015
Analytical methods for modeling biological systems, including white-noise protocols for characterizing nonlinear systems. Crosslisted with CHE, ECE, and ME 4782.

BMED 4783. Introduction to Medical Image Processing
3-0-3.
Prerequisite(s): ECE 2025 and (MATH 3770* or ISYE 3770* or CEE 3770*)
A study of mathematical methods used in medical image acquisition and processing. Concepts, algorithms, and methods associated with acquisition, processing, and display of two- and three-dimensional medical imaged are studied. Crosslisted with ECE 4783.

BMED 4801, -02, -03, -04, -05. Special Topics
Class and credit hours equal last digit in course number.
Courses in special topics of current interest not included in the regular course offerings.

BMED 4811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number.
Courses in special topics of current interest not included in the regular course offerings.

BMED 4823, -33. Special Topics
3-0-3.
Courses in special topics of current interest not included in the regular course offerings.

BMED 4900, -01, -02, -03. Special Problems
Credit hours to be arranged.
Individualized studies in certain specialized areas of interest in biomedical engineering.

BMED 6011. Engineering Science I
4-0-4.
Transport and reaction limitations; diffusion and convective transport; Reaction Networks; signal sampling and filtering.

BMED 6012. Engineering Science II
4-0-4.
Control theory: feedback and feed forward control; Ph.D. designs; stability criteria; rigid body mechanics; fluid mechanics.

BMED 6021. Biomedical Engineering Problem Solving I
0-6-2.
Approaches to solving open-ended problems from industrial and clinical applications in biomedical engineering. Emphasis on critical literature reviews, model formulation and testing, and effective writing.

BMED 6022. Biomedical Engineering Problem Solving II
0-6-2.
Prerequisite(s): BMED 6021
Application of engineering principles to complex problems in physiology and medicine. Emphasis on experimental design, quantitative hypothesis testing, and presentation of results.

BMED 6031. Principles of Basic Biomedical and Biological Sciences I
6-0-6.
Fundamental concepts of genetics function and basic chemical building blocks of cells: proteins, enzymes, carbohydrates, lipids, nucleic acids, replication, transcription, translation, and genetic engineering.

BMED 6032. Principles of Basis Biomedical and Biological Sciences II
6-0-6.
Prerequisite(s): BMED 6031
Fundamental concepts from cell biology, immunology, and metabolism: cell structure, organelles, membrane transport, cell cycle and growth, and excitable membranes.

BMED 6041. Analytical Methods for Biomedical Engineering
3-0-3.
Basic analytical approaches to solve mathematical problems involved in biomedical engineering applications. Course focuses on ordinary and partial differential equations and on integral transform methods.

BMED 6042. Systems Physiology
3-0-3.
Regulation of physiological functions in the cardio-respiratory-renal, musculoskeletal, and gastrointestinal systems, and their interactions with the neural, endocrine, and immune systems.

BMED 6743. Tissue Mechanics
3-0-3.
Structure-function relationships and constitutive models for a variety of biological tissues, with an emphasis on understanding the mechanical behaviors of normal and pathological tissues. Credit not given for both BMED/ME 6783 and BMED/ ME 6743. Crosslisted with ME 6743.

BMED 6753. Principles of Management for Engineers
3-0-3.
The course will provide an introduction to selected topics needed to be successful in the technology industries. Cannot count toward major area requirements in M.S. or Ph.D. programs of study.

BMED 6774. Biomaterials: Structure and Function
3-0-3.
Structure-function relationships of biomaterials and biomaterial characterization will be covered. Materials for medical implants, tissue engineering, biosensing, imaging, and drug delivery will be covered. Crosslisted with CHE, ME, and MSE 6774.

BMED 6777. Advanced Biomaterials
3-0-3.
Prerequisite(s): BMED 6776 or CHBE 6776 or ME 6776 or MSE 6776 or PTFE 6776
Advanced topics of biomaterials performance and engineering, including biointerfaces, host reactions to materials, and bio-inspired/smart-materials strategies. Crosslisted with CHE, ME, and MSE 6777.

BMED 6778. Introduction to Biomaterials
3-0-3.
Introduction to a variety of biomaterials and their biomedical applications. Crosslisted with CHE and PTFE 6778.

BMED 6779. Bioprocess Engineering
3-0-3.
Study of enzymes and microbial and mammalian cells for production of biochemicals and protein therapeutics in bioreactors; downstream separation and purification; integrated view of bioprocesses. Crosslisted with CHE 6779.

BMED 6780. Medical Image Processing
3-0-3.
A study of methods for enhancing, analyzing, interpreting, and visualizing information from two- and three-dimensional data obtained from a variety of medical imaging modalities. Crosslisted with ECE and CS 6780.

BMED 6782. Cellular Engineering
3-0-3.
Engineering analysis of cellular systems. Crosslisted with CHE and ME 6782.

BMED 6784. Cardiovascular Biomechanics
3-0-3.
Mechanical analysis of the cardiovascular system emphasizing the normal and pathologic function in relation to clinical cardiovascular medicine. Crosslisted with CHE and ME 6784.

BMED 6786. Medical Imaging Systems
3-0-3.
A study of the principles and design of medical imaging systems such as X-ray, ultrasound, nuclear medicine, and nuclear magnetic resonance. Crosslisted with ECE 6786.

BMED 6787. Quantitative Electrophysiology
3-0-3.
A quantitative presentation of electrophysiological systems in biological organisms, emphasizing the electrical properties and modeling of neural and cardiac cells and systems. Crosslisted with PHYS and ECE 6787.

BMED 6789. Technology Ventures
1-0-3.
Team discussion and case studies in biomedical engineering technology transfer, including licensing, financial capital, safety and efficacy studies, clinical trials, and strategic planning. Crosslisted with ECE, CHE, ME, and MGT 6789.

BMED 6793. Systems Pathophysiology
3-0-3.
Overview of human pathophysiology from a quantitative perspective. A brief introduction to the application of quantitative models to the understanding of biological systems. Crosslisted with CHE, ECE, and ME 6793.

BMED 6794. Tissue Engineering
3-0-3.
Biological, engineering, and medical issues in developing tissue-engineered constructs. Emphasis in the integration of these disciplines at a basic molecular and cell biology level. Crosslisted with CHE and ME 6794.

BMED 6799. Legal Issues in Technology Transfer
3-0-3.
Study and analysis of U.S. law as it applies to the patenting and licensing processes. Crosslisted with CHE, ME, and MGT 6799.

BMED 7000. Master's Thesis
Credit hours to be arranged.

BMED 8010. Seminar in Bioengineering
1-0-1.
Seminars involving current research projects presented by faculty and invited speakers.

BMED 8015, -16, -17. Biomedical Engineering Laboratory Rotation I, -II, -III
0-3-1
Students will do lab rotations to learn lab techniques, research methods, and experimental design.

BMED 8102. Engineering Science III
5-0-5.
Prerequisite(s): BMED 8100 and BMED 8101
Fundamental analysis of biomedical systems: system transient behavior and steady state analysis; transport and reaction limitations diffusion and convective transport. Reaction networks; feedback and feedforward control.

BMED 8120. Physiologic Systems I
5-0-5.
Prerequisite(s): BMED 8100 and BMED 8101 and BMED 8102 and BMED 8110 and BMED 8111
Physiologic properties of cells and tissues, membrane-level transport and kinetics, cell signaling, energy requirements, tissues organization, electrical, chemical, and mechanical functions of cells.

BMED 8125. Molecular and Cellular Bioengineering: Laboratory Techniques
0-3-1.
Laboratory practices in mammalian cell culture, gene analysis, protein analysis, and genetic engineering for bioengineering research; alternative methods, experimental design, and critical interpretation of results.

BMED 8130. Bioethics-Values in Science
1-0-1.
Brief introduction to ethics and to the common modes of moral reasoning in science.

BMED 8695. Teaching Assistant Training Opportunity Program
1-0-1.
This course provides discipline-specific training that addresses lecturing and leading discussions, writing and grading, the use of writing as a pedagogical tool, the conduct of lab sessions, and the use of technologies.

BMED 8696. Teaching Assistant Training Opportunity Program Stage II
1-0-1.
This course provides discipline-specific training that addresses intellectual problems and teaching strategies from the perspective of the discipline.

BMED 8697. Teaching Assistant Training Opportunity Program Stage III
1-0-1.
The defining characteristic of the teaching assistantship is a controlled, carefully monitored initial teaching opportunity. The graduate student is under close supervision of a faculty member, who provides continued guidance and evaluation.

BMED 8811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number.
Topics of current interest in biomedical engineering.

BMED 8901, -02, -03. Special Problems
Credit hours to be arranged.
Individual studies and/or experimental investigations of problems of current interest in bioengineering.

BMED 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding a teaching assistantship.

BMED 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding a research assistantship.

BMED 9000. Doctoral Thesis
Credit hours to be arranged.

School of Chemical and Biomolecular Engineering

www.chbe.gatech.edu

Established in 1901
Location: Ford Motor Company Environmental Science and Technology Building
Telephone: 404.894.2865
Fax: 404.894.2866

Cecil J. "Pete" Silas Chair and School Chair–Ronald W. Rousseau; *Associate Chair and Professor*–Sue A. Bidstrup Allen; *Associate Chair and Professor*–F. Joseph Schork; *Associate Chair and Regents' Professor*–Amyn S. Teja; *J. Erskine Love Institute Chair in Engineering*–Charles A. Eckert; *William W. LaRoche Chair*–Dennis W. Hess; *Roberto C. Goizueta GRA Chair*–William J. Koros; *Parker H. Petit Distinguished Chair for Engineering in Medicine*–Robert M. Nerem; *Chair, Interdisciplinary Bioengineering Graduate Program*–Timothy M. Wick; *Regents' Professors*–Paul A. Kohl, Charles L. Liotta, Ajit Yoganathan.
Professors–Mark Allen, Sujit Banerjee, Andreas Bommarius, Jeff Empie, W. James Frederick, Thomas Fuller, Jeffrey S. Hsieh, Jay Lee, John D. Muzzy, Athanassios Sambanis, Mark G. White.
Professors Emeriti–William R. Ernst, Charles W. Gorton, John E. Husted, Michael Matteson, Clyde Orr Jr., Gary Poehlein, Ronnie S. Roberts, Robert J. Samuels, A. H. Peter Skelland, Jude T. Sommerfeld, Arnold E. Stancell, Henderson C. Ward, Jack Winnick.
Associate Professors–Pradeep K. Agrawal, Rachel Chen, Yulin Deng, Larry J. Forney, Clifford Henderson, Peter Ludovice, Mark Prausnitz, Matthew Realff, Daniel W. Tedder.
Assistant Professors–Victor Breedveld, Martha Gallivan, Christopher Jones, Hang Lu, J. Carson Meredith, Sankar Nair, Athanasios Nenes.
Adjunct Professors–Yaman Arkun, Charlene W. Bayer, Elliott L. Chaikof.

General Information

Chemical and biomolecular engineering is a discipline whose study prepares students for an enormously varied set of career paths. Graduates have become corporate executives, plant engineers, professors, inventors, lawyers, researchers, bankers, money managers, physicians, consultants, financial officers, and sales engineers; they have found employment with oil, chemical, biomedical, pharmaceutical, microelectronics, environmental, pulp and paper, food, textile, fertilizer, fragrance, and automobile companies, and with academia, government, banks, and brokerages. Chemical engineers have led the development of biomedicine and biotechnology; they have been crucial to the materials revolution, especially in computer chip manufacture, nanotechnology, and plastics and fibers; and they are essential in providing the everyday energy needs of the nation. Chemical and biomolecular engineering emphasizes environmentally benign manufacturing and sustainable development.

The chemical and biomolecular engineering undergraduate curriculum leads to a Bachelor of Science in Chemical and Biomolecular Engineering. Chemical and biomolecular engineering principles are taught as the foundation of that degree, but students also are expected to develop an ability to solve all kinds of problems, to view systems in their entirety, and to formulate and test solutions irrespective of the framework of the problem. Completion of the B.S. degree prepares students for entry into the workforce, advanced study in chemical and biomolecular engineering, or countless other graduate programs.

The curriculum has two options. The Biotechnology Option is for students who wish to focus their education on the biomolecular aspects of chemical and biomolecular engineering. This option includes the core chemical engineering courses, specialized biomolecular engineering courses, biochemistry, and technical electives focused in the biotechnology area. The Standard Program provides the basics of biomolecular engineering but allows much more flexibility for the student to pursue other areas of chemical engineering such as microelectronics, materials, and the environment. Special opportunities exist for students wishing to pursue minors or certificates in fields of particular interest, and students are encouraged to explore the frontiers of knowledge through involvement in faculty-directed research.

In addition to the B.S., the School of Chemical and Biomolecular Engineering offers programs leading to the master of science and the Ph.D. Students should check the School Web site for detailed curriculum information and recent updates.

Undergraduate Program

The educational objectives of the School of Chemical and Biomolecular Engineering program are:

- to educate and train students in the principles and methods essential to modern chemical and biomolecular engineering;
- to broaden perspectives of students regarding social issues and responsibilities, ethics, and professionalism;
- to graduate students recognized for excellence and selected for high-quality industrial, academic, and government positions;
- to conduct research and contribute to a literature supportive of the needs of chemical and biomolecular engineering; and
- to encourage and facilitate the growth of professionalism through continuing education.

In pursuit of these objectives, the following curriculum is designed to provide coverage of core areas of chemical and biomolecular engineering, and to allow students the opportunity to explore the breadth of the discipline. The curriculum requires a total of 132 hours for the B.S. degree. The Biotechnology Option allows the student to focus intensely in this rapidly emerging area of chemical engineering. The Standard Program provides the flexibility to explore other areas of chemical engineering practice, while providing an understanding of the biomolecular aspects of modern chemical engineering. The Standard Program will also allow chemical and biomolecular engineering students to tailor their educations to their particular interests and plans for their professional careers. Students are encouraged to use the elective hours to earn a minor or certificate, or at least to focus their electives in an area of particular interest.

Many graduates have found international experience obtained as a student to be valuable later in their careers. The School is developing special initiatives to facilitate such experiences, and it has a longstanding six-week summer program at University College London in which students receive six hours of elective credit and credit for CHBE 4200 (Transport and Unit Operations Laboratory).

Finally, although the focus of the curriculum is development of technical skills, it has elements geared to enhance communication, teamwork, and business skills.

Transfer Students

Due to the sequence of CHBE courses and the order in which they must be taken, students who transfer into chemical and biomolecular engineering from another university should expect to be enrolled for a minimum of six terms (a term is a semester or a summer session). If, for financial aid purposes, insurance, etc., students are required to be full time, they should transfer to Georgia Tech having sufficient non-chemical and biomolecular engineering courses remaining to enroll full time for six terms. All prerequisites and co-requisites must be followed.

Bachelor of Science in Chemical Engineering (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
MATH 1501	CALCULUS I	4
CHEM 1310	GENERAL CHEMISTRY	4
ENGL 1401	ENGLISH COMPOSITION I	3
BIOL 1510	BIOLOGICAL PRINCIPLES	4
WELLNESS		2
TOTAL SEMESTER HOURS		17

First Year - Second Semester

Course Number/Name		*Hours*
MATH 1502	CALCULUS II	4
CHEM 1311	INORGANIC CHEMISTRY I	3
CHEM 1312	INORGANIC CHEMISTRY LAB I	1
ENGL 1102	ENGLISH COMPOSITION II	3
PHYS 2211	INTRODUCTORY PHYSICS I	4
CS 1371	COMPUTING FOR ENGINEERS	3
TOTAL SEMESTER HOURS		18

Second Year - First Semester

Course Number/Name		Hours
MATH 2401	CALCULUS III	4
PHYS 2212	INTRODUCTORY PHYSICS II	4
CHEM 2311	ORGANIC CHEMISTRY I	3
CHBE 2100	CHEMICAL PROCESS PRINCIPLES	3
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		17

Second Year - Second Semester

Course Number/Name		Hours
MATH 2403	DIFFERENTIAL EQUATIONS	4
CHEM 2312	ORGANIC CHEMISTRY II	3
CHEM 3412	PHYSICAL CHEMISTRY II	3
CHBE 2110	CHEMICAL ENGINEERING THERMODYNAMICS I	3
CHBE 2120	NUMERICAL METHODS	3
TOTAL SEMESTER HOURS		16

Third Year - First Semester

Course Number/Name		Hours
CHBE 3110	CHEMICAL ENGINEERING THERMODYNAMICS II	3
CHBE 3200	TRANSPORT PROCESSES I	3
CHEM 2380	SYNTHESIS LAB I	2
MSE 2001	PRINCIPLES & APPLICATIONS OF ENGINEERING MATERIALS	3
SOCIAL SCIENCE ELECTIVE(S)		3
ECON 2100	ECONOMIC ANALYSIS & POLICY PROBLEMS	3
TOTAL SEMESTER HOURS		17

Third Year - Second Semester

Course Number/Name		Hours
CHBE 3210	TRANSPORT PROCESSES II	3
CHBE 4300	KINETICS & REACTOR DESIGN	3
CHEM 3281 or CHEM 3511 or CHEM 4511		3
SOCIAL SCIENCE ELECTIVE(S)		3
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Fourth Year - First Semester

Course Number/Name		Hours
CHBE 3225	SEPARATION PROCESS	3
CHBE 4400	CHEMICAL PROCESS CONTROL	4
CHBE 4515	CHEMICAL PROCESS SAFETY	1
FREE ELECTIVE(S)		3
HUMANITIES ELECTIVE(S)		3
TECHNICAL ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Fourth Year - Second Semester

Course Number/Name		Hours
CHBE 4200	TRANSPORTATION PHENOMENA/ UNIT OPERATIONS LAB	3
CHBE 4505	PROCESS DESIGN & ECONOMICS	3
CHBE ELECTIVE(S)-CHOOSE ONE: CHBE SPECIAL TOPICS IN BIOPROCESS ENGINEERING or CHBE 4752 or 4770 or 4775		3
HUMANITIES ELECTIVE(S)		3
TECHNICAL ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

TOTAL PROGRAM HOURS = 130 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Bachelor of Science in Chemical Engineering – Biotechnology Option (Suggested Schedule)

First Year - First Semester

Course Number/Name		Hours
MATH 1501	CALCULUS I	4
CHEM 1310	GENERAL CHEMISTRY	4
ENGL 1101	ENGLISH COMPOSITION I	3
BIOL 1510	BIOLOGICAL PRINCIPLES	4
WELLNESS		2
TOTAL SEMESTER HOURS		17

First Year - Second Semester

Course Number/Name		Hours
MATH 1502	CALCULUS II	4
CHEM 1311	INORGANIC CHEMISTRY I	3
CHEM 1312	INORGANIC CHEMISTRY LAB I	1
ENGL 1102	ENGLISH COMPOSITION II	3
PHYS 2211	INTRODUCTORY PHYSICS I	4
CS 1371	COMPUTING FOR ENGINEERS	3
TOTAL SEMESTER HOURS		18

Second Year - First Semester

Course Number/Name		Hours
MATH 2401	CALCULUS III	4
PHYS 2212	INTRODUCTORY PHYSICS II	4
CHEM 2311	ORGANIC CHEMISTRY I	3
CHBE 2100	CHEMICAL PROCESS PRINCIPLES	3
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		17

Second Year - Second Semester

Course Number/Name		Hours
MATH 2403	DIFFERENTIAL EQUATIONS	4
CHEM 2312	ORGANIC CHEMISTRY II	3
CHBE 2120	NUMERICAL METHODS IN CHEMICAL ENGINEERING	3
CHBE 2110	CHEM. ENGR. THERMODYNAMICS I	3
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

Third Year - First Semester

Course Number/Name		Hours
CHBE 3110	CHEM. ENGR. THERMODYNAMICS II	3
CHBE 3200	TRANSPORT PROCESSES I	3
CHEM 2380	SYNTHESIS LAB I	2
MSE 2001	PRINCIPLES & APPLICATIONS OF ENGINEERING MATERIALS	3
CHEM 4511	BIOCHEMISTRY I	3
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Third Year - Second Semester

Course Number/Name		Hours
BIOL 3340	CELL BIOLOGY	3
CHBE 3210	TRANSPORT PROCESSES II	3
CHBE 4300	KINETICS & REACTOR DESIGN	3
CHEM 4512	BIOCHEMISTRY II	3
ECON 2100	ECONOMIC ANALYSIS & POLICY PROBLEMS	3
TOTAL SEMESTER HOURS		15

Fourth Year - First Semester

Course Number/Name		Hours
CHBE 3225	SEPARATION PROCESS	3
CHBE 4400	CHEMICAL PROCESS CONTROL	4
CHBE 4515	CHEMICAL PROCESS SAFETY	1
CHBE 4310	BIOPROCESS ENGINEERING	3
FREE ELECTIVE(S)		3
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Fourth Year - Second Semester

Course Number/Name		Hours
CHBE 4210	TRANSPORTATION PHENOMENA/ UNIT OPERATIONS	3
CHBE 4525	BIOPROCESS DESIGN & ECONOMICS	3
BIOTECHNOLOGY ELECTIVE(S)-CHOOSE ONE: BIOL 3320 or 4668 or 4478 or CHBE 4757 or 4803 or 4901 or 6794 or CS 4710 or MATH 4755		3
HUMANITIES ELECTIVE(S)		3
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

TOTAL PROGRAM HOURS = 130 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Electives

Both options of the curriculum contain significant hours of electives to be chosen from four groups in the normal distribution indicated to satisfy the requirements of the School of Chemical and Biomolecular Engineering: undesignated humanities electives (six hours plus ENGL 1101 and 1102); social sciences (twelve hours, including three hours each in economics (ECON 2100) and history/political science); chemical and biomolecular engineering electives (three hours each for the Standard Program and the Biotechnology Option, but from different lists); technical electives (six hours for the Standard Program; none for the Biotechnology Option); and free electives (six hours). To qualify as a technical elective in the Standard Program, a course must be chosen from courses in the Colleges of Engineering, Sciences, or Computing, and may include one course at the 2000 or higher level plus the remainder at the 3000 or higher level. Students may count up to six hours of undergraduate research (CHBE 4699) toward fulfilling the technical elective requirements, and research hours in excess of six credits may be used to satisfy free elective requirements. Both the Chemical Engineering Elective in the Standard Program and the Biotechnology Elective in the Biotechnology Option must be chosen from restricted lists available on the School's Web site. Up to nine hours of undesignated humanities, social sciences, or free electives may be taken on a pass/fail basis. All

other courses in the chemical and biomolecular engineering curriculum must be taken on a letter-grade basis. Transfer students are restricted to fewer pass/fail hours. All students must satisfy a state requirement regarding coursework in the history and constitutions of the United States and Georgia by taking one of the following: HIST 2111 or 2112; POL 1101; PUBP 3000; or INTA 1200 (this counts as a social science credit). A listing of acceptable humanities and social science electives can be found at **www.registrar.gatech.edu/humanitieselec.htm** or **www.registrar.gatech.edu/socialscience/htm**.

Five-Year B.S./M.S. Program in Chemical and Biomolecular Engineering

This program seeks to engage undergraduate students who indicate an interest in and ability for additional education beyond the B.S. degree. The key components of such a program are: 1) a meaningful undergradnate research experience (CHBE 4699, Undergraduate Research Project) for those seeking the M.S. degree by coursework; and 2) careful advising and course planning to enable students to begin graduate coursework in the fourth year of study. Students with significant AP credit will be especially well positioned to take full advantage of this opportunity.

Students will be eligible to apply for the program after completion of thirty credit hours at Georgia Tech (i.e., at the end of the freshman year). As a practical matter, students will need to apply before the completion of seventy-five semester credit hours (mid-point of junior year) to include transfer and AP credit. Students must have a Georgia Tech GPA of 3.5 or higher for admission to the program and maintain a GPA of 3.0 or higher to continue in the program.

The program will require thirty credit hours beyond those required for the B.S. degree in chemical and biomolecular engineering. Students participating in the program will be eligible for the six-credit-hour Graduate Course Option, described in the "Information for Undergraduate Students" section of the catalog.

Graduate Programs

The School of Chemical and Biomolecular Engineering offers graduate programs involving advanced-level coursework and independent research leading to the M.S. and Ph.D. degrees in Chemical Engineering. The M.S. degree may also be obtained by coursework only. Course selection for both the M.S. and doctoral degrees is quite flexible, with individual plans of study developed for each student.

Research opportunities exist in a broad range of areas of importance to chemical engineers and society, including air pollution control, biochemical and bioprocess engineering, polymer science, process design and simulation, catalysis, chemical reaction engineering, biomedical engineering, pulp and paper engineering, transport phenomena, fine particle technology, thermodynamics, electrochemical engineering, process control, separations, and microelectronics processing. Furthermore, the School of Chemical and Biomolecular Engineering participates with several other schools in offering the M.S. and Ph.D. degrees in bioengineering, polymers, and paper science and engineering.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course. A single asterisk (*) denotes prerequisite courses that may be taken concurrently. A double asterisk (**) indicates prerequisite courses that will be updated soon; students should check **www.chbe.gatech.edu** for the latest updates.

CHEMICAL AND BIOMOLECULAR ENGINEERING

CHE 1750. Introduction to Bioengineering
3-0-3.
An introduction to the field of bioengineering, including the application of engineering principles and methods to problems in biology and medicine, the integration of engineering with biology, and the emerging industrial opportunities. Crosslisted with AE, BMED, ECE, ME, and MSE 1750.

CHBE 2100. Chemical Process Principles
3-0-3.
Prerequisite(s): CHEM 1310 and MATH 1502
Material and energy balances for single-phase and multi-phase processes common to chemical engineering. Phase equilibrium and analysis of reacting systems.

CHBE 2110. Chemical Engineering Thermodynamics I
3-0-3.
Prerequisite(s): CHBE 2100
Elements of engineering thermodynamics. First and second laws. Analysis of engineering machinery: compressors, turbines, engines, refrigeration.

CHBE 2120. Numerical Methods in Chemical Engineering
3-0-3.
Prerequisite(s): CHBE 2100 and PHYS 2211
Numerical methods are introduced and applied to the solution of chemical engineering problems. An introduction to chemical process simulation, and the appropriate software is provided.

CHBE 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

CHBE 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

CHBE 3110. Chemical Engineering Thermodynamics II
3-0-3.
Prerequisite(s): CHBE 2110
Phase and chemical reaction equilibria. Vapor-liquid, liquid-liquid, and solid-vapor phase equilibrium fugacity and activity coefficients. Multi-reaction equilibrium.

CHBE 3200. Transport Process I
3-0-3.
Prerequisite(s): CHBE 2120 and MATH 2403
Fundamentals of fluid mechanics and heat transfer. The design and analysis of equipment using the principles of fluid mechanics and heat transfer.

CHBE 3210. Transport Processes II
3-0-3.
Prerequisite(s): CHBE 3110 and CHBE 3200
Fundamental principles and applications of mass transfer. The analysis of chemical engineering processes and operations involving mass transfer.

CHBE 3225. Separations Processes
3-0-3.
Prerequisite(s): CHBE 3200 and CHBE 3210*
Fundamentals of equilibrium-stage and continuous contacting operations. Applications of principles to distillation, absorption/stripping, extraction, absorption, and other separation technologies.

CHBE 3600. Engineering Ethics and Leadership
3-0-3.
Development of quantitative and qualitative assessment tools to resolve moral and ethical dilemmas that arise in the performance of engineering duties.

CHBE 4200. Transport Phenomena/Unit Operations Laboratory
2-3-3.
Prerequisite(s): CHBE 3210 and CHBE 3225* and CHBE 4300*
This course illustrates engineering/scientific principles and physical models important to the data collection/interpretation of processes important to the practice of chemical engineering.

CHBE 4210. Transport Phenomena /Bioprocess Unit Operations
2-3-3.
Prerequisite(s): CHBE 3225 and CHBE 4300
This course illustrates engineering/scientific principles and physical models important to the data collection/interpretation of processes important in biotechnology.

CHBE 4300. Kinetics and Reactor Design
3-0-3.
Prerequisite(s): CHBE 3200 and CHBE 3210*
Reacting systems are analyzed in terms of reaction mechanisms, kinetics, and reactor design. Both homogeneous and heterogeneous reactions are considered.

CHBE 4310. Bioprocess Engineering
3-0-3.
Prerequisite(s): CHEM 4511
Integrating several ChBE core concepts, bioprocess engineering applies the material to biological systems. Items covered are enzyme kinetics, fermentation, downstream processing, and integrated bioprocesses important to biotech industries.

CHBE 4400. Chemical Process Control
3-3-4
Prerequisite(s): CHBE 3210 and CHBE 3225* and CHBE 4300*
Dynamics of chemical processes and their control. Techniques of conventional process control as well as digital control. Laboratory experiments to illustrate these concepts.

CHBE 4505. Process Design and Economics
3-0-3.
Prerequisite(s): CHBE 3225 and CHBE 4300 and CHBE 4515*
Principles of flowsheet synthesis and economic analysis and optimization. A complete design on a chemical process will be undertaken, including concepts of unit operations, design, economics, and safety.

CHBE 4515. Chemical Process Safety
1-0-1.
Prerequisite(s): CHBE 3225 and CHBE 4300 and CHBE 4515
Fundamental sources of chemical hazards and degree of risk. Process design and hazard avoidance are used to reduce risk.

CHBE 4525. Bioprocess Design and Economics
3-0-3.
Prerequisite(s): CHBE 3225 and CHBE 4300 and CHBE 4515
Principles of flowsheet synthesis and economic analysis and optimization. A complete design of a biochemical process will be undertaken, including concepts of unit operations, design, economics, and safety.

CHBE 4573. Pulping and Bleaching Laboratory
0-6-2.
Experiments of pulping, bleaching, fiber, and chemical testing are performed. Hands-on experience from chip preparation, cooking, pulp processing, and bleaching are provided.

CHBE 4574. Papermaking and Recycled Pulp Laboratory
0-6-2.
Experiments of pulp preparation, refining, paper forming, handsheet testing, deinking, and recycled pulp processing are performed. Small paper machine operation will be taught.

CHBE 4600. Effective Communication for Professional Engineering
3-0-3.
How engineers communicate with engineering and non-engineering professionals. Speakers from different fields. Engineering case study. Weekly written and/or oral presentations.

CHBE 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

CHBE 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

CHBE 4752. Integrated Circuit Fabrication
2-3-3.
The objective of this course is to give students exposure to the various steps involved in the fabrication of integrated circuits and devices. This course will include a laboratory segment in which students fabricate MOS transistors, diffused resistors, and MOS capacitors from a bare silicon substrate. Crosslisted with ECE 4752.

CHBE 4755. Electronic Packaging Substrate Fabrication
1-6-3.
Prerequisite(s): CHEM 1310 and PHYS 2212
This course provides hands-on instruction in basic packaging substrate fabrication techniques, including interconnect design and testing, dielectric deposition, via formation, and metallization. Crosslisted with ECE 4755.

CHBE 4757. Biofluid Mechanics
3-0-3.
Prerequisite(s): AE 2020 or ME 3340 or BMED 3300
Introduction to the study of blood flow in the cardiovascular system. Emphasis on modeling and the potential of flow studies for clinical research application. Crosslisted with AE and ME 4757.

CHBE 4758. Biosolid Mechanics
3-0-3.
Prerequisite(s): (MATH 2403 or MATH 2413 or MATH 24X3) and (ME 3201 or BMED 3300)
The mechanics of living tissue, e.g., arteries, skin, heart muscle, ligament, tendon, cartilage, and bone. Constitutive equations and some simple mechanical models. Mechanics of cells. Applications. Crosslisted with AE and ME 4758.

CHBE 4763. Pulping and Chemical Recovery
3-0-3.
Pulping and chemical recovery processes are studied on the reaction, delignification, energy, and liquor reuse. The process optimization, air and water pollution minimization are taught. Crosslisted with ME 4763.

CHBE 4764. Bleaching and Papermaking
3-0-3.
Pulp bleaching and formation of paper/board products are studied along with testing, end uses, chemical and mechanical treatment of pulp, non-wood and recycled fiber utilization. Crosslisted with ME 4764.

CHBE 4770. Nuclear Chemical Engineering
3-0-3.
This course surveys the chemical engineering aspects of nuclear power. Topics include nuclear reactions, fuel cycles, solvent extraction of metals, the properties of actinides and other irradiated fuel materials, fuel reprocessing, and radioactive waste management. Crosslisted with NRE 4770.

CHBE 4775. Polymer Science and Engineering I: Formation and Properties
3-0-3.
Prerequisite(s): CHEM 2312
An introduction to the chemistry, structure, and formation of polymers, physical states and transitions, physical and mechanical properties to polymer fluids and solids. Crosslisted with CHEM, ME, MSE, and PTFE 4775.

CHBE 4776. Polymer Science and Engineering II: Analysis, Processing, and Laboratory
2-3-3.
Prerequisite(s): CHBE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or PTFE 4775
Polymer fabrication processes and methods of characterization and identification of polymers are presented. Experiments in polymerization, processing and property evaluation of polymers. Crosslisted with CHEM, ME, MSE, and TPE 4776.

CHBE 4781. Biomedical Instrumentation
3-0-3.
Prerequisite(s): ECE 3050 or ECE 3710
A study of medical instrumentation from a systems viewpoint. Pertinent physiological and electro-physiological concepts will be covered. Crosslisted with ECE and ME 4781.

CHBE 4782. Biosystems Analysis
3-0-3.
Prerequisite(s): BMED 3500 or CHBE 4400 or ECE 2040 or ME 3015
Analytical methods for modeling biological systems, including white-noise protocols for characterizing nonlinear systems. Crosslisted with BMED, ECE and ME 4782.

CHBE 4791. Mechanical Behavior of Composites
3-0-3.
Prerequisite(s): ME 3201
Stress-strain behavior of composites, property of matrix and reinforcing materials, mechanics of fiber-reinforced composites, lamina and laminate analysis, and mechanical performance. Crosslisted with AE, CEE, ME, MSE, and PTFE 4791.

CHBE 4793. Composite Materials and Processes
3-0-3.
Prerequisite(s): CHEM 1310 and PHYS 2212
Basic principles of selection and design of composite material and their manufacturing and testing. Cost factors. Laboratory exercises on manufacturing and tests. Crosslisted with AE, CEE, ME, MSE, and PTFE 4793.

CHBE 4794. Composite Materials and Manufacturing
3-3-4.
Prerequisite(s): CHEM 1310 and PHYS 2212
Basic principles of selection and design of composite material and their manufacturing and testing. Cost factors. Laboratory exercises on manufacturing and tests. Crosslisted with AE, CEE, ME, MSE, and PTFE 4794.

CHBE 4801, -02, -03, -04, -05, -06. Special Topics
Class and credit hours equal last digit in course number.
Topics relevant to chemical engineering not currently covered in the undergraduate curriculum are presented as demand or interest warrants.

CHBE 4901, -02, -03. Special Problems
Credit hours to be arranged.
The student is given an opportunity to develop initiative and to apply fundamental principles by doing semioriginal laboratory or theoretical investigation of a chemical engineering problem.

CHBE 6003. Chemical Process Safety
1-0-1.
The course focuses on risk reduction through design and hazard avoidance. Sources of chemical hazards and risks are discussed.

CHBE 6004. Communication Skills for Technical Problem Solving
0-3-1.
Applications of both written and oral communication skills to the solution of technical problems. Includes focus, audience analysis, visual aids, and organization.

CHBE 6100. Advanced Chemical Engineering Thermodynamics
3-0-3.
Equations of state, corresponding states, and activity coefficient models and their relationship to intermolecular forces. Phase and chemical equilibria in chemical engineering.

CHBE 6110. Thermodynamics of Systems of Large Molecules
3-0-3.
Prerequisite(s): CHBE 6100
Classical and statistical thermodynamics of systems that are important in chemical, biochemical, and polymer processing.

CHBE 6120. Molecular Modeling
3-0-3.
Introduction to computational chemistry techniques for modeling substances at the molecular level, including: ab initio and semiempirical quantum methods, molecular dynamics, and Monte Carlo methods.

CHBE 6150. Electrochemical Engineering
3-0-3.
Electrochemical thermodynamics and kinetics. Corrosion. Applications to semiconductor devices, fuel cells, and batteries.

CHBE 6200. Advanced Transport Phenomena, Fluid Mechanics, and Heat Transfer
3-0-3.
Viscous fluid mechanics and convective heat transfer. Scaling analysis and lubrication. Stokes, and boundary layer flows. Transport about solid bodies. Linear stability theory.

CHBE 6210. Fluid Mechanics of Two-Phase Flow
3-0-3.
Prerequisite(s): CHBE 6200
Two-phase flow of nondeformable particles in Newtonian fluids. Rigorous results in the limit of small Reynolds number motions and applications to suspensions and colloids.

CHBE 6220. Computational Fluid Dynamics: Applications in Environmental and Chemical Processes
2-3-3.
Prerequisite(s): CHBE 6200
Introduction to numerical methods for solving transport problems. Applications to problems of interest in environmental and chemical processes.

CHBE 6230. Industrial Emissions Control
3-0-3.
Analysis of air quality criteria, ambient and emission standards, and industrial pollution sources. Recovery and utilization of waste gases and particulate matter.

CHBE 6231. Environmental Modeling in the Forest Products Industry
3-0-3.
Prerequisite(s): CHEM 2120 and CHEM 3412
The science and engineering of waste treatment processes in the pulp and paper industry.

CHBE 6240. Advanced Separation Processes
3-0-3.
This course provides an advanced analysis of separation process technology, with special emphasis on new separation techniques and their applications.

CHBE 6250. Mass Transport through Solids
3-0-3.
An in-depth introduction to transport of penetrants in and through solids. Convective flow through porous media, and conductive flow through homogenous solids. Membrane separations.

CHBE 6260. Transport Phenomena-Mass Transfer
3-0-3.
Mass transport processes and material properties that affect them. Principles of both steady- and unsteady-state molecular diffusion are developed and transfer mechanisms examined.

CHBE 6300. Kinetics and Reactor Design
3-0-3.
A study of chemical kinetics and mechanisms in complex homogeneous and heterogeneous reaction systems. Design and analysis of chemical reactors for such systems.

CHBE 6310. Applied Chemical Kinetics
3-0-3.
Applications of chemical kinetics to homogeneous and heterogeneous gas and liquid reactions, including techniques and analysis.

CHBE 6320. Heterogeneous Catalysis
3-0-3.
Prerequisite(s): CHBE 6300
Physics and chemistry of surfaces; thermodynamics, kinetics, and mechanism of adsorption and surface reactions; modern instrumental analysis; and industrial catalysis.

CHBE 6400. Advanced Process Control
3-0-3.
Fundamentals of multivariate control theory as applied to chemical processes.

CHBE 6410. Dynamic Behavior of Process Systems
2-3-3.
Introduction to process dynamics. Modeling of lumped systems with and without chemical reactions. Lumped processes involving phase equilibrium. Distributed parameter systems. Optimization of transient processes.

CHBE 6500. Mathematical Modeling and Analysis of Chemical Processes
3-0-3.
Formulation and solution of mathematical models of a range of chemical processes with an emphasis on differential balances and incorporation of uncertainty.

CHBE 6600. Polymerization Reaction Engineering
3-0-3.
Polymerization processes are analyzed with regard to reaction mechanism, kinetics, and reactor design. Control of polymer structure during polymerization is emphasized.

CHBE 6608. Semiconductor Microlithography and Patterning
3-0-3.
The study of fundamental issues from physics, chemistry, chemical engineering, and electrical engineering inherent in semiconductor microlithography, encompassing both materials and processes used for pattern definition.

CHBE 6609. Polymers in Microelectronics
3-0-3.
Use of polymers in microelectronics applications such as photolithography, interlevel dielectrics, encapsulation, packaging, magnetic media, and optical storage.

CHBE 6630. Pulp and Paper Manufacturing I
3-0-3.
Prerequisite(s): CHEM 2100
Advanced treatment of pulp and paper manufacturing using engineering and economic tools.

CHBE 6631. Pulp and Paper Manufacturing II
3-0-3.
Prerequisite(s): CHBE 6630
Advanced treatment of the unit operations and systems involved in the manufacture of paper.

CHBE 6634. Wet End Processing of Paper
3-0-3.
Prerequisite(s): CHBE 6631
Wet end colloidal and polymer science of papermaking processes. Processing with fiber, mineral fillers, brighteners, and polymer additives.

CHBE 6741. Pulp and Paper Manufacture I
3-0-3.
The fundamentals of pulp and paper technology are presented. Applications to the several unit operations used are explored and augmented by field trips and recent case studies. Crosslisted with ME 6741.

CHBE 6742. Pulp and Paper Manufacture II
3-0-3.
Prerequisite(s): CHBE 6741 or ME 6741
Papermaking technology is covered from a multidisciplinary engineering perspective with fundamental and practical considerations being addressed. Students participate in groups to run a pilot papermaking trial at the Henry Foundation in Savannah. Crosslisted with ME 6741.

CHBE 6750. Preparation and Reactions of Polymers
3-0-3.
Prerequisite(s): CHBE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or PTFE 4775
A detailed treatment of the reactions involved in the synthesis of both human-made and natural polymers, including preparation and degradative reactions of polymer systems. Crosslisted with CHEM and PTFE 6750

CHBE 6751. Physical Chemistry of Polymer Solutions
3-0-3.
Prerequisite(s): (CHBE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or PTFE 4775) or (ME 4777 or MSE 4777 or PTFE 4777)
Study of polymer solutions, polymer miscibility, adsorption, sorption, plasticization, molecular weights, molecular weight distributions, and interfacial phenomena using thermodynamics and statistical mechanics. Crosslisted with CHEM, MSE, and PTFE 6751.

CHBE 6752. Polymer Characterization
3-3-4.
Prerequisite(s): (CHBE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or PTFE 4775) or (ME 4777 or MSE 4777 or PTFE 4777)
This course introduces the student to surface, near-surface and structural methods of polymer characterization. Specialized techniques critical to physical structure are emphasized. Crosslisted with CHEM, MSE, and PTFE 6752.

CHBE 6759. Plasma Processing of Electronic Materials and Devices
3-0-3.
Fundamental physics, chemistry, chemical engineering, and electrical engineering principles inherent in plasma processes. Includes etching, deposition, diagnostic methods, and control schemes. Crosslisted with ECE 6759.

CHBE 6768. Polymer Structure, Physical Properties and Characterization
3-0-3.
Prerequisite(s): CHBE 4776 or CHEM 4776 or ME 4776 or MSE 4776 or PTFE 4776
Formulations and analysis of molecular and phenomenological models of elastic and viscoelastic behavior, development and description of structure, and fundamental aspects of structure-property relations. Crosslisted with ME, PTFE, and MSE 6768

CHBE 6774. Biomaterials: Structure and Function
3-0-3.
Structure-function relationships of biomaterials and biomaterial characterization will be covered. Materials for medical implants, tissue engineering, biosensing, imaging, and drug delivery will be covered. Crosslisted with BMED, ME, and MSE 6774.

CHBE 6777. Advanced Biomaterials
3-0-3.
Prerequisite(s): BMED 6776 or CHBE 6776 or ME 6776 or MSE 6776 or PTFE 6776
Advanced topics of biomaterials performance and engineering, including biointerfaces, host reactions of materials, and bio-inspired/smart-materials strategies. Crosslisted with BMED, ME, and MSE 6777.

CHBE 6778. Introduction to Biomaterials
3-0-3.
Introduction to a variety of biomaterials and their biomedical applications. Crosslisted with BMED and PTFE 6778.

CHBE 6779. Bioprocess Engineering
3-0-3.
Study of enzymes and microbial and mammalian cells for production of biochemicals and protein therapeutics in bioreactors; downstream separation and purification; integrated view of bioprocesses. Crosslisted with BMED 6779.

CHBE 6782. Cellular Engineering
3-0-3.
Engineering analysis of cellular systems. Crosslisted with BMED and ME 6782.

CHBE 6784. Cardiovascular Biomechanics
3-0-3.
Mechanical analysis of the cardiovascular system emphasizing the normal and pathologic function in relation to clinical cardiovascular medicine. Crosslisted with BMED and ME 6784.

CHBE 6789. Technology Ventures
3-0-3.
Team discussion and case studies in biomedical engineering technology transfer, including licensing, financial capital, safety and efficacy studies, clinical trials, and strategic planning. Crosslisted with BMED, ECE, ME, and MGT 6789.

CHBE 6793. Systems Pathophysiology
3-0-3.
Overview of human pathophysiology from a quantitative perspective. A brief introduction to the application of quantitative models to the understanding of biological systems. Crosslisted with BMED, ECE, and ME 6793.

CHBE 6794. Tissue Engineering
3-0-3.
Biological, engineering, and medical issues in developing tissue-engineered constructs. Emphasis on the integration of these disciplines at a basic molecular and cell biology level. Crosslisted with CHE and ME 6794.

CHBE 6799. Legal Issues in Technology Transfer
3-0-3.
Study and analysis of U.S. law as it applies to the patenting and licensing processes. Crosslisted with BMED, ME, and MGT 6799.

CHBE 7000. Master's Thesis
Credit hours to be arranged.

CHBE 7650. Advanced Physical Chemistry of Polymers
3-0-3.
Prerequisite(s): CHBE 6751 or CHEM 6751 or MSE 6751 or PTFE 6751
Thermodynamics and microscopic dynamics of polymers. Fundamental concepts, including scaling concepts, governing anisotropy of polarizability, phase transitions, morphology, time-dependent correlations, etc.

CHBE 7771. Mechanics of Polymer Solids and Fluids
3-0-3.
Continuum mechanics of solids and fluids; mechanics of deformation of anisotropic polymers; yield, breaking, and fatigue; non-Newtonian viscous and viscoelastic behavior of polymer fluids. Crosslisted with ME, MSE, and PTFE 7771.

CHBE 7772. Fundamentals of Fracture Mechanics
3-0-3.
Prerequisite(s): ME 3201 or MSE 3005
Advanced study of failure of structural materials under load, mechanics of fracture, and microscopic and macroscopic aspects of the fracture of engineering materials. Crosslisted with AE, CEE, ME, and MSE 7772.

CHBE 7773. Advanced Fracture Mechanics
3-0-3.
Prerequisite(s): AE 7772 or CEE 7772 or CHBE 7772 or ME 7772 or MSE 7772
Nonlinear fracture mechanics including elastic-plastic and time-dependent fracture, advanced test methods, J-integral theory, and extensions. Crosslisted with AE, CEE, ME, and MSE 7773.

CHBE 7774. Fatigue of Materials and Structures
3-0-3.
Prerequisite(s): AE 7772 or CEE 7772 or CHBE 7772 or ME 7772 or MSE 7772
Mechanical and microstructural aspects of nucleation and growth of cracks under cyclic loading conditions; notch effects; cumulative damage, multiaxial loading, and fatigue crack propagation. Crosslisted with AE, CEE, ME, and MSE 7774.

CHBE 7775. Topics in Fracture and Fatigue of Metallic and Composite Structures
3-0-3.
Prerequisite(s): ME 2211 or AE 2120
Brittle and ductile failure criteria. Failure prediction in composite structures. Free-edge and internal delamination. Anisotropic cracks. Fatigue behavior of composites and comparison with metal fatigue. Crosslisted with AE, ME, and MSE 7775.

CHBE 7791. Damage, Failure, and Durability of Composite Materials
3-0-3.
Prerequisite(s): AE 4791 or CEE 4791 or CHBE 4791 or ME 4791 or MSE 4791
Provides knowledge of the fundamental concepts and methods related to analysis and assessment of damage, failure, and durability of composite materials. Crosslisted with AE, CEE, ME, MSE, and PTFE 7791.

CHBE 7792. Advanced Mechanics of Composites
3-0-3.
Prerequisite(s): CHBE 4791 and CEE 6312
Anisotropic elasticity, failure theories, hydrothermal behavior, 3-D analysis of laminates, thick laminates, free-edge effects, stress concentrations, joints, creep, and fracture of composites, and advanced topics. Crosslisted with AE, CEE, ME, MSE, and PTFE 7792.

CHBE 7793. Manufacturing of Composites
3-0-3.
Prerequisite(s): CHBE 4793
Major manufacturing techniques for metal, ceramic, and polymer matrix composites. Modeling of processes with emphasis on fundamental mechanisms and effects. Crosslisted with AE, CEE, ME, MSE, and PTFE 7793.

CHBE 8001, -02. Seminar in Chemical Engineering
1-0-1.

CHBE 8801, -02, -03, -04. Special Topics
Class and credit hours equal last digit in course number.

CHBE 8901. Special Problems
Credit hours to be arranged.

CHBE 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding teaching assistantships.

CHBE 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding research assistantships.

CHBE 9000. Doctoral Thesis
Credit hours to be arranged.

A single asterisk (*) denotes prerequisite courses that may be taken concurrently. A double asterisk (**) indicates prerequisite courses that will be updated soon; students should check **www.che.gatech.edu** for the latest version.

School of Civil and Environmental Engineering

www.ce.gatech.edu

Established in 1896
Location: Mason Building
Telephone: 404.894.2201
Fax: 404.894.2278

Chair and Professor–Joseph Hughes; *Associate Chair and Associate Professor*–John Leonard; *Associate Chair for Graduate Studies and Associate Professor*–Kenneth Will; *Associate Chair for Undergraduate Studies and Professor*–Laurence Jacobs; *President and Professor*–G. Wayne Clough; *Provost and Professor*– Jean-Lou Chameau; *Associate Provost and Associate Professor*–Nelson Baker; *Director of Georgia Tech Savannah and Professor*–J. David Frost.
Professors–Mustafa Aral, Bruce Ellingwood, Leroy Emkin, Aris Georgakakos, Leonid Germanovich, Barry Goodno, Lawrence Kahn, Roberto Leon, Stanley Lindsey, Paul W. Mayne, Michael Meyer, Spyros Pavlostathis, Philip Roberts, Armistead Russell, Juan Santamarina, F. Michael Saunders, Terry Sturm, Peter Webster, Donald White, Sotira Yiacoumi, Abdul Hamid Zureick.
Associate Professors–Michael Bergin, Reginald DesRoches, Karen Dixon, Randall Guensler, Rami Haj-Ali, Frank Loëffler, Rafi Muhanna, James Mulholland, Kurt Pennell, Glenn Rix, Fotis Sotiropoulos, Marc Stieglitz, Jorge Vanegas, Donald Webster, Paul Work.
Assistant Professors–Gena Abraham, Adjo Amekudzi, Mulalo Doyoyo, Hermann Fritz, Laurie Garrow, Kevin Haas, Ching-Hua Huang, Michael Hunter, Jaehong Kim, Kimberly Kurtis, David Scott.
Academic Professionals–David Elrod, Mahera Philobos, Lisa Rosenstein.
Research Engineers, Scientists, and Associates–Robert Abernathy, Dan Collins, Claire Cosgrove, Mikhail Fogelson, Anvar Gilmanov, Jiabo Guan, Olga Kemenova, David Key, Jong-Sub Lee, Mehmet Odman, Jennifer Ogle, Feifei Pan, James Pearson, Michael Rodgers, Hamid Zand, Alexander Samoylov, Stacy Stringer, Michael Swanger, Jacqueline Tront, Huaming Yao, Guangxuan Zhu.
Postdoctoral Fellows–Yongtao Hu, Kasemsan Manomaiphboon, Kevin McGuire, Joongcheol Paik, Kirsti Ritalahti, Xiaodong Tian, Jacqueline Tront, Alper Unal, Zhaohua Wang, Qingzhong Wu.

General Information

The School of Civil and Environmental Engineering offers courses in civil engineering, environmental engineering, and engineering science and mechanics, as well as programs leading to the degrees Bachelor of Science in Civil Engineering, Master of Science in Civil Engineering, Master of Science in Engineering Science and Mechanics, Master of Science in Environmental Engineering, Master of Science (undesignated), and Doctor of Philosophy. The School also offers a joint program leading to the degrees Master of Science in Civil Engineering or Master of Science (undesignated) with a concentration in transportation engineering, and Master of City Planning.

Undergraduate Program

The School's program educational objectives are to:

- provide an educational experience that prepares students for the challenges of the civil and environmental engineering profession that they will face during their professional careers;
- promote scholarship and problem-solving skills;
- provide opportunities for our students to exhibit leadership and team-building skills;
- promote service to the profession and to society;
- incorporate interdisciplinary concepts and problem-solving exercises into the educational program; and
- provide exposure to the civil and environmental technologies of today and those likely of tomorrow.

Bachelor of Science

The four-year curriculum leading to the Bachelor of Science in Civil Engineering (B.S.C.E.) enables the graduate to enter professional practice as an engineer or to continue his or her studies in programs leading to advanced degrees in the following broad fields of specialization: construction engineering and management, environmental engineering, environmental hydraulics, geotechnical engineering, hydrology, materials, structural engineering and mechanics, transportation, and water resources planning and management. The B.S.C.E. degree program is designed to offer depth in course material considered essential for all civil and environmental engineers, as well as flexibility in selecting elective courses that offer breadth of topic exposure. Civil engineers contribute to society in numerous ways; thus, the School's philosophy is to provide the student with a range of electives that meet student interests. Civil engineers must not only be technically proficient, but also must be effective in working with people and with professionals in other disciplines. Accordingly, the School faculty has adopted the educational objectives mentioned in the previous section.

The Bachelor of Science in Civil Engineering degree is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology. Graduates of the B.S.C.E. curriculum are eligible to seek licensing as registered professional engineers.

The course requirements of the B.S.C.E. degree are listed in the following pages. Although students are not obligated to take the courses during the semester indicated, they must satisfy all prerequisites for a particular course. In addition to campuswide academic requirements for graduation with a bachelor's degree, the following are also required for the B.S.C.E. degree:

a) A grade of *C* or better must have been earned in MATH 1501-1502, PHYS 2211, CHEM 1310, and COE 2001.
b) The number of quality points earned in civil engineering courses taken toward the degree must be at least twice the number of credit hours in those courses. If a course is repeated, the latest grade will be included in applying this rule. No CEE course may be repeated for the purpose of satisfying this rule if the original grade was a *C* or higher.

Bachelor of Science in Civil Engineering (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
MATH 1501	CALCULUS I	4
CHEM 1310	GENERAL CHEMISTRY	4
ENGL 1101	ENGLISH COMPOSITION I	3
CS 1371	COMPUTING FOR ENGINEERS	3
HIST 2111 or 2112 or POL 1101 or	PUBP 3000 or INTA 1200	3
TOTAL SEMESTER HOURS		17

First Year - Second Semester

Course Number/Name		*Hours*
MATH 1502	CALCULUS II	4
PHYS 2211	INTRODUCTORY PHYSICS I	3
ENGL 1102	ENGLISH COMPOSITION II	3
CEE 1770	ENGINEERING GRAPHICS & VISUALIZATION	3
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Second Year - First Semester

Course Number/Name		*Hours*
MATH 2401	CALCULUS III	4
PHYS 2212	INTRODUCTORY PHYSICS II	4
CEE 2300	ENVIRONMENTAL ENGINEERING PRINCIPLES	3
ECON 2100 or 2105 or 2106		3
COE 2001	STATICS	2
TOTAL SEMESTER HOURS		16

Second Year - Second Semester

Course Number/Name		*Hours*
MATH 2403	DIFFERENTIAL EQUATIONS	4
BIOL 1510 or BIOL 1520 or EAS 2600		4
CEE 2040	DYNAMICS	2
CEE 3000	CIVIL ENGINEERING SYSTEMS	3
PST 3105 or 3109 or 3127 (ETHICS ELECTIVE)		3
TOTAL SEMESTER HOURS		16

Third Year - First Semester

Course Number/Name		*Hours*
CEE 3040	FLUID MECHANICS	3
CEE 3020	CIVIL ENGINEERING MATERIALS	3
COE 3001	MECHANICS OF DEFORMABLE BODIES	3
MSE 3000 or ME 3322 or CHBE 2110 (COE ELECTIVE - GROUP A)		3
SOCIAL SCIENCE ELECTIVE(S)		3
WELLNESS		2
TOTAL SEMESTER HOURS		17

Third Year - Second Semester

Course Number/Name		*Hours*
CEE 4200	HYDRAULIC ENGINEERING	3
CEE 3055 or 4100 or 4300 or 4400 or 4600 (BREADTH ELECTIVES)		9
CEE 3770	STATISTICS & APPLICATIONS	3
TOTAL SEMESTER HOURS		15

Fourth Year - First Semester

Course Number/Name	*Hours*
CEE TECHNICAL ELECTIVE(S)	9
APPROVED ELECTIVE(S)	3
MSE 2001 or ECE 2025 or (ECE 3710 & 3741) (COE TECHNICAL ELECTIVE - GROUP B)	3
TOTAL SEMESTER HOURS	15

Fourth Year – Second Semester

Course Number/Name		*Hours*
CEE TECHNICAL ELECTIVE(S)		6
SOCIAL SCIENCE ELECTIVE(S) (3000 or 4000 LEVEL)		3
CEE 4090	CEE CAPSTONE DESIGN	3
APPROVED ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

TOTAL PROGRAM HOURS = 126 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Electives

Humanities/Social Sciences

A total of twelve credit hours of humanities and twelve credit hours of social sciences are required. The humanities requirement consists of ENGL 1101, ENGL 1102, a three-hour humanities elective*, and an ethics course: PST 3105, 3109, or 3127. The social science requirement consists of a U.S. history/government course, economics (2100, 2105, or 2106), and six hours of general social science. All courses taken to satisfy humanities and social sciences must be taken on a letter-grade basis. To satisfy the state requirements regarding coursework in the history and constitutions of the United States and Georgia, students must complete one of the following courses: HIST 2111, HIST 2112, POL 1101, INTA 1200, or PUBP 3000. Humanities and social science electives are listed on the Registrar's Web site under core curriculum.

Technical Electives

There are eighteen hours of elective credit in the senior year. Students may use these electives to pursue a specific area of interest within civil and environmental engineering. A maximum of six hours, with faculty approval, may be chosen from outside the School of Civil and Environmental Engineering.

CEE 3010 Geomatics (2-3-3)
CEE 4110 Construction Planning, Estimating, and Scheduling (3-0-3)
CEE 4120 Construction Equipment and Methods (3-0-3)
CEE 4210 Hydrology (3-0-3)
CEE 4230 Environmental Transport Modeling (3-0-3)
CEE 4310 Water Quality Engineering (3-0-3)
CEE 4320 Hazardous Substance Engineering (3-0-3)
CEE 4330 Air Pollution Engineering (3-0-3)
CEE 4390 Environmental Engineering Water/Resources Design (3-0-3)
CEE 4410 Geosystems Engineering Design (3-0-3)
CEE 4420 Subsurface Characterization (2-3-3)
CEE 4430 Environmental Geotechnics (3-0-3)
CEE 4510 Structural Steel Design (3-0-3)
CEE 4520 Reinforced Concrete Design (3-0-3)
CEE 4530 Timber and Masonry Design (3-0-3)
CEE 4540 Infrastructure Rehabilitation (2-3-3)
CEE 4550 Structural Analysis II (3-0-3)
CEE 4610 Multimodal Transportation Planning, Design, and Operations (3-0-3)
CEE 4620 Environmental Impact Assessment (3-0-3)
CEE 4630 Computer-Aided Site and Roadway Design (2-3-3)
CEE 4791 Mechanical Behavior of Composites (3-0-3)
CEE 4793 Composite Materials and Processes (3-0-3)
CEE 4794 Composite Materials and Manufacturing (2-3-3)
CEE 4795 Groundwater Hydrology (3-0-3)
CEE 4900 Undergraduate Honors Research Project

Other requirements include additional CEE courses and approved courses from other units.

Graduate Course Option

Students who complete both the bachelor's and any of the master's degrees in the School of Civil and Environmental Engineering (described below) may use up to six credit hours of graduate-level coursework (CEE 6000 or higher) in the major discipline for both degrees. In order to qualify for this option, the student must complete the undergraduate degree with a cumulative grade point average of 3.5 or higher and complete the master's degree within two years after the awarding of the bachelor's degree.

Joint B.S./M.S. Degree Program

The American Society of Civil Engineers has adopted a policy of urging students to obtain a master's degree as the entry-level degree in the profession. The faculty of the School of Civil and Environmental Engineering has concluded that in many civil engineering program areas, a master's degree is necessary for students to have sufficient background to be successful professionally.

The joint five-year B.S./M.S. program is designed to attract the best-of-the-best undergraduate students and is especially intended for students who demonstrate an interest in, and ability for, additional education beyond the bachelor's degree.

Students are eligible to apply for the program after they have completed thirty semester credit hours at Georgia Tech, typically at the end of the freshman year, and they have shown appropriate progress in their degree program. A grade point average of 3.5 or higher is needed for admission to the five-year B.S./M.S. honors program. Students must apply to the program before the completion of seventy-five semester credit hours, including transfer and advanced placement credits, typically at the mid-point of the junior year.

The key components of this program are intense interaction among students and faculty, including mentoring and undergraduate research, and careful advising and course planning to enable students to begin challenging coursework in their fourth year of study.

Students in the joint B.S./M.S. program remain undergraduates until they meet the requirements for the bachelor's degree, at which point they will receive the B.S.C.E. degree. They will then be changed to graduate status. Graduate school application fees and the GRE requirements are waived.

Once admitted, a GPA of at least 3.0 must be maintained to remain in the program. Additionally, students in the B.S./M.S. program are eligible to use the Graduate Course Option (described above) even if their cumulative grade point average is below 3.5 at the time they complete their bachelor's degree.

Graduate Programs

Master of Science

Four master's degrees are available in the School of Civil and Environmental Engineering. M.S. programs are available in the areas of construction engineering and management, environmental engineering, environmental fluid mechanics and water resources, geosystems, structures mechanics and materials, and transportation. The four master's degrees are described on the following page:

Master of Science in Civil Engineering
Students seeking this degree must have previously earned a B.S.C.E. or its equivalent.

a. **Course option**
Required Courses in Major Area of Specialization 18
(Construction Management, Environmental, Geosystems, Structures Mechanics and Materials, Transportation, Environmental Fluid Mechanics and Water Resources)
Approved Electives 12
Semester Hours 30*

b. **Thesis option**
Required Courses in Major Area of Specialization 12
(Construction Management, Environmental, Geosystems, Structures Mechanics and Materials, Transportation, Environmental Fluid Mechanics and Water Resources)
Approved Electives 12
Thesis 6
Semester Hours 30**

Master of Science in Engineering Science and Mechanics
Students seeking this degree must have a B.S. in engineering or the physical sciences.

a. **Course option**
Required Courses in Mechanics 18
Mathematics 6
Approved Electives 6
Semester Hours 30*

b. **Thesis option**
Required Courses in Mechanics 12
Mathematics 6
Approved Electives 6
Thesis 6
Semester Hours 30**

Master of Science in Environmental Engineering
The degree Master of Science in Environmental Engineering (M.S.Env.E.) is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology. Students seeking this degree must have an engineering undergraduate degree.

a. **Special Research Problem Option**
EnvE core 12
EnvE and other electives 15
Special Research Problem (CEE 8950) 3
Semester Hours 30*

b. **Thesis Option**
EnvE core 12
EnvE and other electives 12
Thesis 6
Semester Hours 30**

Through review with program faculty, students seeking the M.S.Env.E. degree must meet additional requirements to assure they are proficient in required areas of environmental engineering.

The educational objectives of the environmental engineering graduate program are to produce graduates who are able to:

- address future challenges in the protection of the environment and the environment-related enhancement of the quality of human life;
- conceive, plan, design, and implement those actions necessary for the protection of the environment and human health;
- participate in interdisciplinary education and research that are fundamental to solving the problems facing a complex society and needed for the protection of the environment and human health within a framework of sustainable development;
- lead an environmental engineering profession that is increasingly being driven by advances in science and technology; and
- understand the value of scholarship, leadership, service, and lifelong learning.

Undesignated Master of Science
Students who do not meet the undergraduate degree requirements above but satisfy all the other requirements in their M.S. area of specialization receive the undesignated master of science degree.

a. **Course option**
Required Courses in Major Area of Specialization 18
(Construction Management, Environmental, Geosystems, Structures Mechanics and Materials, Transportation, Environmental Fluid Mechanics and Water Resources)
Approved Electives 12
Semester Hours 30*

b. **Thesis option**
Required Courses in Major Area of Specialization 12
(Construction Management, Environmental, Geosystems, Structures Mechanics and Materials, Transportation, Environmental Fluid Mechanics and Water Resources)
Approved Electives 12
Thesis 6
Semester Hours 30**

*21 of the 30 hours of coursework must be at the 6000 level or higher.
** 12 of the 24 hours of coursework must be at the 6000 level or higher.

Distance Learning and Professional Education
The School of Civil and Environmental Engineering offers working professionals the opportunity to enroll in graduate courses in environmental engineering through video technologies. Qualified individuals may complete the requirements for the master's program in environmental engineering utilizing the video-based delivery system.

Doctor of Philosophy

Admission to the Ph.D. Program
The Ph.D. program is offered to students with an excellent academic background and a capacity for independent research. Doctoral students tailor a highly individualized program of study directed toward completion of a dissertation that is expected to make an important contribution in their selected area.

Doctoral degrees are offered in civil engineering, environmental engineering, and engineering science and mechanics.

After consultation with the appropriate specialty group, the associate chair for graduate programs may grant the applicant admission to the appropriate doctoral program within the School. Applicants must have received an acceptable master's degree, bachelor's degree, or equivalent from an ABET-accredited program of study.

Students currently pursuing a master's degree who wish to continue studies toward the Ph.D. degree must get written approval from the head of the appropriate specialty group. Admission to the Ph.D. program does not constitute admission to candidacy for the Ph.D. degree.

Specialty Groups
Applicants are encouraged to pursue interdisciplinary programs of study and research. For admission to the Ph.D. program, students must select one specialty group from the following:

- Construction Engineering and Management
- Environmental Engineering
- Environmental Fluid Mechanics and Water Resources
- Geosystems
- Structural Engineering, Mechanics, and Materials
- Transportation

If the student wishes to change from one specialty to another, he or she must obtain written permission from both specialty groups.

Requirements for the Degree

a. A program of study must be approved by the student's Guidance Committee and the associate chair of graduate studies. There are no fixed course requirements for the Ph.D. degree. The student must have a major and minor field. The minor field is preferably outside the School of Civil and Environmental Engineering and must include at least nine hours of coursework. The minor field must be approved by the Office of Graduate Studies.
b. Pass a Ph.D. comprehensive (qualifying) examination consisting of written and oral portions.
c. Complete a Ph.D. dissertation.
d. Pass the final doctoral examination.

Courses of Instruction

Figures entered below the course number and the title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course. An asterisk (*) denotes prerequisite courses that may be taken concurrently.

CIVIL AND ENVIRONMENTAL ENGINEERING

CEE 1770. Introduction to Engineering Graphics and Visualization
2-3-3.
Prerequisite(s): MATH 1501* or MATH 1511* or MATH 15X1
Engineering graphics and visualization including sketching, line drawing, and solid modeling. Development and interpretation of drawings and specification for product realization. Crosslisted with AE and ME 1770.

CEE 2020. Statics and Dynamics
3-0-3.
Prerequisite(s): MATH 1502 or MATH 1512 or (MATH 15X2 and MATH 1522) and PHYS 2211
Elements of statics in two and three dimensions, centroids, friction, kinematics, and kinetics of rigid bodies in plane motion.

CEE 2040. Dynamics
2-0-2.
Prerequisite(s): COE 2001
Kinematics and kinetics of particles and rigid bodies in one and two dimensions; principles of work/energy and impulse/momentum.

CEE 2300. Environmental Engineering Principles
3-0-3.
Prerequisite(s): CHEM 1502 and MATH 1310 and PHYS 2211
Introduction to chemical, biological, and physical processes in the environment. Discussion of the basic processes governing air, water, and land quality, and the behavior and impacts of contaminants associated with human and industrial activities.

CEE 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

CEE 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

CEE 3000. Civil Engineering Systems
3-0-3.
Prerequisite(s): MATH 2401 or MATH 2411 or MATH 24X1
Infrastructure viewed from a systems perspective; analytical approaches and modeling of civil-engineered facilities; sustainability; engineering economy applications.

CEE 3010. Geomatics
3-3-3.
Prerequisite(s): CS 1321 and (AE 1770 or CEE 1770 or ME 1770) and (MATH 2401* or MATH 2411* or MATH 24X1)
Spatial data collection methods including surveying, photogrammetry, remote sensing, and global positioning systems; management, manipulation, and analysis of spatial and associated attribute data.

CEE 3020. Civil Engineering Materials
2-3-3.
Prerequisite(s): COE 3001
Physical, mechanical, and durability properties of concrete, metals, unreinforced and reinforced plastics, timber, asphalt, and asphalt concrete.

CEE 3030. Strength of Materials
3-0-3.
Prerequisite(s): CEE 2020 and CEE 3020* and (MATH 2403* or MATH 2413* or MATH 24X3)
Stress and strain, axially loaded members, torsion of circular sections, bending of beams, transformation of stress and strain, and column buckling.

CEE 3040. Fluid Mechanics
3-0-3.
Prerequisite(s): CEE 2040
Elementary mechanics of fluids with emphasis on hydrostatics, control volume analysis of flowing fluids using kinematics, continuity, energy, and momentum principles; similitude, pipe flow.

CEE 3055. Structural Analysis
3-0-3.
Prerequisite(s): COE 3001
Determination of internal forces and deflection in statically determinate trusses, beams, and frames. Introduction to analysis of statically indeterminate structures.

CEE 3770. Statistics and Applications
3-0-3.
Prerequisite(s): MATH 2401
Introduction to probability, probability distributions, point estimation, confidence intervals, hypothesis testing, linear regression, and analysis of variance. Example applied to the field of civil and environmental engineering. Crosslisted with MATH 3770 and ISYE 3770.

CEE 4090. Capstone Design
2-3-3.
An interdisciplinary civil and environmental design experience. Problem definition, data acquisition, modeling and analysis, evaluation of design alternatives, oral and written presentation of final design.

CEE 4100. Construction Engineering and Management
3-0-3.
Fundamental concepts in planning, design, and construction of civil engineering projects. Introduction to project scheduling, cost estimating, controls, procurement, value engineering, quality assurance, and safety.

CEE 4110. Construction Planning, Estimating, and Scheduling
3-0-3.
Prerequisite(s): CEE 4100
An integrated approach to planning, estimating, and scheduling of construction projects, including basic and advanced concepts, applications, and tools for developing plans, estimates, and schedules.

CEE 4120. Construction Equipment and Methods
3-0-3.
Prerequisite(s): CEE 4100
An integrated approach to construction operations, including basic and advanced concepts, applications, and tools for planning, design, modeling, and analysis of construction operations.

CEE 4200. Hydraulic Engineering
2-3-3.
Prerequisite(s): CEE 3040
Applications of fluid mechanics to engineering and natural systems including fluid drag, open channel flow, turbomachinery, and environmental hydraulics; laboratory experiments; computational hydraulics.

CEE 4210. Hydrology
3-0-3.
Prerequisite(s): CEE 3040
Global circulation and the hydrologic cycle, precipitation mechanisms and analysis, evaporation and other losses, streamflow, hydrographs, river and reservoir routing, and frequency analysis.

CEE 4230. Environmental Transport Modeling
3-0-3.
Prerequisite(s): CEE 4200
Introduction to mixing of pollutants and natural substances in the surface water environment. Use of mathematical models for mixing zones and water quality.

CEE 4300. Environmental Engineering Systems
3-0-3.
Prerequisite(s): CEE 2300
Environmental engineering issues associated with water, air, and land pollution, including risk assessment, groundwater contamination, global climate change, and sustainable technologies.

CEE 4310. Water Quality Engineering
3-0-3.
Prerequisite(s): CEE 4300
Reclamation of water and wastewater for potable and industrial uses, groundwater remediation. Principles of physical, chemical, and biological treatment processes.

CEE 4320. Hazardous Substance Engineering
3-0-3.
Prerequisite(s): CEE 3040 and CEE 4300
Technical aspects of hazardous waste management and treatment including legislation, exposure and risk assessment, contaminant fate and transport, waste treatment methods, and remediation technologies.

CEE 4330. Air Pollution Engineering
3-0-3.
Prerequisite(s): CEE 4300
Introduction to the physical and chemical processes affecting the dynamics and fate of air pollutants at the local, regional, and global scales. Particular emphasis is on tropospheric pollutant chemistry and transport.

CEE 4390. Environmental Engineering Water/Resources Design
2-1-3.
Prerequisite(s): CEE 4200 and CEE 4210 and CEE 4310*
Interdisciplinary design course in environmental engineering and water resources including process design, hydraulic design, reservoir operations and analysis, cost estimates, plans, and specifications.

CEE 4400. Geosystems Engineering
3-0-3.
Prerequisite(s): COE 3001
Introduction to engineering behavior of soils; mechanical, chemical, electrical, and thermal properties; continuum design principles including theory of elasticity and limiting equilibrium applied to particulate soils.

CEE 4410. Geosystems Engineering Design
3-0-3.
Prerequisite(s): CEE 4400
Analysis and design in geosystems engineering projects, including the evaluation of pile foundations, slope stability, earth-retaining structures, and embankments.

CEE 4420. Subsurface Characterization
2-3-3.
Prerequisite(s): CEE 4400
Introduction to field and laboratory methods for characterizing subsurface geological, hydrological, geotechnical, and contaminant conditions.

CEE 4430. Environmental Geotechnics
3-0-3.
Prerequisite(s): CEE 4400*
Chemical equilibria and partitioning in subsurface systems; hazardous waste site assessment technologies and data; including soil gas data, monitoring wells, and direct-push technology.

CEE 4510. Structural Steel Design
3-0-3.
Prerequisite(s): CEE 3055
Principles of behavior of tension and compression members, beams, and connections with application to the design of elementary structures.

CEE 4520. Reinforced Concrete Design
3-0-3.
Prerequisite(s): CEE 3055
Principles of behavior of reinforced concrete beams, short columns, and slabs, with application to the design of elementary concrete structures, foundation, and earth-retaining structures.

CEE 4530. Timber and Masonry Design
3-0-3.
Prerequisite(s): CEE 3055
Stress-based design of tension, compression, and flexural members; design of building systems, unreinforced and reinforced walls using timber and masonry construction materials and techniques.

CEE 4540. Infrastructure Rehabilitation
2-3-3.
Prerequisite(s): CEE 3000 and CEE 3030 and CEE 4100
Rehabilitation of civil infrastructure systems including aspects of deterioration science, nondestructive assessment, renewal engineering, construction planning and management, and public policy and finance.

CEE 4550. Structural Analysis II
3-0-3.
Prerequisite(s): CEE 3055
Analysis of two- and three-dimensional statically indeterminate structures by classical and matrix methods of solution. Flexibility and stiffness techniques, influence lines, approximate analysis, and nonlinear analysis.

CEE 4600. Transportation Planning, Operations, and Design
2-3-3.
Prerequisite(s): CS 1371 and (MATH 2401 or MATH 2411 or MATH 24X1)
Introduction to transportation engineering with specific emphasis on the planning, design, and operation of transportation facilities.

CEE 4610. Multimodal Transportation Planning, Design, and Operations
3-0-3.
Prerequisite(s): CEE 4600
Planning, design, and operation of systems of air, rail, water, and highway facilities, including those for bicycles and pedestrians.

CEE 4620. Environmental Impact Assessment
3-0-3.
Key policy, planning, and methodological issues in the environmental impact assessment of engineering systems including the regulatory framework and analytical techniques.

CEE 4630. Computer-Aided Site and Roadway Design
2-3-3.
Prerequisite(s): CEE 4600 and (AE 1770 or CEE 1770 or ME 1770)
Site development principles and application to a comprehensive design project using computer-based digital terrain model software tools.

CEE 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

CEE 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

CEE 4791. Mechanical Behavior of Composites
3-0-3.
Prerequisite(s): COE 3001
Stress-strain behavior of composites, property of matrix and reinforcing materials, mechanics of fiber-reinforced composites, lamina and laminate analysis, and mechanical performance. Crosslisted with AE, CHE, ME, MSE, and PTFE 4791.

CEE 4793. Composite Materials and Processes
3-0-3.
Prerequisite(s): CHEM 1310 and PHYS 2212
Basic principles of selection and design of composite materials and their manufacturing and testing. Cost factors. Laboratory exercises on manufacturing and tests. Crosslisted with AE, CHE, ME, MSE, and PTFE 4793.

CEE 4794. Composite Materials and Manufacturing
3-3-4.
Prerequisite(s): CHEM 1310 and PHYS 2212
Basic principles of selection and design of composite materials and their manufacturing and testing. Cost factors. Laboratory exercises on manufacturing and tests. Crosslisted with AE, CHE, ME, MSE, and PTFE 4794.

CEE 4795. Groundwater Hydrology
3-0-3.
Prerequisite(s). (MATH 2403 and PHYS 2212 and CEE 3040) or EAS 3630
Dynamics of flow and solute transport in groundwater, including theory, implementation, and case studies. Crosslisted with EAS 4795.

CEE 4801, -02, -03, -04, -05, -06. Special Topics
Class and credit hours equal last digit in course number.

CEE 4900. Undergraduate Honors Research Project
Credit hours to be arranged.
Individual research projects conducted in conjunction with and under the direction of a CEE faculty member. Participation by invitation, and agreement with individual faculty members. Project culminates in a thesis and presentation.

CEE 4901, -02, -03. Special Problems
Credit hours to be arranged.

CEE 6100. Construction Project Planning
3-0-3.
Introduction to project planning concepts including organization development, computer-based scheduling, computer-based estimating, regulatory agencies, and project financing.

CEE 6110. Computer Applications in Construction
3-0-3.
Introduction to computing tools impacting the construction industry and the analysis techniques used to determine company automation requirements.

CEE 6120. Environmentally Conscious Design and Construction
3-0-3.
Introduction to framework, concepts, principles, strategies, and tools for environmentally conscious design and construction of facilities and civil infrastructure systems.

CEE 6130. Construction Project Controls
3-0-3.
Prerequisite(s): CEE 6100
Introduction to project control concepts and advanced implementation techniques. Project control concerns including project budgeting, project productivity, cash flow, and resource allocation will be introduced.

CEE 6140. Advanced Planning and Estimating Methods
3-0-3.
Prerequisite(s): CEE 4110
Overview of advanced methods for planning and estimating construction projects including resource allocation/management, project control techniques, interpretation of schedules and estimates, and value engineering.

CEE 6150. Construction Law
3-0-3.
Overview of construction law and legal issues encountered by the construction engineer and manager.

CEE 6170. Project Delivery and Procurement
3-0-3.
Analysis of construction project delivery including traditional, design-build, construction management, multiple prime contractors, and related financing. The course focuses on the owner's role in construction.

CEE 6180. Construction Organizations
3-0-3.
Introduction to organizational concepts of the construction industry including strategic management, company financing, human resources, and market analysis.

CEE 6190. Construction Field Engineering
3-0-3.
Introduction to construction engineering techniques and practices including site excavation, shoring structures, heavy equipment, site layout, and temporary facility construction.

CEE 6221. Physical Hydrology
3-0-3.
Prerequisite(s): CEE 4210
Occurrence, movement, and distribution of water. Topics: hydrologic cycle, global circulation, climate, atmospheric water vapor, thermodynamics, precipitation, evaporation, snowmelt, soil moisture, unsaturated flow, infiltration, geomorphology, runoff, and routing.

CEE 6222. Hydrometeorology
3-0-3.
Prerequisite(s): CEE 6221
Estimation of hydrologic variables from on-site and remote sensors; operational hydrologic models; parameter estimation; operational forecasting.

CEE 6231. Probability and Statistics for Civil and Environmental Engineers
3-0-3.
Probability distributions applicable to civil engineering systems; function of random variables; regression and correlation analysis; parameters estimation and statistical hypothesis tests.

CEE 6232. Stochastic Hydrology
3-0-3.
Prerequisite(s): CEE 6231
Stochastic modeling of hydrologic processes. Problems of model specifications and parameter identification, and validation. Application to forecasting and synthetic events.

CEE 6241. Water Resources Management I
3-0-3.
Operations research methodologies, including linear and nonlinear programming, and their applications to water resources systems.

CEE 6242. Water Resources Management II
3-0-3.
Prerequisite(s): CEE 6231 and CEE 6241
Design of decision support systems for water resources planning and management.

CEE 6244. Random Fields and Geostatistics
3-0-3.
Probability density function; moments; scales of fluctuations; spectral representation; simulation of random fields; cross-correlated random fields; vector fields; kriging; conditional simulation.

CEE 6251. Intermediate Fluid Mechanics
2-3-3.
Prerequisite(s): CEE 3040 and CEE 4200
Concepts of linear and angular deformation, vorticity, and conservation of mass. Development of Navier-Stokes with solutions: steady and unsteady uniform laminar, vortex, creeping, and potential flow.

CEE 6252. Advanced Fluid Mechanics
3-0-3.
Prerequisite(s): CEE 6251
Theory of three-dimensional turbulent boundary layers with application to environmental flows in rivers, estuaries, and the atmosphere of interest in water resources engineering.

CEE 6261. Environmental Fluid Mechanics
3-0-3.
Dynamics, mixing, and contaminant transport in surface water bodies, including lakes, rivers, estuaries, and coastal waters. Introduction to numerical models. Prediction of mixing zones.

CEE 6262. Advanced Environmental Fluid Mechanics
3-0-3.
Prerequisite(s): CEE 6261
Buoyancy modifications to the mixing and dynamics of pollutant discharges and surface water bodies. Gathering and analysis of laboratory and field data for mixing problems.

CEE 6263. Fluid Mechanics of Organisms
3-0-3.
Prerequisite(s): MATH 1501 and PHYS 2211
Principles of fluid mechanics are applied in the context of biology. Discussion of transport of chemical and mechanical signals and fluid forces affecting organisms.

CEE 6271. Flow and Transport through Porous Media I
3-0-3.
Prerequisite(s): CEE 6221
Basic principles governing ground water flow. Topics covered: fundamental principles of saturated and unsaturated ground water flow, contaminant transport, and salt water intrusion.

CEE 6272. Flow and Transport through Porous Media II
3-0-3.
Prerequisite(s): CEE 6271
Principles of numerical methods used in solving ground water flow, contaminant transport models, building on materials covered in CEE 6271. Topics: finite element, difference methods, saturated/unsaturated ground water flow, and contaminant transport.

CEE 6274. Flow and Transport in Heterogeneous Porous Media
3-0-3.
Prerequisite(s): CEE 6271
Advanced treatment of transport processes in natural porous media: classical description; stochastic description of variability; dynamic models; flow and transport in aquifers; model uncertainty.

CEE 6281. Open Channel Hydraulics
2-3-3.
Prerequisite(s): CEE 4200
Flow of liquids with free surfaces in artificial and natural channels. Analysis of flow resistance. Computation of gradually varied flow profiles. Flow through transitions, spillways, bridges, culverts. Analysis of unsteady flow.

CEE 6282. Sediment Transport
3-0-3.
Prerequisite(s): CEE 4200
Engineering importance of erosion and sedimentation problems. Topics: properties of non-cohesive/cohesive sediments including specific weight/gravity/shape/size/size distribution/fall velocity/mineral structure/rheological properties.

CEE 6284. Hydraulic Transients in Fluid Systems
3-0-3.
Prerequisite(s): CEE 3040 and CEE 4200
Transient flow of liquids in piping systems. One-dimensional wave equations and method of characteristics. Effects of valves and pumps on waterhammer. Cavitation and liquid-column separation.

CEE 6293. Hydrodynamic Stability and Turbulence
3-0-3.
Prerequisite(s): CEE 6251
Flow in stability and turbulence are important in virtually all environmental flows. Fundamental stability, transition, and turbulent concepts along with their engineering relevance will be introduced.

CEE 6310. Process Principles in Environmental Engineering
3-0-3.
Principles that can be used in the analysis and modeling of environmental engineering processes, including material and energy balances, mass transfer, and reaction engineering.

CEE 6311. Microbial Principles in Environmental Engineering
3-0-3.
Microbiological principles with emphasis on microbial nutrition and growth, inhibition and control of growth, biochemical thermodynamics, metabolic pathways, enzyme and microbial kinetics.

CEE 6312. Chemical Principles in Environmental Engineering
3-0-3.
Fundamental principles of chemical equilibria and environmental organic chemistry in dilute aqueous systems with emphasis on chemical speciation and environmental engineering applications.

CEE 6313. Fate of Contaminants in the Subsurface
3-0-3.
Effects of physical, chemical, and biological processes on the fate and transport of contaminants in unsaturated and saturated porous media.

CEE 6319. Environmental Sciences and Engineering Laboratory
2-3-3.
Prerequisite(s): CEE 6310 and CEE 6311 and CEE 6312
Laboratory exercises and discussions for the understanding of fundamental chemical analytical, physicochemical, and applied microbiological principles in environmental engineering.

CEE 6330. Physicochemical Processes
3-0-3.
Prerequisite(s): CEE 6310 and CEE 6312
Theory and application of the physical and chemical processes of coagulation, flocculation, sedimentation, softening, filtration, and disinfection in water and wastewater treatment.

CEE 6331. Biological Processes
3-0-3.
Prerequisite(s): CEE 6310 and CEE 6311 and CEE 6312
Microbial growth kinetics and bioenergetics, theory, modeling, and application of biological processes employed in water, wastewater, and hazardous waste treatment systems as well as subsurface bioremediation.

CEE 6332. Separation Processes
3-0-3.
Prerequisite(s): CEE 6310 and CEE 6312
Theory and applications of the physical and chemical processes of sorption, membrane separation, and absorption in both gas-phase and liquid-phase environmental engineering systems.

CEE 6333. Hazardous Waste Site Remediation
3-0-3.
Prerequisite(s): CEE 6313
Selection, design, and implementation of hazardous waste site remediation technologies, including pump-and-treat, soil vapor extraction, thermal processes, bioremediation, surfactant flushing, and barrier-treatment walls.

CEE 6340. Solid-Liquid Separations
3-0-3.
Prerequisite(s): CEE 6310 and CEE 6311 and CEE 6312
Characterization, stabilization, conditioning, thickening, dewatering, conversion, recovery, transportation, and disposal of air, water, and wastewater treatment residues.

CEE 6341. Industrial Waste Treatment and Disposal
2-3-3.
A review of current policies and approaches in industrial waste treatment, and application of engineering principles and processes for waste treatment, recovery, and disposal.

CEE 6342. Solid Waste Technology
2-3-3.
An introduction of the current regulations and fundamentals of solid waste management, characterization, handling, recycling, transportation, and final disposal systems.

CEE 6343. Membrane Processes
3-0-3.
Prerequisite(s): CEE 6310 and CEE 6312
An introduction of the theories of membrane separation processes with special emphasis on desalination, softening, THM precursors reduction using reverse osmosis and nanofiltration.

CEE 6350. Advanced Environmental Chemistry
3-0-3.
Prerequisite(s): CEE 6312
Chemical behavior of inorganic and organic compounds in natural waters. Topics include chemistry of metal ions, partitioning and distribution of organic pollutants, surface reactions.

CEE 6351. Biotransformation of Xenobiotic Compounds
3-0-3.
Prerequisite(s): CEE 6311
Biotransformation pathways and kinetics of anthropogenic recalcitrant compounds and biological, biochemical, and environmental factors affecting these transformations in natural and engineered systems.

CEE 6355. Industrial Ecology in Environmental Engineering
3-0-3.
Introduces the principles of environmentally conscious products, processes, and manufacturing systems.

CEE 6360. Design of Treatment Facilities for Drinking Water
2-3-3.
Prerequisite(s): CEE 6330
Theory and design of process tanks and equipment for capture, purification, conditioning, storage, and distribution of safe drinking water.

CEE 6361. Modeling and Simulation of Biological Treatment Systems
2-3-3.
Prerequisite(s): CEE 6331
Theory and design of biological treatment systems for water reclamation, nutrient removal, and integrated process design and optimization using advanced computer models.

CEE 6390. Air Pollutant Formation and Control
3-0-3.
Analysis of air pollutants through the study of radical reaction pathways, combustion processes, and removal of particles and gaseous pollutants from exhaust gas streams.

CEE 6391. Advanced Topics in Air Pollution
1-0-1.
Current topics in air pollution engineering presented and discussed.

CEE 6402. Soil Mechanics
3-0-3.
Prerequisite(s): CEE 4400
Fundamental concepts related to the mechanical behavior of soils, including: effective stress, strength, stiffness, permeability, and time-dependent behavior.

CEE 6403. Environmental Geotechnics
3-0-3.
Prerequisite(s): CEE 4400
Evaluation of equilibria and partitioning as applied to site assessment techniques including soil gas data, monitoring wells, soil samples, and direct-push technology.

CEE 6421. Laboratory Characterization of Geomaterials
2-3-3.
Prerequisite(s): CEE 4400
Instruction in the procedures, methods of interpretation and apparatus limitations and influences for geotechnical laboratory index, strength, deformation, and permeability tests.

CEE 6422. Experimental Methods in Soil Behavior
2-3-3.
Macrobehavior and microlevel phenomena in particulate media are experimentally studied. Topics in experimental research include: scale effects, similarity, falsification, errors, transducers, design of experiments.

CEE 6423. In-Situ Testing and Site Characterization of Geomaterials
3-0-3.
Field testing and sampling of geomaterials, primarily soils and rocks. Introduces methods of drilling, probing, and in-situ measurement of soils for determining stratigraphy and engineering parameters for analysis, including soil borings, cone penetration tests, pressuremeter, dilatometer, and other tests.

CEE 6424. Engineering Geophysics
2-3-3.
Prerequisite(s): CEE 6442
Geophysical techniques used to characterize near-surface soils and rocks including seismic, magnetic, electromagnetic, radar, and resistivity methods.

CEE 6441. Analysis of Earth Structures
3-0-3.
Prerequisite(s): CEE 6402
Instruction in techniques for assessing the stability of earth-retaining structures including unreinforced slopes, reinforced slopes, free-standing retaining structures, and reinforced retaining structures.

CEE 6442. Dynamic Analysis in Geotechnical Engineering
3-0-3.
Prerequisite(s): CEE 6402
Dynamic soil properties; response of foundations to dynamic loads; construction and blast vibration criteria; dynamic analysis of pile driving; introduction to liquefaction potential.

CEE 6443. Foundation Systems
3-0-3.
Evaluation and design of foundations for civil engineering structures, including the settlement and bearing capacity of shallow spread footings, mats, and deep foundations. Footings, driven piles, bored piles, and drilled shafts analyzed using elastic continuum theory, limit plasticity, and cavity expansion solutions, supplemented with numerous case studies. Ancillary topics include axial load transfer, pile group interaction, lateral and moment loading, and pile dynamics.

CEE 6444. Geosynthetics in Civil Engineering
3-0-3.
Prerequisite(s): CEE 3020 and CEE 4400
Development, fabrication, design, and applications of geotextiles, geogrids, geonets, and geomembranes.

CEE 6445. Geotechnical Earthquake Engineering
3-0-3.
Earthquake magnitude and intensity, seismic hazard evaluation using deterministic and probabilistic approaches, site response analysis and ground motion amplification liquefaction, and response of earth structures.

CEE 6446. Geotechnical Seepage Analysis
3-0-3.
Prerequisite(s): CEE 6402
Seepage and its effects on engineering behavior of soils and its consequences for design of geoinfrastructure.

CEE 6447. Ground Modification
3-0-3.
Prerequisite(s): CEE 6402
Methods for improving marginal construction sites for geotechnical engineering projects and rehabilitation of geoinfrastructure.

CEE 6448. Landfill Design and Management
3-0-3.
Prerequisite(s): CEE 6402
The course deals with geomaterial selection and characterization, chemical compatibility, placement procedures (including compaction), design strategies, seepage issues, instrumentation, and environmental monitoring.

CEE 6449. Design of Remediation Systems
3-0-3.
Prerequisite(s): CEE 6403
Design of remediation systems and management approaches for the petrochemical, power generation, metals finishing, and mining industries are emphasized. Risk analysis and case histories are presented.

CEE 6450. Pavement Design
3-0-3.
Prerequisite(s): CEE 4400
Analysis and design of flexible and rigid pavement for highway and airfield runway, evaluation of pavement performance and distress, and pavement rehabilitation strategy and techniques.

CEE 6451. Rock Mechanics
3-0-3.
Prerequisite(s): CEE 6751 or EAS 6751
Rock characterization, scale effect, in-situ stresses, mechanisms of rock deformation and fracture, rock engineering; special attention to common principles unifying presented set of topics.

CEE 6461. Mathematical Applications for Civil and Environmental Engineering
3-0-3.
Mathematical techniques are reviewed in the context of CEE problems. The simplified yet mathematically rigorous approach highlights the internal mathematical connections between different engineering problems.

CEE 6462. Signals and Inverse Problems in Civil Engineering
3-0-3.
Prerequisite(s): CEE 6402
Civil engineering signals and systems. Discrete time and frequency domain operations. Nonlinear and nonstationary systems. Inverse problems. Matrix-based and other solutions. Tomography. Civil engineering examples.

CEE 6463. Constitutive Modeling of Soils
3-0-3.
Prerequisite(s): CEE 6402
Fundamental concepts in modeling behavior of soils. Implementation of models into numerical solution codes. Evaluation of models used in practice.

CEE 6481. Unsaturated Soil Mechanics
3-0-3.
Prerequisite(s): CEE 6402
This course presents many of the fundamental concepts behind the mechanical behavior of unsaturated soils.

CEE 6482. Applied Fracture Mechanics
3-0-3.
Prerequisite(s): CEE 6451
Application of fracture mechanics toward practical problems. General fracture behavior studied in the context of a variety of applied topics. Computer and experimental demonstrations.

CEE 6483. Geotechnical Image and Spatial Analysis
3-0-3.
Prerequisite(s): CEE 6402
Presentation of techniques for spatial and image processing and analysis of subsurface data at micro and macro scales.

CEE 6484. Industrial Byproduct Reutilization
2-3-3.
Prerequisite(s): CEE 6402
Explores more fully the interface between geotechnology, geochemistry, and sustainable engineering to develop new applications using industrial byproducts.

CEE 6485. Wave-Based Characterization of Particulate Materials
3-0-3.
Prerequisite(s): CEE 6402
Characterization of materials with mechanical and electromagnetic waves. Emphasis on particulates with extensions to other materials. Laboratory and field applications.

CEE 6501. Matrix Structural Analysis
3-0-3.
Prerequisite(s): CEE 4550
Static analysis of framed structures by flexibility and stiffness methods; computer models and solution for applied loads, temperature, support settlement, and member prestrain effects.

CEE 6504. Finite Element Method of Structural Analysis
3-0-3.
Prerequisite(s): CEE 6551
Introduction to the element method with emphasis on analysis of solids and structures. One-, two-, and three-dimensional finite. Modeling, approximations, and errors.

CEE 6507. Nonlinear Finite Element Analysis
3-0-3.
Prerequisite(s): CEE 6504
Lagrangian formulations for nonlinear analysis of solids and structures, including consistent linearization and state determination. Incremental-iterative solution approaches; computational plasticity. Software implementation.

CEE 6510. Structural Dynamics
4-0-4.
Prerequisite(s): CEE 6501
Vibration and dynamic response of linear and nonlinear structures to periodic and general disturbing forces, with and without damping effects. Wind and earthquake SDOF and MDOF effects.

CEE 6513. Computational Methods in Mechanics
3-0-3.
Generalization of finite element concepts; Galerkin-weighted residual and variational approaches; mixed and hybrid finite element formulations, applications, transient dynamic analysis; software implementation.

CEE 6521. Reinforced Concrete Members
3-0-3.
Prerequisite(s): CEE 4520
Behavior and design of RC members; ductility and inelastic response; deep beams; corbel and torsion design; column biaxial bending; shearwalls; effects of creep and shrinkage.

CEE 6522. Reinforced Concrete Slab Systems
3-0-3.
Prerequisite(s): CEE 4520
Analysis and design of two-way slab systems, structural walls, and complex building configurations. Equivalent frame and analysis, strip and yield-line technique, application of finite element method to design of slab and wall systems.

CEE 6523. Prestressed Concrete
3-0-3.
Prerequisite(s): CEE 4520
Principles and practice of prestressed concrete. Analysis and design of statically determinate and indeterminate beams, and one-way and two-way slabs; precast pretensioned, post-tensioned.

CEE 6527. Advanced Structural Steel Design
3-0-3.
Strength, behavior, and design of steel structures according to WSD and LRFD. Plate girders, composite beams, bolted and welded connections, beam-columns, and torsion.

CEE 6530. Structural Systems
3-0-3.
Prerequisite(s): CEE 4550
Behavior and design of steel and concrete building and bridge systems. Introduction to structural planning with emphasis on economics, structural behavior, serviceability, and strength considerations.

CEE 6533. Design of Polymer Composite Structures
3-0-3.
Prerequisite(s): AE 4791 or CEE 4791 or CHBE 4791 or ME 4791 or MSE 4791 or PTFE 4791
Strength, behavior, and design of polymeric composites, structural members, and connections for civil engineering applications.

CEE 6536. Rehabilitation of Existing Structures
3-0-3.
Deterioration science; corrosion of steel, alkali-silica reaction, freezing and thawing. Assessment and evaluation of existing structures, nondestructive testing, and nondestructive evaluation.

CEE 6541. Earthquake Engineering
3-0-3.
Prerequisite(s): CEE 6510
Characteristics of earthquakes; design and rehabilitation of civil engineering structures for earthquake ground motion; code provisions; case studies.

CEE 6544. Structural Modeling
3-0-3.
Modeling of structures for static, dynamic, and nonlinear analysis using finite elements. Effects of parameters on the structural behavior.

CEE 6547. Nonlinear Design of Frame Structures
3-0-3.
Prerequisite(s): CEE 6527
Analysis and design of structures based on ultimate load capacity. Application of the fundamental theorems of plastic design to continuous beams, frames, and grillages.

CEE 6551. Advanced Strength of Materials
3-0-3.
Study of advanced topics from mechanics of materials with application to structures. Typical topics: energy methods, failure theories, post-yield behavior, generalized bending and torsion.

CEE 6554. Theory of Elastic Stability
3-0-3.
Concepts of elastic stability, simple mechanical models, buckling of beam-columns and frames, beams on elastic foundation, and plates energy methods, torsional and lateral buckling.

CEE 6557. Theory of Plates and Shells
3-0-3.
Plate bending, approximate methods, nonlinearity, stiffened and anisotropic plates. Stress and deformation of shells with and without bending, surfaces of revolutions, and shallow shells.

CEE 6560. Applied Elasticity
3-0-3.
Introduction to traction, stress, and equilibrium; deformations, strain compatibility, constitutive equations; two-dimensional problems in Cartesian and polar coordinates; application to extension, bending, and torsion.

CEE 6563. Energy Methods in Mechanics
3-0-3.
Virtual work, principles of potential energy and complementary energy, Castigliano's theorems, generalized and stationary variational principles, energy methods, structural applications, nonlinear problems, Hamilton's principle.

CEE 6566. Plasticity and Viscoelasticity
3-0-3.
Prerequisite(s): CEE 6581 or CEE 6571
Plastic deformation, yield conditions, flow rules and normality, relaxation and creep, viscoelasticity, tubes and spheres, torsion and bending, slip line fields, viscoelastic boundary value problems.

CEE 6569. Wave Propagation in Solids
3-0-3.
Prerequisite(s): CEE 6560
Plane waves in elastic half-spaces, reflection and refraction; Rayleigh and Stonely waves; waveguides, Lovewaves, Rayleigh-Lamb modes; Cagniard-de Hoop method; in anisotropic media.

CEE 6571. Experimental Stress Analysis
2-3-3.
Study of surface stress and strain using brittle coatings and strain gauges. Strain gauge circuits, static and dynamic problems, transducer design and circuits.

CEE 6581. Engineering Programming Methods
2-3-3.
Engineering programming concepts through the application of numerical solution techniques including program development, efficiencies, documentation, and testing using formal data structures and algorithms.

CEE 6582. Knowledge-Based Programming Methods in Engineering
2-3-3.
Prerequisite(s): CEE 6581
The usage and development of knowledge-based computer systems in engineering is studied. Topics include knowledge acquisition, representation, and verification.

CEE 6583. Object-Oriented and Multimedia Programming in Engineering
3-0-3.
Prerequisite(s): CEE 6581
Coverage of object-oriented and multimedia technologies is presented for their proper development and utilization in solving engineering problems.

CEE 6601. Linear Statistical Models in Transportation
3-3-4.
Prerequisite(s): CEE 3001
Theory of simple and multivariate regression and analysis of variance models. Assessment of modeling assumptions and remedial measures. Applications in the field of transportation planning.

CEE 6602. Urban Transportation Planning
3-3-4.
An overview course on the history, finance, operations, modeling, politics, environmental impacts, and planning of urban transportation systems in the United States.

CEE 6603. Traffic Engineering
2-3-3.
Prerequisite(s): CEE 4600
Characteristics of traffic demand, traffic flow, vehicles, drivers, roadways, and pedestrians. Studies and data analysis. Capacity analysis. Traffic control and intelligent systems. Operations and management.

CEE 6604. Geometric Design of Transportation Facilities
2-3-3.
Prerequisite(s): CEE 4601
Geometric configurations of streets, expressways, busways, railways, and their terminals to meet characteristics of vehicle performance and operator limitations.

CEE 6605. Transportation Administration and Policy Analysis
3-0-3.
Overview of institutions and policy processes in the transportation sector: organizational analysis and implementation; policy analysis.

CEE 6621. GIS in Transportation
2-3-3.
Theory and application of GIS applied to transportation engineering and planning (GIS-T). Laboratory focuses on GIS-T development.

CEE 6622. Travel Demand Analysis
2-3-3.
Prerequisite(s): CEE 6602
Examination of methods for forecasting future site and regional-level travel demand. Model specification, calibration, and validation.

CEE 6623. Survey Design and Analysis
3-0-3.
Prerequisite(s): CEE 6601
Design of telephone, mail out, and personal interview survey instruments. Subsequent estimation of choice-based models from cross-sectional and panel survey data.

CEE 6624. Land Use - Transportation Interaction
3-0-3.
Prerequisite(s): CP 6311
Overview of land use and transportation planning principles, how development impacts air transportation, how transportation investments impact development patterns and air quality.

CEE 6625. Transportation, Energy, and Air Quality
3-0-3.
Students investigate relationships between transportation demand, energy supply and consumption, fuel types, greenhouse gas emissions, and relationships between vehicle technology, pollutant emissions, modeling techniques, and air quality.

CEE 6631. Signalized Intersections and Networks
2-3-3.
Prerequisite(s): CEE 6603
Traffic-responsive signalization. Detector placement and signal timing at individual intersections. Hands-on practice with equipment. Timing of coordinated systems. Signal plans and specifications.

CEE 6632. Simulation Models in Transportation
3-3-3.
Prerequisite(s): CEE 6603
Simulation models in transportation: development, calibration, applications, and analysis of outputs.

CEE 6633. Advanced Traffic Detection and Control
3-0-3.
Prerequisite(s): CEE 6603 and CEE 6631
Latest developments in traffic control equipment and software, including incident management. Communications-technology alternatives. Video, other above-road detector technologies. Hands-on practice with equipment.

CEE 6634. Transportation Safety Analysis
3-0-3.
Prerequisite(s): CEE 6601
Understanding the human factors elements of transportation safety, and how to appropriately model the highly complex and stochastic occurrence of accidents on a transportation network.

CEE 6635. Technology Innovation in Transportation
3-0-3.
Technology innovations in transportation including Intelligent Transportation Systems. Planning and design of ITS systems.

CEE 6636. Traffic Flow Theory
3-0-3.
Prerequisite(s): CEE 6603
Advanced study of underlying principles and analytical procedures used in performing capacity analysis of transportation facilities. Highway Capacity Manual procedures and other analytical techniques presented.

CEE 6641. Transportation Infrastructure Management and Traffic Control
3-0-3.
Prerequisite(s): CEE 6603 and CEE 6604
Transportation infrastructure traffic control and safety-related issues are addressed for initial implementation of transportation facilities as well as daily operational aspects.

CEE 6642. Transit Systems Planning and Design
3-0-3.
Introduction to transit system planning and design concepts. Course will discuss the planning, design, and operations of transit systems, and the operations of intermodal terminals.

CEE 6644. Airport Planning and Design
2-3-3.
Prerequisite(s): CEE 4601
Airport site selection, runway length and orientation, traffic control, drainage and lighting, long-range planning, government responsibility for air transportation.

CEE 6651. Infrastructure Systems Management
3-0-3.
Analytical approaches and tools for infrastructure and asset management, sustainable systems development.

CEE 6751. Physical Properties and Rheology of Rocks
2-3-3.
Structure, properties, and rheology of minerals and rocks with applications to engineering structures and natural phenomena in the Earth. Fundamentals of rock mechanics and crack propagation. Crosslisted with EAS 6751.

CEE 6754. Engineering Communication
3-0-3.
Writing and editing engineering documents; designing and explaining visuals; creating and delivering electronic presentations. Crosslisted with MSE 6754.

CEE 6756. Discovery of Signaling Molecules
3-0-3.
Prerequisite(s): CHEM 2311
The diversity of chemical signals between organisms and their structural specificities will be presented along with chemical and biological methods for isolating signaling molecules. Crosslisted with BIOL 6756 and CHEM 6756.

CEE 6761. Contaminated Sediment Geochemistry
3-0-3.
Prerequisite(s): CEE 6312
Acquaints students with fate of major pollutants, nutrients, organic compounds, such as pesticides, PAHs, and trace metals in sedimentary systems. Crosslisted with EAS 6761.

CEE 6764. Biological Applications of Environmental Fluid Mechanics Laboratory
0-3-1.
Co-requisites: BIOL 7101 and CEE 6263
Provides students with hands-on experimental demonstrations of the basic principles of environmental fluid mechanics regarding chemical and hydrodynamic signals produced and sensed by organisms.

CEE 6790. Air Pollution Physics and Chemistry
3-0-3.
Introduction to physical and chemical processes affecting dynamics and fate of air pollutants at local, regional, and global scales; emphasis on tropospheric pollutant chemistry and transport. Crosslisted with EAS 6790.

CEE 6792. Air Pollution Meteorology and Chemistry
3-0-3.
Vertical temperature and wind structure, topographic effects, natural removal processes, atmospheric dispersion of stack effluents, air pollution climatology, meteorological management of air pollution. Crosslisted with EAS 6792.

CEE 6793. Atmospheric Boundary Layer
3-0-3.
Structure and dynamics of atmospheric boundary layer. Introduction to turbulence and turbulent transport. Crosslisted with EAS 6793.

CEE 6794. Atmospheric Chemical Modeling
3-0-3.
Prerequisite(s): EAS 6410 or EAS 6790 or CEE 6790
Application of modern numerical methods to the prediction of atmospheric chemical and physical compositions; specific applications using computer models developed by the students are included. Crosslisted with EAS 6794.

CEE 6795. Atmospheric Aerosols
3-0-3.
Prerequisite(s): EAS 6410 or EAS 6790 or CEE 6790
Chemical and physical properties of natural and anthropogenic aerosols. Sources, transport, transformation, and fate of primary/secondary, organic/inorganic, atmospheric semi-volatiles and aerosols. Crosslisted with EAS 6795.

CEE 7000. Master's Thesis
Credit hours to be arranged.

CEE 7310. Master's Thesis and Research Presentation
1-0-1.
Oral presentation of master's thesis and research projects.

CEE 7751. Computational Fluid Mechanics
3-0-3.
Prerequisite(s): CEE 6251 and ME 6601
Numerical methods for solving the time-dependent Navier-Stokes equations in complex geometries, including theory, implementation, and applications. Crosslisted with ME 7751.

CEE 7772. Fundamentals of Fracture Mechanics
3-0-3.
Prerequisite(s): AE 3120 or MSE 3005
Advanced study of failure of structural materials under load, mechanics of fracture, and microscopic and macroscopic aspects of the fracture of engineering materials. Crosslisted with AE, CHE, ME, and MSE 7772.

CEE 7773. Advanced Fracture Mechanics
3-0-3.
Prerequisite(s): AE 7772 or CEE 7772 or CHBE 7772 or ME 7772 or MSE 7772
Nonlinear fracture mechanics including elastic-plastic and time-dependent fracture, advanced test methods, J-integral theory, and extensions. Crosslisted with AE, CHE, ME, and MSE 7773.

CEE 7774. Fatigue of Materials and Structures
3-0-3.
Prerequisite(s): AE 7772 or CEE 7772 or CHBE 7772 or ME 7772 or MSE 7772
Mechanical and microstructural aspects of nucleation and growth of cracks under cyclic loading conditions, notch effects, cumulative damage, multiaxial loading, and fatigue crack propagation. Crosslisted with AE, CHE, ME, and MSE 7774.

CEE 7791. Damage, Failure and Durability of Composite Materials
3-0-3.
Prerequisite(s): AE 4791 or CEE 4791 or CHBE 4791 or ME 4791 or MSE 4791
Provide knowledge of the fundamental concepts and methods related to analysis and assessment of damage, failure, and durability of composite materials. Crosslisted with AE, CHE, ME, MSE, and PTFE 7791.

CEE 7792. Advanced Mechanics of Composites
3-0-3.
Prerequisite(s): CEE 4791
Anisotropic elasticity, failure theories, hygrothermal behavior, 3-D analysis of laminates, duck laminates, free-edge effects, stress concentrations, joints, creep and fracture of composites. Crosslisted with AE, CHE, ME, MSE and PTFE 7792.

CEE 7793. Manufacturing of Composites
3-0-3.
Prerequisite(s): AE 4793 or CEE 4793 or CHBE 4793 or ME 4793 or MSE 4793 or PTFE 4793
Major manufacturing techniques for metal-, ceramic-, and polymer-matrix composites. Modeling of processes with emphasis on fundamental mechanisms and effects. Crosslisted with AE, CHE, ME, MSE and PTFE 7793.

CEE 7999. Doctoral Examination Preparation
Credit hours to be arranged.
For students preparing for the doctoral qualifying examination.

CEE 8091. Construction Seminar
1-0-1.
Introduction to leading-edge industry practices not part of the regular curriculum using field trips and guest

CEE 8092. Fluid Mechanics and Hydraulics Seminar
1-0-1.
Presentation and discussion of current research developments in water resources by outside speakers, faculty, and graduate students.

CEE 8093. Hydrology and Water Resources Seminar
1-0-1.
Presentation and discussion of current research developments in water resources by outside speakers, faculty, and graduate students.

CEE 8094. Environmental Engineering Seminar
1-0-1.
Developments in environmental engineering science and technology, current practice, current research, and special topics related to environmental quality assessment and control.

CEE 8095. Research Seminar in Environmental Engineering
1-0-1.
Discussion of current research topics in environmental engineering. Presentations by master's and doctoral students.

CEE 8811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number.
Topics of current interest in civil engineering.

CEE 8900, -01, -02, -03. Special Problems
Credit hours to be arranged.

CEE 8950. Master's Special Research Project
Credit hours to be arranged.
Master's research project to be scheduled by M.S. students not writing thesis.

CEE 8956. Master's Special Research Problem
Credit hours to be arranged.
For nonthesis students performing research.

CEE 8997. Teaching Assistantship
Credit hours to be arranged.
For students holding graduate teaching assistantships.

CEE 8998. Research Assistantship
Credit hours to be arranged.
For students holding a graduate research assistantship.

CEE 8999. Preparation for Doctoral Dissertation
Credit hours to be arranged.
For students in the preliminary stages of formulating their doctoral research program who have not obtained formal approval of dissertation topic.

CEE 9000. Doctoral Thesis
Credit hours to be arranged.

An asterisk (*) denotes prerequisite courses.

School of Electrical and Computer Engineering

www.ece.gatech.edu

Established in 1896
Principal location: Van Leer Building
Telephone: 404.894.2901
Fax: 404.894.4641
E-mail: info@ece.gatech.edu

Chair and Motorola Foundation Professor–Gary S. May; *Associate Chair for Faculty Development and Professor*–Andrew F. Peterson; *Associate Chair for External Affairs and Georgia Power Distinguished Professor*–Hans B. Püttgen; *Associate Chair for Graduate Affairs and Professor*–Paul G. Steffes; *Associate Chair for Undergraduate Affairs and Associate Professor*–Douglas B. Williams; *Associate Chair for Academic Operations and Professor*–Joseph L. A. Hughes; *Associate Chair for Operations and Professor*–Jay H. Schlag; *Assistant to the Chair for Laboratory Instruction*–Thomas E. Brewer; *Assistant to the Chair for Computer Services*–David S. Webb; *Julius Brown Chair Professor and Regents' Professor*–Thomas K. Gaylord; *Joseph M. Pettit Professor and Regents' Professor*–Russell M. Mersereau; *Georgia Power Distinguished Professor and Regents' Professor*–Ajeet Rohatgi; *John Pippin Chair in Electromagnetics and Regents' Professor*–Glenn S. Smith; *Byers Professor*–Ian F. Akyildiz; *Joseph M. Petit Professor*–Mark G. Allen; *Schlumberger Professor in Microelectronics*–Phillip E. Allen; *Arbutus Chair in Distributed Engineering Education and GRA Eminent Scholar*–Thomas P. Barnwell III; *Byers Endowed Professor in Optical Networking*–Gee-Kung Chang; *John H. Weitnauer Jr. Technology Transfer Chair and GRA Eminent Scholar*–John A. Copeland; *Byers Professor*–John D. Cressler; *Steve W. Chaddick Endowed Chair in Electro-Optics and GRA Eminent Scholar*–Russell D. Dupuis; *Duke Power Company Distinguished Professor*–Ronald G. Harley; *Rhesa "Ray" Farmer Jr. Chair in Embedded Experiential Systems and GRA Eminent Scholar*–Ramesh Jain; *John Pippin Chair in Wireless Systems and GRA Eminent Scholar*–Nikil S. Jayant; *Motorola Foundation Chair Professor and GRA Eminent Scholar*–Biing-Hwang (Fred) Juang; *ON Semiconductor Junior Professor*–J. Stevenson Kenney; *Demetrius T. Paris Professor*–Aaron D. Lanterman; *Joseph M. Petit Professor*–Joy Laskar; *John and Marilu McCarty Chair of Electrical Engineering*–James H. McClellan; *Byers Professor*–Steven W. McLaughlin; *Joseph M. Pettit Chair in Microelectronics and Professor*–James D. Meindl; *Julian Hightower Professor*–Allen Tannenbaum; *Joseph M. Pettit Chair in Electronics Packaging and GRA Eminent Scholar*–Rao R. Tummala; *Joseph M. Pettit Professor*–Sudhakar Yalamanchili.
Regents' Professors Emeriti–John W. Hooper, George P. Rodrigue, Ronald W. Schafer, Kendall L. Su.
Professors–Douglas M. Blough, John A. Buck, W. Russell Callen Jr., Abhijit Chatterjee, Mark A. Clements, Stephen P. DeWeerth, Deepak Divan, John E. Dorsey, Ian T. Ferguson, Elias N. Glytsis, Thomas G. Habetler, James O. Hamblen, Monson H. Hayes III, Bonnie S. Heck, William D. Hunt, Bernard Kippelen, W. Marshall Leach Jr., Chin-Hui Lee, Vijay K. Madisetti, A. P. Sakis Meliopoulos, Henry L. Owen, Krishna V. Palem, John B. Peatman, William T. Rhodes, Waymond R. Scott Jr., Gordon L. Stüber, Madhavan Swaminathan, David G. Taylor, George J. Vachtsevanos, Feodor Vainstein**, Erik I. Verriest, Yorai Y. Wardi, D. Scott Wills, Rahman Zaghloul**.
Professors Emeriti–Cecil O. Alford, Henry C. Bourne, Aubrey M. Bush, J. Alvin Connelly, Robert K. Feeney, Joseph L. Hammond, David R. Hertling, Richard J. Higgins, Edward B. Joy, Edward W. Kamen, Richard P. Kenan, Dale C. Ray, William E. Sayle.

Associate Professors–Ali Adibi, Yucel Altunbasak, Christopher Barnes**, John R. Barry, Miroslav M. Begovic, Oliver Brand, Robert J. Butera Jr., David S. Citrin, Ko-Hui Michael Fan, A. Bruno Frazier, Paul E. Hasler, Mary Ann Ingram, Chuanyi Ji, David G. Keezer, Arthur J. Koblasz, Ye (Geoffrey) Li, Jennifer E. Michaels, Thomas E. Michaels, Linda S. Milor, Vincent J. Mooney III, Henry L. Owen, Stephen E. Ralph, Ashraf S. Saad**, David E. Schimmel, Emmanouil M. Tentzeris, Linda M. Wills, Anthony J. Yezzi Jr., P. Douglas Yoder**, G. Tong Zhou.

Associate Professor Emeritus–Mohamed F. Moad.

Assistant Professors–Randal Abler**, Ghassan Al-Regib**, David V. Anderson, Farrokh Ayazi, Jeffrey A. Davis, W. Alan Doolittle, Gregory D. Durgin, Magnus Egerstedt, Faramarz Fekri, Joel R. Jackson**, Benjamin D. B. Klein**, Hsien-Hsin (Sean) Lee, Sung Kyu Lim, Elliot Moore**, Ioannis (John) Papapolymerou, George F. Riley, Gabriel Rincon-Mora, Shyh-Chiang Shen, Raghupathy Sivakumar.

Laboratory Coordinator/Instructor–Allen Robinson.

Lecturers–Catherine Bass, Christina Bourgeois, Giorgio Casinovi, Frank C. Lambert, Christopher J. McGahey, Jerome Meisel, Gail O. Palmer, W. Whitfield Smith.

Adjunct Faculty–Emmanuel Anemogiannis, Paul J. Benkeser, Gisele Bennett, Daniel J. Blumenthal, David E. Bockelman, Bertrand Boussert, Catherine Brechignac, Martin A. Brooke, Marijn Brummer, Brian Butka, Donald D. Davis, Jim D. Echard*, Robert Eisner, Irfan Essa, Gary G. Gimmestad, Jean-Pierre Goedgebuer, Mathieu Hans, Nile F. Hartman, E. Jefferson Holder, Michael L. Jamrozik, Nan Marie Jokerst, Lance Kaplan, Fred Kitson, Laurent Larger, Bob Lee, Y.-L. Li, John O. Limb, Kenneth M. Mackenzie, John H. Matthews, Bill McKinnon, Robert McNally, Jerome Meisel, William L. Melvin, Stephen C. Mettler, Joseph W. Monaco, Romain Murenzi, William R. Owens*, Umakishore Ramachandran, Mark Richards, Craig Richardson, Tariq Samad, Karsten Schwan, Robert E. Schwerzel, Oskar Skrinjar, Christopher Summers, John D. Terry, Kwan K. Truong, May Wang, Stephen B. Wicker, Zhiping (James) Zhou.

**GTRI*

***Georgia Tech Savannah*

General Information

The cornerstones of electrical engineering–the control of information and electric power–result from the fact that electromagnetic energy is the only form of energy that can be transmitted efficiently and under controlled conditions, even over great distances, from point of origin to point of use. Utilization of this fact has enabled electrical engineers to drive and define the information technology revolution by pioneering such diverse and important fields as computers, electric power, microelectronics, and telecommunications.

Computer engineering is a rapidly growing discipline that encompasses the principles, methods, and tools for the design and implementation of digital systems and the integration of computer technology into a wide range of applications. Rapid advances in underlying technologies have resulted in ever smaller, less costly, and higher-performance computer systems, as well as the use of computers as embedded elements in applications ranging from highly complex communication systems to sophisticated biomedical devices to common household appliances. The computer engineering program provides a balanced perspective of both hardware and software elements of computing systems, design trade-offs, and applications.

The School of Electrical and Computer Engineering (ECE) provides undergraduate and graduate programs that prepare students to participate in a broad range of career opportunities. Modern facilities and laboratories support experimental and theoretical programs of instruction and research. Additional information about the School is available at **www.ece.gatech.edu** or upon request by calling 404.894.2900.

Georgia Tech Lorraine

Students may choose to pursue graduate degrees in electrical and computer engineering at Georgia Tech Lorraine, the European campus of the Georgia Institute of Technology, located in Metz, France. Undergraduate programs are also offered in the fall, spring, and summer terms at Georgia Tech Lorraine. In addition to courses taught in English by regular Georgia Tech faculty, students also may participate in courses and academic programs offered by partner French universities. For further information, see page 20 or visit **www.georgiatech-metz.fr/en/index.html**.

Undergraduate Programs

The School of Electrical and Computer Engineering offers two undergraduate degree programs: electrical engineering (EE) and computer engineering (CmpE). Both programs include elective hours, enabling students to individually tailor their programs to provide emphasis in a particular specialization or exposure to a broad range of subjects. Elective courses are available in a wide variety of major areas including analog electronics, bioengineering, computer engineering, systems and controls, microsystems and nanosystems, electronics packaging, digital signal processing, optics and photonics, electric power, energy processing, electro-magnetics, and telecommunications. Additionally, students may elect to take advanced courses in other programs such as computer science, mathematics, physics, or management. Engineering analysis and design concepts are integrated throughout both the electrical engineering and computer engineering programs. Both programs culminate in major design experiences involving a broad range of issues including economics, safety, and societal considerations.

The School of Electrical and Computer Engineering participates in the Georgia Tech Regional Engineering Program (GTREP) in southeast Georgia. Both the computer engineering and electrical engineering degree programs are offered at the Georgia Tech Savannah campus in association with GTREP's partner institutions (Armstrong State University, Georgia Southern University, and Savannah State University) in southeast Georgia. See **www.gtrep.gatech.edu** for additional information.

A five-year combined B.S./M.S. program is available to highly qualified undergraduates. Contact the ECE Graduate Affairs Office for program information and applications.

The School has established the following student educational objectives for its undergraduate programs:

- Graduates will be technically competent within the field, including the ability to analyze and solve electrical/computer engineering problems by applying basic principles of mathematics, science, and engineering sciences. They will be able to use modern engineering techniques, skills, and tools, particularly recognizing the role that computers play in engineering. They will be able to identify, formulate, and solve novel electrical/computer engineering problems that are subject to realistic constraints.
- Graduates will be able to apply the knowledge and skills from a broad education in order to understand the impact of electrical/computer engineering solutions in a global, societal, and environmental context consistent with the principles of sustainable development.
- Graduates will be prepared for professional practice in engineering. They will demonstrate an understanding of ethical, social, and professional responsibility; recognize the need for and have the ability to engage in perpetual learning; and have the ability to function and communicate effectively, both individually and within multidisciplinary teams.

Additional requirements and restrictions apply to the course requirements listed below. Contact the ECE Academic Office for more information.

Bachelor of Science in Electrical Engineering (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
MATH 1501	CALCULUS I	4
ENGL 1101	ENGLISH COMPOSITION I	3
CHEM 1310	GENERAL CHEMISTRY I	4
CS 1371	COMPUTING FOR ENGINEERS	3
WELLNESS		2
TOTAL SEMESTER HOURS		16

First Year – Second Semester

Course Number/Name		*Hours*
MATH 1502	CALCULUS II	4
ENGL 1102	ENGLISH COMPOSITION II	3
PHYS 2211	INTRODUCTORY PHYSICS I	4
CS 1322	OBJECT-ORIENTED PROGRAMMING	3
ECE 2050	INTRO. TO COMPUTER ENGINEERING	3
TOTAL SEMESTER HOURS		17

Second Year - First Semester

Course Number/Name		*Hours*
ECE 2025	INTRO. TO SIGNAL PROCESSING	4
LCC 3401	TECHNICAL COMMUNICATION PRACTICES	2
MATH 2401	CALCULUS III	4
PHYS 2212	INTRODUCTORY PHYSICS II	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		17

Second Year - Second Semester

Course Number/Name		Hours
ECE 2031	DIGITAL DESIGN LAB	2
ECE 2040	CIRCUIT ANALYSIS	3
MATH 2403	DIFFERENTIAL EQUATIONS	4
SCIENCE ELECTIVE (CHEM, PHYS, BIOL, EAS)		3
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Third Year - First Semester

Course Number/Name		Hours
ECE 3025	ELECTROMAGNETICS	3
ECE 3040	MICROELECTRONIC CIRCUITS	4
ECE 3041	INSTRUMENTATION & CIRCUITS LAB	2
ECON 2100 or 2105 or 2106		3
HUMANITIES ELECTIVE(S)		3
APPROVED ELECTIVE(S)		3
TOTAL SEMESTER HOURS		18

Third Year - Second Semester

Course Number/Name		Hours
ECE 3042	MICROELECTRONIC CIRCUITS LAB	2
ECE BREADTH ELECTIVE(S)		9
APPROVED ELECTIVE(S)		3
ENGINEERING ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Fourth Year - First Semester

Course Number/Name		Hours
ECE 4000	PROJECT ENGINEERING & PROFESSIONAL PRACTICE	3
ECE ELECTIVE(S)		4
ENGINEERING ELECTIVE(S)		3
APPROVED ELECTIVE(S)		3
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

Fourth Year - Second Semester

Course Number/Name	Hours
ECE DESIGN ELECTIVE(S)	3
ECE ELECTIVE(S)	4
ENGINEERING ELECTIVE(S)	3
APPROVED ELECTIVE(S)	3
HUMANITIES ELECTIVE(S)	3
TOTAL SEMESTER HOURS	16

TOTAL PROGRAM HOURS = 130 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Electives

The electrical engineering curriculum includes sixty-two semester hours of electives, subject to the following requirements:

1) Humanities, six hours: refer to pages 35-36 for a list of approved courses.
2) Social Sciences, twelve hours: must include HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200; must include ECON 2100, 2105, or 2106; refer to pages 35-36 for a list of approved courses to satisfy the remaining hours.
3) Sciences, three hours: BIOL 1510, BIOL 1520, CHEM 1311, EAS 1600, EAS 1601, PHYS 2213, PHYS 3225, or course(s) approved by the School.
4) Engineering electives, nine hours: AE 2120, COE 2001, COE 3001, or courses at the 3000 level or above in the College of Engineering outside ECE, subject to School approval; must include an approved thermodynamics course and an approved probability/statistics course.
5) ECE, twenty hours: 3000 level or above in ECE, at least nine hours at the 4000 level or above; must include an approved electrical engineering major design course; must include three of the following course options: ECE 3050, ECE 3055 or 3060, ECE 3065, ECE 3070, ECE 3075 or 3076, ECE 3080, ECE 3085, or ECE 3090.
6) Approved (Free), twelve hours: ECE, other engineering, mathematics, sciences, computing, management, humanities, social sciences, or ROTC; all other courses subject to School approval.

Additionally, an approved ethics course must be completed; this is normally taken as part of either the humanities or social sciences electives.

Bachelor of Science in Computer Engineering (Suggested Schedule)

First Year - First Semester

Course Number/Name		Hours
MATH 1501	CALCULUS I	4
ENGL 1101	ENGLISH COMPOSITION I	3
CHEM 1310	GENERAL CHEMISTRY I	4
CS 1371	COMPUTING FOR ENGINEERS	3
WELLNESS		1
TOTAL SEMESTER HOURS		16

First Year - Second Semester

Course Number/Name		Hours
MATH 1502	CALCULUS II	4
ENGL 1102	ENGLISH COMPOSITION II	3
PHYS 2211	INTRODUCTORY PHYSICS I	4
CS 1322	OBJECT-ORIENTED PROGRAMMING	3
ECE 2030	INTRO. TO COMPUTER ENGINEERING	3
TOTAL SEMESTER HOURS		17

Second Year - First Semester

Course Number/Name		Hours
ECE 2025	INTRO. TO SIGNAL PROCESSING	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
MATH 2401	CALCULUS III	4
PHYS 2212	INTRODUCTORY PHYSICS II	4
LCC 3401	TECHNICAL COMMUNICATION PRACTICES	2
TOTAL SEMESTER HOURS		17

Second Year - Second Semester

Course Number/Name		Hours
ECE 2031	DIGITAL DESIGN LAB	2
ECE 2040	CIRCUIT ANALYSIS	3
MATH 2403	DIFFERENTIAL EQUATIONS	4
SCIENCE ELECTIVE (CHEM, PHYS, BIOL, EAS)		3
ECE 3055	MECHANISMS FOR COMPUTING SYSTEMS	4
TOTAL SEMESTER HOURS		16

Third Year - First Semester

Course Number/Name		Hours
ECE 3040	MICROELECTRONIC CIRCUITS	4
ECE 3041	INSTRUMENTATION & CIRCUITS LAB	2
ECE 3055	COMPUTER ARCHITECTURE & OPERATING SYSTEMS	4
ECON 2100 or 2105 or 2106		3
DISCRETE MATH ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

Third Year - Second Semester

Course Number/Name		Hours
ECE 3042	MICROELECTRONIC CIRCUITS LAB	2
ECE 3060	VLSI & ADVANCED DIGITAL DESIGN	4
ECE 3025	ELECTROMAGNETICS	3
ENGINEERING ELECTIVE(S)		3
HUMANITIES ELECTIVE(S)		3
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		18

Fourth Year - First Semester

Course Number/Name		Hours
ECE 4000	PROJECT ENGINEERING & PROFESSIONAL PRACTICE	3
ECE/CS ELECTIVE(S)		4
ENGINEERING ELECTIVE(S)		3
APPROVED ELECTIVE(S)		3
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

Fourth Year - Second Semester

Course Number/Name	Hours
COMPUTER ENGINEERING DESIGN COURSE	3
ECE/CS ELECTIVE(S)	7
SOCIAL SCIENCE ELECTIVE(S)	3
APPROVED ELECTIVE(S)	3
TOTAL SEMESTER HOURS	16

TOTAL PROGRAM HOURS = 130 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Electives

The computer engineering curriculum includes fifty-four semester hours of electives, subject to the following requirements:

1) Humanities, six hours: refer to pages 35-36 for a list of approved courses.
2) Social Sciences, twelve hours: must include HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200; must include ECON 2100, 2105, or 2106; refer to pages 35-36 for a list of approved courses to satisfy the remaining hours.
3) Sciences, three hours: BIOL 1510, BIOL 1520, CHEM 1311, EAS 1600, EAS 1601, PHYS 2213, PHYS 3225, or course(s) approved by the School.
4) Advanced Programming, four hours: CS 2130 or course(s) approved by the School.
5) Discrete Mathematics, three hours: MATH 2602, MATH 3012, or course(s) approved by the School; course must be taken on a letter-grade basis.
6) Engineering electives, six hours: must include an approved thermodynamics course and an approved probability/statistics course.
7) ECE/CS, fourteen hours: 3000 level or above in

ECE or CS, at least nine hours at the 4000 level or above; must include an approved computer engineering major design course.

8) Approved (Free), six hours: ECE, other engineering, mathematics, sciences, management, humanities, social sciences, or ROTC; all other courses subject to School approval.

Additionally, an approved ethics course must be completed; this is normally taken as part of either the humanities or social science electives.

Graduate Programs

Programs leading to the master's and doctoral degrees in electrical and computer engineering are provided by the School. Technical interest areas include bioengineering, computer engineering, digital signal processing, electric power, electromagnetics, electronic design and applications, microsystems, optics and photonics, systems and controls, and telecommunications.

The master's degree program requires thirty semester credit hours beyond the bachelor's degree. Courses are offered all three terms. Full-time students planning to complete the Master of Science degree in twelve months should start their programs in the fall semester.

The doctoral degree program is research-oriented and highly individualized. Typically, at least four years of study beyond the bachelor's degree are required to complete the doctoral program.

Distance Learning and Professional Education

The School of Electrical and Computer Engineering offers working professionals throughout the continental United States the opportunity to enroll in many of its graduate courses through video and online technologies. Qualified individuals can complete the requirements for the master's degree utilizing the video-based and online delivery system. See page 19, Distance Learning and Professional Education.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course. An asterisk (*) denotes prerequisite courses that may be taken concurrently.

ELECTRICAL AND COMPUTER ENGINEERING

ECE 1750. Introduction to Bioengineering
3-0-3.
An introduction to the field of bioengineering, including the application of engineering principles and methods to problems in biology and medicine, the integration of engineering with biology, and the emerging industrial opportunities. Crosslisted with AE, BMED, CHE, ME, and MSE 1750.

ECE 1801, -02, -03, -04, -05. Special Topics
Class and credit hours equal last digit in course number.

ECE 1811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number.

ECE 1881, -91. Special Topics
0-3-1.

ECE 1882, -92. Special Topics
1-3-2.

ECE 1883, -93. Special Topics
2-3-3.

ECE 1884, -94. Special Topics
3-3-4.

ECE 1900, -01, -02, -03. Special Problems
Credit hours to be arranged.

ECE 2001, -02, -03. ECE Seminar
1-0-1.
Speakers with diverse backgrounds and representing many different industries, professions, and institutions describe their experiences, entrepreneurial ventures, and research challenges.

ECE 2025. Introduction to Signal Processing
3-3-4.
Prerequisite(s): (MATH 1502 or (MATH 15X2 and MATH 1522) or MATH 1512) and (CS 1322 or CS 1371 or CS 1171)
Introduction to signal processing for discrete-time and continuous-time signals. Filtering. Frequency response. Fourier Transform. Z Transform. Laboratory emphasizes computer-based signal processing.

ECE 2030. Introduction to Computer Engineering
3-0-3.
Prerequisite(s): CS 1321 or CS 1371 or CS 1171
Computer system and digital design principles. Architectural concepts, software, Boolean algebra, number systems, combinational datapath elements, sequential logic, and storage elements. Design of DRAM control and I/O bus.

ECE 2031. Digital Design Laboratory
1-3-2.
Prerequisite(s): CS 1322 and ECE 2030 and LCC 3401*
Design and implementation of digital systems, including a team design project. CAD tools, project design methodologies, logic synthesis, and assembly language programming.

ECE 2040. Circuit Analysis
3-0-3.
Prerequisite(s): ECE 2025 and (PHYS 2212 or PHYS 2232) and (MATH 24X3 or MATH 2413* or MATH 2403*)
Basic concepts of DC and AC circuit theory and analysis.

ECE 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

ECE 2801, -02, -03, -04, -05. Special Topics
Class and credit hours equal last digit in course number.

ECE 2811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number.

ECE 2881, -91. Special Topics
0-3-1.

ECE 2882, -92. Special Topics
1-3-2.

ECE 2883, -93. Special Topics
2-3-3.

ECE 2884, -94. Special Topics
3-3-4.

ECE 2900, -01, -02, -03. Special Problems
Credit hours to be arranged.

ECE 3025. Electromagnetics
3-0-3.
Prerequisite(s): ECE 2040 and (MATH 2401 or MATH 2411 or MATH 24X1) and (MATH 2403 or MATH 2413 or MATH 24X3)
To present the laws and applications of electromagnetics.

ECE 3035. Mechanisms for Computing Systems
4-1-4.
Prerequisite(s): ECE 2030 and CS 1322
Computing system execution and storage mechanisms, starting with instruction set architecture and concluding with support for high-level languages and operating systems.

ECE 3040. Microelectronic Circuits
4-0-4.
Prerequisite(s): (ECE 2030 or BMED 2200*) and ECE 2040 and (CHEM 1310 or CHEM 12X1) and (MATH 2401 or MATH 2411 or MATH 24X1)
Basic concepts of microelectronic materials, devices, and circuits.

ECE 3041. Instrumentation and Circuits Laboratory
1-3-2.
Prerequisite(s): (ECE 2031 or BMED 2200*) and ECE 3040*
Fundamental experimental techniques for the laboratory analysis of signals and passive electrical circuits using basic electronic test and measurement instrumentation. Component characterization, computer-automated measurements, and simulation. Technical writing.

ECE 3042. Microelectronic Circuits Laboratory
1-3-2.
Prerequisite(s): ECE 3040 and ECE 3041
Design, analysis, simulation, implementation, and evaluation of electronic circuits. Employs op amp, clock, counter, and converter integrated circuits, discrete diodes, bipolar junction, and field effect transistors; and some integrated circuits.

ECE 3050. Analog Electronics
3-0-3.
Prerequisite(s): ECE 3040
To present concepts of analysis and design of electronic circuits and systems. Biasing, small-signal analysis, frequency response, feedback amplifiers, active filters, nonlinear op-amp applications, and oscillators.

ECE 3055. Computer Architecture and Operating Systems
3-3-4.
Prerequisite(s): ECE 2031
Core concepts of computer architecture and operating systems. Instruction set architectures (ISA), compiler/ISA relationships, pipelined datapaths. Memory hierarchy, memory management, and protection. Processes, threads, CPU scheduling, and associated techniques.

ECE 3060. VLSI and Advanced Digital Design
3-3-4.
Prerequisite(s): ECE 2031 and ECE 3040
Advanced digital design issues in the context of VLSI systems. Introduction to a design methodology that encompasses the range from behavioral models to circuit simulation.

ECE 3065. Electromagnetic Applications
3-0-3.
Prerequisite(s): ECE 3025
To present concepts in waveguiding and radiation, with application to microwaves, antennas, and optics.

ECE 3070. Electromechanical and Electromagnetic Energy Conversion
3-0-3.
Prerequisite(s): ECE 3025 and ECE 3040
This course serves as an introduction to three-phase power systems, electromechanical energy conversion, and operating principles of electric machines.

ECE 3075. Random Signals
3-0-3.
Prerequisite(s): ECE 2025 and (ISYE 3770 or MATH 3770 or CEE 3770 or ISYE 2027)
Study of random variables and random processes for applications in electrical and computer engineering. Includes an introduction to statistical filtering, parameter estimation, Markov processes.

ECE 3076. Computer Communications
3-0-3.
Prerequisite(s): ECE 2025 and ECE 2030
Presents the basic concepts of computer communications network protocols.

ECE 3080. Semiconductor Devices for Computer Engineering and Telecommunication Systems
3-0-3.
Prerequisite(s): ECE 3040
To gain an understanding of the device needs for current and future computers, and fiber optic and wireless communication systems addressing the future needs of high-frequency, GHz-range, device operation.

ECE 3085. Introduction to Systems and Controls
3-0-3.
Prerequisite(s): ECE 2040
Theory of linear time-invariant systems for continuous and discrete time. Laplace and Z-Transforms. Transfer function and state space representations. Introduction to feedback control theory.

ECE 3090. Software Fundamentals for Engineering Systems
3-3-4.
Prerequisite(s): ECE 2025 and ECE 2030 and ECE 2040
Using computer algorithms for solving electrical engineering problems arising in various application domains. Development of effective algorithms and their implementation by object-oriented code.

ECE 3301. Energy Conversion and Mechatronics
1-2-2.
Prerequisite(s): ECE 3040 or ECE 3710
Basic methods of measuring electrical and mechanical parameters, electrical machinery, sensors and control, and power electronics.

ECE 3451. Analog Electronics Laboratory
1-3-2.
Prerequisite(s): ECE 3050 and ECE 3042
Design, analysis, simulation, implementation, and evaluation of advanced electronic circuits. Employs bipolar junction, metal oxide semiconductor and field effect transistors; and some integrated circuits.

ECE 3710. Circuits and Electronics
2-0-2.
Prerequisite(s): PHYS 2212 or PHYS 2232
An introduction to electric circuit elements and electronic devices and a study of circuits containing such devices. Both analog and digital systems are considered.

ECE 3741. Instrumentation and Electronics Lab
0-3-1.
Prerequisite(s): ECE 3710
Basic analog and digital electronic circuits and principles. Techniques of electrical and electronic measurements with laboratory instruments.

ECE 3801, -02, -03, -04, -05. Special Topics
Class and credit hours equal last digit in course number.

ECE 3811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number.

ECE 3881, -91. Special Topics
0-3-1.

ECE 3882, -92. Special Topics
1-3-2.

ECE 3883, -93. Special Topics
2-3-3.

ECE 3884, -94. Special Topics
3-3-4.

ECE 3900, -01, -02, -03. Special Problems
Credit hours to be arranged.

ECE 3951. Undergraduate Research I
Credit hours to be arranged.
Participation in an individual or group research project under the direction of a faculty member.

ECE 3952. Undergraduate Research II
Credit hours to be arranged.
Prerequisite(s): ECE 3951
Participation in an individual or group research project under the direction of a faculty member. Requires a formal research report.

ECE 4000. Project Engineering and Professional Practice
2-3-3.
Prerequisite(s): ECE 3040 and (ECON 2100 or ECON 2105 or ECON 2106) and (CEE 3770 or ISYE 3770 or MATH 3770 or ISYE 2027)
Project engineering techniques and professional practice issues. Design methods and tools, product life-cycle, professional communication skills, ethical issues in electrical/computer engineering.

ECE 4006. Major Design Project
1-6-3.
Prerequisite(s): ECE 4000
Team-oriented major design project in electrical/computer engineering. Incorporating engineering standards and realistic design constraints. Requires formal reports and oral presentations.

ECE 4100. Advanced Computer Architecture
3-0-3.
Prerequisite(s): ECE 3055
Comprehensive coverage of the architecture and system issues that confront the design of high-performance workstation/PC computer architectures with emphasis on quantitative evaluation. Credit is not allowed for both ECE 4100 and any of the following courses: ECE 6100, CS 4290, CS 6290.

ECE 4110. Internetwork Programming
3-3-4.
Prerequisite(s): ECE 3076 or CS 3251 or CEE 3770 or ISYE 3770 or MATH 3770 or ISYE 2027
Exploration of Internet implementation as a network of computing systems. Internetworking skills for design and implementation of hardware and software Internet products.

ECE 4112. Internetwork Security
3-3-3.
Prerequisite(s): ECE 3076 or ECE 4110 or CS 3251
Hands-on experimentation and evaluation of Internet security theory, principles, and practices. Laboratory component involves implementing both defensive and offensive security techniques.

ECE 4130. Advanced VLSI Systems
3-3-4.
Prerequisite(s): ECE 3050 or ECE 3060
An advanced treatment of VLSI systems analysis, design, and testing with emphasis on complex systems and how they are incorporated into a silicon environment. Credit is not allowed for both ECE 4130 and ECE 6130.

ECE 4170. Introduction to HDLs with Applications to Digital System Design
2-3-3.
Prerequisite(s): ECE 2031
Introduction to hardware description languages and associated methodologies for digital system design. In-depth coverage includes applications to the simulation and synthesis of digital systems.

ECE 4175. Embedded Microcontroller Design
3-3-4.
Prerequisite(s): ECE 2031
Microcontroller structure, instruction set, addressing modes. Code development by assembly language programming and using an emulator. Programmable timer use, interrupt handlers, and timing.

ECE 4180. Embedded Systems Design
3-3-4.
Prerequisite(s): ECE 3055
Processors, chipsets, busses, and I/O devices for high-ended embedded systems. Embedded operating systems; device drivers and applications for embedded systems.

ECE 4270. Fundamentals of Digital Signal Processing
3-0-3.
Prerequisite(s): ECE 3075
Introduction to digital signal processing. Sampling theorem, discrete-time Fourier transform. Power spectrum, discrete Fourier transform and the FFT algorithm, Z-transform, digital filter design and implementation.

ECE 4271. Applications of Digital Signal Processing
3-3-4.
Prerequisite(s): ECE 4270
Applications of DSP in speech, image processing, radar, pattern recognition, and adaptive filtering requiring working software implementations applied to the analysis of real signals.

ECE 4273. Design Synthesis of Application-Specific Signal Processors
2-3-3.
Prerequisite(s): ECE 4270
Fundamentals of theory and practice of DSP chip design in VHDL. Exposure to tools and environments for chip design, simulation, and verification.

ECE 4320. Power System Analysis and Control
3-0-3.
Prerequisite(s): ECE 3070
Introduces basic concepts in electric power generation, distribution, system control, and economic operation.

ECE 4321. Power System Engineering
3-0-3.
Prerequisite(s): ECE 3070
To introduce basic concepts of electric power system design, encompassing protection, stability, and control.

ECE 4330. Power Electronics
2-2-3.
Prerequisite(s): ECE 3040 and ECE 3042*
Introduces power semiconductor devices and power electronic converters, including single-phase and three-phase ac/dc rectifiers, ac voltage controllers, dc/dc converters, and dc/ac inverters.

ECE 4340. Building Electrical Systems and Illumination
3-0-3.
Prerequisite(s): ECE 3070
Introduction to the elements of electrical systems in building and manufacturing facilities. Introduction to illumination engineering and its application in various types of facilities.

ECE 4360. RF-Microwave Measurement Laboratory
1-3-2.
Prerequisite(s): ECE 3065 and ECE 4415*
RF/microwave measurement theory and techniques. Use of state-of-the-art equipment operating into the GHz range.

ECE 4370. Antenna Engineering
3-0-3.
Prerequisite(s): ECE 3065
Basic theory, application, and design of a broad range of antennas.

ECE 4390. Introduction to Radar and Electromagnetic Sensing
3-0-3.
Prerequisite(s): ECE 3065
Introduces students to radar systems, including pulsed, CW, CWFM, and MTI radars. Other techniques for electromagnetic sensing such as radiometry and EM tagging are discussed.

ECE 4391. Electromagnetic Compatibility
3-0-3.
Prerequisite(s): ECE 3025 and ECE 3040
To study electromagnetic interference and susceptibility of electrical systems, with application to analog and digital circuits.

ECE 4410. Analog Filters
3-0-3.
Prerequisite(s): ECE 3040
An introduction to the theory, design techniques, and applications of analog passive, active, and switched-capacitor filters.

ECE 4415. RF Engineering I
3-0-3.
Prerequisite(s): ECE 3025 and ECE 3050
Fundamentals of RF engineering. Components at high frequencies, device modeling, amplifiers, lumped-element and microstrip impedance transformation networks, S-parameter-based design of RF and microwave amplifiers.

ECE 4418. RF Engineering II
3-0-3.
Prerequisite(s): ECE 4415
Fundamentals learned in RF-I are employed to design the elements of radio receivers, transmitters, and similar systems. Systems analysis, mixers, detectors, power amplifiers, low-noise amplifiers, and oscillators are covered.

ECE 4420. Digital Integrated Circuits
3-0-3.
Prerequisite(s): ECE 3040
Analysis and design of bipolar and MOS digital integrated circuit families and their applications in modern electronic systems.

ECE 4430. Analog Integrated Circuits
3-0-3.
Prerequisite(s): ECE 3050
Analysis and design of analog ICs using analytic techniques and CAD tools. Topics include amplifiers, current sources, output circuits, and other analog building blocks.

ECE 4435. Operational Amplifier Design
2-3-3.
Prerequisite(s): ECE 3042
Analysis and design techniques for utilization of integrated circuit operational amplifiers for applications in electronic systems.

ECE 4445. Audio Engineering
3-0-3.
Prerequisite(s): ECE 3040
Concepts of acoustics and electroacoustic modeling for the analysis and design of microphones, loudspeakers, and crossover networks. Methods of analysis and design of audio power amplifiers.

ECE 4451. Semiconductor Devices for Wireless and Fiber Communication
3-0-3.
Prerequisite(s): ECE 3080
Advanced development of semiconductor device theory focusing on optoelectronic emitters, detectors, and high-frequency transistors to provide an understanding of devices used in communications systems.

ECE 4460. Introduction to Electronic Systems Packaging
3-0-3.
Prerequisite(s): ECE 3040 or ECE 3710
Introduction to packaging technologies, technology drivers, electrical performance, thermal management, materials, optoelectronics, RF integration, reliability, system issues, assembly, testing.

ECE 4500. Optical Engineering
3-0-3.
Prerequisite(s): ECE 3025
Introduction to applications of geometric and physical optics to engineering, including optical measurements, matrix methods, instruments, interference, holography, beam optics, Fourier optics, and diffraction.

ECE 4501. Fiber Optics
3-4-5.
Prerequisite(s): ECE 3025
Combined lecture-laboratory exploration of the technology of fiber optics, with special emphasis on optical fiber communications systems.

ECE 4551. Systems and Controls I
3-3-4.
Prerequisite(s): ECE 3085
Introduction to feedback control. Root locus and bode design for SISO systems, continuous and discrete. Introduction to state space formulation, continuous and discrete.

ECE 4560. Introduction to Automation and Robotics
3-3-4.
Prerequisite(s): ECE 3085
Concurrent engineering principles; robotic manipulator kinematics, dynamics, and control; applications of robots in industry, medicine, and other areas; team projects and hands-on laboratory experience.

ECE 4562. Neural Networks and Fuzzy Logic in Control
2-3-3.
Prerequisite(s): ECE 3085
Principles of neural networks and fuzzy systems; the MATLAB Neural Network and Fuzzy Logic Toolboxes; examples from system identification, classification, and control; laboratory experience.

ECE 4570. System Theory for Communication and Control
3-3-4.
Prerequisite(s): ECE 3085
Study of the basic concepts in linear system theory and numerical linear algebra with applications to communication, computation, control, and signal processing. A unified treatment.

ECE 4580. Computational Computer Vision
3-0-3.
Prerequisite(s): ECE 2025
Computational and theoretical aspects of computer vision. Application areas include robotics, autonomous vehicles, tracking, and image-guided surgery. Includes major protocol

ECE 4601. Communication Systems
3-0-3.
Prerequisite(s): ECE 3075
To present the fundamentals of modern digital communication systems and evaluate their performance with realistic channel models.

ECE 4602. Communication Systems Laboratory
0-3-1.
Prerequisite(s): ECE 4601
To examine the performance of analog and digital telecommunications systems and components.

ECE 4604. Network Design and Simulation
3-3-4.
Prerequisite(s): ECE 3076 or ECE 4603
Introduces the principles of Monte Carlo techniques and network simulation, and applies them to design issues in ATM systems.

ECE 4605. Advanced Internetworking
3-3-4.
Prerequisite(s): ECE 3076*
Networking fundamentals, including TCP/IP protocol suite. Latest networking technologies in wireless networks and mobile computing, network quality of service, network programmability, and miscellaneous topics. Project intensive.

ECE 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

ECE 4751. Laser Theory and Applications
3-0-3.
Prerequisite(s): PHYS 2212
Provides an introduction to the theory and applications of laser principles and related instrumentation. Emphasis is on the fundamental principles underlying laser action. Crosslisted with PHYS 4751.

ECE 4752. Integrated Circuit Fabrication
2-3-3.
Prerequisite(s): ECE 3040 or ECE 3710
Gives students exposure to the various steps involved in the fabrication of integrated circuits and devices. The course will include a laboratory segment in which students fabricate MOS transistors, diffused resistors, and MOS capacitors from a bare silicon substrate. Crosslisted with CHE 4752.

ECE 4754. Electronics Packaging Assembly, Reliability, Thermal Management, and Test
1-6-3.
Prerequisite(s): ECE 3040 or ECE 3710
The course provides hands-on instruction in electronics packaging, including assembly, reliability, thermal management, and test of next-generation microsystems. Crosslisted with ME and MSE 4754.

ECE 4755. Electronic Packaging Substrate Fabrication
1-6-3.
Prerequisite(s): CHEM 1310 and PHYS 2212
This course provides hands-on instruction in basic packaging substrate fabrication techniques, including interconnect design and testing, dielectric deposition, via formation, and metallization. Crosslisted with CHE 4755.

ECE 4761. Industrial Controls and Manufacturing
2-3-3.
Prerequisite(s): ECE 3085
Students are introduced to industrial controls and the fundamentals of manufacturing with hands-on experience based on lab projects using industry software and hardware for communications and control. Crosslisted with PTFE 4761.

ECE 4781. Biomedical Instrumentation
3-0-3.
Prerequisite(s): ECE 3040 or ECE 3710
A study of medical instrumentation from a systems viewpoint. Pertinent physiological and electro-physiological concepts will be covered. Crosslisted with CHE and ME 4781.

ECE 4782. Biosystems Analysis
3-0-3.
Prerequisite(s): BMED 3500 or CHBE 4400 or ECE 2040 or ME 3015
Analytical methods for modeling biological systems, including white-noise protocols for characterizing nonlinear systems. Crosslisted with BMED, CHE and ME 4782.

ECE 4783. Introduction to Medical Image Processing
3-0-3.
Prerequisite(s): ECE 2025 and (MATH 3770* or ISYE 3770* or CEE 3770*)
A study of mathematical methods used in medical acquisition and processing. Concepts, algorithms, and methods associated with acquisition, processing, and display of two- and three-dimensional medical images are studied. Crosslisted with BMED 4783.

ECE 4801, -02, -03, -04, -05. Special Topics
Class and credit hours equal last digit in course number.

ECE 4811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number.

ECE 4823, -33. Special Topics
3-0-3.

ECE 4881, -91. Special Topics
0-3-1.

ECE 4882, -92. Special Topics
1-3-2.

ECE 4883, -93. Special Topics
2-3-3.

ECE 4884, -94. Special Topics
3-3-4.

ECE 4900, -01, -02, -03. Special Problems
Credit hours to be arranged.

ECE 4951. Undergraduate Research I
Credit hours to be arranged.
Participation in an individual or group research project under the direction of a faculty member.

ECE 4952. Undergraduate Research II
Credit hours to be arranged.
Prerequisite(s): ECE 4951
Participation in an individual or group research project under the direction of a faculty member.

ECE 6100. Advanced Computer Architecture
3-0-3.
Prerequisite(s): ECE 3055
Comprehensive coverage of the architecture and system issues that confront the design of high-performance workstation/PC computer architectures with emphasis on quantitative evaluation.

ECE 6101. Parallel and Distributed Computer Architecture
3-0-3.
Prerequisite(s): ECE 6100
An advanced study of the critical issues and limiting factors in the design of asynchronous and synchronous parallel and distributed architectures.

ECE 6102. Dependable Distributed Systems
3-0-3.
Concepts, theory, and practice of dependable distributed systems. Techniques for tolerating hardware and software faults. Security aspects such as confidentiality, availability, and integrity.

ECE 6110. CAD for Computer Communication Networks
2-3-3.
Prerequisite(s): ECE 6607
Investigation of the methodologies and algorithms used for designing and optimizing computer/communications networks with a focus on the algorithmic aspects of network design.

ECE 6120. Automata Theory
3-0-3.
The course presents a broad base of topics in modern automata and switching theory. These elements form the essentials upon which modern digital systems are constructed.

ECE 6121. Combinatorial Strategies for Engineers
3-0-3.
Modern counting theory and algorithmic approaches necessary for discrete computation.

ECE 6130. Advanced VLSI Systems
3-0-3.
Prerequisite(s): ECE 3060
An advanced treatment of VLSI systems analysis, design, and testing with emphasis on complex systems and how they are incorporated into a silicon environment.

ECE 6132. Computer-Aided VLSI System Design
3-0-3.
Prerequisite(s): ECE 3060
Theory and practice of computer-aided VLSI digital systems design. Logic synthesis, semi-custom VLSI design, high-level synthesis, low-power systems, and hardware/software co-design. Individual and group projects.

ECE 6133. Physical Design Automation of VLSI Systems
3-0-3.
Various design automation problems in the physical design process of VLSI circuits including clustering, partitioning, floorplanning, placement, routing, and compaction.

ECE 6140. Digital Systems Test
3-0-3.
Prerequisite(s): ECE 3060
Introduction to the basic concepts in digital systems testing. Advanced topics in fault modeling and simulation, test pattern generation, and design for testability.

ECE 6250. Advanced Digital Signal Processing
3-0-3.
Prerequisite(s): ECE 4270
An introduction to advanced signal processing methods that are used in a variety of applications areas.

ECE 6254. Statistical Digital Signal Processing and Modeling
3-0-3.
Prerequisite(s): ECE 4270
Introductory course in digital signal processing, and includes the following topics: signal modeling, optimum filters, and power spectrum estimations.

ECE 6255. Digital Processing of Speech Signals
3-0-3.
Prerequisite(s): ECE 4270 or ECE 6250
The application of digital signal processing to problems in speech communication. Part of this goal requires a laboratory project.

ECE 6258. Digital Image Processing
3-0-3.
Prerequisite(s): ECE 4270
An introduction to the theory of multidimensional signal processing and digital image processing, including key applications in multimedia products and services, and telecommunications.

ECE 6271. Adaptive Filtering
3-0-3.
Prerequisite(s): ECE 4270
Basic theory of adaptive filter design and implementation. Steepest decent, LMS algorithms, nonlinear adaptive filters, and neural networks. Analysis of performance and applications.

ECE 6272. Fundamentals of Radar Signal Processing
3-0-3.
Prerequisite(s): ECE 4270
Signal modeling including radar cross section, multipath, and clutter. Properties of the ambiguity function and coded waveforms. Algorithms for doppler processing, detection, and radar imaging.

ECE 6273. Methods of Pattern Recognition with Application to Voice
3-0-3.
Prerequisite(s): ECE 4270
Theory and application of pattern recognition with a special application section for automatic speech recognition and related signal processing.

ECE 6276. DSP Hardware Systems Design
2-3-3.
Prerequisite(s): ECE 4270
A study of theory and practice in the design and implementation of DSP algorithms on programmable processors, multiprocessors, and ASICs.

ECE 6277. DSP Software Systems Design
2-3-3.
Prerequisite(s): ECE 4270
Specification, evaluation, and implementation of real-time DSP applications on embedded DSP-based environments.

ECE 6279. Spatial Array Processing
3-0-3.
Prerequisite(s): ECE 4270
Introduce application areas where signals are sampled over space and time. Transfer knowledge of time-based techniques to spatial processing. Develop algorithms unique to spatial processing.

ECE 6320. Power Systems Control and Operation
3-0-3.
Prerequisite(s): ECE 4320
Introduction to methods used in the real-time operation and control of power systems as well as to the hardware and software technology of energy management systems (EMS).

ECE 6321. Power System Stability
3-0-3.
Prerequisite(s): ECE 4320
Techniques for stability analysis of electric power systems and applications of these methods.

ECE 6322. Power System Planning and Reliability
3-0-3.
Prerequisite(s): ECE 4320
To introduce basic concepts as well as analysis and optimization techniques underlying reliability assessment of electric power systems and planning techniques.

ECE 6323. Power System Protection
3-2-3.
Prerequisite(s): ECE 4320
Theory and practice of modern power system protection techniques.

ECE 6330. Power Electronic Devices and Subsystems
3-0-3.
Prerequisite(s): ECE 3040
Physical considerations involved in the fabrication and use of power semiconductor devices and high-frequency magnetic transformers and inductors.

ECE 6331. Power Electronic Circuits
3-0-3.
Prerequisite(s): ECE 4330
The analysis, control, and design of switching power converters: rectifiers, cycloconverters, voltage-sourced and current-source inverters, dc-dc converters, pfc and resonant converts.

ECE 6332. Power Electronic CAD Laboratory
0-3-1.
Prerequisite(s): ECE 6331
To introduce the use of CAD tools in the simulation, analysis, and design of power electronic circuits and systems.

ECE 6335. Electric Machinery Analysis
3-0-3.
Prerequisite(s): ECE 3070
An introduction to the analysis and basic construction principles of rotating electric machines and transformers, including ac synchronous and induction machines and dc machines.

ECE 6336. Dynamics and Control of Electric Machine Drives
3-0-3.
Prerequisite(s): ECE 3070
A study of the dynamics and control of electric machinery and variable-speed machine drive systems.

ECE 6340. Electric Power Quality
2-2-3.
Prerequisite(s): ECE 4320
Study transients and harmonics in power systems, along with analysis methods and mitigation practices. Understand the causes of power quality problems and relate them to equipment susceptibility.

ECE 6350. Applied Electromagnetics
3-0-3.
The methodology and application of advanced electromagnetic theory.

ECE 6360. Microwave Design
3-0-3.
Applications of electromagnetic theory to microwave components and systems. Introduction to the latest characterization and design techniques including monolithic microwave integrated circuit (MMIC) technology.

ECE 6361. Microwave Design Laboratory
2-3-3.
Prerequisite(s): ECE 6360
This laboratory course will teach microwave measurement/design fundamentals for both passive and active components. Students will use both CAD tools and network analyzers.

ECE 6370. Electromagnetic Radiation and Antennas
3-0-3.
Prerequisite(s): ECE 6350
The fundamentals of electromagnetic radiation and antennas.

ECE 6380. Introduction to Computational Electromagnetics
3-0-3.
The practical application of the finite-difference time-domain and finite element techniques to electromagnetic problems. Computer projects are required.

ECE 6390. Satellite Communications and Navigation Systems
3-0-3.
To introduce satellite communications and navigation system design including microwave transmission, satellite transponders, earth station hardware, and satellite networks. A design project is required.

ECE 6412. Analog Integrated Circuit Design
3-0-3.
Prerequisite(s): ECE 4430
Design of analog circuits using CMOS and bipolar technologies.

ECE 6414. Analog Integrated System Design
3-0-3.
Prerequisite(s): ECE 4435
Design of analog systems using CMOS and bipolar technologies. A higher level of design for analog and digital systems is presented.

ECE 6416. Low Noise Electronic System Design
2-3-3.
Prerequisite(s): ECE 4430
A study of the sources of noise found in electronic instrumentation. Teaches the recognition of sources of noise and the design techniques to achieve noise reduction.

ECE 6420. Wireless IC Design
3-0-3.
Prerequisite(s): ECE 4430
Wireless system specifications are translated to architectures and building blocks compatible with silicon technology. The course focuses on the analysis and design of these blocks.

ECE 6430. Digital MOS Integrated Circuits
3-0-3.
Detailed analysis of the operation and design of high-performance MOS digital integrated circuits. Emphasis is on circuit design techniques with examples from the literature.

ECE 6435. Neuromorphic Analog VLSI Circuits
3-0-3.
Prerequisite(s): ECE 3050
Large-scale analog computation for sensory and motor processing. Analog building blocks are presented, leading to VLSI systems inspired by neurobiological architectures and computational paradigms.

ECE 6440. Frequency Synthesizers
3-0-3.
Frequency synthesizers generate many discrete RF frequencies from one reference frequency. General synthesizers, digital PLL, direct digital, and hybrid synthesizers are covered.

ECE 6442. Electronic Oscillators
3-0-3.
Starting from nonlinear differential equations, this course presents a systematic approach to the design of electronic oscillators. Design of negative resistance and feedback oscillators is discussed. CAD techniques are employed.

ECE 6450. Introduction to Microelectronics Technology
3-0-3.
Presents the fundamentals of microelectronics material, device, and circuit fabrication.

ECE 6451. Introduction to the Theory of Microelectronics
3-0-3.
Basis of quantum mechanics, statistical mechanics, and the behavior of solids to serve as an introduction to the modern study of semiconductors and semiconductor devices.

ECE 6453. Theory of Electronic Devices
3-0-3.
Prerequisite(s): ECE 6451
Presents the fundamentals of electronic device operation.

ECE 6455. Semiconductor Process Control
3-0-3.
Prerequisite(s): ISYE 3770 or MATH 3770 or CEE 3770
This course is designed to explore methods of applying statistical process control and statistical quality control to semiconductor manufacturing processes. Students will be required to complete a design project.

ECE 6456. Solar Cells
3-0-3.
To provide a practical understanding of semiconductor materials and technology as it relates to design and development of efficient solar cells and photovoltaic systems.

ECE 6458. Gigascale Integration
3-0-3.
Prerequisite(s): ECE 3080
Hierarchy of physical principles that enable understanding and estimation of future opportunities to achieve multibillion transistor silicon chips using sub-0.25 micron technology.

ECE 6500. Fourier Techniques and Signal Analysis
3-0-3.
Introduction to the use of Fourier Methods for analysis of signals.

ECE 6501. Fourier Optics and Holography
3-0-3.
Prerequisite(s): ECE 6500
Applications of the Fourier transform and linear systems theory to the analysis of optical propagation, diffraction imaging, holography, wavefront modulation, and signal processing.

ECE 6510. Electro-Optics
3-0-3.
Study of the fundamental principles and primary applications of lasers and of detectors of optical radiation.

ECE 6520. Integrated Optics
3-0-3.
Theory and design of optical waveguides and optical waveguide devices.

ECE 6521. Optical Fibers
3-0-3.
Provides an in-depth understanding of the light-guiding properties of optical fibers as used in communication systems.

ECE 6522. Nonlinear Optics
3-0-3.
Provides an introduction to the field of nonlinear optics, exploring the physical mechanisms, applications, and experimental techniques.

ECE 6530. Modulation, Diffractive, and Crystal Optics
3-0-3.
Provides a working knowledge of temporal and spatial optical modulation, diffractive optical devices, and crystal optics.

ECE 6542. Optoelectronics: Devices, Integration, Packaging, Systems
3-0-3.
Optoelectronic devices (detectors, emitters, modulators) from the practical realized and theoretical performance perspective. Explores monolithic and hybrid integration of devices, packaging, and system implementation.

ECE 6543. Fiber-optic Networks
3-0-3.
Architectural, performance and design aspects of fiber-optic communications networks, components, and technologies. Relationship between the physical network implementation and the higher-level network architecture.

ECE 6550. Linear Systems and Controls
3-0-3.
Introduction to linear system theory and feedback control. Topics include state space representations, controllability and observability, linear feedback control.

ECE 6551. Digital Control
3-0-3.
Prerequisite(s): ECE 6550
Techniques for analysis and synthesis of computer-based control systems. Design projects provide an understanding of the application of digital control to physical systems.

ECE 6552. Nonlinear Systems and Control
3-0-3.
Prerequisite(s): ECE 6550
Classical analysis techniques and stability theory for nonlinear systems. Control design for nonlinear systems, including robotic systems. Design projects.

ECE 6553. Optimal Control and Optimization
3-0-3.
Prerequisite(s): ECE 6550
Optimal control of dynamic systems, numerical optimization, techniques and their applications in solving optical-trajectory problems.

ECE 6554. Adaptive Control
3-0-3.
Prerequisite(s): ECE 6550
Methods of parameter estimation and adaptive control for systems with constant or slowly varying unknown parameters. MATLAB design projects emphasizing applications to physical systems.

ECE 6555. Optimal Estimation
3-0-3.
Prerequisite(s): ECE 6550
Techniques for signal and state estimation in the presence of measurement and process noise with the emphasis on Wiener and Kalman filtering.

ECE 6556. Intelligent Control
3-0-3.
Prerequisite(s): ECE 6550
Principles of intelligent systems and their utility in modeling, identification, and control of complex systems; neuro-fuzzy tools applied to supervisory control; hands-on laboratory experience.

ECE 6557. Manufacturing Systems Design
3-0-3.
Analytic and simulation tools for design, control, and optimization of manufacturing systems. Discrete event dynamic systems and optimization.

ECE 6558. Stochastic Systems
3-0-3.
Prerequisite(s): ISYE 3770 or MATH 3770 or CEE 3770
Advanced techniques in stochastic analysis with emphasis on stochastic dynamics, nonlinear filtering and detection, stochastic control, and stochastic optimization and simulation methods.

ECE 6559. Advanced Linear Systems
3-0-3.
Prerequisite(s): ECE 6550
Study of multivariable linear system theory and robust control design methodologies.

ECE 6601. Random Processes
3-0-3.
Prerequisite(s): ECE 3075
To develop the theoretical framework for the processing of random signals and data.

ECE 6602. Digital Communications
3-0-3.
Prerequisite(s): ECE 6601
Basic M-ary digital communications systems, with emphasis on system design and performance analysis in the presence of additive noise.

ECE 6603. Advanced Digital Communications
3-0-3.
Prerequisite(s): ECE 6602
The theory and practice of efficient digital communications over linear dispersive channels, including adaptive equalization and synchronization.

ECE 6604. Personal and Mobile Communications
3-0-3.
Prerequisite(s): ECE 6602
To introduce various topics that are fundamental to cellular mobile telephone systems.

ECE 6605. Information Theory
3-0-3.
Prerequisite(s): ECE 3075
To introduce the mathematical theory of communications. Emphasis will be placed on Shannon's theorems and their use in the analysis and design of communication systems.

ECE 6606. Coding Theory and Applications
3-0-3.
Prerequisite(s): ECE 3075
To introduce the theory and practice of error control coding, with emphasis on linear, cyclic, convolutional, and parallel concatenated codes.

ECE 6607. Computer Communication Networks
3-0-3.
Fundamental concepts of computer network architecture and protocols.

ECE 6608. Performance Analysis of Communications Networks
3-0-3.
Prerequisite(s): ECE 6601 and ECE 6607
Fundamental concepts of queueing systems, and applications of queueing theory to the performance evaluation of computer networks.

ECE 6610. Wireless Networks
3-0-3.
Prerequisite(s): ECE 6607
Fundamental concepts of wireless networks.

ECE 6611. Broadband Networking
3-0-3.
Prerequisite(s): ECE 6607
Fundamental concepts of broadband networking, including network models, ATM networks, quality of service, and traffic management.

ECE 6612. Computer Network Security
3-0-3.
Prerequisite(s): ECE 3076 or ECE 4110 or ECE 6607 or CS 3251
Fundamental concepts of network information security, including encryption, secure access methods, and vulnerabilities in network protocols, operating systems, and network applications.

ECE 6759. Plasma Processing of Electronic Materials and Devices
3-0-3.
Fundamental physics, chemistry, chemical engineering, and electrical engineering principles inherent in plasma processes. Includes etching, deposition, diagnostic methods, and control schemes. Crosslisted with CHE 6759.

ECE 6771. Optoelectronics: Materials, Processes, Devices
3-0-3.
Optoelectronic materials, physical processes, and devices. Includes compound semiconductor materials, excitation, recombination, gain, and modulation processes and devices such as emitters, detectors, and modulators. Crosslisted with PHYS 6771.

ECE 6776. Integrated Low-Cost Microelectronics Systems Packaging
3-0-3.
Broad overview of system-level, cross-disciplinary microelectronics packaging technologies, including design, test, thermal, reliability, optoelectronics, and RF integration. Comparison of system-on-chip and system-on-package. Crosslisted with ME and MSE 6776.

ECE 6779. Thermal Engineering for Packaging of Micro and Nano Systems
3-0-3.
Prerequisite(s): (ME 3322 and ME 3345) or ME 3720
Passive, active, and hybrid thermal management techniques, and computational modeling of micro systems. Air cooling, single phase and phase-change liquid cooling, heat pipes, and thermoelectrics. Crosslisted with ME 6779.

ECE 6780. Medical Image Processing
3-0-3.
Prerequisite(s): BMED 6786 or ECE 6786
A study of methods for enhancing, analyzing, interpreting, and visualizing information from two- and three-dimensional data obtained from a variety of medical imaging modalities. Crosslisted with CS and BMED 6780.

ECE 6786. Medical Imaging Systems
3-0-3.
A study of the principles and design of medical imaging systems such as X-ray, ultrasound, nuclear medicine, and nuclear magnetic resonance. Crosslisted with BMED 6786.

ECE 6787. Quantitative Electrophysiology
3-0-3.
A quantitative presentation of electrophysiological systems in biological organisms, emphasizing the electrical properties and modeling of neural and cardiac cells and systems. Crosslisted with BMED and PHYS 6787.

ECE 6789. Technology Ventures
3-0-3.
Team discussion and case studies in biomedical engineering technology transfer, including licensing, financial capital, safety and efficacy studies, clinical trials, and strategic planning. Crosslisted with BMED, CHE, ME, and MGT 6789.

ECE 6792. Manufacturing Seminar
1-0-1.
Guest speakers on a broad range of manufacturing-related topics, research, applications, and technology. Required for Certificate in Manufacturing. Crosslisted with ISYE and ME 6792.

ECE 7000. Master's Thesis
Credit hours to be arranged.

ECE 7102. RISC Architectures
3-0-3.
Prerequisite(s): ECE 6100
An advanced design-oriented class studying the design techniques and operational principles of modern Superscalar RISC datapaths.

ECE 7131. Asynchronous and Self-Timed Systems
3-0-3.
Prerequisite(s): ECE 6130
Specification and design of asynchronous digital systems.

ECE 7141. Advanced Digital Systems Test
3-3-3.
Prerequisite(s): ECE 6140
Design and test techniques for high-speed digital systems operating at rates above 100 MHz with a practical emphasis via substantial projects.

ECE 7142. Fault Tolerant Computing
3-0-3.
Prerequisite(s): ECE 6100
Key concepts in fault-tolerant computing. Understanding and use of modern fault-tolerant hardware and software design practices. Case studies.

ECE 7251. Signal Detection and Estimation
3-0-3.
Prerequisite(s): ECE 6250
Detection theory and estimation theory and their application to communications and statistical signal processing problems.

ECE 7252. Advanced Signal Processing Theory
3-0-3.
Prerequisite(s): ECE 6250
A lecture and seminar treatment of the latest developments in signal processing. Emphasis is placed on current literature and emerging research areas.

ECE 7370. Antennas and Wave Propagation in Matter
3-0-3.
Prerequisite(s): ECE 6350
Basic methods for characterizing the electromagnetic properties of common materials (geophysical, biological, etc.) and techniques for analyzing antennas and wave propagation in these materials.

ECE 7380. Topics in Computational Electromagnetics
3-0-3.
Prerequisite(s): ECE 6350
Computational approaches for applications such as radar signature prediction, microwave antenna and device design, and modeling techniques for electronic packaging.

ECE 7611. Advanced Communication Theory
3-0-3.
Latest developments in communications and networking are treated in lecture and seminar. Emphasis on current literature and open research areas.

ECE 8001, -02, -03. ECE Seminar
1-0-1.
Speakers with diverse backgrounds and representing many different industries, professions, and institutions describe their experiences, entrepreneurial ventures, and research challenges.

ECE 8010. Research Seminar
1-0-1.
Seminar presentations describing ECE-related research projects, centers, and other activities at Georgia Tech.

ECE 8020. Professional Communication Skills
2-3-3.
Written, oral, and graphical communication skills needed by electrical and computer engineering professionals. Credit for this course may not be used toward the master's degree in ECE.

ECE 8022. Professional Communication Seminar
1-0-1.
Seminar presentations on oral and written technical communication skills needed by electrical and computer engineering professionals. Credit for this course may not be used toward the master's degree in ECE.

ECE 8801, -02, -03, -04, -05. Special Topics
Class and credit hours equal last digit in course number.

ECE 8811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number.

ECE 8823, -33, -43, -53, -63, -73. Special Topics
3-0-3.

ECE 8881, -91. Special Topics-Laboratory
0-3-1.

ECE 8882, -92. Special Topics-Laboratory
1-3-2.

ECE 8883, -93. Special Topics-Laboratory
2-3-3.

ECE 8884, -94. Special Topics-Laboratory
3-3-4.

ECE 8900, -01, -02, -03. Special Problems
Credit hours to be arranged.

ECE 8997. Teaching Assistantship
Credit hours to be arranged.
For students holding graduate teaching assistantships.

ECE 8998. Research Assistantship
Credit hours to be arranged.
For students holding graduate research assistantships.

ECE 9000. Doctoral Thesis
Credit hours to be arranged.

An asterisk (*) denotes prerequisite courses that may be taken concurrently.

School of Industrial and Systems Engineering

www.isye.gatech.edu

School established in 1945, Department in 1924
Location: Groseclose Building
Telephone: 404.894.2300
Fax: 404.894.2301

H. Milton and Carolyn J. Stewart School Chair and Professor–William B. Rouse; *Associate Chair for Graduate Studies and Professor*–R. Gary Parker; *Associate Chair for Undergraduate Studies and Associate Professor*–Paul M. Griffin; *NSF ADVANCE Professor of Engineering*–Jane C. Ammons; *Manhattan Associates Chair and Professor*–John J. Bartholdi III; *Russ and Sammie Chandler Chair and Professor*–William J. Cook; *Coca-Cola Chair and Professor*–Ellis L. Johnson; *John P. Hunter Chair and Professor*–Jan Karel Lenstra; *Eugene C. Gwaltney Jr. Chair in Manufacturing Systems and Professor*–L. F. McGinnis Jr.; *A. Russell Chandler III Chair and Institute Professor*–George L. Nemhauser; *UPS and Regents' Professor*–H. Donald Ratliff; *William W. George Professor of Health Systems*–Francois Sainfort; *Georgia Freight Bureau Chair in Transportation and Logistics and Professor*–Chelsea C. White III; *Coca-Cola Chair of Engineering Statistics and Professor*–Jeff Wu.

Professors–Sigrun Andradottir, Earl R. Barnes, Stephen E. Cross, Jim Dai, Augustine O. Esogbue, Robert D. Foley, David M. Goldsman, John J. Jarvis, Jack R. Lohmann, Jye-Chi Lu, Christine M. Mitchell, Renato Monteiro, Martin Savelsbergh, Richard L. Serfozo, Alexander Shapiro, Mark Spearman, Michael E. Thomas, Craig A. Tovey, Kwok-Leung Tsui, John H. VandeVate, Branislav Vidakovic.

Professors Emeriti–Jerry Banks, Leslie G. Callahan, William W. Hines, Cecil G. Johnson, Lynwood A. Johnson, Robert N. Lehrer (director emeritus), Nelson K. Rogers, C. M. Shetty, Rocker T. Staton, Gerald J. Thuesen, Harrison M. Wadsworth.

Associate Professors–Karen Aardal, Faiz Al-Khayyal, Christos Alexopoulos, Bayriye Ayhan, Marc Goetschalckx, T. Govindaraj, Steven T. Hackman, Anthony J. Hayter, Julie Jacko, Anton J. Kleywegt, Paul H. Kvam, Eva Lee, Loren K. Platzman (adjunct), Amy Prichett, Spiridon A. Reveliotis, Gunter P. Sharp, Chen Zhou.

Associate Professor Emeritus–Willard R. Fey.

Assistant Professors–Shabbir Ahmed, Ronald Billings, Shijie Deng, Wedad Elmaghraby, Alan Erera, Ozlem Ergun, Xiaoming Huo, Pinar Keskinocak, Seong-Hee Kim, Yuan Ming, Joel Sokol, Julie Swann, Roshan Joseph Vengazhiyil, Amy Ward, Joseph Wu.

Courtesy Faculty Appointments–Terry Blum, Dean and Tedd Munchak Professor, College of Management; Narayanan Jayaraman, Associate Professor, College of Management; Robin Thomas, Professor, School of Mathematics; Marie C. Thursby, Professor of Strategic Management and Hal and John Smith Chair in Entrepreneurship, College of Management.

Director, Global Logistics–Mokhtar Bazaraa; *Director, Professional Education (TLI)*–Carole Bennet; *Director, The Logistics Institute (TLI)*–Harvey M. Donaldson; *Director, Executive Master's in International Logistics (EMIL)*–Terri Herod; *Director of Information Technology*–Mark Iken; *Director of Development*–Diane Kollar; *Director of Supply Chain Executive Programs*–C. John Langley Jr.; *Director of Workplace and Academic Communication*–Judith Norback.

Research Engineers–Douglas Bodner, Jennifer Ockerman.

General Information

Industrial and systems engineering is a branch of engineering that deals with the description, evaluation, design, modification, control, and improvement of the performance of complex systems. The field is unique in its identification of human beings as central contributors to the inherent complexity of such systems, but also as the primary targets and benefactors of their analysis and anticipated improvement. Students in the program are typically interested in obtaining a fundamental engineering background as a basis for the subsequent professional specialization in the various activities associated with the field. Among these are operations research, systems analysis, distribution and logistics, production, manufacturing planning, quality control, economic and financial modeling, and others. Graduates can be found in a host of settings including transportation, telecommunications, hospitals, banking and finance, environmental systems, retailing, and consulting.

Undergraduate Program

Bachelor of Science in Industrial Engineering

The principal strength of the academic program leading to the Bachelor of Science in Industrial Engineering (B.S.I.E.) is its blend of fundamental topics in mathematics and the physical and engineering sciences that are common to all engineering disciplines coupled with specialized study in subject areas such as optimization, probability and statistics, computing, economics, and psychology. It is precisely this blend that produces the flexibility that is inherent in the field of industrial and systems engineering and that affords B.S.I.E. graduates a wide array of career options.

Educational Objectives for the Bachelor of Science

The School of Industrial and Systems Engineering has six educational objectives for students receiving the B.S.I.E. Students will:

- be prepared to function effectively and provide leadership within an organization as an industrial engineering (IE) professional including an ability to form, facilitate, lead, coordinate, and participate in teams as well as understand organizational processes and behavior;
- be able to utilize the methodological and computational skills with which to operate effectively within the IE problem domain through training in problem representation, abstraction, and validation;
- demonstrate an understanding of and an appreciation for the need to collect, analyze, and interpret data relevant to problems arising in the IE problem domain;
- have the ability to approach unstructured problems, to synthesize and design potential solutions, and to evaluate the impact of their solutions in the broader context of the organization and society;
- demonstrate the ability to effectively present and sell their solutions and to do so in the context of written, oral, and electronic media; and
- demonstrate an understanding of and the need for the ability to accomplish lifelong growth within the field/profession of industrial and systems engineering.

Options for Exceptional Students

Program activities and options are available to encourage and reward students with superior records and abilities. Participation in these programs requires demonstrated scholastic excellence and prior arrangement with the student's advisor and/or the associate chair for Undergraduate Studies.

Graduate-Level Courses

Students with a cumulative grade point average of 3.3 or above may schedule up to nine credit hours of approved graduate-level courses. Some of these credits, when approved by the associate chair for Graduate Studies, may apply subsequently toward a graduate degree. Specific details regarding the latter are available in the Office of Academic Programs.

Honors Courses

When faculty resources permit, the School offers honors versions of some of the required courses for the B.S.I.E. Students with a cumulative grade point average of at least 3.3 are allowed to enroll in these courses and use them as replacements for the analogous course requirements in the curriculum.

Certificate and Minor in Cognitive Science

As part of the Cognitive Science Program at Georgia Tech, the School offers both a certificate and a minor in cognitive science for students who wish to link their studies with a broader interdisciplinary understanding of cognition. More information can be found at **www.cc.gatech.edu/cogsci**.

Visiting Scholar/Practitioner Offerings

Occasionally, the School brings to campus selected individuals of unique accomplishment for course offerings built around their special areas of activity, thus making available a broader range of course materials than regularly provided. Prominent in this regard is the James C. Edenfield Executive-in-Residence program, which brings highly successful executives to the School. Participating much like visiting faculty, these executives bring to a classroom setting, both graduate and

undergraduate, the benefit of their work experiences as they support the ISyE curriculum.

Bachelor of Science in Industrial Engineering (Suggested Schedule)

First Year - First Semester

Course Number/Name		Hours
MATH 1501	CALCULUS I	4
ENGL 1101	ENGLISH COMPOSITION I	3
PSYC 1101	GENERAL PSYCHOLOGY	3
LAB SCIENCE ELECTIVE (BIOL, CHEM, EAS)		4
TOTAL SEMESTER HOURS		14

First Year - Second Semester

Course Number/Name		Hours
MATH 1502	CALCULUS II	4
ENGL 1102	ENGLISH COMPOSITION II	3
PHYS 2211	INTRODUCTORY PHYSICS I	4
CS 1371	COMPUTING FOR ENGINEERS	3
WELLNESS		2
TOTAL SEMESTER HOURS		16

Second Year - First Semester

Course Number/Name		Hours
MATH 2401	CALCULUS III	4
PHYS 2212	INTRODUCTORY PHYSICS II	4
CS 1322	OBJECT-ORIENTED PROGRAMMING	3
ISYE 2027	PROBABILITY WITH APPLICATIONS	3
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		17

Second Year - Second Semester

Course Number/Name		Hours
MATH 2602	LINEAR & DISCRETE MATHEMATICS	4
ECON 2100	ECONOMIC ANALYSIS & POLICY PROBLEMS	3
ISYE 2030	MODELING IN INDUSTRIAL ENGINEERING	3
ISYE 2028	BASIC STATISTICAL METHODS	3
LAB SCIENCE ELECTIVE (BIOL, CHEM, EAS, PHYS)		4
TOTAL SEMESTER HOURS		17

Third Year - First Semester

Course Number/Name		Hours
ISYE 3025	ESSENTIALS OF ENGINEERING ECONOMY	3
ISYE 3039	METHODS OF QUALITY IMPROVEMENT	3
ISYE 3103	SUPPLY CHAIN MODELING: LOGISTICS	3
ISYE 3232	STOCHASTIC MFG. & SERVICE SYSTEMS	3
CS 4400	INTRO. TO DATABASE SYSTEMS	3
MGT 3100 or 3150 or ACCT 2101		3
TOTAL SEMESTER HOURS		16

Third Year - Second Semester

Course Number/Name		Hours
ISYE 3044	SIMULATION ANALYSIS & DESIGN	3
ISYE 3104	SUPPLY CHAIN MODELING: MANUFACTURING & WAREHOUSING	3
ECON 3150	ECONOMIC & FINANCIAL MODELING or MGT 3078 FINANCE & INVESTMENTS	3
LCC 3401	TECHNICAL COMMUNICATION PRACTICES	2
ENGINEERING ELECTIVE(S)		3
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Fourth Year - First Semester

Course Number/Name		Hours
ISYE 4009	DESIGN OF HUMAN-INTEGRATED SYSTEMS	3
ISYE 4231	ENGINEERING OPTIMIZATION	3
ENGINEERING ELECTIVE(S)		3
HUMANITIES ELECTIVE(S)		3
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Fourth Year - Second Semester

Course Number/Name		Hours
ISYE 4106	SENIOR DESIGN	4
ENGINEERING ELECTIVE(S)		3
SOCIAL SCIENCE ELECTIVE(S)		3
FREE ELECTIVE(S)		3
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

TOTAL PROGRAM HOURS = 126 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Electives

1) Science electives I and II are selected from courses in physics, chemistry, biology, and/or earth and atmospheric sciences.
2) Engineering science electives are taken from (thermodynamics, statics, dynamics, circuits, DSP, junior/senior-level courses for other engineering schools).
3) Among all science and free electives, at least one course must be on the environment.

To satisfy the state requirements regarding coursework on the history and constitutions of the United States and Georgia, students must complete one of the following courses: HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200.

Graduate Programs

Master's Programs

The School of Industrial and Systems Engineering offers seven master's degrees: the Master of Science in Industrial Engineering (M.S.I.E.); the Master of Science in Operations Research (M.S.O.R.); the Master of Science in Statistics (M.S.S.); the Master of Science in Health Systems (M.S.H.S.); the Master of Science in Quantitative and Computational Finance (M.S.Q.C.F.); the Executive Master of Science in International Logistics (E.M.I.L.); and the undesignated Master of Science (M.S.).

The M.S.I.E. program is available to students with an industrial engineering background and to other engineers who satisfy requirements covering the principal subject matter of the current B.S.I.E. curriculum. The other master's programs are available for students holding the B.S. in engineering, mathematics, or science. Requisites include work in probability, statistics, linear algebra, calculus, and optimization, as well as selected application area work. The student may satisfy these requirements after enrollment; however, such coursework may not apply toward fulfillment of the degree requirements. The undesignated M.S. program is typically for those students who wish to work in the area of human-integrated systems.

All proposed master's degree programs require thirty semester hours with the exception of E.M.I.L. and the M.S.Q.C.F., both of which require thirty-six hours; one option, the undesignated M.S. in Human-Integrated Systems, requires a thesis. In addition, the M.S.I.E. allows a choice of two tracks. One of these accommodates advanced study in modern manufacturing, warehousing, and logistics while the second allows for a concentration in human-integrated systems analysis.

Distance Learning and Professional Education

The School of Industrial and Systems Engineering offers off-campus working professionals the opportunity to enroll in many of its graduate courses through video technologies. Qualified individuals can complete the requirements for the M.S.I.E. or M.S.O.R. utilizing the video-based delivery system. Admission as a degree-seeking student in the video program is based upon the same criteria as for regular students. See "Distance Learning and Professional Education" on page 19.

Program in Statistics

The Master of Science in Statistics is offered through joint cooperation between the School of Industrial and Systems Engineering and the School of Mathematics. The nature of this relationship emphasizes statistics as a science necessary in a technological environment. Within this program, students may concentrate their studies on a specific area of application such as engineering, quality control, or management. Although this program can lead to further work toward a doctorate in statistics, it will primarily provide the background requisite for a professional career in statistics.

Program in Quantitative and Computational Finance

The M.S.Q.C.F. is offered through joint cooperation between the School of Industrial and Systems Engineering, the School of Mathematics, and the College of Management. The aim of the M.S.Q.C.F. is to provide students with the practical skills and theoretical understanding they need to be leaders in the formulation, implementation, and evaluation of the models used by the financial sector to structure transactions, manage risk, and construct investment strategies.

Doctoral Programs

The Ph.D. program is intended for highly qualified individuals for whom past accomplishments and evaluation indicate a high potential for successful completion of the program requirements and a subsequent creative intellectual contribution to the field. Admission is, therefore, dependent upon student qualification rather than educational background in any specified discipline. Consideration for admission is based largely upon performance in prior academic work, the Graduate Record Examination (GRE), and credible letters of reference. Admitted students may pursue their work in any of six tracks: optimization, stochastic systems, manufacturing/logistics, economic decision analysis, applied statistics, and human-integrated systems.

Program in Algorithms, Combinatorics, and Optimization

The Ph.D. program in algorithms, combinatorics, and optimization (ACO) is a multidisciplinary graduate program sponsored jointly by the School of Industrial and Systems Engineering, the College of Computing, and the School of Mathematics. The program is arranged to bring together the study of discrete structures and the design and analysis of algorithms in areas such as graph theory, integer programming, combinatorial optimization, network flows, and polyhedral theory. It is intended for students possessing a strong mathematical perspective and background in one or more of the fields represented by the sponsoring units.

Students in the program will have a single home department chosen from among the participating units, all of which contribute courses for the program. Students may apply to the ACO program at Georgia Tech through any one of these three units.

Cognitive Science Program

As part of the Cognitive Science Program at Georgia Tech, the School offers a graduate certificate in cognitive science. More information can be found at **www.cc.gatech.edu/cogsci**.

Financial aid for Ph.D. study is available in the form of traineeships, fellowships, sponsored externships, and research and teaching assistantships.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course. This section includes courses in Industrial and Systems Engineering (ISYE), Health Systems (HS), and International Logistics (IL).

INDUSTRIAL AND SYSTEMS ENGINEERING

ISYE 2027. Probability with Applications
3-0-3.
Prerequisite(s): MATH 1502 or MATH 1512 or (MATH 15X2 and MATH 1522)
Topics include conditional probability, density and distribution functions from engineering, expectation, conditional expectation, laws of large numbers, central limit theorem, and introduction to Poisson Processes.

ISYE 2028. Basic Statistical Methods
3-0-3.
Prerequisite(s): ISYE 2027 and CS 1322
Co-requisite: ISYE 2030.
Point and interval estimation of systems parameters, statistical decision making about differences in system parameters, analysis and modeling of relationships between variables.

ISYE 2030. Modeling in Industrial Engineering
2-3-3.
Prerequisite(s): CS 1322 and ISYE 2027 and (MATH 2401 or MATH 2411 or MATH 24X1)
Co-requisite: ISYE 2028.
Coverage includes projects involving information collection, data acquisition, analysis, and presentation as well as the motivation and use of analytical algorithmic, conceptual, and computational models.

ISYE 2127. Honors Probability
3-0-3.
Prerequisite(s): MATH 1502 or MATH 1512 or (MATH 15X2 and MATH 1522)
Topics parallel those in ISYE 2027 with an intended treatment that is more innovative and challenging. Credit not allowed for both ISYE 2127 and 2027.

ISYE 2128. Honors Statistics
3-0-3.
Prerequisite(s): CS 1322 and ISYE 2027
Topics parallel to those in ISYE 2028 with an intended treatment that is more innovative and challenging. Credit not given for both ISYE 2028 and 2128.

ISYE 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

ISYE 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

ISYE 3025. Essentials of Engineering Economy
1-0-1.
Prerequisite(s): ECON 2100
Introduction to engineering economic decision making, economic decision criteria, discounted cash flow, replacement and timing decisions, risk, depreciation, and income tax.

ISYE 3039. Methods of Quality Improvement
3-0-3.
Prerequisite(s): ISYE 2028
Topics include quality system requirements, designed experiments, process capability analysis, measurement capability, statistical process control, and acceptance sampling plans.

ISYE 3044. Simulation Analysis and Design
3-0-3.
Prerequisite(s): ISYE 2028 and ISYE 3232
Discrete event simulation methodology emphasizing the statistical basis for simulation modeling and analysis. Overview of computer languages and simulation design applied to various industrial situations.

ISYE 3103. Introduction to Supply Chain Modeling: Logistics
3-0-3.
Prerequisite(s): ISYE 2028 and ISYE 2030
Course focuses on engineering design concepts and optimization models for logistics decision making in three modules: supply chain design, planning and execution, and transportation.

ISYE 3104. Introduction to Supply Chain Modeling: Manufacturing and Warehousing
3-0-3.
Prerequisite(s): ISYE 2028 and ISYE 3232
Design and operation of manufacturing and warehousing facilities.

ISYE 3232. Stochastic Manufacturing and Service Systems
3-0-3.
Prerequisite(s): ISYE 2027
Methods for describing stochastic movements of material in manufacturing facilities, supply chain, and equipment maintenance networks. Includes analysis of congestion, delays, and inventory ordering policies.

ISYE 3332. Honors Random Systems
3-0-3.
Prerequisite(s): ISYE 2027
Topics parallel those in ISYE 3232 with an intended treatment that is more innovative and challenging. Credit not allowed for both ISYE 3332 and 3232.

ISYE 3770. Statistics and Applications
3-0-3.
Prerequisite(s): MATH 2401 or MATH 2411 or MATH 24X1
Introduction to probability, probability distributions, point estimation, confidence intervals, hypothesis testing, linear regression, and analysis of variance. Crosslisted with MATH 3770 and CEE 3770.

ISYE 3790. Introduction to Cognitive Science
3-0-3.
Multidisciplinary perspectives on cognitive science. Interdisciplinary approaches to issues in cognition, including memory, language, problem solving, learning, perception, and action. Crosslisted with CS, PST, and PSYC 3790.

ISYE 4009. Design of Human-Integrated Systems
3-0-3.
Prerequisite(s): ISYE 2028 and CS 1322
Topics include general cognitive systems engineering concepts and principles, and specific concepts and principles of interface design, task analysis, prototyping, and empirical usability of evaluation methods.

ISYE 4106. Senior Design
0-12-4.
Prerequisite(s): ISYE 3044 and ISYE 3103 and ISYE 3104 and ISYE 4231*
Senior design project requiring student to formulate a project plan with an off-campus enterprise. Includes specific milestones, targets, and evaluation criteria.

ISYE 4231 Engineering Optimization
3-0-3.
Prerequisite(s): CS 1322 and MATH 2602
Topics include modeling with networks and graphs; linear, nonlinear, and integer programming; construction of models employing modern modeling languages; and general solution strategies.

ISYE 4257. Applications of Robotics and Automated Data Collection
3-0-3.
Prerequisite(s): ISYE 2028 and MATH 2602
Topics include robot configurations, accuracy and analysis, programming, sensors and integration. The latter will focus on automated identification, automated materials tracking in manufacturing, and logistics systems.

ISYE 4331. Honors Optimization
3-0-3.
Prerequisite(s): CS 1322 and MATH 2602
Topics parallel those in ISYE 4231 with an intended treatment that is more innovative and challenging. Credit not given for both ISYE 4331 and 4231.

ISYE 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

ISYE 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

ISYE 4756. Technology Forecasting and Assessment
3-0-3.
Develops skills in methods for technology monitoring, forecasting, and assessment; draws on examples in various emerging technologies. Collection and analysis of quantitative and qualitative data on emerging technologies and their implications. Crosslisted with PUBP 4756.

ISYE 4790. Seminar in Cognitive Science
3-0-3.
A seminar-type course in cognitive science focusing on integrating and deepening students' cognitive science knowledge and skills. Topics include memory, language, problem solving, learning, perception, and action. Crosslisted with CS, PST, and PSYC 4790.

ISYE 4791. Integrative Project in Cognitive Science
3-0-3.
An integrative course in cognitive science focusing on the integration and use of concepts and skills from cognitive science. A different integrative project or set of projects will be taken on each semester; students will contribute on the basis of their background and skills. Crosslisted with CS, PST, and PSYC 4791.

ISYE 4792. Design Project in Cognitive Science
3-0-3.
Individual project with a cognitive science faculty member, designed as a supplement to the student's senior design project or thesis in their major area. Crosslisted with CS, PST, and PSYC 4792.

ISYE 4803, -13, -23. Special Topics
3-0-3.
Courses in special topics of timely interest to the profession, conducted by resident or visiting faculty.

ISYE 4833. Honors Topics
3-0-3.
Topics of current interest in the field of ISYE that are covered with an appropriately high level of innovation and rigor.

ISYE 4991, -92, -93. Special Problems
Credit hours to be arranged.
A variable hour credit opportunity to develop initiative and apply fundamental principles by performing semioriginal laboratory or research work in ISYE.

ISYE 6101. Organizational Behavior for Engineers
3-0-3.
Studies the scientific generation, formalization, and application of the knowledge of individual and group behaviors that engineers need to function effectively within contexts.

ISYE 6201. Manufacturing Systems
3-0-3.
Prerequisite(s): ISYE 6650 and ISYE 6669
Topics include analysis of flows, bottlenecks and queueing, types of operations, manufacturing inventories, aggregate production planning, lot sizes and lead times, and pull production systems.

ISYE 6202. Warehousing Systems
3-0-3.
Prerequisite(s): ISYE 6669
Topics include design and analysis of materials handling systems, warehouse layout, order picking strategies, warehousing inventories, warehouse management systems, integration of production and distribution systems.

ISYE 6203. Transportation and Supply Chain Systems
3-0-3.
Prerequisite(s): ISYE 6669
Topics include supply chain characterization, site location, mode selection, distribution planning, vehicle routing, demand management, replenishment management, geographic information systems, and real-time control issues.

ISYE 6205. Cognitive Engineering
3-0-3.
Application of cognitive science concepts to system design, and the development of concepts appropriate for understanding and aiding cognition in naturally or technologically complex environments.

ISYE 6215. Models in Human-Machine Systems
3-0-3.
Prerequisite(s): ISYE 4009
The development and use of mathematical models of human behavior are considered. Approaches from estimation theory, control theory, queueing theory, and fuzzy set theory are considered.

ISYE 6223. Understanding and Supporting Human Decision Making
3-0-3.
Prerequisite(s): ISYE 4009
Prescriptive and descriptive theories of human decision making are discussed/contrasted. Approaches to aiding human decision making are considered in context of these theoretical frameworks.

ISYE 6224. Topics in Human-Integrated Systems
3-0-3.
Prerequisite(s): ISYE 4009 or ISYE 6215
State-of-the-art research directions including supervisory control models of human command control tasks; human-computer interface in scheduling and supervision of flexible manufacturing systems.

ISYE 6225. Engineering Economy
3-0-3.
Prerequisite(s): ISYE 3025 and ISYE 4231
Advanced engineering economy topics, including economic worth, economic optimization under constraints, risk and uncertainty, foundations of utility theory.

ISYE 6227. Introduction to Financial Engineering
3-0-3.
Prerequisite(s): ISYE 6650 and ISYE 6669
Advanced techniques for economic analysis of capital investment. Basic terminology and financial engineering concepts for managing and valuing project risk. Real options applications in systems engineering.

ISYE 6229. Productivity Measurement and Analysis
3-0-3.
Prerequisite(s): ISYE 6401 and ISYE 6669
Modern measurement of productivity measurement and analysis including principles, issues, and latest techniques associated with benchmarking, efficiency measurement, and productivity tracking. Empirical studies and group projects.

ISYE 6230. Economic Decision Analysis
3-0-3.
Prerequisite(s): ISYE 6669
Topics include preferences and utilities, social choice, equilibrium concepts, noncooperative and cooperative game theory, price mechanisms, auction mechanisms, voting theory, and incentive compatibility.

ISYE 6231. Design of Human-Integrated Systems
3-0-3.
Prerequisite(s): ISYE 4009
Analysis and design of complex work domains in technological environments.

ISYE 6232. Safety-Critical Real-Time Systems
3-0-3.
Prerequisite(s): ISYE 4009
Study of system safety, human error, and software reliability.

ISYE 6234. Measurement and Evaluation of Human-Integrated Systems
3-0-3.
Prerequisite(s): ISYE 6739
Measurements of complex systems including workload, operator strategy, and performance.

ISYE 6307. Scheduling Theory
3-0-3.
Prerequisite(s): ISYE 6669
Includes topics in sequencing and scheduling with emphasis on deterministic machine scheduling problems with some stochastic results examined. Complexity of various problems will be analyzed.

ISYE 6401. Statistical Modeling and Design of Experiments
3-0-3.
Prerequisite(s): ISYE 6739
Fundamental coverage of topics in multiple regression and factorial experiments.

ISYE 6402. Time Series Analysis
3-0-3.
Prerequisite(s): ISYE 6739
Basic forecasting methods, ARIMA models, transfer functions.

ISYE 6404. Nonparametric Data Analysis
3-0-3.
Prerequisite(s): ISYE 6739
Nonparametric statistics and basic categorical data analysis.

ISYE 6405. Statistical Methods for Manufacturing Design and Improvement
3-0-3.
Prerequisite(s): ISYE 6401
Fractional factorial designs, response surface methods.

ISYE 6411. Fundamentals of Statistics with Applications
3-0-3.
Prerequisite(s): MATH 2401 or MATH 2411 or MATH 24X1
Relationships of statistical estimation and linear models with regression, planning and analysis of experiments, and the analysis of correlated data. More mathematical than ISYE 6401.

ISYE 6412. Theoretical Statistics
3-0-3.
Rigorous introduction to theory of statistical inference. Estimation and testing. Construction and assessment of estimator and tests. Fundamentals of decision theory, minimax, and Bayes Paradigms.

ISYE 6413. Design and Analysis of Experiments
3-0-3.
Prerequisite(s): ISYE 6739
Analysis of variance, full and fractional factoral designs at two and three levels, orthogonal arrays, response surface methodology, robust parameter design for production/process improvement.

ISYE 6414. Statistical Modeling and Regression Analysis
3-0-3.
Prerequisite(s): ISYE 6739
Simple and multiple linear regression, inferences and diagnostics, stepwise regression and model selection, advanced regression methods, basic design and analysis of experiments, factorial analysis.

ISYE 6644. Simulation
3-0-3.
Prerequisite(s): ISYE 2028 and ISYE 3232
Covers modeling of discrete-event dynamic systems and introduces methods for using these models to solve engineering design and analysis problems.

ISYE 6650. Probabilistic Models and Their Applications
3-0-3.
Prerequisite(s): ISYE 2027
An introduction to basic stochastic processes such as Poisson and Markov processes and their applications in areas such as inventory, reliability, and queueing.

ISYE 6656. Queueing Theory
3-0-3.
Prerequisite(s): ISYE 6650
Processing networks with queueing. Performance analysis using Markov process description of system behavior. Applications and numerical studies in manufacturing, system maintainability, computer systems, telecommunication networks.

ISYE 6661. Optimization I
3-0-3.
Prerequisite(s): MATH 2406
Theory, algorithms, and applications of linear programming. Topics include the simplex method and resolution of degeneracy, duality and sensitivity analysis, basis factorization, the dual and revised simplex methods, and geometry of polyhedra. Intended for Ph.D. students.

ISYE 6662. Optimization II
3-0-3.
Prerequisite(s): ISYE 6661
Fundamentals of integer and combinatorial optimization. Topics include polyhedra, cuts, Lagrangean duality, complexity, and others. This course is intended for Ph.D. students.

ISYE 6663. Optimization III
3-0-3.
Prerequisite(s): ISYE 6661
Fundamentals of nonlinear optimization. Topics include optimality conditions; convex programming and duality; unconstrained and constrained methods. Polynomial algorthims and interior point methods. Dual methods. This course is for students seriously considering a Ph.D.

ISYE 6664. Stochastic Optimization
3-0-3.
Prerequisite(s): ISYE 6762 or MATH 6762
An introduction to sequential decision making under uncertainty. Much of the course is devoted to the theoretical, modeling, and computational aspects of Markov decision processes.

ISYE 6669. Deterministic Optimization
3-0-3.
Prerequisite(s): ISYE 4231
An introduction to deterministic optimization methodologies including approaches from linear, discrete, and nonlinear optimization including algorithms and computations. Applications will be introduced as appropriate.

ISYE 6673. Financial Optimization Models
3-0-3.
Prerequisite(s): ISYE 6225 or MGT 6078
An introduction to optimization techniques with special emphasis on applications to finance, including portfolio optimization, immunization, and risk management.

ISYE 6679. Computational Methods
3-0-3.
Prerequisite(s): ISYE 6669
Strategies and techniques for converting optimization theory into effective computational procedures. Emphasis is on applications in linear, integer, and nonlinear programming; networks and graphs.

ISYE 6739. Basic Statistical Methods
3-0-3.
Prerequisite(s): MATH 2401 or MATH 2411 or MATH 24X1
Overview of basic tools used in statistical analysis and modeling. Credit not allowed to students seeking a degree in ISYE.

ISYE 6759. Stochastic Processes in Finance
3-0-3.
Prerequisite(s): MATH 3215 or MATH 3225
Mathematical modeling of financial markets, derivative securities pricing, and portfolio optimization. Concepts from probability and mathematics are introduced as needed. Crosslisted with MATH 6759.

ISYE 6761. Stochastic Processes I
3-0-3.
Prerequisite(s): ISYE 2027
Discrete time Markov chains, Poisson and renewal processes; transient and limiting behavior; average cost and utility measures of systems. Intended for Ph.D. students. Crosslisted with MATH 6761.

ISYE 6762. Stochastic Processes II
3-0-3.
Prerequisite(s): ISYE 6761 or MATH 6761
Continuous time Markov chains; uniformization, transient and limiting behavior; Brownian motion and martingales; optional sampling and convergence. Intended for Ph.D. students. Crosslisted with MATH 6762.

ISYE 6767. Design and Implementation of Systems to Support Computational Finance
3-0-3.
Introduction to large-scale system design to support computational finance for options, stocks, or other financial instruments. Some programming experience and previous exposure to stocks, bonds, and options required. Crosslisted with MATH 6767.

ISYE 6769. Fixed-Income Securities
3-0-3.
Prerequisite(s): MATH 3215 or MATH 3225 and (MGT 6060 or MGT 6078)
Description, institutional features, and mathematical modeling of fixed-income securities. Use of both deterministic and stochastic models. Crosslisted with MATH 6769.

ISYE 6772. Managing Resources of the Technological Firm
3-0-3.
This course explores the competitive advantage manufacturing and service firms derive from the effective management of their technology, workforce, materials, and information resources. Crosslisted with MGT 6772.

ISYE 6773. Strategic Management of Technology-Based Ventures
3-0-3.
This course provides a forum for the in-depth examination of issues involving the strategic management of high-tech corporate start-ups and small technology-based businesses. Crosslisted with MGT 6773.

ISYE 6774. Management of Technology Project
3-0-3.
This course organizes students into multidisciplinary teams devoted to solving a real problem for a technology-based firm. Crosslisted with MGT 6774.

ISYE 6775. Management of Technology Seminar
1-0-1.
This course introduces the frontiers of key technologies, provides a forum for visiting speakers from the corporate world, and supplements topics from other MOT courses. Crosslisted with MGT 6775.

ISYE 6777. Analysis of Emerging Technologies
3-0-3.
Methods for technology monitoring, forecasting, and assessment. Crosslisted with PUBP 6777.

ISYE 6779. Dynamic System Simulation and Modeling
3-0-3.
Prerequisite(s): AE 2220
Models of dynamic systems, such as aircraft, ground vehicles, and machinery, and manual control. Numerical simulation techniques and applications. Interactive simulators. Student programming project. Crosslisted with AE 6779.

ISYE 6781. Reliability Theory
3-0-3.
Prerequisite(s): MATH 3215 or MATH 3225
Structural properties and reliability of coherent systems.

ISYE 6783. Statistical Techniques of Financial Data Analysis
3-0-3.
Prerequisite(s): MATH 3215 or MATH 3225
Fundamentals of statistical inference for models used in the modern analysis of financial data. Crosslisted with MATH 6783.

ISYE 6785. The Practice of Quantitative and Computational Finance
3-0-3.
Case studies, visiting lecturers from financial institutions, student group projects of an advanced nature, and student reports, all centered around quantitative and computational finance. Crosslisted with MATH and MGT 6785.

ISYE 6792. Manufacturing Seminar
1-0-1.
Guest speakers on a broad range of manufacturing-related topics: research, applications, and technology. Required for Certificate in Manufacturing. Crosslisted with ECE and ME 6792.

ISYE 6793. Advanced Topics in Quantitative and Computational Finance
3-0-3.
Advanced foundational material and analysis techniques in quantitative and computational finance. Crosslisted with MATH 6793.

ISYE 6795. Introduction to Cognitive Science
3-0-3.
Multidisciplinary perspectives on cognitive science. Interdisciplinary approaches to issues in cognition, including memory, language, problem solving, learning, perception, and action. Crosslisted with CS and PSYC 6795.

ISYE 6805. Reliability Engineering
3-0-3.
Prerequisite(s): ISYE 2027
Topics include hazard functions, life distributions, censoring, life tables, nonparametric and parametric estimation and inference, accelerated life testing, structure functions, reliability and maintenance systems, and replacement theory.

ISYE 6831. Advanced Simulation
3-0-3.
Prerequisite(s): ISYE 2028 and (ISYE 6761 or MATH 6761)
Topics include generalized semi-Markov processes; input and output analysis; random number, variate, and sample path generation, rare event simulation; and optimization via simulation.

ISYE 7000. Master's Thesis
Credit hours to be arranged.
Required of degree candidates in the master's thesis option.

ISYE 7210. Real-Time Interactive Simulation
3-0-3.
Prerequisite(s): ISYE 6215 and ISYE 6831
Principles and laboratory experience in design and implementation of interactive simulations of complex dynamic systems.

ISYE 7400. Advanced Design of Experiments
3-0-3.
Prerequisite(s): ISYE 6401
Random and mixed models, nested and blocked designs. Intended for Ph.D. students and those seeking the M.S. in Statistics.

ISYE 7401. Advanced Statistical Modeling
3-0-3.
Prerequisite(s): ISYE 6401
Nonlinear models, logistic regression, loglinear models. Intended for Ph.D. students and those seeking the M.S. in Statistics.

ISYE 7405. Multivariate Data Analysis
3-0-3.
Prerequisite(s): ISYE 6401
Multivariate ANOVA, principal components, factor analysis etc. Intended for Ph.D. students and those seeking the M.S. in Statistics.

ISYE 7406. Data Mining and Statistical Learning
3-0-3.
Prerequisite(s): ISYE 6413 and ISYE 6414
Topics include neural networks, support vector machines, classification trees, boosting and discriminant analysis. Intended for Ph.D. students and those seeking the M.S. in Statistics.

ISYE 7441. Theory of Linear Models
3-0-3.
Prerequisite(s): MATH 4261 and ISYE 6401
Intended for Ph.D. students and those seeking the M.S. in Statistics.

ISYE 7653. Case Studies in Logistics/Manufacturing
3-0-3.
Prerequisite(s): ISYE 6201 and ISYE 6203 and ISYE 6661 and (ISYE 6761 or MATH 6761)
Advanced topics in logistics and manufacturing through the use of industrial case studies. Difficult modeling issues such as data representation and consistency will be introduced.

ISYE 7790. Cognitive Modeling
2-6-4.
Prerequisite(s): CS 6795 or ISYE 6795 or PSYC 6795
A hands-on course covering a range of cognitive methodologies. It explores the analysis, development, construction, and evaluation of models of cognitive processing. Crosslisted with CS and PSYC 7790.

ISYE 8011, -12, -13. Graduate Seminar
1-0-1.
Audit basis only.

ISYE 8795. Colloquium in Cognitive Sciences
1-0-1.
Reading of research papers by leading cognitive scientists, attendance at their colloquia, and meeting with them to discuss research. Crosslisted with CS and PSYC 8795.

ISYE 8803. Special Topics
3-0-3.
Special topics in industrial and systems engineering.

ISYE 8813. Special Topics in Operations Research
3-0-3.
Special topics in the field of operations research.

ISYE 8843. Advanced Topics in Statistics
3-0-3.
For Ph.D. students.

ISYE 8851. Topics in Manufacturing
3-0-3.
Prerequisite(s): ISYE 6661 and (ISYE 6761 or MATH 6761)
Current topics in manufacturing including: manufacturing automation and controls, advanced planning systems, heuristic scheduling techniques, stochastic models of manufacturing systems, advanced warehousing, and materials handling.

ISYE 8852. Topics in Logistics
3-0-3.
Prerequisite(s): ISYE 6661
Current topics in logistics including: inventory control in supply chain design, stochastic vehicle routing, computational methods in logistics systems, location theory, and geographic information systems.

ISYE 8861. Advanced Topics in Stochastics
3-0-3.
Prerequisite(s): ISYE 6762 or MATH 6762
Coverage of advanced topics of interest that support research interests of students in the field.

ISYE 8862. Advanced Topics in Simulation
3-0-3.
Prerequisite(s): (ISYE 6762 or MATH 6762) and ISYE 6851
Coverage of advanced topics of interest that support research interests of students in the field.

ISYE 8871. Advanced Topics in Linear and Discrete Optimization
3-0-3.
Prerequisite(s): ISYE 6662
Topics may vary with each offering and include subjects such as integer programming, combinatorics, graphs and networks, matching, matroids, polyhedral combinatorics, as well as others.

ISYE 8872. Advanced Topics in Nonlinear Optimization
3-0-3.
Prerequisite(s): ISYE 6663
Similar to ISYE 8871 but deals with subjects in nonlinear programming, interior-point methods, convexity, global optimization, etc. Topics may vary each term.

ISYE 8893. Special Topics in Cognitive Science
3-0-3.

ISYE 8900. Special Problems in Industrial Engineering
Credit hours to be arranged.

ISYE 8901. Special Problems in Operations Research
Credit hours to be arranged.

ISYE 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding graduate teaching assistantships.

ISYE 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding graduate research assistantships.

ISYE 9000. Doctoral Thesis
Credit hours to be arranged.

HEALTH SYSTEMS

HS 4001. Introduction to Health Systems
3-0-3.
Background of U.S. healthcare; the workforce; mechanisms and costs of delivery; facilities; ambulatory care; regulation and quality; managed care, finance, and role of government.

HS 6000. Introduction to Healthcare Delivery
3-0-3.
Historical background; the healthcare workforce; nature, problems, and costs of delivery sites; health planning, finance, role of government, alternative delivery models, and health policy.

HS 6100. Healthcare Delivery Systems Models
3-0-3.
Prerequisite(s): HS 6000
Progression in service delivery from individual providers to complex financing and delivery organizations. Alternative models are explored with an emphasis on access, efficiency, and effectiveness.

HS 6200. Healthcare Financial Management
3-0-3.
Prerequisite(s): HS 6000
Applications of accounting and finance in the healthcare delivery system; methods of reimbursement, product costing, strategic financial planning, and capital formation.

HS 6300. Healthcare Information Systems
3-0-3.
Prerequisite(s): HS 6000
Application of information systems to assist in medical practice including communication within the healthcare enterprise, reimbursement for care, clinical decision making, and assessment of outcomes.

HS 6400. Health Systems Practice
3-0-3.
Prerequisite(s): HS 6000 and HS 6100
An actual project conducted by individual graduate students within a healthcare institution or a health service organization. Project has both a faculty and site sponsor.

HS 8803, -13. Special Topics
3-0-3.
Topics of current interest in health systems.

HS 8900, -01. Special Problems
Credit hours to be arranged.

HS 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding graduate teaching assistantships.

HS 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding graduate research assistantships.

INTERNATIONAL LOGISTICS

IL 6450. Analytical Methods
1-0-1.
This course provides an overview of optimization, statistical, and stochastic models and methods with special emphasis on application to logistics.

IL 6451. Demand and Yield Management
1-0-1.
This course focuses on demand estimation and modeling and revenue management.

IL 6452. Reverse Green Logistics
1-0-1.
This course addresses issues, driving forces, and analytical approaches to aid in designing operating reverse logistics systems.

IL 6453. Labor Relations
1-0-1.
This course compares labor practices in Europe, North America, and Asia with special attention on the influences on logistics.

IL 6454. European Trade and Transport
1-0-1.
This course provides an overview of legal, cultural, political, and infrastructure issues influencing logistics in Europe.

IL 6455. Finance for the Logistics Practitioner
1-0-1.
This course provides an in-depth understanding of concepts of finance that relate to logistics, such as valuing logistics activities and measuring logistics performance.

IL 6456. Financial Decision Making for Logistics
1-0-1.
This course provides a thorough understanding of the key elements of building a better logistics business case.

IL 6457. Trade and Transportation in the Americas
1-0-1.
This course provides an overview of legal, cultural, political, and infrastructure issues influencing logistics practices in the Americas.

IL 6458. Warehousing and Cross-Docking
1-0-1.
This course surveys the different types of warehouses and their functions, principles of operation, and strategic relationship to the supply chain.

IL 6459. International Trade and Transportation
1-0-1.
This course discusses how international trade is financed, what instruments are used and how they work, how transactions are settled, and the role of documentation.

IL 6460. International Freight Management
1-0-1.
This course focuses on international freight management including consolidation, export packaging, customs, tracking, terminal operations, mode selection, and carrier selection.

IL 6461. Asian Trade and Transportation
1-0-1.
This course provides an overview of legal, cultural, political, and infrastructure issues influencing logistics practices in Asia.

IL 6462. New Ventures
1-0-1.
This course focuses on concepts and theories relevant to starting and managing new corporate ventures as well as building alliances and partnerships.

IL 6463. Supply Chain Management I: E-Commerce
1-0-1.
This course provides an overview of electronic commerce on the Internet and focuses on opportunities for applying this technology to supply chain management.

IL 6464. Supply Chain Management II: ERP Systems
1-0-1.
This course provides a strategic view of Enterprise Resource Planning and its relationship to logistics functions.

IL 6465. Marketing Channels and Partnering
1-0-1.
This course focuses on logistics and supply chain issues as they impact the global marketing strategies of companies.

IL 6466. Global Supply Chain Design and Measurement
1-0-1.
This course focuses on concepts and models for designing and measuring a global supply chain, with special focus on the impact of e-commerce.

IL 6467. Transportation
1-0-1.
This course focuses on logistics planning, execution, and performance measurement in the transportation industry.

IL 6468. Manufacturing
1-0-1.
This course focuses on logistics issues within the manufacturing facility including inventory, throughput, lead-time batching, and managing variability.

IL 6470, -71. Supply Chain Integration Lab I, -II
0-6-2.
This course integrates supply chain management techniques in the Americas, Asia, and Europe through case studies.

IL 6472. Supply Chain Integration Lab III
0-3-1.
This course integrates supply chain management techniques in the Americas, Asia, and Europe through case studies.

IL 6473, -74. Supply Chain Integration Lab IV, -V
0-6-2.
This course integrates supply chain management techniques in the Americas, Asia, and Europe through case studies.

IL 6475, -76, -77, -78. Cases in International Logistics I, -II, -III, -IV
2-0-2.
In this course, cases are used to integrate strategic, management, and operating issues in international logistics and supply chain design.

School of Materials Science and Engineering

www.mse.gatech.edu

Established in 1985, School of Ceramic Engineering established in 1924
Location: J. Erskine Love Jr. Manufacturing Building
Telephone: 404.894.2888
Fax: 404.894.9140
E-mail: academic@mse.gatech.edu

School Chair and Professor–Robert L. Snyder; *Associate Chair and Professor*–Naresh N. Thadhani; *Carter N. Paden Jr. Distinguished Chair in Metals Processing*–David L. McDowell; *Joseph M. Pettit Chair in Electronic Packaging and GRA Eminent Chair*–Rao Tummala.
Regents' Professors–Thomas H. Sanders, Zhong Lin Wang, C. P. Wong.
Professors–Hamid Garmestani, Rosario Gerhardt, Arun M. Gokhale, W. Steven Johnson, Meilin Liu, William S. Rees, Michael D. Sacks, Kenneth Sandhage, Robert F. Speyer, Christopher J. Summers.
Associate Professors–W. Brent Carter, Mo Li, Preet Singh, Rina Tannenbaum.
Assistant Professors–Nils Kröger, Valeria T. Milam, Roger Narayan.
Professors Emeriti–James F. Benzel, Joe K. Cochran, Helen Grenga, Robert F. Hochman.
Senior Research Scientist Emeritus–D. Norman Hill.
Adjunct Professors–Stephen D. Antolovich, Janet Hampikian, James Wuifu Lee, Shawn-Yu Lin, Rajesh Naik, William J. Ready, Ashok Saxena, Kee-Bong Yoon.
Principal Research Engineer Emeritus–Kathryn V. Logan.
Courtesy Faculty Appointments: Barbara Boyan-Price Gilbert Jr. Chair in Tissue Engineering (BME); David Bucknall–Associate Professor (PTFE); Russell D. Dupuis–Steve W. Chaddick Endowed Chair in Electro-Optics, Georgia Research Alliance Eminent Scholar (ECE); Ian Ferguson–Professor (ECE); Seth Marder–Professor (CHM); Rick Neu–Associate Professor (ME); Angus Wilkinson–Professor (CHM); Min Zhou–Associate Professor (ME).

General Information

The School of Materials Science and Engineering provides high-quality academic programs focused on developing a fundamental understanding of materials and the creation of new materials for the next generation of engineering applications. A discipline on the cutting edge of both science and engineering, it views biomaterials, nanomaterials, ceramics, metals, polymers, electronic materials and composites from a fundamental point of view, emphasizing the relationships between the atomic and micro-structure as well as the properties, processing, and performance of the materials.

Completion of the B.S. degree prepares students for entry into the workforce, advanced study in materials science and engineering, or other graduate programs. Materials engineers have many career options available, including employment in industries such as aerospace, automotive, biomedical, chemical, electronic, materials processing, and recreational equipment, as well as employment in universities and government laboratories.

Research and instruction in the School of Materials Science and Engineering at Georgia Tech spans the following areas:

- synthesis and processing focusing on development of advanced materials with novel compositions and tailored microstructures
- characterization and evaluation of structure and properties using advanced techniques and state-of-the-art instrumentation
- modeling of structure-property-performance relationships emphasizing correlation of properties with the structure across nano-, micro-, meso-, and macro-length scales

MSE faculty participate in collaborative research projects with faculty from other schools in the Colleges of Engineering and Sciences, and the Georgia Tech Research Institute. Several interdisciplinary centers are led by MSE faculty. The external funding brought in by the faculty in the School of Materials Science and Engineering exceeds $16 million per year and comes from a wide variety of sources including industry, private foundations and federal funding agencies. A significant number of materials specialists are required to meet the present and future opportunities and challenges of this field.

The School offers a Bachelor of Science in Materials Science and Engineering degree. An undergraduate minor in materials science and engineering is available for non-MSE majors. Graduate degrees (M.S. and Ph.D.) are offered in materials science and engineering, paper science and engineering, and in polymers. The various degree programs are described in the following sections.

Undergraduate Program

Bachelor of Science in Materials Science and Engineering

The materials science and engineering undergraduate program offers a B.S. degree in Materials Science and Engineering. This versatile degree combines traditional instruction in ceramic engineering, metallurgy, and polymer science with modern materials, including nanomaterials, biomaterials, composite materials, electronic materials, and optical and magnetic materials. Freshmen and sophomores study basic chemistry, physics, mathematics, and engineering science and are introduced to the basic aspects of materials. Two English courses taken in the freshman year provide the foundation for further instruction in communications that is integrated throughout the curriculum. Juniors and seniors take courses in the science of materials and in the details of materials processing, structure, and properties. The curriculum culminates in a two-course senior design sequence in which students work in teams to design a material, component, or process using previously learned skills and knowledge. Two technical electives and one free elective provide flexibility that allows students to specialize in a particular area of materials or to pursue other interests. Courses in the humanities/fine arts and social sciences ensure that graduates understand the role of engineering in today's global society.

Program Educational Objectives

The general educational objective of the Materials Science and Engineering undergraduate program is to provide its graduates with the fundamental knowledge to function effectively in materials-related positions in industry, government, and academics. The following specific Program Educational Objectives were established to ensure the attainment of this general objective consistent with the visions and missions of Georgia Tech and the College of Engineering, and ABET Criteria for Evaluating Engineering Programs:

- To produce graduates of high quality
- To produce graduates who are able to apply the fundamentals of mathematics and physical sciences to engineering problems
- To produce graduates who are knowledgeable about processing-structure-property relationships in engineering materials such as metals, ceramics, polymers, electronic materials, composites, and biomaterials
- To produce graduates who are able to identify and define problems, including design problems, develop and evaluate economically feasible alternative solutions from diverse knowledge bases, and implement an acceptable solution
- To produce graduates who are able to communicate and contribute effectively while working in multidisciplinary teams
- To produce graduates who are adept at using computers for analysis, design, and communication
- To produce graduates who understand their professional and ethical responsibility to society in a global context
- To produce graduates who understand the importance of lifelong learning and have the skills to pursue it

Grade Requirements

In order to encourage students to explore subjects of personal or professional interest without jeopardizing their GPA, the Institute has a limited pass/fail option. The policy of the School of Materials Science and Engineering regarding the use of pass/fail hours for credit is as follows: no course specifically required by number by the materials science and engineering curriculum may be taken on a pass/fail basis and used toward graduation, unless the course is offered only on that basis.

In addition to the Institute scholastic requirements, the School of Materials Science and Engineering requires that a grade of *C* or above be obtained in all MSE courses in order for them to be used as credit toward graduation. An *S* (satisfactory) in a course taken pass/fail is equivalent to at least a *C*.

A student whose final grade in an MSE course is *D* must repeat that course and earn a *C* or better for it to be used as credit toward graduation. If the course is not offered again before the student's expected graduation term, the student will be permitted one re-examination in a single course if the following conditions are met:

a) The student did not receive any *F* grades in courses required for graduation for the graduation term.
b) The *D* was not the result of poor lab performance.

The re-examination will be graded *S* (satisfactory) or *U* (unsatisfactory) with a *C* or better performance required for an *S*. The previously assigned *D* will remain unchanged, but the director of undergraduate programs will approve its use toward graduation if the re-examination grade assigned is an *S*. The student's GPA must satisfy Institute requirements for graduation with the *D*.

The re-examination for a single *D* deficiency in an MSE course taken prior to the expected graduation term must be taken by the end of the final examination period for the expected graduation term.

The re-examination for a single *D* deficiency received during the expected graduation term must be taken prior to the last day of phase II registration. If an *S* is received, the deficiency will be removed and the student will be eligible to graduate the following term and may obtain a letter of completion from the registrar.

A re-examination becomes invalid if the student fails to qualify for graduation before the course for which the re-examination was given is offered again.

Bachelor of Science in Materials Science and Engineering (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
MATH 1501	CALCULUS I	4
CHEM 1310	GENERAL CHEMISTRY I	4
ENGL 1101	ENGLISH COMPOSITION I	3
CS 1371	COMPUTING FOR ENGINEERS	3
MSE 1001	INTRO. TO ENGINEERING	1
WELLNESS		2
TOTAL SEMESTER HOURS		17

First Year - Second Semester

Course Number/Name		*Hours*
MATH 1502	CALCULUS II	4
CHEM 1311	INORGANIC CHEMISTRY I	3
ENGL 1102	ENGLISH COMPOSITION II	3
PHYS 2211	INTRODUCTORY PHYSICS I	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		17

Second Year - First Semester

Course Number/Name		*Hours*
MATH 2401	CALCULUS III	4
PHYS 2212	INTRODUCTORY PHYSICS II	4
CHEM 2311	ORGANIC CHEMISTRY I	3
MSE 2001	PRINCIPLES & APPLICATIONS OF ENGINEERING MATERIALS	3
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Second Year - Second Semester

Course Number/Name		*Hours*
MATH 2403	DIFFERENTIAL EQUATIONS	4
MSE 2020	CHARACTERIZATION OF MATERIALS	3
MSE 2120 or ME 2211	INTRO. TO MECHANICS or STATICS & DEFORMABLE BODIES	3
ECON 2100 or 2105 or 2106		3
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Third Year - First Semester

Course Number/Name		*Hours*
MSE 3000	CHEMICAL THERMODYNAMICS OF MATERIALS	3
MSE 3005	MECHANICAL BEHAVIOR OF MATERIALS	3
MSE 3015	ELECTRICAL, OPTICAL, & MAGNETIC PROPERTIES	3
ECE 3710	CIRCUITS & ELECTRONICS	2
CEE/MATH/ISYE 3770	STATISTICS & APPLICATIONS	3
TOTAL SEMESTER HOURS		15

Third Year - Second Semester

Course Number/Name		*Hours*
MSE 3002	STRUCTURAL TRANSFORMATIONS	3
MSE 3012	THERMAL & TRANSPORT PROPERTIES OF MATERIALS	3
MSE 3020	MATERIALS LAB	3
ECE 3741	INSTRUMENTATION & ELECTRONICS LAB	1
ISYE 3025	ESSENTIALS OF ENGINEERING ECONOMY	3
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

Fourth Year - First Semester

Course Number/Name		*Hours*
MSE 4002	CERAMIC MATERIALS	3
MSE 4004	MATERIALS IN ELECTRONIC APPLICATIONS	3
MSE 4020	DESIGNING WITH MATERIALS I	1
MSE 4777	INTRO. TO POLYMERS	3
SOCIAL SCIENCE ELECTIVE(S)		3
TECHNICAL ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

Fourth Year - Second Semester

Course Number/Name		*Hours*
MSE 4010	ENVIRONMENTAL DEGRADATION	3
MSE 4021	DESIGNING WITH MATERIALS II	2
MSE 4006	PROCESSING & APPLICATIONS OF ENGINEERING ALLOYS	3
TECHNICAL ELECTIVE(S)		3
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		14

TOTAL PROGRAM HOURS = 125 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Electives

Humanities/Fine Arts Electives

This elective is satisfied by completing six hours from the list on pages 35-36.

Social Sciences Electives

To satisfy the state requirements regarding coursework on the history and constitutions of the United States and Georgia, students must complete one of the following courses: HIST 2111, HIST 2112, POL 1101, INTA 1200, or PUBP 3000. This course, along with either ECON 2100, 2105, or 2106, satisfies half of the twelve-hour social science obligation. Six additional hours of social science electives should be selected from the list on pages 35-36.

Technical Electives

Technical electives may be any MSE course that is not required by number or most other engineering, science, or mathematics courses, including those in the following list. Students desiring to use courses not listed here should contact the director of Undergraduate Programs in the School of Materials Science and Engineering for approval.

AE/ME/CE 1770 (2-3-3) Introduction to Engineering Graphics & Visualization
AE 2020 (3-0-3) Low-speed Aerodynamics
AE 2220 (3-0-3) Dynamics
BIOL 1510 (3-3-4) Biological Principles
BIOL 1520 (3-3-4) Introduction to Organismal Biology
BIOL 2334 (3-4-4) Genetics
BMED 1300 (1-6-3) Problems in BME I
BMED 2300 (1-6-3) Problems in BME II
CEE 3020 (2-3-3) Civil Engineering Materials
CEE 3030 (3-0-3) Strength of Materials
CHE 2100 (3-0-3) Chemical Process Principles
CHE 2110 (3-0-3) Chemical Engineering Thermodynamics I
CHEM 2312 (3-0-3) Organic Chemistry II
CHEM 3411 (3-0-3) Physical Chemistry I
CHEM 3412 (3-0-3) Physical Chemistry II
CS 1322 (3-0-3) Object-Oriented Programming
ECE 2025 (3-3-4) Introduction to Signal Processing
ECE 2030 (3-0-3) Introduction to Computer Engineering
ISYE 2027 (3-0-3) Probability with Applications
MATH 2602 (4-0-4) Linear and Discrete Mathematics
ME 2016 (3-0-3) Computing Techniques
ME 2120 (2-3-3) Creative Decisions and Design
ME 2202 (3-0-3) Dynamics of Rigid Bodies
PHYS 2213 (3-0-3) Introduction to Modern Physics
PTFE 2001 (3-0-3) Introduction to Fiber Science

Free Elective

Any course(s), with the exception of courses such as MATH 1113, may be used to satisfy the free elective. Students can strengthen their program of study with an appropriate selection of this elective.

Certificates

The School of Materials Science and Engineering offers certificates in Biomaterials, Composites, and Nanotechnology. Students may fulfill the certificate requirements by taking twelve credit hours* of approved courses. By appropriate choice of technical and free electives, only one course outside of those required for the B.S. M.S.E. degree is required for any certificate. Contact the director of undergraduate programs in MSE or go to **http://www.mse.gatech.edu/academics/**

Certificate_Programs/certificate_programs.html for eligibility requirements and an updated list of approved courses.
*BIOL 1510 is required for the Biomaterials certificate. Since this is a four credit hour course, thirteen hours are required for MSE students to obtain this certificate.

Transfer Students

Students transferring into Materials Science and Engineering from another university or program of study should meet with the director of Undergraduate Programs to discuss possible course substitutions and plan their remaining coursework.

Minor in Materials Science and Engineering

The School of Materials Science and Engineering offers an undergraduate minor in Materials Science and Engineering for non-MSE majors. The purpose of the minor is to broaden the materials background of non-materials science and engineering students and to introduce them to a materials approach to problem solving that is different from that provided by their major.

A requirement for earning a minor in Materials Science and Engineering is to complete eighteen semester hours of MSE coursework, of which twelve semester hours must be at the 3000 level or higher and all of which must be at the 2000 level or higher. Courses required for the major (excluding electives) may not be applied toward the minor. Many students will be able to complete a considerable portion of the minor requirements by scheduling MSE courses as electives required by their major.

Non-MSE undergraduate majors are encouraged to participate in this program provided they have the appropriate prerequisites and approval of their home school academic advisor. To participate or for additional information, contact the director of Undergraduate Programs in the School of Materials Science and Engineering.

Five-Year B.S./M.S. Program

The School of Materials Science and Engineering (MSE) offers a five-year B.S./M.S. program for outstanding students who want to obtain a graduate degree in addition to their B.S. degree. The advanced degree provides the additional knowledge and specialization needed to further facilitate a technical career. As a participant in this program, students have an opportunity to work with individual faculty members on projects in one of the traditional or cutting-edge research areas in MSE. See **www.mse.gatech.edu** for more details.

Graduate Programs

Materials graduates are essential to the economic growth of the country. They contribute to the development, selection, and use of materials in all engineering and scientific applications. Master's and doctoral degrees in materials science and engineering are offered. An excellent selection of undergraduate courses is also offered in preparation and support of graduate studies. Course offerings and research activities cover a diversity of subjects in the broad field of materials. Subjects include computational materials science, physical metallurgy, mechanical properties, fracture mechanics, corrosion phenomena, processing, thermodynamics and phase equilibria, non-destructive testing, X-ray analysis, phase transformations, glass science, electronic/technical ceramics, thin-film semiconductors, electronic and optical microscopy, dispersions and rheology, refractories, surface analysis, fiber science, polymerization reaction engineering, polymer process simulation, mechanical properties of polymers, and process-structure-property characterization of polymers. For a listing of approved polymer courses, also see the listings in the Schools of Chemical Engineering and Polymer, Textile, and Fiber Engineering. State-of-the-art research facilities in the School of Materials Science and Engineering contribute to the strength of the program.

MSE graduates find employment with manufacturing firms in light and heavy industry, in research laboratories of private firms and federal agencies, and in academic institutions. Several recent graduates have filled positions of high responsibility in these areas and have been instrumental in advancing the level of materials engineering practice in the United States. The MSE faculty participate in numerous multidisciplinary programs including manufacturing engineering, surface science technology, microelectronics, electronic packaging, polymers, and composites.

The Master's Degree

MSE offers graduate work leading to the degrees of Master of Science in Materials Science and Engineering, Master of Science in Paper Science and Engineering, and Master of Science with a major in materials engineering. The student admitted for graduate work will normally have completed an undergraduate program in materials, ceramics, metallurgy, or polymers. However, students with undergraduate degrees or backgrounds in other fields (e.g., physics, chemistry, geology, and chemical, mechanical, nuclear, or geological engineering) may qualify by taking certain minimum prerequisites during the early part of their graduate studies. To assure a smooth transition into the graduate program, the student should select appropriate electives during his or her undergraduate studies.

Students in the M.S. program must complete a core of graduate materials courses and prepare an individualized program of study for this degree in consultation with their graduate advisors. The proposed program must receive the approval of the graduate coordinator and the School chair. Thesis, nonthesis, and industrial internship options are available. The minimum credit hour requirements for the M.S. degree include nineteen credit hours of courses and a minimum of eleven credit hours of thesis research, or thirty-one credit hours of courses, or twenty-five hours of courses and six hours of project work conducted as part of an industrial internship. A total of twelve course hours must be in the major, and twelve course hours must be at the 6000 level or higher. A minimum GPA of 3.0 is required for graduation.

The Doctoral Degree

The Doctor of Philosophy degree is directed to attain proficiency in the pursuit of independent scholarly work. The degree comprises coursework in the general principles of materials, with emphasis on metallurgy, polymers, ceramics, paper science and engineering, or electronic materials. Additional requirements include specialized courses both in the area of the doctoral thesis and in one or two other areas, passing comprehensive examinations, and an independent research investigation.

Candidates for the doctoral degree are required to complete at least twenty-two credit hours of graduate-level coursework beyond the M.S. degree, with a minimum GPA of 3.0, and pass the course-based and oral parts of the Ph.D. qualification examination. Each student must also earn nine credit hours in a coherent minor field, chosen in consultation with the advisor, to satisfy the School's core course requirements. Students should commence participation in the School's research programs early in their graduate careers.

Financial Aid

A number of fellowships and research assistantships from outside sources and industry are available to provide financial assistance for qualified graduate students. In addition, a limited number of presidential fellowships, as well as teaching and research assistantships, are available from the Institute. Further information can be obtained by writing the director of graduate programs in the School of Materials Science and Engineering.

Master of Science and Ph.D. in Paper Science and Engineering

The School of Materials Science and Engineering offers a Master of Science and Ph.D. in Paper Science and Engineering. The multidisciplinary degree covers engineering and science disciplines involved in the production of paper, tissue, and other products from natural fiber. Degree requirements include completion of all MSE core courses and degree requirements for the appropriate degree. In addition to satisfying curriculum requirements as set forth in the PSE curriculum, Ph.D. students take the qualifying examination in MSE. Individual programs of study are reviewed at the school level.

Master of Science and Ph.D. in Polymers

The Master of Science in Polymers is offered through the Schools of Materials, Chemical, and Polymer, Textile, and Fiber Engineering. The core course requirements for polymer degrees are the same in each school. This core is designed to provide a balanced treatment of the chemistry, physics, and engineering of polymeric materials. At the same time, the wide range of elective courses and research projects permits students to develop an in-depth knowledge of a particular area of polymer science and engineering. This combination of breadth and depth of study is vital for the successful performance of polymer scientists and engineering graduates.

Master of Science and Ph.D. in Bioengineering

The School of Materials Science and Engineering participates in the interdisciplinary program

leading to a Master of Science and Ph.D. in Bioengineering and Biomedical Engineering. The program curriculum was developed by a broadly based faculty group with research activities in bioengineering and the life sciences. Students in the program are enrolled in a participating school, such as the School of Materials Science and Engineering, as their home department. The program is directed toward engineering graduates who wish to pursue a graduate degree in bioengineering or biomedical engineering rather than in a traditional field of engineering. For more details on the degree requirements for the M.S. and Ph.D. in BME, see page 140.

Minor in Materials Science and Engineering

For qualified Ph.D. students in other programs, a sequence of crosslisted courses in MSE (MSE 6795, 6796, and 6797) is available to introduce non-MSE students to advanced topics covering the broad field of materials. One or more of these courses along with other MSE courses can be used to satisfy the nine-credit-hour Institute minor requirement in other programs. Students wishing to participate in the MSE minor program must check with their advisor in their home school as to the appropriateness of the selected courses.

Multidisciplinary Programs

Materials Science and Engineering students may pursue a certificate within a designated multidisciplinary field in the College of Engineering. This can be facilitated with an appropriate choice of electives. For a complete description of available programs, see page 121.

Mechanical Properties Research Laboratory

The Mechanical Properties Research Laboratory (MPRL) is an interdisciplinary laboratory that supports education and research programs in structural materials. Its principal activities are directed toward the measurement and modeling of the mechanical properties of engineering materials, primarily related to deformation, fatigue, and fracture. Graduate students participating in the MPRL benefit from the association with students and faculty from other departments in the interdisciplinary setting. In its role as an interdisciplinary umbrella organization for experimental research in mechanical properties of materials, MPRL provides a degree of coordination of equipment usage, training, and maintenance with the College of Engineering.

Composites Education and Research Center

The Composites Education and Research Center (CERC) is another interdisciplinary center similar to MPRL, providing students with the opportunity to participate in interdisciplinary coursework and research projects in the area of composites. An undergraduate-level certificate program is available to students of materials science and engineering in composites.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

MATERIALS SCIENCE AND ENGINEERING

MSE 1001. Introduction to Engineering
1-0-1.
A general introduction to engineering. Topics include social, professional, and ethical issues; Georgia Tech's engineering curricula; contemporary issues; engineering design; teamwork; and a description of engineering skills.

MSE 1750. Introduction to Bioengineering
3-0-3.
An introduction to the field of bioengineering, including the application of engineering principles and methods to problems in biology and medicine, the integration of engineering with biology, and the emerging industrial opportunities. Crosslisted with AE, BMED, CHE, ECE, and ME 1750.

MSE 1801, -02, -03. Special Topics
Class and credit hours equal last digit in course number.
Topics of current interest not covered in other courses.

MSE 2001. Principles and Applications of Engineering Materials
3-0-3.
Prerequisite(s): CHEM 1310
The structure-property-processing-performance relationships of engineering materials are described. Materials selection is treated as a part of engineering design.

MSE 2020. Characterization of Materials
3-3-4.
Prerequisite(s): MSE 2001
Understanding of microstructural development in materials and structure quantification by optical and scanning electron microscopy, and crystallography and X-ray diffraction is provided.

MSE 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

MSE 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

MSE 2801, -02, -03. Special Topics
Class and credit hours equal last digit in course number.
Topics of current interest not covered in other courses.

MSE 3000. Chemical Thermodynamics of Materials
3-2-4.
Prerequisite(s): MSE 2001 and (MATH 2413 or MATH 2433 or MATH 2602 or MATH 2403)
Principles and applications of thermodynamics to materials science and engineering. Phase equilibria and the concepts necessary to intrepret phase diagrams.

MSE 3002. Structural Transformations in Metallic, Ceramic, and Polymeric Systems
3-0-3.
Prerequisite(s): MSE 3000
Principles that govern the important structural transformations that occur in engineering materials.

MSE 3005. Mechanical Behavior of Materials
3-0-3.
Prerequisite(s): MSE 2001 and (ME 2211 or AE 2120)
The correlation of mechanical properties with atomic bonding, microstructure, and micromechanics, for applications relevant to materials selection and design, mechanical forming, and failure of materials.

MSE 3012. Thermal and Transport Properties of Materials
3-0-3.
Prerequisite(s): PHYS 2212 and MSE 2001
The thermophysical and transport properties of solids and fluids, i.e. heat capacity, expansion, viscosity, conduction, convection, and radiation are discussed, along with thermal analysis instrumentation.

MSE 3015. Electrical, Optical, and Magnetic Properties
3-0-3
Prerequisite(s): MSE 2001
Introduction to quantum mechanics and the band theory of solids to describe semiconducting, superconducting, dielectric, optical, and magnetic properties of nano- and micro-structured materials.

MSE 3020. Materials Laboratory
1-6-3
Prerequisite(s): MSE 2001
Fundamental principles of materials demonstrated in hands-on and demonstration experiments. Instruction on basic laboratory skills, safety, and proper technical report writing.

MSE 3801, -02, -03. Special Topics
Class and credit hours equal last digit in course number.
Topics of current interest not covered in other courses.

MSE 4002. Ceramic Materials: Properties, Processing, Applications
3-0-3.
Prerequisite(s): MSE 3002
Properties, processing, and applications of the industrially and technically important ceramic materials. Traditional and oxide ceramics in addition to glass and nonoxide ceramics.

MSE 4004. Materials in Electronic Applications
3-0-3.
Prerequisite(s): MSE 3015
Basics of photolithography, screen printing, and tape casting. Requirements for fuel cells, magnetic nanocomposites, flat-panel displays, gas sensors, piezoelectric actuators, photonic crystals, etc.

MSE 4006. Processing and Applications of Engineering Alloys
3-0-3.
Prerequisite(s): MSE 2020 and MSE 3002
Solidification, deformation, and powder processing of metals and alloy; microstructural design at nano- and meso-length scales; and structure-property correlations.

MSE 4010. Environmental Degradation
3-0-3.
Prerequisite(s): MSE 2001
Theory of environmental degradation of metals, ceramics, polymers, and biomaterials. Emphasis on the scientific principles of corrosion and physical degradation.

MSE 4020. Designing with Materials I
1-0-1.
Introduction to principles of engineering design with emphasis on materials. Topics covered also include professional ethics and contemporary socio-political issues.

MSE 4021. Designing with Materials II
0-6-2.
Prerequisite(s): MSE 4020
A team-oriented, interdisciplinary course that emphasizes creativity in solving industrial-based problems. The design solutions developed must be demonstrated by feasibility testing, which highlights this capstone design experience.

MSE 4315. Nondestructive Evaluation
3-0-3.
Prerequisite(s): CHEM 1310 and PHYS 2212
Principles and theory of industrial nondestructive evaluation methods are covered. Emphasis is on testing the soundness and reliability of primary and secondary engineering structures.

MSE 4320. Electronic Packaging and Design
3-0-3.
Prerequisite(s): MSE 2001
Electronic packaging design, covering properties of materials, fabrication and assembly processes, thermal-mechanical considerations, practical concerns regarding interconnection and processing issues, and reliability assessment.

MSE 4325. Thin-Film Materials Science
3-0-3.
Prerequisite(s): MSE 2001
Introduction to principal vapor deposition processes and vacuum technology. The fundamentals of the formation, characterization, and properties of inorganic nano- to micro-scale thin films.

MSE 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

MSE 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

MSE 4754. Electronics Packaging Assembly, Reliability, Thermal Management, and Test
1-6-3.
Prerequisite(s): ECE 3040 or ECE 3710
The course provides hands-on instruction in electronics packaging, including assembly, reliability, thermal management, and test of next-generation microsystems. Crosslisted with ECE and ME 4754.

MSE 4755. Electronic Packaging Substrate Fabrication
1-6-3.
Prerequisite(s): MATH 2401 and MATH 2403 and CHEM 1211 and PHYS 2212
This course provides students with hands-on instruction in basic SOP concepts and techniques, including interconnect design, substrate material selection and properties, photodielectric deposition, via formation and photolithography, copper metalization, and finally, substrate testing. Laboratory instructions are augmented by an interactive multimedia educational presentation that makes the coursework material remotely accessible via the internet.

MSE 4775. Polymer Science and Engineering I: Formation and Properties
3-0-3.
Prerequisite(s): CHEM 2312 and CHEM 3411
An introduction to the chemistry, structure, and formation of polymers, physical states and transitions, physical and mechanical properties of polymer fluids and solids. Crosslisted with CHE, CHEM, ME, and PTFE 4775.

MSE 4776. Polymer Science and Engineering II: Analysis, Processing, and Laboratory
2-3-3.
Prerequisite(s): CHBE 4775 or CHEM 4775 or ME 4775 or PTFE 4775
Polymer fabrication processes and methods of characterization and identification of polymers are presented. Experiments in polymerization, processing, and property evaluation of polymers. Crosslisted with CHE, CHEM, ME, and TFE 4776.

MSE 4777. Introduction to Polymer Science and Engineering
3-0-3.
Prerequisite(s): MSE 2001 and CHEM 2311
An introduction to the structure and formation of polymers, physical states and transitions, physical and mechanical properties of polymer fluids and solids, and processing of polymers. Crosslisted with ME and PTFE 4777.

MSE 4791. Mechanical Behavior of Composites
3-0-3.
Prerequisite(s): MSE 3005
Introduction to properties and structures of common matrix and reinforcing materials, mechanics of fiber-reinforced composites, lamina and laminate analysis, and mechanical performance. Crosslisted with AE, CEE, CHE, ME, and PTFE 4791.

MSE 4793. Composite Materials and Processing
3-0-3.
Prerequisite(s): CHEM 1310 and PHYS 2212
Basic principles of selecting component materials and manufacturing composites are presented. Polymeric, metallic, and ceramic systems are considered. Crosslisted with AE, CEE, CHE, ME, and PTFE 4793.

MSE 4794. Composite Materials and Manufacturing
3-3-4.
Basic principles of selection and design of composite materials and their manufacturing and testing. Cost factors. Laboratory exercises on manufacturing and tests. Crosslisted with AE, CEE, CHE, ME, and PTFE 4794.

MSE 4801, -02, -03. Special Topics
Class and credit hours equal last digit in course number.

MSE 4901, -02. Special Problems
Credit hours to be arranged.

MSE 6001. Written and Visual Communications
2-0-2.
Writing and editing engineering documents; designing and explaining visuals; creating electronic presentations. May not be used for duplicate credit with MSE 6754.

MSE 6010. Fundamentals of Functional Materials
3-0-3.
This course focuses on the effects of defects on physical properties; charge/mass transport; semiconductors, heterojunctions, electrical and magnetic polarization, interaction processes between various physical properties; electrical characterization techniques.

MSE 6105. Diffraction Studies
2-3-3.
Principles and theory of crystallography and diffraction analysis of materials are covered, emphasizing X-ray diffraction, including electron diffraction and diffraction-based imaging. Reciprocal lattice concepts are emphasized.

MSE 6110. Transmission Electron Microscopy
3-0-3.
Prerequisite(s): MSE 2020
Introduction to the kinematical electron scattering theory, optics in TEM, diffraction contrast imaging of defects, dynamical electron diffraction effects; and chemical microanalysis using EDS.

MSE 6120. Quantitative Characterization of Microstructures
2-3-3.
Application of statistically unbiased methods for estimating geometrical attributes of microstructures and nonplanar fracture surfaces from plane sections and projections, digital image analysis, and computer simulations of microstructures.

MSE 6130. Surface Analysis
3-0-3.
Introduction to vacuum science and technology; structure of solid surfaces; electron and ion energy analyzers, electron spectroscopies (e.g., AES and XPS); ion-based techniques (e.g., SIMS and RBS); depth profiling; ion channeling.

MSE 6210. Defects
3-0-3.
Emphasis on the origin and character of point, line, and surface defects in crystalline materials and their influence on mechanical, chemical, magnetic, optical, and electronic properties.

MSE 6310. Thermodynamics and Kinetics of Transformations
3-0-3.
Prerequisite(s): MSE 3002
Classical thermodynamics and phase equilibria with applications to chemical reactions, control of phase transformations via reduction of chemical-free energy, strain energy, and interfacial energy.

MSE 6510. Polymers for Electronic and Photonic Applications I
3-0-3.
Review of fundamentals and principles of polymers used in electronics and photonics; relationships between the advances of semiconductor technology and the importance of polymers and their applications.

MSE 6610. Biomaterials
2-0-2.
The course will emphasize the interaction between the human body environment and synthetic materials. Materials for both medical implants and dental restoration and appliances will be covered.

MSE 6620. Advanced Corrosion
3-3-3
Prerequisite(s): MSE 4010
The emphasis will be on electrochemical corrosion and dry oxidation of metals and alloys. In the laboratory, the student will be introduced to the methodology of corrosion testing.

MSE 6751. Physical Chemistry of Polymer Solutions
3-0-3.
Prerequisite(s): (CHBE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or PTFE 4775) or (ME 4777 or MSE 4777 or PTFE 4777)
Study of polymer solutions, polymer miscibility, adsorption, sorptions, plasticization, molecular weights, molecular weight distribution, and interfacial phenomena using thermodynamics and statistical mechanics. Crosslisted with CHEM, CHE, and PTFE 6751.

MSE 6752. Polymer Characterization
3-3-4.
Prerequisite(s): (CHBE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or PTFE 4775) or (ME 4777 or MSE 4777 or PTFE 4777)
This course introduces the student to surface, near-surface, and structural methods of polymer characterization. Specialized techniques critical to physical structure are emphasized. Crosslisted with CHEM, CHE, and PTFE 6752.

MSE 6754. Engineering Communication
3-0-3.
Writing and editing engineering documents; designing and explaining visuals; creating and delivering electronic presentations. Crosslisted with CEE 6754.

MSE 6755. Theoretical Chemistry of Polymers
3-0-3.
Prerequisite(s): CHEM 6471 and (CHBE 6751 or CHEM 6751 or MSE 6751 or PTFE 6751)
Thermodynamics and microscopic dynamics of polymers. Fundamental concepts, including scaling concepts, governing anisotropy of polarizability, phase transitions, morphology, time-dependent correlations, etc. are discussed. Crosslisted with CHEM and PTFE 6755.

MSE 6759. Materials in Environmentally Conscious Design and Manufacturing
3-0-3.
Covers the environmental impact of materials choices and quantitative measure of life-cycle assessment and environmental burden. The Natural Step philosophy will be used as a model for the overall approach. Crosslisted with ME and PTFE 6759.

MSE 6768. Polymer Structure, Physical Properties, and Characterization
3-0-3.
Prerequisite(s): CHBE 4776 or CHEM 4776 or ME 4776 or MSE 4776 or PTFE 4776
Formulations and analysis of molecular and phenomenological models of elastic and viscoelastic behavior, development and description of structure, and fundamental aspects of structure-property relations. Crosslisted with TPE, CHE, and ME 6768.

MSE 6774. Biomaterials: Structure and Function
3-0-3.
Structure-function relationships of biomaterials and biomaterial characterization will be covered. Materials for medical implants, tissue engineering, biosensing, imaging, and drug delivery will be covered. Crosslisted with BMED, CHE, and ME 6774.

MSE 6776. Integrated Low-Cost Microelectronics Systems Packaging
3-0-3.
Broad overview of system-level, cross-disciplinary microelectronics packaging technologies, including design, test, thermal, reliability, optoelectronics, and RF integration. Comparison of system-to-chip and system-to-package. Crosslisted with ECE and ME 6776.

MSE 6777. Advanced Biomaterials
3-0-3.
Prerequisite(s): BMED 6776 or CHBE 6776 or ME 6776 or MSE 6776 or PTFE 6776
Advanced topics of biomaterials performance and engineering, including biointerfaces, host reactions to materials, and bio-inspired/smart-materials strategies. Crosslisted with BMED, CHE, and ME 6777.

MSE 6795. Mathematical, Statistical, and Computational Techniques in Materials Science
3-0-3.
Fundamental physical, analytical, and mathematical techniques encountered in materials engineering including stress and strain, crystallographic and orientation transformations, X-ray, TEM, and solid-state concepts are emphasized. Crosslisted with ME and PTFE 6795.

MSE 6796. Structure-Property Relationships in Materials
3-0-3.
Introduction to the multi-scale structure effects on material properties. Course will prepare students for future in-depth courses. Crosslisted with PTFE and ME 6796.

MSE 6797. Thermodynamics and Kinetics of Microstructural Evolution
3-0-3.
The reduction of chemical-free, strain, and interfacial energies control of the kinetics of diffusional transformations. These factors are explored from the viewpoint of processing and stability of microstructure during service. Crosslisted with PTFE and ME 6797.

MSE 7000. Master's Thesis
Credit hours to be arranged.

MSE 7010. Electroceramics
3-0-3.
Prerequisite(s): MSE 6010
Defects chemistry; electrochemical and electrophysical behavior of metallic/semiconducting ceramics, dielectrics, and ferrites; device applications of various electronic ceramics.

MSE 7110. Advanced Transmission Electron Microscopy
3-0-3.
Prerequisite(s): MSE 6110
Introduction to theory, techniques, and applications of high-resolution transmission electron microscopy (HRTEM) in materials research.

MSE 7140. Impedance and Dielectric Spectroscopy
3-0-3.
Prerequisite(s): MSE 6010
The basic theory of how current, voltage, and phase angle measurements over a wide frequency range (typically mHz-MHz) can provide information about microstructural features at all length scales.

MSE 7210. Dislocation and Deformation Mechanics
3-0-3.
Prerequisite(s): MSE 6210
Emphasis on interactions of dislocations with other defects, dislocation dynamics, and their correlation with mechanical properties under different rates of loading.

MSE 7420. Solidification Processing
3-0-3.
Prerequisite(s): MSE 6310
Fundamentals of thermodynamics, kinetics, mass transport, and physical materials are applied to the development of microstructure during solidification.

MSE 7510. Polymers for Electronic and Photonic Applications II
3-0-3.
Prerequisite(s): MSE 6510
Review of fundamentals and principles of polymers used in electronics and photonics. The relationship between the recent advances of semiconductor technology and the importance of polymers will be discussed.

MSE 7771. Mechanics of Polymer Solids and Fluids
3-0-3.
Prerequisite(s): MSE 4777 and MSE 6768
Continuum mechanics of solids and fluids; mechanics of deformation of anisotropic polymers; yield, breaking and fatigue; non-Newtonian viscous and viscoelastic behavior of polymer fluids. Crosslisted with CHE, ME, and PTFE 7771.

MSE 7772. Fundamentals of Fracture Mechanics
3-0-3.
Prerequisite(s): ME 3201 or MSE 3005
Advanced study of failure of structural materials under load; mechanics of fracture, and microscopic and macroscopic aspects of the fracture of engineering materials. Crosslisted with AE, CEE, CHE, and ME 7772.

MSE 7773. Advanced Fracture Mechanics
3-0-3.
Prerequisite(s): AE 7772 or CEE 7772 or CHBE 7772 or ME 7772 or MSE 7772
Nonlinear fracture mechanics including elastic-plastic and time-dependent fracture, advanced test methods, J-integral theory, and extensions. Crosslisted with AE, CEE, CHE, and ME 7773.

MSE 7774. Fatigue of Materials and Structures
3-0-3.
Prerequisite(s): AE 7772 or CEE 7772 or CHBE 7772 or ME 7772 or MSE 7772
Mechanical and microstructural aspects of nucleation and growth of cracks under cyclic loading conditions, notch effect, cumulative damage, multiaxial loading, and fatigue crack propagation. Crosslisted with AE, CEE, CHE, and ME 7774.

MSE 7775. Topics in Fracture and Fatigue of Metallic and Composite Structures
3-0-3.
Prerequisite(s): ME 2211 or AE 2120
Brittle and ductile failure criteria. Failure prediction in composite structures. Free-edge and internal delamination. Anisotropic cracks. Fatigue behavior of composites and comparison with metal fatigue. Crosslisted with AE, CHE, and ME 7775.

MSE 7791. Damage, Failure, and Durability of Composite Material
3-0-3.
Prerequisite(s): AE 4791 or CEE 4791 or CHBE 4791 or ME 4791 or MSE 4791
Analysis and failure of fiber-reinforced composite material systems. Mechanisms of toughening, multiple cracking mechanisms. Failure in woven fabric, braided, and special geometry composites. Crosslisted with AE, CHE, CEE, ME, and PTFE 7791.

MSE 7792. Advanced Mechanics of Composites
3-0-3.
Prerequisite(s): AE 4791 or CEE 4791 or CHBE 4791 or ME 4791 or MSE 4791 or PTFE 4791
Anisotropic elasticity, hygrothermal behavior, stress analysis of laminated composites including 3-D effects, stress concentrations, free-edge effects, thick laminates, adhesive and mechanical connections, fracture of composites. Crosslisted with AE, CHE, CEE, ME, and PTFE 7792.

MSE 7793. Manufacturing of Composites
3-0-3.
Prerequisite(s): AE 4793 or CEE 4793 or CHBE 4793 or ME 4793 or MSE 4793 or PTFE 4793
Major manufacturing techniques for metal, ceramic, and polymer composites. Modeling of processes with emphasis on fundamental mechanisms and effects. Crosslisted with AE, CHE, CEE, ME, and PTFE 7793.

MSE 8001. Seminar
1-0-1
The latest advances in research and development will be presented by the enrolled students from articles in recent issues of recognized periodicals.

MSE 8801, -02, -03. Special Topics
Class and credit hours equal last digit in course number.
Special topic offerings of current interest not included in regular courses.

MSE 8901, -02, -03. Special Problems
Credit hours to be arranged.
Lectures, laboratory, and library work on special topics of current interest in materials suitable for a master's degree candidate.

MSE 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding teaching assistantships.

MSE 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding a research assistantship.

MSE 9000. Doctoral Thesis
Credit hours to be arranged.

Woodruff School of Mechanical Engineering

www.me.gatech.edu

Established in 1885
Location: Manufacturing Related Disciplines Complex (MRDC)
Telephone: 404.894.3200 (Administrative Office)
404.894.3203 (Undergraduate Office)
404.894.3204 (Graduate Office)
Fax: 404.385.4545
E-mail: information@me.gatech.edu

Chair, Eugene C. Gwaltney Jr. School Chair and Regents' Professor–Ward O. Winer; *Associate Chair for Graduate Studies and John M. McKenney and Warren D. Shiver Distinguished Chair in Building Mechanical Systems*–Yogendra Joshi; *Associate Chair for Administration and Associate Professor*–Christopher S. Lynch; *Associate School Chair, Chair of the Nuclear and Radiological Engineering/Medical Physics Program, and Professor*–Farzad Rahnema; *Associate Chair for Undergraduate Studies and Senior Academic Professional*–David M. Sanborn; *Southern Nuclear Distinguished Professor*–Said Abdel-Khalik; *HUSCO/Ramirez Chair in Fluid Power and Motion Control*–Wayne J. Book; *Morris M. Bryan Jr. Chair in Mechanical Engineering for Advanced Manufacturing Systems*–Steven Danyluk; *George W. Woodruff Chair in Mechanical Systems*–Jerry H. Ginsberg; *George W. Woodruff Chair in Thermal Systems*–Ari Glezer; *Lawrence P. Huang Endowed Chair in Engineering and Entrepreneurship*–David N. Ku; *Morris M. Bryan Jr. Professor in Mechanical Engineering*–Steven Y. Liang; *Carter N. Paden Distinguished Chair in Metals Processing*–David L. McDowell; *Parker H. Petit Distinguished Chair for Engineering in Medicine*–Robert M. Nerem; *Rae and Frank H.*

Neely Chair in Mechanical Engineering–Peter H. Rogers; *Georgia Power Distinguished Professor in Mechanical Engineering*–Richard F. Salant; *Fuller E. Callaway Professor in Nuclear Engineering*–Weston M. Stacey Jr.; *David S. Lewis Chair in Aerospace Engineering*–Ben T. Zinn. *Regents' Professor*–Ajit P. Yoganathan. *Professors*–Frederick W. Ahrens, Cyrus K. Aidun, Yves H. Berthelot, Bert Bras, Ye-Hwa Chen, Mohammed Cherkaoui, Jonathan S. Colton, J. Karl Davidson, Cassiano de Oliveira, Srinivas Garimella, S. Mostafa Ghiaasiaan, James L. Gole, Itzhak Green, Nolan E. Hertel, Peter J. Hesketh, Laurence J. Jacobs, W. Steven Johnson, Thomas R. Kurfess, Kok-Meng Lee, Farrokh Mistree, G. Paul Neitzel, David Orloff, David Parekh, Jianmin Qu, David W. Rosen, Suresh K. Sitaraman, Marc K. Smith, I. Charles Ume, Raymond P. Vito, William J. Wepfer, Timothy M. Wick, Cheng Zhu. *Associate Professors*–Daniel F. Baldwin, Kenneth A. Cunefare, Imme Ebert-Uphoff, Aldo A. Ferri, Andrés J. García, Robert E. Guldberg, Karl Jacob, Sheldon M. Jeter, Jens O. M. Karlsson, Marc E. Levenston, Harvey Lipkin, Shreyes N. Melkote, Richard W. Neu, John G. Papastavridis, Nader Sadegh, Samuel V. Shelton, Fotis Sotiropoulos, Jeffrey L. Streator, C-K. Chris Wang, Minami Yoda, Zhuomin Zhang, Min Zhou. *Assistant Professors*–E. Levent Degertekin, Andrei G. Fedorov, Samuel Graham, William P. King, Chris Paredis, Timothy Patterson, William E. Singhose, Wenjing Ye.

General Information

Mechanical engineering (ME) was the first academic program established at Georgia Tech. On September 20, 1985, the School of Mechanical Engineering celebrated its centennial by assuming the name of one of its most distinguished alumni. Atlanta businessman and philanthropist George W. Woodruff (Class of 1917). Today, the Woodruff School offers undergraduate and graduate degrees in mechanical engineering, nuclear and radiological engineering, medical physics, bioengineering, and paper science.

Mechanical engineering traditionally deals with diverse engineering problems. Because of its general nature, mechanical engineering encourages a number of multidisciplinary activities to be conveniently organized within it. Mechanical engineering embraces the generation, conversion, transmission, and utilization of thermal and mechanical energy; the design and production of tools and machines and their products; the consideration of fundamental characteristics of materials as applied to design; and the synthesis and analysis of mechanical, thermal, and fluid systems including the automation of such systems. Design, production, manufacture, operation, administration, economics, and research are functional aspects of mechanical engineering.

Nuclear and radiological engineering provides graduates with the professional flexibility to work in either nuclear power generation, radiation protection, or in non-power professions that use nuclear and radiation technology.

Nuclear engineering concerns the release, control, utilization, and environmental impact of energy from nuclear fission and fusion sources.

Radiological engineering combines a knowledge of radiation physics and engineering fundamentals to design and analyze radiation sources and detection instruments, to measure dosage, to design protective shielding, and to handle radioactive materials.

Medical physics involves the application of physical principles to medicine, particularly in the diagnosis and treatment of human diseases. Medical physics includes diagnostic radiology, the diagnosis of disease with X-rays, ultrasound, and magnetic resonance imaging; health physics, the study of radiation hazards and radiation protection; nuclear medicine, the diagnosis and treatment of diseases with injected radio-pharmaceuticals; and radiation oncology, the treatment of cancer by ionizing radiation.

School Facilities

The Woodruff School is housed in a multibuilding classroom/research complex. Included in this complex are modern classroom/seminar conference rooms that serve the entire Institute. The School has many types of specialized instruments and other equipment associated with its laboratories in mechanical engineering for the study of acoustics and dynamics; automation and mechatronics; bioengineering; computer-aided engineering and design; fluid mechanics; heat transfer, combustion, and energy systems; manufacturing; mechanics of materials; microelectromechanical systems; and tribology. The Nuclear and Radiological Engineering Program has special facilities for the study of fission, fusion, and medical physics.

Special facilities in the Woodruff School include laboratories dedicated to undergraduate use; the Integrated Acoustic Laboratory (anechoic chamber); a hi-bay area for research and testing; an underwater acoustic tank; a wind tunnel; and a clean room for MEMS fabrication. Laboratories include: Computer-Aided Simulation of Packaging Reliability Lab, Dynamics Properties Research Lab, Fluid Mechanics Research Laboratories, Composites Manufacturing Research Lab, Intelligent Machine Dynamics Laboratory, Mechanical Properties Research Lab, Precision Machining Research Consortium, Systems Realization Laboratory, Sustainable Thermal Systems Laboratory, and the Vascular and Biofluids Laboratory.

The facilities available for the nuclear engineering program include the Neely Research Center, which houses graphite subcritical assemblies, more than 120,000 curies of cobalt-60, a californium-252 source for use in neutron dosimetry studies, hot cells for handling radioactive materials, a complete nuclear instrumentation laboratory, nuclear radiography equipment, radiochemical laboratories, and facilities for analyzing environmental samples by nuclear techniques.

Undergraduate Programs

Program Educational Objectives

The educational objectives of the undergraduate programs in the Woodruff School are:

- to prepare students for successful careers and lifelong learning;
- to train students thoroughly in methods of analysis, including the mathematical and computational skills appropriate for engineers to use when solving problems;
- to develop the skills pertinent to the design process, including the students' ability to formulate problems, to think creatively, to communicate effectively, to synthesize information, and to work collaboratively;
- to teach students to use current experimental and data analysis techniques for engineering applications; and
- to instill in our students an understanding of their professional and ethical responsibilities.

The undergraduate curriculum in mechanical engineering covers the fundamental aspects of the field, emphasizes basic principles, and educates the student in the use of these principles to reach optimal design solutions for engineering problems. Specific design subject matter and materials are also drawn from engineering activities such as biomechanical systems, as well as from the more traditional areas. Emphasis in the freshman and sophomore years is on mathematics, chemistry, physics, mechanics of materials, applied mechanics, graphic communications, and an introduction to design. The junior and senior years are devoted to thermodynamics, heat transfer, fluid mechanics, systems and controls, design, manufacturing, and the application of fundamentals to the diverse problems of mechanical engineering. The curriculum stresses laboratory work and design projects. Computer skills developed during the first two years are a prerequisite for junior- and senior-level courses. Satisfactory completion of the curriculum leads to the degree Bachelor of Science in Mechanical Engineering (B.S.M.E.).

In addition to the Institute's academic requirements for graduation with a bachelor's degree, the following are required for a B.S.M.E. degree:

- A grade of *C* or better must be earned in MATH 1501, MATH 1502, MATH 2401, and MATH 2403
- The aggregate GPA of all mechanical engineering classes must be a 2.0 or higher

The undergraduate curriculum in nuclear and radiological engineering is structured to meet the needs of both the student who contemplates employment immediately after graduation and the student planning to pursue graduate study. It provides maximum flexibility in the form of options for each student to develop his or her unique interests and capabilities. The core curriculum covers the basic principles of nuclear engineering, nuclear reactor core design, reactor systems engineering, nuclear power economics, reactor operations, radiation sources and detection instruments, radiation transport, radiation protection, critical safety, regulatory requirements, and radioactive materials management.

In addition to the Institute's academic requirements for graduation with a bachelor's degree, the following are required for a B.S.N.R.E degree.

- A grade of *C* or better must be earned in MATH 1501, MATH 1502, MATH 2401, MATH 2403, and ISYE/MATH 3770
- The aggregate GPA of all NRE classes must be a 2.0 or higher

Bachelor of Science in Mechanical Engineering (Suggested Schedule)

First Year - First Semester

Course Number/Name		Hours
MATH 1501	CALCULUS I	4
ENGL 1101	ENGLISH COMPOSITION I	3
CHEM 1310	GENERAL CHEMISTRY I	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
WELLNESS		2
TOTAL SEMESTER HOURS		16

First Year - Second Semester

Course Number/Name		Hours
MATH 1502	CALCULUS II	4
ENGL 1102	ENGLISH COMPOSITION II	3
PHYS 2211	INTRODUCTORY PHYSICS I	4
CS 1371	COMPUTING FOR ENGINEERS	3
ME 1770	ENGINEERING GRAPHICS & VISUALIZATION	3
TOTAL SEMESTER HOURS		17

Second Year - First Semester

Course Number/Name		Hours
MATH 2401	CALCULUS III	4
PHYS 2212	INTRODUCTORY PHYSICS II	4
ME 2211	INTRO. TO MECHANICS	3
ME 2016	COMPUTING TECHNIQUES	3
ME 2110	CREATIVE DECISIONS & DESIGN	3
TOTAL SEMESTER HOURS		17

Second Year - Second Semester

Course Number/Name		Hours
MATH 2403	DIFFERENTIAL EQUATIONS	4
ME 2202	DYNAMICS OF RIGID BODIES	3
MSE 2001	PRINCIPLES & APPLICATIONS OF ENGINEERING MATERIALS	3
LAB SCIENCE ELECTIVE (BIOL, CHEM, EAS, PHYS)		3
ECE 3710	CIRCUITS & ELECTRONICS	2
TOTAL SEMESTER HOURS		15

Third Year - First Semester

Course Number/Name		Hours
ME 3015	SYSTEM DYNAMICS & CONTROL	4
ME 3322	THERMODYNAMICS	3
ME 3340	FLUID MECHANICS	3
ME 3201	MECHANICS OF MATERIALS	3
ECON 2100 or 2105 or 2106		3
ECE 3741	INSTRUMENTATION & ELECTRONICS LAB	1
TOTAL SEMESTER HOURS		17

Third Year - Second Semester

Course Number/Name		Hours
ME 3056	EXPERIMENTAL METHODOLOGY LAB	2
ME 3345	HEAT TRANSFER	3
ME 3180	MACHINE DESIGN	3
ECE 3301	ENERGY CONVERSION & MECHATRONICS	2
ISYE 3025	ESSENTIALS OF ENGINEERING ECONOMY	1
CEE/MATH/ISYE 3770	STATISTICS & APPLICATIONS	3
TOTAL SEMESTER HOURS		14

Fourth Year - First Semester

Course Number/Name		Hours
ME 4053	MECHANICAL ENGINEERING SYSTEMS LAB	2
ME 4315	ENERGY SYSTEMS ANALYSIS & DESIGN	3
ME 4210	MANUFACTURING PROCESSES & ENGINEERING	3
ETHICS ELECTIVE(S)		3
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		14

Fourth Year - Second Semester

Course Number/Name		Hours
ME 4055	EXPERIMENTAL ENGINEERING	1
ME 4182	CAPSTONE DESIGN	3
HUMANITIES ELECTIVE(S)		3
TECHNICAL ELECTIVES(S)		6
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

TOTAL PROGRAM HOURS = 124 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Mechanical Engineering Electives

Humanities and Social Sciences

A total of twelve credit hours of humanities and twelve credit hours of social sciences are required. Modern languages are considered humanities electives.

The twelve hours of humanities are comprised of six hours of English composition classes and six hours of electives. The English composition classes are satisfied by ENG 1101 and ENG 1102 (English Composition 1 and 2).

The twelve hours of social sciences include

three hours of economics, three hours of work in history and the constitutions of the United States and Georgia and six hours of social science electives. The three hours of economics is satisfied by either ECON 2100 (Economic Analysis and Policy Problems), ECON 2105 (Principles of Macroeconomics), or ECON 2106 (Principles of Microeconomics). The three hours of history and constitutions are satisfied by selecting one of the following courses: HIST 2111 (The United States to 1877), HIST 2112 (The United States Since 1877), POL 1101 (Government of the United States), PUBP 3000 (American Constitutional Issues), or INTA 1200 (American Government in Comparative Perspective).

The six hours of social science electives and the six hours of humanities electives must include three hours of ethics. The ethics class can be selected from PST 3127 (Science, Technology, and Human Values), PST 3105 (Ethical Theories), PST 3109 (Ethics for Technical Professions), PST 4176 (Environmental Ethics), INTA 2030 (Ethics in International Affairs), or HTS 2084 (Technology and Society). The PST ethics courses are humanities electives, while the INTA and HTS ethics courses are social science electives. The remaining hours of social science electives and humanities electives must be selected from a list of core curriculum classes on pages 35-36.

Free Electives

No free electives are required for graduation.

Technical Electives

Technical electives may be any 3000- or 4000-level course in the Colleges of Engineering, Sciences, or Computing. This excludes psychology (PSYC) and applied physiology (APPH) classes. ME courses at the 6000 level may also be scheduled, provided the student has a grade point average of 3.0 or higher and prior consent is obtained from the instructor.

A student completing his or her sophomore year with a grade point average of 2.5 or higher may elect one technical elective for a maximum of four credit hours from the Design Special Problems course, ME 4903 or the Research Special Problem Design course, ME 4699.

Science Electives

The three-hour science elective may be satisfied by classes from the following list: CHEM 1311 (Inorganic Chemistry) and CHEM 1312 (Inorganic Chemistry Lab) taken together, or one of the following: BIOL 1510 (Biology Principles), BIOL 1520 (Introduction to Organismal Biology), EAS 1600 (Introduction to Environmental Science), EAS 1601 (Habitable Planet), or PHYS 2213 (Modern Physics).

Bachelor of Science in Nuclear and Radiological Engineering (Suggested Schedule)

First Year - First Semester

Course Number/Name		Hours
MATH 1501	CALCULUS I	4
ENGL 1101	ENGLISH COMPOSITION I	3
CHEM 1310	GENERAL CHEMISTRY I	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
WELLNESS		2
TOTAL SEMESTER HOURS		16

First Year - Second Semester

Course Number/Name		Hours
MATH 1502	CALCULUS II	4
ENGL 1102	ENGLISH COMPOSITION II	3
PHYS 2211	INTRODUCTORY PHYSICS I	4
CS 1371	COMPUTING FOR ENGINEERS	3
NRE 2110	INTRO. TO NUCLEAR & RADIOLOGICAL ENGINEERING	2
TOTAL SEMESTER HOURS		16

Second Year - First Semester

Course Number/Name		Hours
MATH 2401	CALCULUS III	4
PHYS 2212	INTRODUCTORY PHYSICS II	4
ME 2211	INTRO. TO MECHANICS	3
ECON 2100 or 2105 or 2106		3
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Second Year - Second Semester

Course Number/Name		Hours
MATH 2403	DIFFERENTIAL EQUATIONS	4
PHYS 2133	INTRO. TO MODERN PHYSICS	4
MSE 2001	PRINCIPLES & APPLICATIONS OF ENGINEERING MATERIALS	3
ECE 3710	CIRCUITS & ELECTRONICS	2
NRE 3212	FUNDAMENTALS OF NUCLEAR & RADIOLOGICAL ENGINEERING	3
TOTAL SEMESTER HOURS		16

Third Year - First Semester

Course Number/Name		*Hours*
NRE 3301	RADIATION PHYSICS	3
ME 3322	THERMODYNAMICS	3
ME 3340	FLUID MECHANICS	3
ECE 3741	INSTRUMENTATION & ELECTRONICS LAB	1
ISYE 3025	ESSENTIALS OF ENGINEERING ECONOMY	1
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		14

Third Year - Second Semester

Course Number/Name		*Hours*
ECE 3301	ENERGY CONVERSION & MECHATRONICS	2
NRE 3316	RADIATION PROTECTION ENGINEERING	3
NRE 3112	NUCLEAR RADIATION DETECTION	3
MATH/ISYE 3770	STATISTICS & APPLICATIONS	3
ME 3345	HEAT TRANSFER	3
ME 3201	MECHANICS OF MATERIALS	3
TOTAL SEMESTER HOURS		17

Fourth Year - First Semester

Course Number/Name		*Hours*
NRE 4214	REACTOR ENGINEERING	3
NRE 4328	RADIATION SOURCES & APPLICATIONS	3
NRE 4204	NUCLEAR REACTOR PHYSICS	4
ETHICS ELECTIVE(S)		3
TECHNICAL ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

Fourth Year - Second Semester

Course Number/Name		*Hours*
SOCIAL SCIENCE ELECTIVE(S)		3
NRE 4232	NUCLEAR & RADIOLOGICAL ENGINEERING DESIGN	4
TECHNICAL ELECTIVE(S)		6
NRE 4206	RADIATION PHYSICS LAB	2
TOTAL SEMESTER HOURS		15

TOTAL PROGRAM HOURS = 124 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Nuclear and Radiological Engineering Electives

Humanities, Social Sciences, and Modern Languages

A total of twelve credit hours of humanities and twelve credit hours of social sciences are required. Modern languages are considered humanities electives.

The twelve hours of humanities are comprised of six hours of English composition classes and six hours of electives. The English composition classes are satisfied by ENG 1101 and 1102 (English Composition 1 and 2).

The twelve hours of social sciences include three hours of economics, three hours of work in history and the constitutions of the United States and Georgia, and six hours of social science electives. The three hours of economics is satisfied by either ECON 2100 (Economic Analysis and Policy Problems), ECON 2105 (Principles of Macroeconomics), or ECON 2106 (Principles of Microeconomics). The three hours of history and constitutions are satisfied by selecting one of the following courses: HIST 2111 (The United States to 1877), HIST 2112 (The United States Since 1877), POL 1101 (Government of the United States), PUBP 3000 (American Constitutional Issues), or INTA 1200 (American Government in Comparative Perspective).

The six hours of social science electives and the six hours of humanities electives must include three hours of ethics. The ethics class can be selected from PST 3127 (Science, Technology, and Human Values), PST 3105 (Ethical Theories), PST 3109 (Ethics for Technical Professions), PST 4176 (Environmental Ethics), INTA 2030 (Ethics in International Affairs), or HTS 2084 (Technology and Society). The PST ethics courses are humanities electives, while the INTA and HTS ethics courses are social science electives. The remaining hours of social science electives and humanities electives must be selected from a list of core curriculum classes on pages 35-36.

Science Elective

No science electives are required.

Free Electives

No free electives are required for graduation.

Technical Electives

Technical electives may be any 3000- or 4000-level course in the Colleges of Engineering, Sciences, or Computing. This excludes psychology (PSYC) and applied physiology (APPH) courses. NRE courses at the 6000 level may also be scheduled, provided the student has a grade point average of 3.0 or higher and prior consent is obtained from the instructor.

A student completing his or her sophomore year with a grade point average of 2.5 or higher may elect one technical elective for a maximum of four credit hours from the Design Special Problem Course, NRE 4903 or the Research Special Problem Course, NRE 4699.

Graduate Programs

Program Educational Objectives

The educational objectives of the doctoral programs in the Woodruff School are:

- to prepare students for successful careers in industry and/or academia and to promote and instill an ethic for lifelong learning;
- to educate students in methods of advanced analysis, including the mathematical, computational, and experimental skills appropriate for professionals to use when solving problems;
- to provide a substantial depth of knowledge in a particular field or subfield of study that allows the student to be recognized as an expert;
- to provide a breadth of knowledge in a minor field of study that fosters an awareness of and skill in interdisciplinary approaches to problem solving;
- to develop the skills pertinent to the research process, including the students' ability to formulate problems, to synthesize and integrate information, to work collaboratively, to communicate effectively, and to publish the results of their research; and
- to promote a sense of scholarship, leadership, and service among our graduates.

The educational objectives of the master's degree programs in the Woodruff School are:

- to prepare students for successful careers in industry and to promote and instill an ethic for lifelong learning;
- to educate students in methods of advanced analysis appropriate for professionals to use when solving problems;
- to provide a depth of knowledge in a particular field of study that allows the student to apply innovative techniques to solve problems;
- to provide a breadth of knowledge that fosters an awareness of and skill in interdisciplinary approaches to problem solving; and
- to develop the skills pertinent to the research process, including the students' ability to formulate problems, to synthesize and integrate information, to work collaboratively, to communicate effectively, and to publish the results of their research (M.S. thesis students).

The graduate program in **mechanical engineering** offers advanced study and research in the areas of acoustics and dynamics; automation and mechatronics; bioengineering; computer-aided engineering and design; fluid mechanics; heat transfer, combustion, and energy systems; manufacturing; mechanics of materials; microelectromechanical systems; and tribology. The graduate programs lead to the degrees of Master of Science in Mechanical Engineering, Master of Science, Master of Science in Bioengineering, Master of Science in Paper Science and Engineering, and Doctor of Philosophy for qualified graduates having backgrounds in engineering, mechanics, mathematics, the physical sciences, or the biological sciences.

The master's degree requires a minimum of thirty approved credit hours. Students may elect to earn nine of these hours by writing a thesis, or they may earn all credit toward the degree through coursework. Six hours of credit for graduate courses taken as an undergraduate at Georgia Tech and used for credit toward the B.S.M.E. may be included in the M.S. program of study if the student graduated with an undergraduate grade point average of at least 3.5. Students must earn a graduate grade point average of at least 3.0 and satisfy all remaining requirements to be certified for the master's degree. Candidates for the Doctor of Philosophy degree must earn a graduate grade point average of at least 3.3. Students may obtain additional information about the programs by viewing the *Woodruff School Handbook for Graduate Students* at **www.me.gatech.edu/me/academics/graduate**. Every student enrolled must consult this source of information with respect to special rules and degree requirements.

The graduate program in **nuclear and radiological engineering/medical physics** leads to the degrees of Master of Science in Nuclear Engineering, Master of Science in Medical Physics, Master of Science, and Doctor of Philosophy. In nuclear and radiological engineering, students with a bachelor's degree in engineering pursue the Master of Science in Nuclear Engineering degree, while students with a Bachelor of Science degree in other fields enroll for the Master of Science

degree. Depending on the career objectives of the student, the Woodruff School may encourage a thesis as part of the Master of Science program. Nuclear and radiological engineering students must earn a graduate grade point average of at least 3.0 and satisfy all remaining requirements to be certified for the master's degree. The doctoral program is designed with great latitude to capitalize on variations in experience and interests of individual students. Candidates for the Doctor of Philosophy degree must earn a graduate grade point average of at least 3.3.

The graduate program in **medical physics** leads to the degree of Master of Science in Medical Physics (M.S.M.P.). The program focuses on the application of radiation to medicine, particularly in the diagnosis and treatment of human disease. In addition to the traditional on-campus M.S. program, a distance learning program leading to the M.S.M.P. degree is also offered to accommodate the needs of professionals in the field. A large number of medical physics practitioners in government and industry participate in the video-based program.

Three hours of credit for graduate courses taken as an undergraduate at Georgia Tech and used for credit toward an undergraduate degree in science or engineering may also be included in the M.S. medical physics program of study if the student graduated with an undergraduate grade point average of at least 3.5. Medical physics students must earn a graduate grade point average of at least 3.0 and satisfy all remaining requirements to be certified for the master's degree.

Interdisciplinary Bioengineering Program

The Woodruff School participates in Georgia Tech's interdisciplinary bioengineering graduate program, offering both the M.S. and the Ph.D. degrees. The program enrolls students in a participating school (the home school) and upon completion of the degree requirements, the home school (the Woodruff School) recommends the award of the degree. Bioengineering research focuses on the development of new or improved physical and mathematical concepts and techniques that may be applied to problems in medicine and biology, including the development of new medical devices. The curriculum provides the flexibility to concentrate in special areas so that the training is both multidiciplinary and integrated. For more information, see **www.bioengineering.gatech.edu**.

Interdisciplinary Program in Paper Science and Engineering

The Master's (M.S.P.S.) and Ph.D. degrees in Paper Science and Engineering (PSE) provide an education in the science and engineering involved in the production of paper, tissue, and other products from natural fiber. PSE students are enrolled in a participating school (the home school) and, upon completion of the degree requirements, the home school (in this case, the Woodruff School) recommends the award of an M.S. or Ph.D. degree.

Distance Learning Programs

The Woodruff School offers working professionals the opportunity to enroll in many of its graduate courses through video, CD-ROM, or Internet technologies. The distance-learning program has the same admission, course, and degree requirements as those for graduate students attending classes at the Atlanta campus or at Georgia Tech Lorraine. Qualified individuals may complete the requirements for the master's degrees in mechanical engineering (M.S.M.E.) and medical physics (M.S.M.P.) by utilizing the distance-learning mode. See page 19, "Distance Learning and Professional Education."

Dual Degree Program in Management

Through the dual degree program, qualified graduate students wishing to pursue an M.B.A. degree and a graduate degree in mechanical engineering can efficiently earn two graduate degrees in almost the same time it would take to earn the M.B.A. alone. For example, the M.B.A. program is normally sixty hours. For students pursuing a graduate degree in mechanical engineering, the length of the M.B.A. program is reduced to thirty-nine hours, with the area of concentration being the coursework in the mechanical engineering program. Students in the dual degree program take approximately thirty hours of required management core courses, plus nine hours of graduate management electives. Those interested in graduate degrees in management and in mechanical engineering should consult with advisors in the College of Management as well as the Woodruff School, because admissions requirements for both programs must be met.

Georgia Tech Lorraine (GTL)

The Woodruff School participates in Georgia Tech Lorraine (see page 20). The mechanical engineering program offered at GTL, which focuses on the M.S. degree, has the same admission, course, and degree requirements as those for graduate students in mechanical engineering attending classes on the Atlanta campus or through the distance learning mode. Students at GTL are enrolled in an M.S. program in mechanical engineering. Georgia Tech has a cooperative agreement with ENSAM, a leading institution for the study of mechanical and industrial engineering with eight campuses across France, including one in Metz.

The Five-Year B.S./M.S. Program

The Woodruff School offers a five-year B.S./M.S. program for those students who demonstrate an interest in and ability for additional education beyond the B.S. degree. The program fosters intense interaction among students and faculty and includes mentoring and undergraduate research. Careful advising and course planning will enable students to begin graduate coursework in their fourth year of study. Woodruff School students with a GPA of 3.5 or higher are eligible to apply for the program after completion of thirty semester credit hours at Georgia Tech, but before the completion of seventy-five semester credit hours, including transfer and advanced placement credits.

Multidisciplinary Programs

Mechanical engineering students may plan electives that satisfy simultaneously the requirements of the degree program and a designated multidisciplinary field within the College of Engineering, thus earning both a graduate degree and a certificate indicating expertise in a related specialty. For a complete description of these and other multidisciplinary programs, see page 121.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course. An asterisk (*) denotes prerequisite courses that may be taken concurrently. This section includes courses in Mechanical Engineering (ME), Nuclear and Radiological Engineering (NRE), Health Physics (HP), and Medical Physics (MP).

MECHANICAL ENGINEERING

ME 1750. Introduction to Bioengineering
3-0-3.
An introduction to the field of bioengineering, including the application of engineering principles and methods to problems in biology and medicine, the integration of engineering with biology, and the emerging industrial opportunities. Crosslisted with AE, BMED, CHE, ECE, and MSE 1750.

ME 1770. Introduction to Engineering Graphics and Visualization
2-3-3.
Prerequisite(s): MATH 1501* or MATH 15X1 or MATH 1511*
Introduction to engineering graphics and visualization including sketching, line drawing, and solid modeling. Development and interpretation of drawings and specifications for product realization. Crosslisted with AE and CEE 1770.

ME 2016. Computing Techniques
3-0-3.
Prerequisite(s): CS 1321 and (MATH 1502 or MATH 1513) or (MATH 15X2 and MATH 1522)
An introduction to the use of computers and MATLAB programming for the solution of mechanical engineering problems. Topics include: sources of error in computing, the use of modular software design, basic numerical methods, and signal processing.

ME 2110. Creative Decisions and Design
2-3-3.
Prerequisite(s): (AE 1770 or CEE 1770 or ME 1770) and ME 2016* and (AE 2120 or ME 2211*)
To learn fundamental techniques for creating, analyzing, synthesizing, and implementing design solutions to open-ended problems with flexibility, adaptability, and creativity through team and individual efforts.

ME 2202. Dynamics of Rigid Bodies
3-0-3.
Prerequisite(s): ME 2016 and ME 2211
Kinematics and dynamics of particles and rigid bodies in one, two, and three dimensions. Work-energy and impulse-momentum concepts.

ME 2211. Introduction to Mechanics
3-0-3.
Prerequisite(s): (MATH 2401* or MATH 24X1 or MATH 2411*) and PHYS 2211
Forces and moments; equilibrium in two and three dimensions; multiforce members; friction; stress and strain; axially loading; torsion, and bending of beams.

ME 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

ME 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

ME 3015. System Dynamics and Control
4-0-4.
Prerequisite(s): (MATH 2403 or MATH 24X3 or MATH 2413) and ME 2202 and ECE 3741*
Dynamic modeling and response of systems with mechanical, hydraulic, thermal, and/or electrical elements. Linear feedback control systems design and analysis in time and frequency domains.

ME 3056. Experimental Methodology Laboratory
1-3-2.
Prerequisite(s): (MATH 3770 or ISYE 3770) and ME 3015 and ME 3201 and ME 3345
Introduction to basic instrumentation used in mechanical engineering, including calibration, use, precision, and accuracy. Consideration of error, precision, and accuracy in experimental measurements.

ME 3180. Machine Design
3-0-3.
Prerequisite(s): (AE 1770 or CEE 1770 or ME 1770) and ME 3201
The selection, analysis, and synthesis of springs, joining and fastening methods, bearings, shafts, gears, and other elements. Design of assemblies. Computer-based methods.

ME 3201. Mechanics of Materials
3-0-3.
Prerequisite(s): ME 2016 and ME 2211 and (MATH 2403* or MATH 24X3 or MATH 2413*) and MSE 2001*
Analysis of stress and strain applied to beams, pressure vessels, and combined loading; problems involving resistance of materials to plastic deformation, fracture, fatigue, and creep.

ME 3322. Thermodynamics
3-0-3.
Prerequisite(s): PHYS 2211 and (MATH 2403 or MATH 24X3 or MATH 2602 or MATH 2413) and ME 2016
Introduction to thermodynamics. Thermodynamic properties, energy and mass conservation, entropy and the second law. Second-law analysis of thermodynamic systems, gas cycles, vapor cycles.

ME 3340. Fluid Mechanics
3-0-3.
Prerequisite(s): ME 2202 and ME 3322
The fundamentals of fluid mechanics. Topics include fluid statics; control-volume analysis; the Navier-Stokes equations; similitude; viscous, inviscid and turbulent flows; boundary layers.

ME 3345. Heat Transfer
3-0-3.
Prerequisite(s): (MATH 2403 or MATH 24X3) and ME 3340
Introduction to the study of heat transfer, transport coefficients, steady state conduction, transient conduction, radiative heat transfer, and forced and natural convection.

ME 3720. Introduction to Fluid and Thermal Engineering
3-0-3.
Prerequisite(s): CHEM 1310 and PHYS 2211 and (MATH 2403 or MATH 24X3 or MATH 2413)
Theory and application, but no exhaustive treatment of fluid mechanics, thermodynamics, and heat transfer in analysis and design of fluid and thermal energy systems.

ME 4041. Interactive Computer Graphics and Computer-Aided Design
3-0-3.
Prerequisite(s): ME 3180 and ME 3345
Principles of geometric modeling, finite-element method, and interactive computer graphics hardware and software. CAD and CAE applications in thermal and mechanical design problems. Design projects.

ME 4053. Mechanical Engineering Systems Laboratory
1-3-2.
Prerequisite(s): ME 3056 and ME 3345 and (MATH 3770 or ISYE 3770)
Measurement and analysis of mechanical, acoustic, manufacturing, thermodynamic, fluid, and heat transfer phenomena. Emphasis on data acquisition, reduction, and analysis and report preparation.

ME 4055. Experimental Engineering
0-3-1.
Prerequisite(s): ME 4053
Application of experimental techniques to engineering problems involving various mechanical engineering processes. Open-ended investigations are accomplished by teams.

ME 4113. Kinematics and Dynamics of Linkages
3-0-3.
Prerequisite(s): ME 2202
Analysis and synthesis of n-bar, cam-follower, and gear-train systems. Balancing of rotating and reciprocating systems.

ME 4171. Environmentally Conscious Design and Manufacturing
3-0-3.
Including environmental considerations in engineering design; reducing environmental impact by design; recycling; material selection; de- and remanufacturing; life-cycle considerations, analysis, tradeoffs; ISO 14000.

ME 4172. Designing Sustainable Engineering Systems
3-0-3.
Understanding sustainability in context of market forces, availability of resources, technology, society. Methods for identifying, modeling, and selecting sustainable designs.

ME 4182. Capstone Design
1-6-3.
Prerequisite(s): ME 2110 and ME 3180 and ME 4210 and ME 4315
Teams apply a systematic design process to real multidisciplinary problems. Problems selected from a broad spectrum of interest areas, including biomedical, ecological, environmental, mechanical, and thermal.

ME 4189. Structural Vibrations
3-0-3.
Prerequisite(s): ME 3015
Single and multi-degree-of-freedom systems as well as continuous systems are analyzed for their vibrational response characteristics using both exact and approximate methods.

ME 4193. Tribological Design
3-0-3.
Prerequisite(s): ME 3201 and ME 3340
Analysis of tribological aspects of machine components, including friction, lubrication, and wear. Group design project to optimize system tribological performance.

ME 4210. Manufacturing Processes and Engineering
3-0-3.
Prerequisite(s): (MATH 3770 or ISYE 3770) and ME 3345
Major manufacturing processes, their capabilities, analysis, and economics. Manufacturing process selection.

ME 4211. Manufacturing Engineering and Process Applications
3-3-4.
Prerequisite(s): (MATH 3770 or ISYE 3770) and ME 3201
Advanced treatment of manufacturing process. Machining, casting, metal forming, polymer processing, manufacturing systems, and process planning are major topics. Laboratory practice supplements classroom.

ME 4213. Materials Selection and Failure Analysis
3-0-3.
Prerequisite(s): ME 3201
Principles of selecting both materials and processes required for mechanical design as well as failure analysis. Mechanics and materials knowledge used in solving practical problems.

ME 4315. Energy Systems Analysis and Design
3-0-3.
Prerequisite(s): (AE 1770 or CEE 1770 or ME 1770) and ISYE 3025 and ME 3345
Integrated concepts, laws, and methodologies from thermal sciences are used to analyze, model, and design energy systems and to predict system performance for fixed designs.

ME 4321. Refrigeration and Air Conditioning
3-0-3.
Prerequisite(s): ME 3322 and ME 3345
Application of thermodynamics principles to analysis and design of refrigeration and air conditioning systems, absorption and heat-driven systems, gas-vapor mixture psychrometrics, load estimates, delivery, and control.

ME 4324. Power Generation Technology
3-0-3.
Prerequisite(s): ISYE 3025 and ME 3345
Technology review and application of engineering sciences and economics to the analysis and design of power generation systems. Fossil, nuclear, and renewable energy systems are considered.

ME 4330. Heat and Mass Exchangers
3-0-3.
Prerequisite(s): ME 3345
Heat transfer, fluid flow, and thermodynamics principles applied to the analysis and design of heat and mass exchangers, periodic regenerators, and cooling towers.

ME 4340. Applied Fluid Mechanics
3-0-3.
Prerequisite(s): ME 3345
Advanced study in three areas of fluid mechanics. Topics may be chosen from turbomachinery, flow measurement, compressible flow, applied aerodynamics, and others.

ME 4342. Computational Fluid Dynamics
2-3-3.
Prerequisite(s): ME 3345
An introduction to computational fluid dynamics (CFD) in mechanical engineering. The theory and numerical techniques of CFD. Modern CFD software including grid generation and flow visualization tools will be used. Projects with complex fluid-flow systems.

ME 4447. Microprocessor Control of Manufacturing Systems
2-3-3.
Prerequisite(s): ME 3056
Lectures address the fundamental aspects of manufacturing elements and microprocessors and their applications. Hands-on application of machine and machine tool control will be stressed.

ME 4451. Robotics
2-2-3.
Prerequisite(s): ME 3015
Mathematical modeling, simulation, and control of robotic systems with mechanical and sensory elements.

ME 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

ME 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

ME 4754. Electronics Packaging Assembly, Reliability, Thermal Management, and Test
1-6-3.
Prerequisite(s): ECE 3040 or ECE 3710
The course provides hands-on instruction in electronics packaging, including assembly, reliability, thermal management, and test of next-generation microsystems. Crosslisted with ECE and MSE 4754.

ME 4757. Biofluid Mechanics
3-0-3.
Prerequisite(s): AE 2020 or ME 3340
Introduction to the study of blood flow in the cardiovascular system. Emphasis on modeling and the potential of flow studies for clinical research application. Crosslisted with AE and CHE 4757.

ME 4758. Biosolid Mechanics
3-0-3.
Prerequisite(s): ME 3201 or BMED 3400
The mechanics of living tissue, e.g., arteries, skin, heart muscle, ligament, tendon, cartilage, and bone. Constitutive equations and some simple mechanical models. Mechanics of cells. Applications. Crosslisted with AE and CHE 4758.

ME 4760. Engineering Acoustics and Noise Control
3-0-3.
Prerequisite(s): MATH 2403 or MATH 2453 or MATH 2413
Study of acoustics related to noise and its control; acoustic terminology, wave propagation, wave equation solutions, instrumentation, data processing, room acoustics, noise control, hearing, noise legislation. Crosslisted with AE 4760.

ME 4763. Pulping and Chemical Recovery
3-0-3.
Pulping and chemical recovery processes are studied on the reaction, delignification, energy, and liquor reuse. The process optimization, air and water pollution minimization are taught. Crosslisted with CHE 4763.

ME 4764. Bleaching and Papermaking
3-0-3.
Pulp bleaching and formation of paper/board products are studied along with testing, end uses, chemical and mechanical treatment of pulp, non-wood and recycled fiber utilization. Crosslisted with CHE 4764.

ME 4775. Polymer Science and Engineering I: Formation and Properties
3-0-3.
Prerequisite(s): CHEM 2312 and CHEM 3411
An introduction to the chemistry, structure and formation of polymers, physical states and transitions, physical and mechanical properties of polymer fluids and solids. Crosslisted with CHEM, CHE, MSE, and PTFE 4775.

ME 4776. Polymer Science and Engineering II: Analysis, Processing, and Laboratory
2-3-3.
Prerequisite(s): CHBE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or PTFE 4775
Polymer fabrication processes and methods of characterization and identification of polymers are presented. Experiments in polymerization, processing, and property evaluation of polymers. Crosslisted with CHE, CHEM, MSE, and TFE 4776.

ME 4777. Introduction to Polymer Science and Engineering
3-0-3.
Prerequisite(s): MSE 2001 and CHEM 2311
An introduction to the structure and formation of polymers, physical states and transitions, physical and mechanical properties of polymer fluids and solids, and processing of polymers. Crosslisted with MSE and PTFE 4777.

ME 4781. Biomedical Instrumentation
3-0-3.
Prerequisite(s): ECE 3040 or ECE 3710
A study of medical instrumentation from a systems viewpoint. Pertinent physiological and electro-physiological concepts will be covered. Crosslisted with CHE and ECE 4781.

ME 4782. Biosystems Analysis
3-0-3.
Prerequisite(s): BMED 3500 or CHBE 4400 or ECE 2040 or ME 3015
Analytical methods for modeling biological systems, including white-noise protocols for characterizing nonlinear systems. Crosslisted with BMED, CHE and ECE 4782.

ME 4791. Mechanical Behavior of Composites
3-0-3.
Prerequisite(s): ME 3201
Stress-strain behavior of composites, properties of matrix and reinforcing materials, mechanics of fiber-reinforced composites, lamina and laminate analysis, and mechanical performance. Crosslisted with AE, CEE, CHE, MSE, and PTFE 4791.

ME 4793. Composite Materials and Processes
3-0-3.
Prerequisite(s): PHYS 2212 and CHEM 1310
Basic principles of selection and design of composite materials and their manufacturing and testing. Cost factors. Laboratory exercises on manufacturing and tests. Crosslisted with AE, CEE, CHE, ME, MSE, and PTFE 4793.

ME 4794. Composite Materials and Manufacturing
3-3-4.
Prerequisite(s): CHEM 1310 and PHYS 2212
Basic principles of selection and design of composite materials and their manufacturing and testing. Cost factors. Laboratory exercises on manufacturing and tests. Crosslisted with AE, CEE, CHE, MSE, and PTFE 4794.

ME 4801, -02, -03, -04, -05. Special Topics, Mechanical Engineering
Class and credit hours equal last digit in course number.
Special topic offerings of current interest not included in regular courses.

ME 4811, -12, -13, -14, 15. Special Topics
Class and credit hours equal last digit in course number.

ME 4821, -22, -23, -24, -25. Special Topics
Class and credit hours equal last digit in course number.

ME 4831, -32, -33, -34, -35. Special Topics
Class and credit hours equal last digit in course number.

ME 4901, -02, -03. Special Problems
Credit hours to be arranged.
Individual studies in certain specialized areas, and mathematical analysis and/or experimental investigations of problems of current interest in mechanical engineering.

ME 6101. Engineering Design
3-0-3.
Design concepts, processes, and methodologies, including quality and robustness. Group project.

ME 6102. Designing Open Engineering Systems
3-0-3.
Decision-based integrated product and process development, meta-design, and decision support problems; mathematical modeling of decisions involving ambiguity and uncertainty; critical thinking and analysis; verification and validation; research issues.

ME 6103. Optimization in Engineering Design Project
3-0-3.
Use of single and multi-objective optimization in modeling and solving mechanical engineering design problems. Formulations, solution algorithms, validation and verification, computer implementation.

ME 6104. Computer-Aided Design
3-0-3.
Fundamentals of CAD, including geometric and solid modeling, parametric representations, features, and human-machine interactions. Applications to design, analysis, and manufacturing.

ME 6124. Finite-Element Method: Theory and Practice
3-0-3.
Line, plane, solid, plate, and shell elements-theory; practical aspects of modeling; applications in mechanical engineering; final project.

ME 6140. Physical Properties of Paper
3-0-3.
Prerequisite(s): ME 6201
Structure and physical properties of paper and other fibrous composites. Fundamental concepts related to single fibers and web structures.

ME 6201. Principles of Continuum Mechanics
3-0-3.
Prerequisite(s): MATH 4581
Introductory treatment of the fundamental, unifying concepts of the mechanics of continua.

ME 6203. Inelastic Deformation of Solids
3-0-3.
Prerequisite(s): ME 6201
Phenomenological aspects of nonlinear material behavior and deformation with emphasis on model development.

ME 6204. Micromechanics of Materials
3-0-3.
Prerequisite(s): ME 6201
Fundamental concepts of micromechanics of solids with emphasis on application to composite materials.

ME 6222. Manufacturing Processes and Systems
3-0-3.
Prerequisite(s): ME 4210
Materials processing analysis and selection. Manufacturing systems design. Economic analysis.

ME 6223. Automated Manufacturing Process Planning
3-0-3.
Prerequisite(s): ME 6222
Fundamentals of process planning. Automated process planning approaches and algorithms. Geometric modeling for process planning. Modeling and analysis of flexible fixturing systems. Mechanical assembly planning.

ME 6224. Machine Tool Analysis and Control
3-0-3.
Prerequisite(s): ME 6222
Mechanics and dynamics of machining, machine tool components and structures, sensors and control of machine tools, machine process planning and optimization.

ME 6225. Metrology and Measurement Systems
3-0-3.
Prerequisite(s): ME 3015 and ME 6222
Metrology techniques and procedures. Precision manufacturing system design and analysis.

ME 6226. Fundamentals of Semiconductor Manufacture and Assembly
3-0-3.
Prerequisite(s): ME 6222
Basic mechanical and materials processes in production including silicon boule growth, plastic encapsulation, interconnect metal migration, solder joining, printing, manufacturing process cost analysis.

ME 6229. Introduction to Micro-Electro-Mechanical Systems
2-3-3.
Principles of microfabrication for sensors and actuators. Lumped parameter analysis and computer-aided design; materials properties; case studies include cantilever beam, pressure sensor, and accelerometer.

ME 6242. Mechanics of Contact
3-0-3.
Prerequisite(s): ME 6201
Mechanics of surface contact, with emphasis on tribological interactions as in rolling element bearings, slider bearings, mechanical seals, and materials processing.

ME 6243. Fluid Film Lubrication
3-0-3.
Analytical and numerical investigation of full-film compressible and incompressible hydrodynamic lubrication problems for steady and unsteady conditions.

ME 6244. Rotordynamics
3-0-3.
Analysis and design of shafts for rotating machinery. Torsional vibration, synchronous and nonsynchronous whirl, stability, gyroscopic effects, hydrodynamic bearings, hysteresis, squeeze film dampers, and balancing.

ME 6281. Mechanics of Paper Forming and Coating
3-0-3.
Prerequisite(s): ME 6601 or ME 6602
Fundamentals of multiphase flow in paper forming and coating processes, and its impact on the physical properties of composite fiber structure and surface characteristics.

ME 6301. Conduction Heat Transfer
3-0-3.
Prerequisite(s): ME 3345
Steady and transient one- and multi-dimensional conduction. Emphasis on analytical methods, numerical techniques, and approximate solutions.

ME 6302. Convection Heat Transfer
3-0-3.
Prerequisite(s): ME 3345
Convection (forced and free) in laminar and turbulent, internal and external flows. Analogy between momentum and heat transfer. Scaling laws and modeling.

ME 6303. Thermal Radiation Heat Transfer
3-0-3.
Prerequisite(s): ME 3345
Fundamentals of thermal radiation, blackbody radiation, surface characteristics, exchange in enclosures, radiation through continua, and combined mode heat transfer.

ME 6304. Principles of Thermodynamics
3-0-3.
Prerequisite(s): ME 3322
Fundamentals of thermodynamics including energy, entropy, and energy analysis, property relations, equilibrium conditions, and evaluation of properties.

ME 6305. Applications of Thermodynamics
3-0-3.
Prerequisite(s): ME 6304
Applications of the first and second laws of thermodynamics to analysis and design optimization of power and refrigeration systems incorporating heat exchangers and combustion processes.

ME 6401. Linear Control Systems
3-0-3.
Prerequisite(s): ME 3015
Theory and applications of linear systems, state space, stability, feedback controls, observers, LQR, LQG, Kalman filters.

ME 6402. Nonlinear Control Systems
3-0-3.
Prerequisite(s): ME 6401
Analysis of nonlinear systems, geometric control, variable structure control, adaptive control, optimal control, applications.

ME 6403. Digital Control Systems
3-0-3.
Prerequisite(s): ME 3015
Comprehensive treatment of the representation, analysis, and design of discrete-time systems. Techniques include Z- and W- transforms, direct method, control design, and digital tracking.

ME 6404. Advanced Control System Design and Implementation
2-3-3.
Prerequisite(s): ME 6403
Analysis, synthesis, and implementation techniques of continuous-time and real-time control systems using classical and state-space methods.

ME 6405. Introduction to Mechatronics
2-3-3.
Prerequisite(s): ME 3015
Modeling and control of actuators and electro-mechanical systems. Performance and application of microprocessors and analog electronics to modern mechatronic systems.

ME 6406. Machine Vision
3-0-3.
Design of algorithms for vision systems for manufacturing, farming, construction, and the service industries. Image processing, optics, illumination, feature representation.

ME 6407. Robotics
3-0-3.
Prerequisite(s): ME 3015 or ECE 3085
Analysis and design of robotic systems including arms and vehicles. Kinematics and dynamics. Algorithms for describing, planning, commanding, and controlling motion force.

ME 6441. Dynamics of Mechanical Systems
3-0-3.
Prerequisite(s): ME 3015
Motion analysis and dynamics modeling of systems of particles and rigid bodies in three-dimensional motion.

ME 6442. Vibration of Mechanical Systems
3-0-3.
Prerequisite(s): ME 3015 and ME 3201
Introduction to modeling and oscillatory response analysis for discrete continuous mechanical and structural systems.

ME 6443. Variational Methods in Engineering
3-0-3.
Calculus of variations, Hamilton's principle and Lagrange's equations, Sturm-Liouville problems, approximation techniques.

ME 6444. Nonlinear Systems
3-0-3.
Investigation of nonlinear systems using analytical and numerical techniques.

ME 6449. Acoustic Transducers and Signal Analysis
2-3-3.
Prerequisite(s): AE 6760 or ME 6760
Acoustic instrumentation and methods of signal analysis.

ME 6452. Wave Propagation in Solids
3-0-3.
Wave motion in solids, wave equations, analytical and numerical solutions, ultrasonic NDE.

ME 6601. Introduction to Fluid Mechanics
3-0-3.
The fundamentals of fluid mechanics. Derivation of the governing equations of motion. An introduction to viscous, inviscid, turbulent, and boundary-layer flows.

ME 6602. Viscous Flow
3-0-3.
Prerequisite(s): ME 6601
The mechanics of Newtonian viscous fluids. The use of modern analytical techniques to obtain solutions for flows with small and large Reynolds numbers.

ME 6622. Experimental Methods
3-0-3.
Experimental methods in mechanics. Includes measurement techniques, instrumentation, data acquisition, signal processing, and linear and digital electronics.

ME 6741. Pulp and Paper Manufacture I
3-0-3.
The fundamentals of pulp and paper technology are presented. Applications to the several unit operations used are explored and augmented by field trips and recent case studies. Crosslisted with CHE 6741.

ME 6742. Pulp and Paper Manufacture II
3-0-3.
Prerequisite(s): CHBE 6741 or ME 6741
Papermaking technology is covered from a multidisciplinary engineering perspective with fundamental and practical considerations being addressed. Students participate in groups to run a pilot papermaking trial at the Henry Foundation in Savannah. Crosslisted with CHE 6742.

ME 6743. Tissue Mechanics
3-0-3.
Structure-function relationships and constitutive models for a variety of biological tissues, with an emphasis on understanding the mechanical behaviors of normal and pathological tissues. Credit not given for both ME/BMED 6783 and ME/BMED 6743. Crosslisted with BMED 6743.

ME 6753. Principles of Management for Engineers
3-0-3.
The course will provide an introduction to selected topics needed to be successful in the technology industries. Cannot count toward major area requirements on M.S. or Ph.D. programs of study. Crosslisted with MGT 6753.

ME 6754. Engineering Database Management Systems
3-0-3.
Modeling and managing engineering information systems, integration of design and manufacturing functions in engineering product development, logical models of engineering product and processes. Crosslisted with CS 6754.

ME 6758. Numerical Methods in Mechanical Engineering
3-0-3.
Numerical methods for solution of engineering problems; initial, eigenvalue, and boundary-value problems; computational stability for ordinary and linear partial differential equations. Crosslisted with NRE and HP 6758.

ME 6759. Materials in Environmentally Conscious Design and Manufacturing
3-0-3.
Covers the environmental impact of materials choices and quantitative measure of life-cycle assessment and environmental burden. The Natural Step philosophy will be used as a model for the overall approach. Crosslisted with MSE and PTFE 6759.

ME 6760. Acoustics I
3-0-3.
Prerequisite(s): MATH 2403 or MATH 2413 or MATH 24X3
Fundamental principles governing the generation, propagation, reflection, and transmission of sound waves in fluids. Crosslisted with AE 6760.

ME 6761. Acoustics II
3-0-3.
Prerequisite(s): ME 6760 or AE 6760
Radiation and scattering of sound waves in fluids, duct acoustics, dissipation phenomena. Crosslisted with AE 6761.

ME 6762. Applied Acoustics
3-0-3.
Prerequisite(s): ME 6760 or AE 6760
Mufflers, resonators, acoustic materials, barriers, industrial noise, room acoustics, active noise control. Crosslisted with AE 6762.

ME 6765. Kinetics and Thermodynamics of Gases
4-0-4.
Thermodynamics of nonreacting and reacting gas mixtures. Introductory quantum theory, statistical thermodynamics, and gas kinetic theory. Crosslisted with AE 6765.

ME 6766. Combustion
3-0-3.
Prerequisite(s): ME 6304 or ME 6765 or AE 6765
Introductory chemical kinetics, deformations and deflagrations, laminar flame propagation in premixed gases, ignition and quenching, laminar diffusion flames, droplet burning, and turbulent reacting flows. Crosslisted with AE 6766.

ME 6767. Advanced Topics in Combustion
3-0-3.
Prerequisite(s): ME 6766 or AE 6766
Turbulent combustion, combustion instability and control, solid propellents and explosives, chemical kinetics, pollutant formation and destruction, computational methods for reacting flow. Crosslisted with AE 6767.

ME 6768. Polymer Structure, Physical Properties, and Characterization
3-0-3.
Prerequisite(s): CHBE 4776 or CHEM 4776 or ME 4776 or MSE 4776 or PTFE 4776
Formulations and analysis of molecular and phenomenological models of elastic and viscoelastic behavior, development and description of structure, and fundamental aspects of structure-property relations. Crosslisted with CHE, MSE, and PTFE 6768.

ME 6769. Linear Elasticity
3-0-3.
Governing equations of linear elasticity, plane elasticity, boundary-value problems, airy stress function and complex variable methods, simple three-dimensional solutions. Crosslisted with AE 6769.

ME 6770. Energy and Variational Methods in Elasticity and Plasticity
3-0-3.
Prerequisite(s): MATH 2403 and (AE 3120 or ME 3201)
Applications in energy and variational methods in engineering mechanics to elastic, plastic, and dynamical behavior of deformable media. Crosslisted with AE 6770.

ME 6774. Biomaterials: Structure and Function
3-0-3.
Structure-function relationships of biomaterials and biomaterial characterization will be covered. Materials for medical implants, tissue engineering, biosensing, imaging, and drug delivery will be covered. Crosslisted with BMED, CHE, and MSE 6774.

ME 6776. Integrated Low-Cost Microelectronics Systems Packaging
3-0-3.
Broad overview of system-level, cross-disciplinary microelectronics packaging technologies, including design, test, thermal, reliability, optoelectronics, and RF integration. Comparison of system-on-chip and system-on-package. Crosslisted with ECE and MSE 6776.

ME 6777. Advanced Biomaterials
3-0-3.
Prerequisite(s): BMED 6776 or CHBE 6776 or ME 6776 or MSE 6776 or PTFE 6776
Advanced topics of biomaterials performance and engineering, including biointerfaces, host reactions to materials, and bio-inspired/smart-materials strategies. Crosslisted with BMED, CHE, and MSE 6777.

ME 6779. Thermal Engineering for Packaging of Micro and Nano Systems
3-0-3.
Prerequisite(s): (ME 3322 and ME 3345) or ME 3720
Passive, active, and hybrid thermal management techniques, and computational modeling of micro systems. Air cooling, single phase and phase change liquid cooling, heat pipes, and thermoelectrics. Crosslisted with ECE 6779.

ME 6782. Cellular Engineering
3-0-3.
Engineering analysis of cellular systems. Crosslisted with BMED and CHE 6782.

ME 6789. Technology Ventures
3-0-3.
Team discussion and case studies of issues in biomedical engineering technology transfer including licensing, financial capital, safety and efficacy studies, clinical trials, and strategic planning. Crosslisted with BMED, ECE, CHE, and MGT 6789.

ME 6792. Manufacturing Seminar
1-0-1.
Guest speakers on a broad range of manufacturing-related topics: research, applications, and technology. Required for Certificate in Manufacturing. Crosslisted with ECE and ISYE 6792.

ME 6793. Systems Pathophysiology
3-0-3.
Overview of human pathophysiology from a quantitative perspective. Emphasis on systems of interest to bioengineering faculty. Introduction to quantitative models for biological systems. Crosslisted with BMED, CHE, and ECE 6793.

ME 6794. Tissue Engineering
3-0-3.
Biological, engineering, and medical issues in developing tissue-engineered constructs. Emphasis in the integration of these disciplines at a basic molecular and cell biology level. Crosslisted with BMED and CHE 6794.

ME 6795. Mathematical, Statistical, and Computational Techniques in Materials Science
3-0-3.
Emphasizes the fundamental physical, analytical, and mathematical techniques commonly encountered in materials engineering including stress and strain, crystallographic and orientation transformations, X-ray, TEM, and solid-state concepts. Crosslisted with MSE and PTFE 6795.

ME 6796. Structure-Property Relationships in Materials
3-0-3.
Introduction to the multi-scale structure effects on material properties. For MSE students, this course will prepare students for future in-depth courses. For non-MSE students, the course will provide a background in materials and may serve as part of the program of study for a minor in materials. Crosslisted with MSE and PTFE 6796.

ME 6797. Thermodynamics and Kinetics of Microstructural Evolution
3-0-3.
The reduction of chemical-free energy, strain energy, and interfacial energy controls the kinetics of diffusional transformations. These factors are explored from the point of view of processing and stability of the microstructure during service. Crosslisted with MSE and PTFE 6797.

ME 6799. Legal Issues in Technology Transfer
3-0-3.
Study and analysis of U.S. law as it applies to the patenting and licensing processes. Crosslisted with CHE, MGT, and BMED 6799.

ME 7000. Master's Thesis
Credit hours to be arranged.

ME 7101. Seminar in Engineering Design
3-0-3.
Prerequisite(s): ME 6101
Reading from the literature, presentations, and discussions on current theories and methods in engineering design.

ME 7201. Computational Mechanics of Materials
3-3-3.
Prerequisite(s): ME 6201
Computational treatments of material and geometric nonlinearity, with emphasis on rate-dependent elasto-plasticity and fracture.

ME 7203. Advanced Constitutive Relations for Solids
3-0-3.
Prerequisite(s): ME 6201
Advanced treatment of constitutive laws for nonlinear behavior of solids. Coupled thermomechanical laws and underlying physical and thermodynamical bases. Behavior of media with underlying substructure.

ME 7226. Interface and Surface Properties
3-0-3
Prerequisite(s): PHYS 4222 and ME 6242
Physical phenomena associated with surfaces and interfaces. Gas-solid, liquid-solid, and solid-solid interactions associated with physics, chemistry, and engineering.

ME 7227. Rapid Prototyping in Engineering
3-0-3.
Prerequisite(s): ME 6104 and ME 6222
Rapid prototyping technologies in engineering design. Physical principles, materials, materials processing. Laboratory demonstrations and project.

ME 7228. Thermomechanical Reliability in Electronic Packaging
3-0-3.
Prerequisite(s): ME 6124 and ME 6222
Modeling and validation of thermomechanical behavior of printed wiring board and PWB assembly; microelectronic packaging, packaging materials, manufacturing process modeling, reliability, failure modes.

ME 7301. Transport Phenomena in Multiphase Flow
3-0-3.
Prerequisite(s): ME 6301 and ME 6302 and ME 6602
Gas-liquid, two-phase flow patterns, basic and empirical models; conservation equations and closure relations; pool and convective boiling; aerosol transport; condensation.

ME 7442. Vibration of Continuous Systems
3-0-3.
Prerequisite(s): ME 6442
Equations of motion and oscillatory response of dynamic systems modeled as continuous media.

ME 7602. Hydrodynamic Stability
3-0-3.
Prerequisite(s): ME 6601
Hydrodynamic stability of fluid flows using linear, energy, and nonlinear stability theories. Taylor-Couette, buoyancy-driven, surface-tension-driven, shear, and thin-film flows.

ME 7751. Computational Fluid Mechanics
3-0-3.
Prerequisite(s): CEE 6251 and ME 6601
Numerical methods for solving the time-dependent Navier-Stokes equations in complex geometries, including theory, implementation, and applications. Crosslisted with CEE 7751.

ME 7757. Teaching Practicum
1-6-3.
Supervised teaching for doctoral students. Teaching techniques, course and curriculum design, student evaluation methods and criteria. Students may, in some instances, prepare and present lectures. Crosslisted with NRE and HP 7757.

ME 7764. Acoustic Propagation
3-0-3.
Prerequisite(s): AE 6760 or ME 6760
Propagation of sound in inhomogeneous fluids; ray acoustics, ocean and atmospheric acoustics, nonlinear acoustics. Crosslisted with AE 7764.

ME 7771. Mechanics of Polymer Solids and Fluids
3-0-3.
Continuum mechanics of solids and fluids; mechanics of deformation of anisotropic polymers; yield, breaking, and fatigue; non-Newtonian viscous and viscoelastic behavior of polymer fluids. Crosslisted with CHE, MSE, and PTFE 7771.

ME 7772. Fundamentals of Fracture Mechanics
3-0-3.
Prerequisite(s): ME 3201 or MSE 3005
Advanced study of failure of structural materials under load, mechanics of fracture, and microscopic and macroscopic aspects of the fracture of engineering materials. Crosslisted with AE, CEE, CHE, and MSE 7772.

ME 7773. Advanced Fracture Mechanics
3-0-3.
Prerequisite(s): AE 7772 or CEE 7772 or CHBE 7772 or ME 7772 or MSE 7772
Nonlinear fracture mechanics including elastic-plastic and time-dependent fracture, advanced test methods, J-integral theory, and extensions. Crosslisted with AE, CEE, CHE, and MSE 7773.

ME 7774. Fatigue of Materials and Structures
3-0-3.
Prerequisite(s): AE 7772 or CEE 7772 or CHBE 7772 or ME 7772 or MSE 7772
Mechanical and microstructural aspects of nucleation and growth of cracks under cyclic loading conditions, notch effects, cumulative damage, multiaxial loading, and fatigue crack propagation. Crosslisted with AE, CEE, CHE, and MSE 7774.

ME 7775. Topics in Fracture and Fatigue of Metallic and Composite Structures
3-0-3.
Prerequisite(s): ME 2211 or AE 2120
Brittle and ductile failure criteria. Failure prediction in composite structures. Free-edge and internal delamination. Anisotropic cracks. Fatigue behavior of composites and comparison with metal fatigue. Crosslisted with AE, CHE, and MSE 7775.

ME 7791. Damage, Failure, and Durability of Composite Materials
3-0-3.
Prerequisite(s): AE 4791 or CHBE 4791 or CEE 4791 or ME 4791 or MSE 4791
Analysis and failure of fiber-reinforced composite material systems. Mechanisms of toughening, multiple cracking mechanisms. Failure in woven fabric, braided, and special geometry composites. Crosslisted with AE, CHE, CEE, MSE, and PTFE 7791.

ME 7792. Advanced Mechanics of Composites
3-0-3.
Prerequisite(s): AE 4791 or CEE 4791 or CHBE 4791 or ME 4791 or MSE 4791 or PTFE 4791
Anisotropic elasticity, hygrothermal behavior, stress analysis of laminated composites including 3-D effects, stress concentrations, free-edge effects, thick laminates, adhesive and mechanical connections, fracture of composites. Crosslisted with AE, CHE, CEE, MSE, and PTFE 7792.

ME 7793. Manufacturing of Composites
3-0-3.
Prerequisite(s): AE 4793 or AE 4794 or CEE 4793 or CEE 4794 or CHBE 4793 or CHBE 4794 or ME 4793 or ME 4794
Major manufacturing techniques of metal-ceramic and polymer matrix composites. Modeling of processes with emphasis on fundamental mechanisms and effects. Crosslisted with AE, CEE, CHE, MSE, and PTFE 7793.

ME 8010, -11, -12. Seminars in Mechanical Engineering
1-0-1.
Seminars involving current research projects presented by graduate students, faculty, and invited speakers.

ME 8801, -02, -03, -04, -05, -06. Special Topics in Manufacturing
Class and credit hours equal last digit in course number.
Special topic offerings of current interest in manufacturing not included in regular courses.

ME 8811, -12, -13, -14, -15, -16. Special Topics in Computer-Aided Engineering and Design
Class and credit hours equal last digit in course number.
Special topic offerings of current interest in computer-aided engineering not included in regular courses.

ME 8821, -22, -23, -24, -25, -26. Special Topics in Tribology
Class and credit hours equal last digit in course number.
Special topic offerings of current interest in tribology not included in regular courses.

ME 8831, -32, -33, -34, -35, -36. Special Topics in Thermal Sciences
Class and credit hours equal last digit in course number.
Special topics offerings of current interest in thermal sciences not included in regular courses.

ME 8841, -42, -43, -44, -45, -46. Special Topics in Automation and Mechatronics
Class and credit hours equal last digit in course number.
Special topic offerings of current interest in automation and mechatronics not included in regular courses.

ME 8851, -52, -53, -54, -55, -56. Special Topics in Acoustics and Dynamics
Class and credit hours equal last digit in course number.
Special topic offerings of current interest in acoustics and dynamics not included in regular courses.

ME 8861, -62, -63, -64, -65, -66. Special Topics in Fluid Mechanics
Class and credit hours equal last digit in course number.
Special topic offerings of current interest in fluid mechanics not included in regular courses.

ME 8871, -72, -73, -74, -75, -76. Special Topics in Bioengineering
Class and credit hours equal last digit in course number.
Special topic offerings of current interest in bioengineering not included in regular courses.

ME 8881, -82, -83, -84, -85, -86. Special Topics in Mechanics of Materials
Class and credit hours equal last digit in course number.
Special topic offerings of current interest in mechanics of materials not covered in regular courses.

ME 8901, -02, -03, -04, -05, -06. Special Problems in Manufacturing
Credit hours to be arranged.
Individual studies and/or experimental investigation of problems of current interest in manufacturing.

ME 8911, -12, -13, -14, -15, -16. Special Problems in Computer-Aided Engineering and Design
Credit hours to be arranged.
Individual studies and/or experimental investigations of problems of current interest in computer-aided engineering and design.

ME 8921, -22, -23, -24, -25, -26. Special Problems in Tribology
Credit hours to be arranged.
Individual studies and/or experimental investigations of problems of current interest in tribology.

ME 8931, -32, -33, -34, -35, -36. Special Problems in Thermal Sciences
Credit hours to be arranged.
Individual studies and/or experimental investigations of problems of current interest in thermal sciences.

ME 8941, -42, -43, -44, -45, -46. Special Problems in Automation and Mechatronics
Credit hours to be arranged.
Individual studies and/or experimental investigations of problems of current interest in automation and mechatronics.

ME 8951, -52, -53, -54, -55, -56. Special Problems in Acoustics and Dynamics
Credit hours to be arranged.
Individual studies and/or experimental investigations of problems of current interest in acoustics and dynamics.

8961, -62, -63, -64, -65, -66. Special Problems in Fluid Mechanics
Credit hours to be arranged.
Individual studies and/or experimental investigations of problems of current interest in fluid mechanics.

ME 8971, -72, -73, -74, -75, -76. Special Problems in Bioengineering
Credit hours to be arranged.
Individual studies and/or experimental investigations of problems of current interest in bioengineering.

ME 8981, -82, -83, -84, -85, -86. Special Problems in Mechanics of Materials
Credit hours to be arranged.
Individual studies and/or experimental investigations of problems of current interest in the mechanics of materials.

ME 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding graduate teaching assistantships.

ME 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding graduate research assistantships.

ME 9000. Doctoral Thesis
Credit hours to be arranged.

NUCLEAR AND RADIOLOGICAL ENGINEERING

NRE 2110. Introduction to Nuclear and Radiological Engineering
2-0-2.
Introduction to nuclear and radiological engineering; nuclear energy production and radiation technologies and their role of importance to society, their environmental impact.

NRE 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

NRE 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

NRE 3112. Nuclear Radiation Detection
2-3-3.
Prerequisite(s): NRE 2110 and NRE 3301
An introduction to the principles and characteristics of basic detectors for nuclear radiation and the pulse processing electronics associated with them.

NRE 3212. Fundamentals of Nuclear and Radiological Engineering
3-0-3.
Prerequisite(s): MATH 2401 and MATH 2403* and PHYS 2213*
Intermediate treatment of nuclear and radiological engineering, with emphasis on reactor physics and engineering, radiation protection, and radiation shielding.

NRE 3301. Radiation Physics
3-0-3.
Prerequisite(s): PHYS 2213
Characteristics of atomic and nuclear radiations, transition probabilities, radioactivity, classical and quantum-mechanical derivations of cross sections, interactions of photon, neutron, and charged particles with matter.

NRE 3316. Radiation Protection Engineering
3-0-3.
Prerequisite(s): (MATH 2403 or MATH 2413 or MATH 24X3) and NRE 3301
Covers radiation dosimetry, biological effects of radiation, radiation-protection criteria and exposure limits, external radiation protection, internal radiation protection, and sources of human exposure.

NRE 4204. Nuclear Reactor Physics
4-0-4.
Prerequisite(s): NRE 3301 and MATH 4581
Covers physical principles of nuclear reactors. Topics include neutron diffusion theory, criticality and multigroup theory, slowing down theory, heterogeneity effects, and reactor kinetics.

NRE 4206. Radiation Physics Laboratory
1-3-2.
Prerequisite(s): NRE 3212 and NRE 4204
Measurements of reactor parameters, such as approach to criticality, flux mapping, buckling, and diffusion length using subcritical assemblies. Neutron spectral measurements, shield transmission measurements, and other radiation field measurements.

NRE 4214. Reactor Engineering
3-0-3.
Prerequisite(s): ME 3340 and ME 3345
Nuclear heat generation; fuel elements' thermal analysis; single and two-phase flow and heat transfer in reactor systems; core thermal design and treatment of uncertainties.

NRE 4232. Nuclear and Radiological Engineering Design
1-9-4.
Prerequisite(s): NRE 4328
Introduction to the methodologies of nuclear and radiological design. An open-ended design project that integrates all relevant engineering aspects is to be completed in this course.

NRE 4234. Nuclear Criticality Safety Engineering
2-3-3.
Prerequisite(s): NRE 4204
This course covers the theoretical concepts, the computational techniques, and the principal methods of criticality safety.

NRE 4266. Light Water Reactor Technology
3-0-3.
Prerequisite(s): NRE 4204 and NRE 4214
A systematic survey of the technology of both pressurized and boiling water reactors with emphasis on the nuclear steam supply system and its associated safety and control systems.

NRE 4328. Radiation Sources and Applications
3-0-3.
Prerequisite(s): NRE 3301 and (NRE 3112 or NRE 3212)
Application of radiation and radioisotope technology in industry and medicine.

NRE 4335. Radiation Imaging
3-0-3.
Prerequisite(s): NRE 3212 and NRE 4204
Introduction to camera and signal processing systems for medical and industrial imaging and dosimetry applications; associated instrumentation and film; and deconvolution/reconstruction algorithms.

NRE 4404. Radiological Assessment and Waste Management
3-0-3.
Prerequisite(s): NRE 3316
Mathematical models for movement in the environment. Scenario development for release, environmental transport, and exposure. Radioactive waste disposal facilities and waste disposal technology.

NRE 4430. Nuclear Regulatory Requirements
2-0-2.
Prerequisite(s): NRE 3316
This course introduces regulatory organizations and delineates their jurisdictions. It covers the fundamentals of regulations, the impacts on occupational workers, the public, and the environment.

NRE 4610. Introduction to Plasma Physics and Fusion Engineering
3-0-3.
A first course in plasma physics and magnetic confinement fusion: basic plasma physics, magnetic confinement concepts, fusion engineering, and a review of the current status of fusion research.

NRE 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

NRE 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

NRE 4750. Diagnostic Imaging Physics
3-0-3.
Prerequisite(s): NRE 3112
Physics and image formation methods for conventional X-ray CT, nuclear medicine, and magnetic resonance and ultrasound imaging.

NRE 4770. Nuclear Chemical Engineering
3-0-3.
This course surveys the chemical engineering aspects of nuclear power. Topics include nuclear reactions, fuel cycles, solvent extraction of metals, the properties of actinides and other irradiated fuel materials, fuel reprocessing, and radioactive waste management. Crosslisted with CHE 4770.

NRE 4801, -02, -03, -04,-05. Special Topics
Class and credit hours equal last digit in course number.
Special topic offerings of current interest not included in regular courses.

NRE 4901, -02, -03. Special Problems
Credit hours to be arranged.

NRE 6101. Transport Fundamentals
3-0-3.
Neutral and charged particle transport. Fluid mass, energy, and momentum transport. Models used in nuclear radiation transport; fluid hydrodynamics, radiative and plasma transport.

NRE 6102. Plasma Physics
3-0-3.
Physics of ionized plasmas. Magnetic confinement, kinetic and fluid theories, equilibrium, waves and stability, plasma-material interactions, atomic/molecular-plasma interactions, multi-species transport. Plasma processing applications.

NRE 6103. Computational Methods of Radiation Transport
3-0-3.
Prerequisite(s): NRE 6101
Deterministic and stochastic computational methods for solving transport equations of neutral particles.

NRE 6201. Reactor Physics
3-0-3.
Prerequisite(s): NRE 6101
Fundamentals of reactor physics for nuclear analysis of neutron chain reactors and for developing tools required for design of those reactors.

NRE 6301. Reactor Engineering
3-0-3.
Two-phase flow, boiling heat transfer, fast reactor thermal-hydraulics, reactor thermal-hydraulics uncertainty analysis, loss-of-coolant accidents. Reactor thermal-hydraulic accident analysis.

NRE 6401. Advanced Nuclear Engineering Design
1-6-3.
Prerequisite(s): NRE 6102 and NRE 6201 and NRE 6301
Synthesis of principles of nuclear engineering in the design of nuclear reactors and other facilities.

NRE 6434. Nuclear Criticality Safety Engineering
2-3-3.
Prerequisite(s): NRE 4204
Concepts, computational techniques, and the principal methods of criticality safety such as accident experience, standards, experiments, computer and hand calculations, limits and regulations. Application to overall facility operation.

NRE 6501. Nuclear Fuel Cycle
3-0-3.
Prerequisite(s): NRE 6201
Fission fuel cycle, uranium mining and milling, enrichment. Fuel fabrication. In-core fuel management. Reprocessing and fuel cycle economics. Spent-fuel waste management.

NRE 6502. Nuclear Materials
3-0-3.
Materials science and engineering of metallic and ceramic fuels; cladding, structural, and control materials including radiation effects.

NRE 6755. Radiological Assessment and Waste Management
3-0-3.
Prerequisite(s): HP 6403 and HP 6406*
Critical analysis of sources and human exposures, mathematical models for movement through the biosphere, environmental transport, and exposure for nuclear facilities and waste disposal processing. Crosslisted with HP 6755.

NRE 6756. Radiation Physics
3-0-3.
Characteristics of atomic and nuclear radiation, transition probabilities, radioactivity and isotopes, cross sections, electromagnetic radiation, neutrons, and charged-particle interaction with matter. Crosslisted with HP 6756.

NRE 6757. Radiation Detection
3-3-3.
Prerequisite(s): NRE 6756 or HP 6756
Introduction to the theory and application of radiation detectors, measurement methods, signal processing, and data analysis. Crosslisted with HP 6757.

NRE 6758. Numerical Methods in Mechanical Engineering
3-0-3.
Numerical methods for solution of engineering problems; initial, eigenvalue, and boundary-value problems; computational stability for ordinary and linear partial differential equations. Crosslisted with ME and HP 6758.

NRE 7000. Master's Thesis
Credit hours to be arranged.

NRE 7103. Advanced Plasma Physics
3-0-3.
Prerequisite(s): NRE 6102
Classical and collective transport phenomena, plasma instabilities, plasma-materials interactions, and plasma edge physics. Emphasis on magnetic fusion, plasma processing, and other plasma applications research.

NRE 7203. Advanced Reactor Physics
3-0-3.
Prerequisite(s): NRE 6102
Advanced topics in reactor physics and transport theory.

NRE 7757. Teaching Practicum
1-6-3.
Supervised teaching for doctoral students. Teaching techniques, course and curriculum design, student evaluation methods and criteria. Students may, in some instances, prepare and present lectures. Crosslisted with HP and ME 7757.

NRE 8011, -12. Seminars in Nuclear Engineering
1-0-1.
Seminars involving current research projects presented by graduate students, faculty, and invited speakers.

NRE 8801, -02, -03, -04, -05, -06. Special Topics in Nuclear Engineering
Class and credit hours equal last digit in course number.
Special topic offerings of current interest in nuclear engineering not included in regular courses.

NRE 8901, -02, -03, -04, -05, -06. Special Problems in Nuclear Engineering
Credit hours to be arranged.
Individual studies and/or experimental investigations of problems of current interest in nuclear engineering.

NRE 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding graduate teaching assistantships.

NRE 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding graduate research assistantships.

NRE 9000. Doctoral Thesis
Credit hours to be arranged.

MEDICAL PHYSICS

MP 4750. Diagnostic Imaging Physics
3-0-3.
Prerequisite(s): NRE 3112
Physics and image formation methods for conventional X-ray CT, nuclear medicine, and magnetic resonance and ultrasound imaging.

MP 6101. Nuclear Medicine Physics
3-0-3.
Prerequisite(s): NRE 6756* or HP 6756*
Radioisotope production, radiopharmacy, planar gamma cameras, SPECT systems, PET systems, medical internal radiation dose (MIRD) method, nuclear medicine facilities and regulations.

MP 6201. Radiation Therapy Physics
3-0-3.
Prerequisite(s): MP 6405 and MP 6407 and (HP 6756 or NRE 6756)
Clinical radiation oncology, phantom systems, radiation machines, photon beams, electron beams, brachytherapy, dose modeling and treatment planning.

MP 6405. Radiation Protection and Dosimetry
3-0-3.
Prerequisite(s): NRE 6756 or HP 6756
Radiation dosimetry quantities, calculational and experimental methods for assessing the absorbed dose, effective dose assessment, committed effective dose assessment, radiation shielding methods.

MP 6407. Radiation Biology and Oncology
3-0-3.
Prerequisite(s): NRE 6756* or HP 6756*
Radiation lesions and repair, mechanisms of cell death, cell cycle effect, radiation sensitizers and protectors, tumor radiobiology, relative sensitivities of human tissues, and radiation carcinogensis.

MP 6756. Radiation Physics
3-0-3.
Characteristics of atomic and nuclear radiation, transition probabilities, radioactivity and isotopes, cross sections, electromagnetic radiation, neutrons, and charged-particle interaction with matter. Crosslisted with NRE 6756 and HP 6756.

MP 6757. Radiation Detection
3-0-3.
Introduction to the theory and application of radiation detectors, measurement methods, signal processing, and data analysis. Crosslisted with HP 6757 and NRE 6757.

MP 7000. Master's Thesis
Credit hours to be arranged

MP 8101. Clinical Internship in Nuclear Medicine
1-0-1.
Prerequisite(s): MP 6101
One hundred supervised contact hours of clinical internship in the Nuclear Medicine Department of Emory University.

MP 8102. Clinical Internship in Diagnostic Imaging
1-0-1.
Prerequisite(s): MP 4336
One hundred supervised contact hours of clinical internship in the Radiology Department of Emory University (or equivalent).

MP 8103. Clinical Internship in Radiation Therapy
1-0-1.
Prerequisite(s): MP 6101*
Two hundred supervised contact hours of clinical internship in the Radiation Oncology Department of Emory University (or equivalent).

MP 8801, -02, -03, -04, -05, -06. Special Topics
Class and credit hours equal last digit in course number.
Special topics offerings of current interest in medical physics not included in regular courses.

MP 8901, -02, -03, -04, -05, -06. Special Problems
Credit hours to be arranged.
Individual studies and/or experimental investigations of problems of current interest in medical physics.

HEALTH PHYSICS

HP 6403. Radiological Health I
3-0-3.
Prerequisite(s): MATH 2403
Applied nuclear and atomic physics, radioactive decay, guidelines; instrumentation, radiation protection and basics of criticality safety.

HP 6406. Radiological Health II
3-0-3.
Prerequisite(s): HP 6403
Radiation quantities, microdosimetry, biological effects of ionizing radiation, radiation risk, internal radiation protection, ALARA, and radiological emergency response.

HP 6416. Applied Radiological Health Laboratory
2-3-3.
Prerequisite(s): HP 6403 and (HP 6757 or NRE 6757) and HP 6406*
Co-requisite: HP 6406.
Advanced laboratory course in radiochemical and instrumental analysis. Practical radiation/radioactivity monitoring problems in nuclear facilities and environmental surveillance.

HP 6506. Operational Health Physics
3-0-3.
Prerequisite(s): HP 6403 and HP 6406*
Co-requisite: HP 6406.
Radiation sources, radiological safety practices and procedures for nuclear facilities, and the impact of radiological safety in the design of such facilities.

HP 6601. Industrial Hygiene
3-0-3.
Prerequisite(s): MATH 2403
Chemical, physical, biological, and ergonomic exposures. Occupational environment regulations. Application of scientific and engineering principles to hazard evaluation and general occupational health control measures.

HP 6755. Radiological Assessment and Waste Management
3-0-3.
Prerequisite(s): HP 6403 and HP 6406*
Critical analysis of sources and human exposures, mathematical models for movement through the biosphere, environmental transport, and exposure for nuclear facilities and waste disposal processing. Crosslisted with NRE 6755.

HP 6756. Radiation Physics
3-0-3.
Characteristics of atomic and nuclear radiation, transition probabilities, radioactivity and isotopes, cross sections, electromagnetic radiation, neutrons, and charged particle interaction with matter. Crosslisted with NRE 6756.

HP 6757. Radiation Detection
2-3-3.
Prerequisite(s): NRE 6756 or HP 6756
Introduction to the theory and application of radiation detectors, measurement methods, signal processing, and data analysis. Crosslisted with NRE 6757.

HP 6758. Numerical Methods in Mechanical Engineering
3-0-3.
Numerical methods for solution of engineering problems; initial, eigenvalue, and boundary-value problems; computational stability for ordinary and linear partial differential equations. Crosslisted with ME and NRE 6758.

HP 7000. Master's Thesis
Credit hours to be arranged.

HP 7757. Teaching Practicum
1-0-3.
Supervised teaching for doctoral students. Teaching techniques, course and curriculum design, student evaluation methods and criteria. Students may, in some instances, prepare and present lectures. Crosslisted with NRE and ME 7757.

HP 8011, -12. Seminars in Health Physics
1-0-1.
Seminars involving current research projects presented by graduate students, faculty, and invited speakers.

HP 8801, -02, -03, -04, -05, -06. Special Topics in Health Physics
Class and credit hours equal last digit in course number.
Special topic offerings of current interest in health physics not included in regular courses.

HP 8901, -02, -03, -04, -05, -06. Special Problems in Health Physics
Credit hours to be arranged.
Individual studies and/or experimental investigations of problems of current interest in health physics.

HP 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding a graduate teaching assistantship.

HP 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding a graduate research assistantship.

HP 9000. Doctoral Thesis
Credit hours to be arranged.

An asterisk (*) denotes prerequisite courses that may be taken concurrently.

School of Polymer, Textile, and Fiber Engineering

www.ptfe.gatech.edu

Established in 1897
Location: Manufacturing Related Disciplines Complex I
Telephone: 404.894.2490
Fax: 404.894.8780
E-mail: webadmin@ptfe.gatech.edu

Chair and Professor–Anselm C. Griffin; *Director of Undergraduate Affairs and Associate Professor*–Mary Lynn Realff.
Professors–Wallace W. Carr, Fred L. Cook, Sundaresan Jayaraman, Satish Kumar, Youjiang Wang.
Associate Professors–Haskell W. Beckham, David G. Bucknall, Karl I. Jacob, Mohan Srinivasarao.
Assistant Professors–Yonathan Thio, Donggang Yao.
Professors Emeriti– John L. Lundberg, Malcom B. Polk, Wayne C. Tincher.
Research Scientist–Radhakrishnaiah Parachuru.

General Information

Polymers and fibers can be used to form Engineered Fibrous structures (EFSs), which play critical, complex roles in fields such as space, aeronautics, automotives, medicine, safety, environmental control, sports, transportation and construction.

Multidisciplinary by nature, the EFS field encompasses, among other areas: the syntheses of polymers in the laboratory and in nature; fiber fabrication processes; design, engineering, and assembly of fibers into one-, two-, and three-dimensional structures; modification of structural properties through dyeing, finishing, and coating; and measurement of complex aesthetic and mechanical properties of fiber-based systems. New polymers and fibers, design of novel EFSs, new methods of assembling fibers into useful products, and expanded engineering applications of fibers are continually being developed.

The School of Polymer, Textile, and Fiber Engineering prepares students for rewarding

careers in the polymer-fiber-textile-fabricated products (PFTFP) industrial complex. Graduates obtain positions in design, process and plant engineering, manufacturing, research, technical service, sales, product and process development, quality control, and corporate management. They participate in the design, development, manufacturing, and marketing of a broad range of EFSs and associated products. Many hold key decision-making positions at a young age.

The PFTFP industry is by far the largest manufacturer and employer in the Southeast. When all the associated segments are included, the fiber conversion industry is the largest in the United States, representing one out of every eight manufacturing jobs. Not surprisingly, the industry's needs for university graduates each year far exceed the number available.

Undergraduate Program

The undergraduate program offers two tracks leading to the Bachelor of Science in Polymer and Fiber Engineering. Students may pursue the Polymer or Fiber track in a regular four-year program or under the five-year cooperative plan. Because of the multidisciplinary nature of polymers, fibers, and EFSs, the curricula stress broad, diverse academic backgrounds. Emphasis in the freshman and sophomore years is on mathematics, chemistry, and physics, and in the junior and senior years on materials science, polymer/textile chemistry and engineering, process dynamics, applied mechanics, business administration, and application of each field to the broad range of problems encountered in the PFTFP industrial complex. The program allows students to select courses from a range of general and technical electives.

Since most of the polymer/fiber/EFS coursework is concentrated in the last two years of the programs, students from junior and community colleges can readily transfer into the School of Polymer, Textile, and Fiber Engineering. The Regents' Engineering Transfer Program (RETP) greatly facilitates such transfers. Eligible students may also enroll in the five-year B.S./M.S. degree program (see Graduate Programs).

Program Educational Objectives

The mission of the School of Polymer, Textile, and Fiber Engineering is to foster the development and growth of an innovative, vibrant, and globally competitive polymer, fiber, and textile products (PFTP) industrial complex by advancing and disseminating knowledge through world-class education and research. Therefore, the School has established the following set of program educational objectives:

- Graduates will have a strong foundation in the fundamental aspects of polymer and fiber formation processes, structures, and properties.
- Graduates will know the basic principles for selecting and designing structures and processes to meet the desired end-use applications.
- Graduates will be prepared for engineering positions in the polymer, fiber, and textile products (PFTP) industrial complex.
- Graduates will be prepared to enter graduate school for advanced study and research.

Minor and Certificate Programs for Nonmajors

The School offers two certificate programs and one minor program. A substantial number of students graduating in other majors at Georgia Tech enter the PFTFP industry. Minor and certificate programs have been implemented in fiber enterprise management. The certificate program is designed to impart basic understanding of EFS materials, as well as an understanding of their manufacturing processes. The Minor in Fiber Enterprise Management is designed to provide more in-depth understanding of EFS materials and their manufacturing processes through a combination of required and elective courses. Attainment of the certificate requires twelve credit hours of specified courses. Attainment of a minor requires nineteen credit hours of specified courses. Both the certificate and minor programs draw on some of the courses taught for the School's undergraduate degree program. Requirements for the minor and certificate programs are available in the School's main office or at **www.ptfe.gatech.edu**.

The School also offers a multidisciplinary certificate program in Polymer Engineering and Polymers. The objective of the Polymers Certificate Program is to provide students with a structured program for an in-depth study of polymers. Programs of study will be structured to meet the needs and to fit the background of individual students. Required courses will cover the areas of polymer production, polymer chemistry, measurement of polymer structure and properties, and polymer processing. Opportunities are available for independent research. The certificate program requires six credit hours of specified courses and six hours of electives selected from a list of courses. The director of undergraduate affairs acts as advisor for all certificate and minor programs.

Bachelor of Science in Polymer and Fiber Engineering – Fiber Track (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
MATH 1501	CALCULUS I	4
CHEM 1310	GENERAL CHEMISTRY I	4
ENGL 1101	ENGLISH COMPOSITION I	3
CS 1371	COMPUTING FOR ENGINEERS	3
PTFE 1100	INTRO. TO THE POLYMER, FIBER, TEXTILE, & FABRICATED PRODUCTS ENTERPRISES	1
WELLNESS		2
TOTAL SEMESTER HOURS		17

First Year - Second Semester

Course Number/Name		*Hours*
MATH 1502	CALCULUS II	4
CHEM 1311	INORGANIC CHEMISTRY I	3
ENGL 1102	ENGLISH COMPOSITION II	3
PHYS 2211	INTRODUCTORY PHYSICS I	4
ECON 2100 or 2105 or 2106		3
TOTAL SEMESTER HOURS		17

Second Year - First Semester

Course Number/Name		*Hours*
MATH 2401	CALCULUS III	4
PHYS 2212	INTRODUCTORY PHYSICS II	4
ME 2020	STATICS & DYNAMICS	3
CHEM 1315	SURVEY OF ORGANIC CHEMISTRY	3
MSE 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		17

Second Year - Second Semester

Course Number/Name		*Hours*
MATH 2403	DIFFERENTIAL EQUATIONS	4
ME 3322	THERMODYNAMICS or CHEM 3411 PHYSICAL CHEMISTRY I	3
CEE 3030	STRENGTH OF MATERIALS	3
PTFE 2200	STRUCTURE & PROPERTIES OF FIBERS & POLYMERS	3
[illegible] 4001	TECHNICAL COMMUNICATION PRACTICES	2
TOTAL SEMESTER HOURS		15

Third Year - First Semester

Course Number/Name		*Hours*
MSE 2001	PRINCIPLES & APPLICATIONS OF ENGINEERING MATERIALS	3
ECE 3710	CIRCUITS & ELECTRONICS	2
PTFE 4775	POLYMER SCIENCE & ENGINEERING I	3
ISYE 3025	ESSENTIALS OF ENGINEERING ECONOMY	1
ECE 3741	INSTRUMENTATION & ELECTRONICS LAB	1
ME 3340	FLUID MECHANICS	3
CEE/MATH/ISYE 3770	STATISTICS & APPLICATIONS	3
TOTAL SEMESTER HOURS		16

Third Year - Second Semester

Course Number/Name		*Hours*
PTFE 3200	YARN & FABRIC FORMATION	3
PTFE 3221	TEXTILE FORMATION & TESTING	2
PTFE 3210	FUNDAMENTALS OF TRANSPORT	3
PTFE 4776	POLYMER SCIENCE & ENGINEERING II	3
PTFE 3230	POLYMER & FIBER PROCESSING	3
PTFE 3220	TEXTILE OPERATIONS & MANAGEMENT METHODS	3
TOTAL SEMESTER HOURS		17

Fourth Year - First Semester

Course Number/Name		*Hours*
APPROVED ELECTIVE(S)		3
PTFE 4100	CHEM. PROCESSING OF TEXTILE MATERIALS	2
PTFE 4122	TEXTILE CHEMISTRY LAB	1
PTFE 4110	POLYMER & FIBER ENGINEERING DESIGN I	3
SOCIAL SCIENCE ELECTIVE(S)		3
ETHICS ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Fourth Year - Second Semester

Course Number/Name		*Hours*
PTFE 4210	POLYMER & FIBER ENGINEERING DESIGN II	3
PTFE 4761	INDUSTRIAL CONTROLS & MANUFACTURING	3
HUMANITIES ELECTIVE(S)		3
APPROVED ELECTIVE(S)		3
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

TOTAL PROGRAM HOURS = 127 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Bachelor of Science in Polymer and Fiber Engineering – Polymer Track (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
MATH 1501	CALCULUS I	4
CHEM 1310	GENERAL CHEMISTRY I	4
ENGL 1101	ENGLISH COMPOSITION I	3
CS 1371	COMPUTING FOR ENGINEERS	3
PTFE 1100	INTRO. TO THE POLYMER, FIBER, TEXTILE, & FABRICATED PRODUCTS ENTERPRISES	1
WELLNESS		2
TOTAL SEMESTER HOURS		17

First Year - Second Semester

Course Number/Name		*Hours*
MATH 1502	CALCULUS II	4
CHEM 1311	INORGANIC CHEMISTRY I	3
ENGL 1102	ENGLISH COMPOSITION II	3
PHYS 2211	INTRODUCTORY PHYSICS I	4
ECON 2100 or 2105 or 2106		3
TOTAL SEMESTER HOURS		17

Second Year - First Semester

Course Number/Name		*Hours*
MATH 2401	CALCULUS III	4
PHYS 2212	INTRODUCTORY PHYSICS II	4
CEE 2020	STATICS & DYNAMICS	3
CHEM 2311	ORGANIC CHEMISTRY I	3
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		17

Second Year - Second Semester

Course Number/Name		*Hours*
MATH 2403	DIFFERENTIAL EQUATIONS	4
CHEM 3411	PHYSICAL CHEMISTRY I	3
CEE 3030	STRENGTH OF MATERIALS	3
PTFE 2200	STRUCTURE & PROPERTIES OF FIBERS & POLYMERS	3
CHEM 2312	ORGANIC CHEMISTRY II	3
TOTAL SEMESTER HOURS		16

Third Year - First Semester

Course Number/Name		*Hours*
MSE 2001	PRINCIPLES & APPLICATIONS OF ENGINEERING MATERIALS	3
ECE 3710	CIRCUITS & ELECTRONICS	2
PTFE 4775	POLYMER SCIENCE & ENGINEERING I	3
ISYE 3025	ESSENTIALS OF ENGINEERING ECONOMY	1
ECE 3741	INSTRUMENTATION & ELECTRONICS LAB	1
ME 3340	FLUID MECHANICS	3
CEE/MATH/ISYE 3770	STATISTICS & APPLICATIONS	3
TOTAL SEMESTER HOURS		16

Third Year - Second Semester

Course Number/Name		*Hours*
SOCIAL SCIENCE ELECTIVE(S)		3
HUMANITIES ELECTIVE(S)		3
PTFE 3210	FUNDAMENTALS OF TRANSPORT	3
PTFE 4776	POLYMER SCIENCE & ENGINEERING II	3
PTFE 3230	POLYMER & FIBER PROCESSING	3
LCC 3401	TECHNICAL COMMUNICATION PRACTICES	2
TOTAL SEMESTER HOURS		17

Fourth Year - First Semester

Course Number/Name		*Hours*
APPROVED ELECTIVE(S)		4
PTFE 4140	POLYMER SOLUTIONS & SURFACES	3
PTFE 4141	POLYMER CHARACTERIZATION	4
PTFE 4110	POLYMER & FIBER ENGINEERING DESIGN I	3
TOTAL SEMESTER HOURS		14

Fourth Year - Second Semester

Course Number/Name		*Hours*
PTFE 4210	POLYMER & FIBER ENGINEERING DESIGN II	3
PTFE 4761	INDUSTRIAL CONTROLS & MANUFACTURING	3
ETHICS ELECTIVE(S)		3
APPROVED ELECTIVE(S)		3
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

TOTAL PROGRAM HOURS = 127 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Electives

Humanities/Social Sciences/Modern Languages Electives

A total of twelve credit hours of humanities and twelve credit hours of social sciences are required. Humanities consists of ENGL 1101, ENGL 1102, a three-hour humanities elective*, and an ethics course (PST 3105, 3109, 3127, or 4176). Social sciences consists of a U.S. history/government course (HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200), ECON 2100, and six hours of general social science*.

* See pages 35-36 for a list of acceptable courses.

Approved Electives

These electives must be approved by the School.

Graduate Programs

The School of Polymer, Textile, and Fiber Engineering offers graduate programs leading to the degrees Master of Science, Master of Science in Polymers (Polymer Materials Science or Polymer Chemistry track), and Doctor of Philosophy. Ph.D. studies in the field of polymers may follow either the Polymer Materials Science or the Polymer Chemistry track. Students holding an undergraduate degree in any one of several fields of science or engineering may qualify for admission. A textile-specific undergraduate degree is not a requirement for admission. Each student pursues an individually structured program. The School participates in the Graduate Course Option Program (see page 32).

Current undergraduate students may participate in the five-year B.S./M.S. program offered by the School. Georgia Tech undergraduate students may be admitted into the program upon completion of thirty semester credit hours at Georgia Tech and attaining a GPA of 3.5 or higher. Students must maintain a 3.0 GPA to continue in the program.

The M.S. and Ph.D. programs encompass advanced study and research in polymer synthesis, mechanics of structured fibrous materials, process dynamics, dye/chemical transport, heat transfer, fiber formation-structure-property relationships, properties of fibrous materials, polymer flow, environmental issues, sports materials, computer process control, composites, and nonwovens. The school has a variety of active research programs in which students participate.

Facilities

The School of Polymer, Textile, and Fiber Engineering is centered in the Manufacturing Related Disciplines Complex I Building, a modern classroom and laboratory facility. Well-equipped laboratories are also available for synthesis as well as chemical and physical characterization of polymers, fibers, and EFSs. Specialized equipment is available for, among others, fabric flammability studies, polymer environmental stability experiments, polymer synthesis, fiber-reinforced composite formation and testing, imaging, carbon and other high-performance fiber development, electrostatic chemical deposition, sports physiology, energy conservation, and water pollution studies. Machine shop and instrumentation facilities with supporting technicians are also available.

Courses of Instruction

Figures entered below the course number and title of the course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course. An asterisk (*) denotes prerequisite courses that may be taken concurrently.

POLYMER, TEXTILE, AND FIBER ENGINEERING

PTFE 1100. Introduction to the Polymer, Fiber, Textile, and Fabricated Products Enterprises
0-3-1.
Prerequisite(s): CHEM 1310 and MATH 1501
Introduction to and overview of the breadth and depth of the polymer, fiber, textile, and fabricated products manufacturing complex, its infrastructure, resources, opportunities, and career paths.

PTFE 2200. Structure and Properties of Fibers and Polymers
2-3-3.
Prerequisite(s): CHEM 1310 and MATH 1501
The micro and macro structure of fibers are examined. Structure property relationships will be covered, and various properties of both natural and synthetic fibers will be discussed.

PTFE 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

PTFE 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

PTFE 3200. Yarn and Fabric Formation
3-0-3.
Prerequisite(s): CEE 2020 and PTFE 2200
Principles of yarn formation, weaving preparation and weaving, modern processing technologies, and product structure-property relationship.

PTFE 3210. Fundamentals of Transport in Polymer and Fiber Processes and Structures
3-3-3.
Prerequisite(s): (CHEM 3411 or ME 3322) and (MATH 2403 or MATH 2413)
An introduction to heat and mass transfer, psychrometrics, and flow through porous media, emphasizing applications to polymers, fibers, and textiles.

PTFE 3220. Textile Operations and Management Methods
3-0-3.
Prerequisite(s): PTFE 3200 or PTFE 3210 or PTFE 4720
Principles and applications of production and operations management to the textile enterprise, including process flow analysis, production planning and scheduling, optimization, quality management, and facilities planning.

PTFE 3221. Textile Formation and Testing
1-3-2.
Prerequisite(s): (PTFE 3200 or PTFE 4723) and (ISYE 3770 or MATH 3770)
Plant layout and processing equipment for yarn and fabric formation. Laboratory testing on yarns, fabrics, and carpet. Data analysis.

PTFE 3230. Polymer and Fiber Processing
3-0-3.
Prerequisite(s): PTFE 3210 and (CHBE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or PTFE 4775 or ME 4777 or MSE 4777
Discussion of the principles of fiber formation from polymers including rheology, mechanics, energetics, phase transition, and polymer structure. High-performance fiber processing, and plastics processing.

PTFE 3720. Introduction to the Fiber Enterprise
3-0-3.
This course approaches the manufacture of engineered fibrous structures from a manager's viewpoint. The student will receive a working knowledge and understanding of the various processes in manufacturing fibers and fibrous structures from yarns to fiber optics for telecommunications. Guest lectures from industry representatives and plant trips will enhance understanding.

PTFE 4020. Textile Management Internship
0-3-1.
Students will participate in an internship at an industrial site where they will receive management training and be involved with corporate activities such as sales, marketing, management, and human resources.

PTFE 4043. Safety and Ethics
1-0-1.
Principles of ethics and safety are presented. The legal requirements for chemical usage and worker safety are discussed.

PTFE 4100. Chemical Processing of Textile Materials
2-0-2.
Prerequisite(s): PTFE 2200
The chemical, thermal, and mechanical processes used in the preparation, coloration, and finishing of textile surfaces.

PTFE 4101. Carpet Technology
2-0-2.
Prerequisite(s): PTFE 2200
A study of materials and production systems used in carpet manufacturing. Carpet structures and performance characteristics, and industry structure and markets are examined.

PTFE 4102. Nonwovens Technology
2-0-2.
Prerequisite(s): PTFE 2200
A review of the principles of nonwoven processes. Review of the machinery requirements for the most commonly produced structures is followed by an analysis of the structure-property relationships of nonwoven fabrics.

PTFE 4103. Knitting Technology
2-0-2.
Prerequisite(s): PTFE 2200
An overview of warp and weft knitting processes. Review of the machinery requirements and analysis of structure-property relationships of knit fabrics.

PTFE 4104. Industrial Textiles
2-0-2.
Prerequisite(s): PTFE 3200
Design, structures, properties, and processes of textiles for industrial applications.

PTFE 4105. Survey of the Apparel Industry
2-0-2.
Prerequisite(s): PTFE 2200
Study of processes in manufacturing of apparel including sourcing options available nationally and internationally. Includes the analysis of the stages of production, marketing, and distribution.

PTFE 4106. Science of Color
2-3-3.
Prerequisite(s): CHEM 1311 and PHYS 2212
The physical, chemical, and biological principles involved in the perception, measurement, and specification of color and its applications.

PTFE 4107. Applications of Mechanics of Textile Structures
2-0-2.
Prerequisite(s): CEE 3030 and PTFE 3200
Applications of mechanics of yarns, fabrics, and other flexible bodies, including yarn and fabric geometry, response to tensile and bending deformations, and fabric shear and drape.

PTFE 4108. Textile Production Economics: A Global Perspective
2-0-2.
Prerequisite(s): ECON 2100 or ECON 2105
A PTFE elective course designed to explore the factor costs of production across seven countries within the context of industry globalization drivers.

PTFE 4110. Polymer and Fiber Engineering Design I
3-3-3.
Prerequisite(s): PTFE 3200 or PTFE 3230 or PTFE 3221*
A design course covering the principles of concurrent product/process design and development. Team-based projects will explore product/process design and development in the polymers, fibers, and areas of polymers and textiles.

PTFE 4122. Textile Chemistry Laboratory
0-3-1.
Prerequisite(s): CHEM 1310 and MATH 1501
Laboratory course in preparation, colorization, and finishing of textiles.

PTFE 4140. Polymer Solutions and Surfaces
3-0-3.
Prerequisite(s): CHEM 3411 and (CHBE 4775 or CHEM 4775 or PTFE 4775 or ME 4775 or MSE 4775 or PTFE 4777 or ME 4777
Physical chemistry of polymer solutions, polymer miscibility, adsorptions, sorptions, plasticization, molecular weights, molecular weight distributions. Study of polymer surfaces.

PTFE 4141. Instrumental Methods of Polymer Characterization
3-3-4.
Prerequisite(s): CHEM 3411 and (CHBE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or PTFE 4775)
Polymer characterization using thermomechanical, scattering, and microscopy, as well as spectroscopy techniques.

PTFE 4210. Polymer and Fiber Engineering Design II
0-9-3.
Prerequisite(s): PTFE 4110
A team problem-solving approach is used to work on a project developed in cooperation with a textile company. Weekly communications, both oral and written, are required.

PTFE 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

PTFE 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

PTFE 4720. Fiber Processing for Managers
3-0-3.
Prerequisite(s): PTFE 3720
Fundamental understanding of the processing of fibers into engineered structures such as yarns and fabrics (woven, knitted, tufted, and nonwoven). Medical products to space suits will be discussed.

PTFE 4721. Fabric Processing for Color and Performance
3-0-3.
Prerequisite(s): PTFE 4720*
Aesthetic and/or physical properties of engineered fibrous structures are changed dramatically by chemical treatments including coloration. The student will receive a basic understanding of the various processes that provide fabrics a silky feel to dazzling colors.

PTFE 4723. Properties of Textile Materials
2-0-2.
Prerequisite(s): PTFE 4720 and (MATH 3770 or ISYE 3770 or MGT 2250)
Mechanics of yarns, fabrics, and other flexible bodies, including yarn and fabric geometry, response to tensile and bending deformations, and fabric shear and drape.

PTFE 4761. Industrial Controls and Manufacturing
2-3-3.
Prerequisite(s): ECE 3710
Students are introduced to industrial controls and the fundamentals of manufacturing with hands-on experience based on lab projects using industry software and hardware for communications and control. Crosslisted with ECE 4761.

PTFE 4775. Polymer Science and Engineering I
3-0-3.
Prerequisite(s): CHEM 2312 and PTFE 2200 and (CHEM 3411 or ME 3322)
An introduction to the chemistry, structure, and formation of polymers, physical states and transitions, physical and mechanical properties of polymer fluids and solids. Crosslisted with CHE, CHEM, ME, and MSE 4775.

PTFE 4776. Polymer Science and Engineering II: Analysis, Processing, and Laboratory
2-3-3.
Prerequisite(s): CHBE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or PTFE 4775 or ME 4777 or MSE 4777 or PTFE 4777
Polymer fabrication processes and methods of characterization and identification of polymers are presented. Experiments in polymerization, processing, and property evaluation of polymers. Crosslisted with CHE, CHEM, ME, and MSE 4776.

PTFE 4777. Introduction to Polymer Science and Engineering
3-0-3.
Prerequisite(s): MSE 2001 and (CHEM 2311 or CHEM 1315)
An introduction to the structure and formation of polymers, physical states and transitions, physical and mechanical properties of polymer fluids and solids, and processing of polymers. Crosslisted with MSE and ME 4777.

PTFE 4791. Mechanical Behavior of Composites
3-0-3.
Prerequisite(s): ME 3201
Stress-strain behavior of composites, property of matrix and reinforcing materials, mechanics of fiber-reinforced composites, lamina and laminate analysis, and mechanical performance. Crosslisted with AE, CEE, CHE, ME, and MSE 4791.

PTFE 4793. Composite Materials and Process
3-0-3.
Prerequisite(s): CHEM 1310 and PHYS 2212
Basic principles of selection and design of composite materials and their manufacturing and testing. Cost factors. Laboratory exercises on manufacturing and tests. Crosslisted with AE, CEE, CHE, ME, and MSE 4793.

PTFE 4794. Composite Materials and Manufacturing
3-3-4.
Prerequisite(s): CHEM 1310 and PHYS 2212
Basic principles of selection and design of composite materials and their manufacturing and testing. Cost factors. Laboratory exercises on manufacturing and tests. Crosslisted with AE, CEE, CHE, ME, and MSE 4794.

PTFE 4801, -02, -03, -04. Special Topics
Class and credit hours equal last digit in course number.
Topics of special interest in polymers, fibers, and textiles not included in the regular offerings.

PTFE 4901, -02, -03. Special Problems
Credit hours to be arranged.
Special problems involving analytical and/or experimental investigations in the fields of polymers, fibers, and textiles.

PTFE 6100. Mechanics of Fibrous Materials
3-0-3.
Discussion of deformation of anisotropic fibrous materials; anisotropy and critical phenomena in the mechanical behavior of fibrous materials; models for viscoelastic behavior of fibrous materials.

PTFE 6101. Dynamics of Textile Processing I: Dry Processing
3-0-3.
Prerequisite(s): MATH 2403
Features of modern weaving, weaving preparatory, and spinning equipment, and their interaction with fibrous materials are discussed at length.

PTFE 6200. Industrial Chemical Processes
3-0-3.
Prerequisite(s): CHEM 2312
The industrial chemical processes for the production of chemicals, monomers, and textile auxiliaries are covered. Chemical textile auxiliaries are discussed in relation to theory and applications.

PTFE 6201. Dye Synthesis
3-0-3.
Prerequisite(s): CHEM 2312
The chemistry of the synthesis and structures of dyes is covered. Color of dyes is discussed in relation to structure and molecular orbital theory.

PTFE 6202. Physical Chemistry of Polymer Sorption
3-0-3.
Prerequisite(s): CHEM 3411 and PTFE 3003 and (PTFE 4775 or CHBE 4775 or CHEM 4775 or ME 4775 or MSE 4775)
Detailed description of sorption by polymers, emphasizing physico-chemical laws of transport of chromophores through solution, interfaces, and solid state.

PTFE 6301. Natural Polymers
3-0-3.
The structures and properties of natural products are presented. Production of cellulose and proteins is discussed.

PTFE 6750. Preparation and Reactions of Polymers
3-0-3.
Prerequisite(s): CHBE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or PTFE 4775
A detailed treatment of the reactions involved in the synthesis of both human-made and natural polymers, including preparation and degradative reactions of polymer systems. Crosslisted with CHE and CHEM 6750.

PTFE 6751. Physical Chemistry of Polymer Solutions
3-0-3.
Prerequisite(s): CHEM 3411 and (CHBE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or PTFE 4775) or (ME 4777 or MSE 4777)
Study of polymer solutions, polymer miscibility, adsorptions, sorptions, plasticization, molecular weights, molecular weight distributions, and interfacial phenomena using thermodynamics and statistical mechanics. Crosslisted with CHE, CHEM, and MSE 6751.

PTFE 6752. Polymer Characterization
3-3-4.
Prerequisite(s): CHEM 3411 and (CHBE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or PTFE 4775) or (ME 4777 or MSE 4777)
This course introduces the student to surface, near-surface, and structural methods of polymer characterization. Specialized techniques critical to physical structure are emphasized. Crosslisted with CHE, CHEM, and MSE 6752.

PTFE 6755. Theoretical Chemistry of Polymers
3-0-3.
Prerequisite(s): CHEM 6471 or (CHBE 6751 or CHEM 6751 or MSE 6751 or PTFE 6751)
Thermodynamics and microscopic dynamics of polymers. Fundamental concepts, including scaling concepts, governing anisotropy of polarizability, phase transitions, morphology, time-dependent correlations, etc. are discussed. Crosslisted with CHEM and MSE 6755.

PTFE 6759. Materials in Environmentally Conscious Design and Manufacturing
3-0-3.
Covers the environmental impact of materials choices and quantitative measure of life-cycle assessment and environmental burden. The Natural Step philosophy will be used as a model for the overall approach. Crosslisted with ME and MSE 6759.

PTFE 6768. Polymer Structure, Physical Properties, and Characterization
3-0-3.
Prerequisite(s): CHBE 4776 or CHEM 4776 or ME 4776 or MSE 4776 or PTFE 4776
Formulations and analysis of molecular and phenomenological models of elastic and viscoelastic behavior, development and description of structure, and fundamental aspects of structure-property relations. Crosslisted with MSE, CHE, and ME 6768.

PTFE 6778. Introduction to Biomaterials
3-0-3.
Introduction to a variety of biomaterials and their biomedical applications. Crosslisted with CHE and BMED 6778.

PTFE 6795. Mathematical, Statistical, and Computational Techniques in Materials Science
3-0-3.
Emphasizes the fundamental physical, analytical, and mathematical techniques commonly encountered in materials engineering including stress and strain, crystallographic and orientation transformations, X-ray, TEM, and solid-state concepts. Crosslisted with MSE and ME 6795.

PTFE 6796. Structure-Property Relationships in Materials
3-0-3.
Introduction to the multi-scale structure effects on material properties. For MSE students, the course will prepare students for future in-depth courses. For non-MSE, students the course will provide a background in materials and may serve as part of the program of study for a minor in materials. Crosslisted with ME and MSE 6796.

PTFE 6797. Thermodynamics and Kinetics of Microstructural Evolution
3-0-3.
The reduction of chemical-free energy, strain energy, and interfacial energy control the kinetics of diffusional transformations. These factors are explored from the point of view of processing and stability of the microstructure during service. Crosslisted with MSE and ME 6797.

PTFE 6998. Safety and Ethics
1-0-1.
Principles of ethics and safety are presented. The legal requirements for chemical usage and worker safety are discussed.

PTFE 6999. Textile and Fiber Engineering Graduate Research Colloquium
1-0-1.
Graduate students discuss their research work and special topics in a structured setting with their research groups and research advisors.

PTFE 7000. Master's Thesis
Credit hours to be arranged.

PTFE 7100. Advanced Principles of Fiber Formation, Structure, and Properties
3-0-3.
Prerequisite(s): MATH 2403 and (CHBE 4776 or PTFE 4776 or CHEM 4776 or ME 4776 or MSE 4776)
Principles and theories of structure, properties, and formation of fibers; structural models, physical properties, rheology, mechanics, energetics, and phase transitions in fiber formation processes.

PTFE 7771. Mechanics of Polymer Solids and Fluids
3-0-3.
Prerequisite(s): (CHBE 4776 or CHEM 4776 or ME 4776 or MSE 4776 or PTFE 4776) and (CHBE 6768 or ME 6768 or MSE 6768)
Continuum of solids and fluids; mechanics of deformation of anisotropic polymers; yield, breaking, and fatigue; non-Newtonian viscous and viscoelastic behavior of polymer fluids. Crosslisted with CHE, ME, and MSE 7771.

PTFE 7791. Damage, Failure, and Durability of Composite Material
3-0-3.
Prerequisite(s): AE 4791 or CEE 4791 or CHBE 4791 or ME 4791 or MSE 4791 or PTFE 4791
Provides knowledge of the fundamental concepts and methods related to analysis and assessment of damage, failure, and durability of composite material. Crosslisted with AE, CHE, CEE, ME, and MSE 7791.

PTFE 7792. Advanced Mechanics of Composites
3-0-3.
Prerequisite(s): AE 4791 or CEE 4791 or CHBE 4791 or ME 4791 or MSE 4791 or PTFE 4791
Anisotropic elasticity, failure theories, hygrothermal behavior, 3-D analysis of laminates, thick laminates, free-edge effects, stress concentrations, joints, creep and fracture of composites, and advanced topics. Crosslisted with AE, CEE, CHE, ME, and MSE 7792.

PTFE 7793. Manufacturing of Composites
3-0-3.
Prerequisite(s): AE 4793 or CEE 4793 or CHBE 4793 or ME 4793 or MSE 4793 or PTFE 4793
Major manufacturing techniques of metal-, ceramic-, and polymer-matrix composites. Modeling of processes with emphasis on fundamental mechanisms and effects. Crosslisted with AE, CEE, CHE, ME, and MSE 7793.

PTFE 7999. Preparation for Doctoral Qualifying Examinations
1-0-1.

PTFE 8001, -02. Textile and Fiber Engineering Seminar
1-0-1.
Graduate students discuss their research work. Invited speakers with diverse backgrounds describe their experiences, entrepreneurial ventures, and research challenges.

PTFE 8801, -02, -03, -04. Special Topics
Class and credit hours equal last digit in course number.
Graduate-level special topic offerings of current interest in polymers, fibers, and textiles, not included in regular courses.

PTFE 8813. Special Topics
2-3-3.
Graduate-level special topic offerings of current interest in polymers, fibers, and textiles not included in regular courses.

PTFE 8814. Special Topics
3-3-4.
Graduate-level special topic offerings of current interest in polymers, fibers, and textiles not included in regular courses.

PTFE 8900, -01, -02. Special Problems
Credit hours to be arranged.
Graduate-level special problems involving research investigations in the fields of polymers, fibers, and/or textiles.

PTFE 8997. Teaching Assistantship
Credit hours to be arranged.
For students holding a teaching assistantship.

PTFE 8998. Research Assistantship
Credit hours to be arranged.
For students holding graduate research assistantships.

PTFE 9000. Doctoral Thesis
Credit hours to be arranged.

An asterisk (*) denotes prerequisite courses that may be taken concurrently.

Ivan Allen College of Liberal Arts

www.iac.gatech.edu

This version of the *General Catalog* was current as of the date of printing in May 2005. For the most up-to-date version, visit **www.catalog.gatech.edu**. In addition, this is the final printed version of the *General Catalog*. Beginning in May 2006 it will be available online only.

Established in 1990
Location: 781 Marietta Street
Telephone: 404.385.1493
Fax: 404.894.8573
Student Services Web site:
www.iac.gatech.edu/students

Dean–Sue V. Rosser; *Associate Deans*–Richard P. Barke, Ann Bostrom.

General Information

The Ivan Allen College, named after a visionary leader who served as mayor of Atlanta during a time associated with the creation of the "New South," is a unique configuration of six schools as well as Georgia Tech's three ROTC departments. The College was established in 1990 in order to broaden the range of majors available to Tech students. The degree programs are unique in the ways they link the study of the social sciences and humanities to the world of technology and science. IAC majors prepare students for a wide range of professional careers, including leadership in government, business, and technology.

Study in these fields also prepares students for advanced study in professional programs in law, medicine, international affairs, public policy, and new media as well as graduate study in the humanities and social sciences. The success of these new programs has resulted in a realization of the close connections between service and progress expressed in Georgia Tech's motto.

The Ivan Allen College offers nine undergraduate degrees, five master's degrees, and three doctoral degrees. Detailed descriptions of these programs can be found under the appropriate school headings. In addition to its degree programs, the Ivan Allen College provides all Tech students with instruction in the humanities and social sciences. The College's course offerings and its certificate and minor programs enable students, regardless of major, to broaden their educational experience and to better understand the cultural underpinnings of their professional and personal lives and the international context in which they live and work.

Getting Started

Freshmen may enter directly into any of the undergraduate programs of the College, or they may enter as Undecided Ivan Allen College (UIAC) students. In any case, the course requirements for the first year of study are virtually identical among all the majors in the College, so it is easy to postpone or change a decision about the major within the first year.

Certificate Programs and Minor Programs

The schools of the Ivan Allen College offer certificates and minor programs in a variety of areas for students who wish to concentrate on coursework in areas of particular interest. All certificates require a minimum of twelve semester hours of concentration. Minor programs require at least eighteen hours of concentration (at least twelve hours taken at the 3000 level or above). Faculty advisors in the relevant schools should be consulted for details.

School of Economics
- Economics

School of History, Technology, and Society
- African American Studies (with Literature, Communication, and Culture)
- Asian Affairs (with International Affairs)
- European Affairs (with International Affairs)
- History
- Sociology
- Women, Science, and Technology (with Literature, Communication, and Culture)

The Sam Nunn School of International Affairs
- Asian Affairs (with History, Technology, and Society)
- European Affairs (with History, Technology, and Society)
- International Affairs

School of Literature, Communication, and Culture
- African American Studies (with History, Technology, and Society)
- American Literature
- Film Studies
- Literary and Cultural Studies
- Performance Studies
- Women, Science, and Technology (with History, Technology, and Society)

School of Modern Languages
- Chinese
- French
- German
- Japanese
- Linguistics
- Russian
- Spanish

School of Public Policy
- Law, Science, and Technology
- Philosophy, Science, and Technology
- Political Science
- Pre-Law
- Public Policy

Department of Air Force Aerospace Studies

www.afrotc.gatech.edu

Established in 1946
Location: D. M. Smith Building, Bobby Dodd Way
Telephone: 404.894.4919
Fax: 404.894.1890

Department Head and Professor–Col. Terry McCarthy; *Assistant Professors*–Maj. Richard Isherwood, Capt. Marcus Smith, Capt. Pamela Woods.

General Information

The Air Force Reserve Officer Training Corps (AFROTC) program provides professional military and academic training for students seeking a commission in the United States Air Force. Though academic classes are open to all students without obligation, the AFROTC program for those pursuing a commission includes two phases. The first two years constitute the General Military Course (GMC) and the last two years, the Professional Officer Course (POC).

Undergraduate Program

Four-year Program

Students entering the four-year program enroll in AFROTC courses in the same manner in which they register for other undergraduate courses. A formal application is not required. Students enrolled in the GMC incur no military obligation unless they are on an AFROTC scholarship. Those students desiring to become commissioned officers in the Air Force must compete for entry into the POC, which is normally taken during the last two years of college. In the summer, between the sophomore and junior years, cadets normally attend a four-week field training session conducted at an Air Force base. Students accepted for the POC become members of the Air Force Reserve and receive a monthly tax-free subsistence allowance of $350 in their junior academic year and $400 in their senior academic year.

Two-year Program

The two-year program and the last two years of the four-year program are identical in academic content. The basic requirement for entry into this program is that the student must have two academic years remaining in school. This may be at the undergraduate or graduate level or a combination of the two. Selection of two-year applicants require that students major in technical/engineering areas in addition to other criteria. Candidates must also successfully complete a six-week field training course at an Air Force base during the summer preceding their enrollment and be recommended to enter the POC upon their return to campus.

Ivan Allen College of Liberal Arts

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Dean–Sue V. Rosser; *Associate Deans*–Richard P. Barke, Ann Bostrom.

General Information

The Ivan Allen College, named after a visionary leader who served as mayor of Atlanta during a time associated with the creation of the "New South," is a unique configuration of six schools as well as Georgia Tech's three ROTC departments. The College was established in 1990 in order to broaden the range of majors available to Tech students. The degree programs are unique in the ways they link the study of the social sciences and humanities to the world of technology and science. IAC majors prepare students for a wide range of professional careers, including leadership in government, business, and technology.

Study in these fields also prepares students for advanced study in professional programs in law, medicine, international affairs, public policy, and new media as well as graduate study in the humanities and social sciences. The success of these new programs has resulted in a realization of the close connections between service and progress expressed in Georgia Tech's motto.

The Ivan Allen College offers nine undergraduate degrees, five master's degrees, and three doctoral degrees. Detailed descriptions of these programs can be found under the appropriate school headings. In addition to its degree programs, the Ivan Allen College provides all Tech students with instruction in the humanities and social sciences. The College's course offerings and its certificate and minor programs enable students, regardless of major, to broaden their educational experience and to better understand the cultural underpinnings of their professional and personal lives and the international context in which they live and work.

Getting Started

Freshmen may enter directly into any of the undergraduate programs of the College, or they may enter as Undecided Ivan Allen College (UIAC) students. In any case, the course requirements for the first year of study are virtually identical among all the majors in the College, so it is easy to postpone or change a decision about the major within the first year.

Certificate Programs and Minor Programs

The schools of the Ivan Allen College offer certificates and minor programs in a variety of areas for students who wish to concentrate on coursework in areas of particular interest. All certificates require a minimum of twelve semester hours of concentration. Minor programs require at least eighteen hours of concentration (at least twelve hours taken at the 3000 level or above). Faculty advisors in the relevant schools should be consulted for details.

School of Economics
- Economics

School of History, Technology, and Society
- African American Studies (with Literature, Communication, and Culture)
- Asian Affairs (with International Affairs)
- European Affairs (with International Affairs)
- History
- Sociology
- Women, Science, and Technology (with Literature, Communication, and Culture)

The Sam Nunn School of International Affairs
- Asian Affairs (with History, Technology, and Society)
- European Affairs (with History, Technology, and Society)
- International Affairs

School of Literature, Communication, and Culture
- African American Studies (with History, Technology, and Society)
- American Literature
- Film Studies
- Literary and Cultural Studies
- Performance Studies
- Women, Science, and Technology (with History, Technology, and Society)

School of Modern Languages
- Chinese
- French
- German
- Japanese
- Linguistics
- Russian
- Spanish

School of Public Policy
- Law, Science, and Technology
- Philosophy, Science, and Technology
- Political Science
- Pre-Law
- Public Policy

Department of Air Force Aerospace Studies

www.afrotc.gatech.edu

Established in 1946
Location: D. M. Smith Building, Bobby Dodd Way
Telephone: 404.894.4919
Fax: 404.894.1890

Department Head and Professor–Col. Terry McCarthy; *Assistant Professors*–Maj. Richard Underwood, Capt. Marcus Smith, Capt. Pamela Woods.

General Information

The Air Force Reserve Officer Training Corps (AFROTC) program provides professional military and academic training for students seeking a commission in the United States Air Force. Though academic classes are open to all students without obligation, the AFROTC program for those pursuing a commission includes two phases. The first two years constitute the General Military Course (GMC) and the last two years, the Professional Officer Course (POC).

Undergraduate Program

Four-year Program

Students entering the four-year program enroll in AFROTC courses in the same manner in which they register for other undergraduate courses. A formal application is not required. Students enrolled in the GMC incur no military obligation unless they are on an AFROTC scholarship. Those students desiring to become commissioned officers in the Air Force must compete for entry into the POC, which is normally taken during the last two years of college. In the summer, between the sophomore and junior years, cadets normally attend a four-week field training session conducted at an Air Force base. Students accepted for the POC become members of the Air Force Reserve and receive a monthly tax-free subsistence allowance of $350 in their junior academic year and $400 in their senior academic year.

Two-year Program

The two-year program and the last two years of the four-year program are identical in academic content. The basic requirement for entry into this program is that the student must have two academic years remaining in school. This may be at the undergraduate or graduate level or a combination of the two. Selection of two-year applicants require that students major in technical/engineering areas in addition to other criteria. Candidates must also successfully complete a six-week field training course at an Air Force base during the summer preceding their enrollment and be recommended to enter the POC upon their return to campus.

AFROTC Scholarship Program

AFROTC college scholarships are available on a competitive basis to qualified cadets in the two- and four-year programs. Scholarships cover up to $15,000 in tuition, matriculation, health services, student activities fees, and provide a $600 book allowance. All scholarship cadets receive a tax-free subsistence allowance of $250-$400 per month during the academic year depending on the cadet course level. Additional scholarships are available to sophomores and above meeting minimum eligibility requirements.

Leadership Laboratory

Leadership Laboratory is a separate course requiring two hours per week throughout the cadet's enrollment in AFROTC. It involves a study of Air Force customs and courtesies, drill and ceremony, professional development opportunities in the Air Force, and the life and work of an Air Force junior officer. Students develop their leadership potential in a practical, supervised laboratory, which may include field trips to Air Force installations and presentations by Air Force personnel.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

AIR FORCE AEROSPACE STUDIES

AS 1110. Foundations of the Air Force I
1-0-1.
A survey course designed to introduce students to the United States Air Force and Air Force Reserve Officer Training Corps. Topics include: military customs and courtesies, Air Force officer opportunities, and an introduction to communication skills. Leadership Laboratory is mandatory for AFROTC cadets, and complements this course by providing cadets with followership experiences.

AS 1111. Leadership Laboratory
0-2-1.
Introduction to the customs, traditions, and courtesies of the Air Force through drill and ceremonies, guest speakers, physical fitness activities, sports, and base visits.

AS 1120. Foundations of the Air Force II
1-0-1.
A survey course designed to introduce students to the United States Air Force and Air Force Reserve Officer Training Corps. Featured topics include: mission and organization of the Air Force, officership, and professionalism. Leadership Laboratory is mandatory for AFROTC cadets and complements this course.

AS 1121. Leadership Laboratory
0-2-1.
Continuation of AS 1111. Emphasis on role and responsibilities of an Air Force junior officer. Air Force customs and courtesies, drill and ceremonies, and introduction to the military environment.

AS 2210. Evolution of U.S. Air and Space Power I
1-0-1.
This course provides the students with a knowledge level of understanding for the general element and employment of air and space power, and is designed to examine general aspects of it through a historical perspective covering a time period from the first balloons and dirigibles to the beginning of the Vietnam War. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followership experiences.

AS 2211. Leadership Laboratory
0-2-1.
Emphasizes development of techniques used to direct and inform. Prepares students for field training.

AS 2220. Evolution of U.S. Air and Space Power II
1-0-1.
This course is a continuation of AS 2210 and examines the use of air and space power from Southeast Asia to the space age global positioning systems of the Persian Gulf War. In addition the students will continue to discuss the importance of the Air Force Core Values with the use of operational examples and historical Air Force leaders, and will continue to develop their communication skills. Leadership Laboratory is mandatory for AFROTC cadets and complements this course.

AS 2221. Leadership Laboratory
0-2-1.
Continuation of AS 2211. Emphasis on preparation for field training.

AS 3310. Leadership Studies I
3-0-3.
A study of leadership, management fundamentals, professional knowledge, and communication skills required of an Air Force junior officer. Case studies are used to examine Air Force leadership and management situations as a means of demonstrating and exercising practical application of the concepts being studied. A mandatory Leadership Laboratory for AFROTC cadets complements this course.

AS 3311. Leadership Laboratory
0-2-1.
Supervisory practice and exercise of leadership functions in controlling and directing activities of the cadet corps. Practical development of leadership potential.

AS 3320. Leadership Studies II
3-0-3.
Examine the Air Force personnel and evaluation systems, leadership ethics, and Air Force supervision and counseling techniques. A mandatory Leadership Laboratory for AFROTC cadets complements this course by providing advanced leadership experiences in office-type activities, giving students the opportunity to apply the leadership and management principles of this course.

AS 3321. Leadership Laboratory
0-2-1.
Continues AS 3311 with emphasis on supervisory and leadership skills, and advantages of an Air Force career.

AS 4410. National Security Affairs
3-0-3.
Examines the national security process, Air Force structure, and doctrine. Special topics of interest focus on civilian control of the military and joint operations with the Army, Navy, and Marines. Within this structure, continued emphasis is given to refining communication skills. A mandatory Leadership Laboratory for AFROTC cadets complements this course.

AS 4411. Leadership Laboratory
0-2-1.
Exercise of management functions in planning, supervising, and directing cadet corps activities. Emphasis on acquiring proficiency in military leadership skills.

AS 4420. Preparation for Active Duty
3-0-3.
Topics include the military as a profession, regional studies, officership, military justice, advanced leadership ethics, preparation for active duty, and current issues affecting military professionalism. A mandatory Leadership Laboratory for AFROTC cadets complements this course.

AS 4421. Leadership Laboratory
0-2-1.
Continues AS 4411. Emphasis on developing top-level management skills. Includes the planning, organizing, and implementation of cadet military training.

School of Economics

www.econ.gatech.edu

Established in 1990
Location: The Habersham Building
781 Marietta Street
Telephone: 404.894.4919
Fax: 404.894.1890
E-mail: admin@econ.gatech.edu

Chair and Professor–Patrick S. McCarthy.
Associate Chair and Associate Professor–Willie J. Belton Jr.
Professors–Thomas D. Boston, Christine P. Ries.
Associate Professors–Vivek Ghosal, Mikhail Klimenko, Usha Nair-Reichert.
Assistant Professors–Maurizio Iacopetta, Derek Kellenberg, Rehim Kilic, Haizheng Li, Mark J. McCabe.
Adjunct Professors–Parks A. Dodd, Richard Fritz, Derek Tittle.
Emeritus Professors–W. Carl Biven, Kong Chu, Marilu H. McCarty, William A. Schaffer.

General Information

The School of Economics provides high-quality programs of study leading to a Bachelor of Science degree in Economics and to a minor or certificate in Economics for students in other disciplines. The program focuses on skills and knowledge critical for a life of learning and leading to careers in management, the public sector, academics, and the professions. A degree in economics is especially appropriate for students intending to pursue advanced degrees in the social sciences and in professional schools of management, law, and public administration.

Modern economics is analytically rigorous, requiring a background in mathematics and statistics. At the same time, it is critically linked with the other social sciences and humanities, as well as to the more practical management and policy studies. The undergraduate curriculum provides a strong and broadening overview of economic thought and policy and is intended to prepare students for productive careers, for useful roles in society, and for satisfying personal lives in a technologically complex, culturally diverse world.

The School of Economics, in cooperation with the School of Modern Languages, offers a Bachelor of Science degree in Global Economics and Modern Language. The degree program offers students an opportunity to broaden their educational experience and to enhance their marketability.

The School of Economics also offers graduate courses leading to a Master of Science degree and in support of Ph.D. programs in management, public policy, industrial and systems engineering, and city and regional planning.

Certificate in Economics

The School of Economics offers a Certificate in Economics for students in all disciplines at Georgia Tech. The certificate program provides a general acquaintance with economic thought and is especially appropriate for students considering graduate work in law or business administration. The certificate program should also be attractive to students who want to apply the tools of economics toward a fuller understanding of the forces that shape the modern world.

The certificate requires a minimum of twelve semester hours of economics courses in which a grade of *C* or better is earned. At least nine hours of credit must be at the 3000 level or above. Courses required in the student's major degree program may not be used toward the certificate.

Minor in Economics

The School of Economics offers a Minor in Economics for students in all disciplines at Georgia Tech. The minor program provides a general acquaintance with economic thought and is especially valuable for students considering graduate work in law or management. It should also be attractive to students who wish to broaden their education and to understand the forces that shape the modern world.

The minor requires a minimum of eighteen semester hours in economics, of which twelve semester hours are upper-level courses (numbered 3000 or above). All courses counting toward the minor must be taken on a letter-grade basis and must be completed with an overall grade point average of at least 2.0. Courses required by name and number in a student's major degree program may not be used toward the minor.

Undergraduate Programs

Bachelor of Science

The program of study provides a thorough grounding in science, the humanities, and mathematics; a broad grasp of the tools of economic analysis and decision making; and an understanding of the institutional milieu in which tomorrow's leaders must operate. In addition, the curriculum provides ample opportunities for career-oriented studies in fields such as accounting, finance, management science, public policy, and international affairs; life-enriching studies in history and literature are also available.

Bachelor of Science in Economics (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501 CALCULUS I or MATH 1712 SURVEY OF CALCULUS		4
LAB SCIENCE (BIOL, CHEM, EAS, PHYS)		4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
FREE ELECTIVE(S)		1
TOTAL SEMESTER HOURS		15

First Year - Second Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502 CALCULUS II or MATH 1711 FINITE MATHEMATICS		4
LAB SCIENCE (BIOL, CHEM, EAS, PHYS)		4
COMPUTING REQUIREMENT		3
WELLNESS		2
TOTAL SEMESTER HOURS		16

Second Year - First Semester

Course Number/Name		*Hours*
ECON 2106	PRINCIPLES OF MICROECONOMICS	3
MGT 2250	MANAGEMENT STATISTICS or SUBSTITUTE	3
CS 1322 OBJECT-ORIENTED PROGRAMMING or SUBSTITUTE		3
ENGINEERING, SCIENCE, or MATH ELECTIVE(S)		3
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Second Year - Second Semester

Course Number/Name		*Hours*
ECON 2105	PRINCIPLES OF MACROECONOMICS	3
ECON 3161	ECONOMETRIC ANALYSIS	3
HUMANITIES ELECTIVE(S)		3
INTERNATIONAL AFFAIRS ELECTIVE(S)		3
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Third Year - First Semester

Course Number/Name		*Hours*
ECON 3110	ADVANCED MICROECONOMIC ANALYSIS	3
ECON 4160	ECONOMIC FORECASTING	3
NON-MAJOR CLUSTER ELECTIVE(S)		6
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Third Year - Second Semester

Course Number/Name		*Hours*
ECON 3120	ADVANCED MACROECONOMIC ANALYSIS	3
ECONOMICS ELECTIVE(S)		6
NON-MAJOR CLUSTER ELECTIVE(S)		3
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Fourth Year - First Semester

Course Number/Name		*Hours*
ECONOMICS ELECTIVE(S)		9
NON-MAJOR CLUSTER ELECTIVE(S)		3
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Fourth Year - Second Semester

Course Number/Name		*Hours*
ECON 4610	SEMINAR ON ECONOMIC POLICY	3
ECON 4910	INDIVIDUAL RESEARCH IN ECONOMICS	3
ECONOMICS ELECTIVE(S)		3
FREE ELECTIVE(S)		4
NON-MAJOR CLUSTER ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS
PLUS WELLNESS (2 HOURS)

Bachelor of Science in Economics and International Affairs

The primary objectives of the Bachelor of Science degree in Economics and International Affairs are to provide students with 1) a detailed understanding of economic theory and practice in the contemporary world; 2) an understanding of the global, interdependent, and multicultural environment in which they live; and 3) a set of quantitative and qualitative analytical skills centered around policy-oriented issue areas in economics and international affairs. These skills will provide graduates with the capabilities to engage in strategic planning and analysis efforts in economic and international contexts.

Bachelor of Science in Economics and International Affairs (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I or	
MATH 1712	SURVEY OF CALCULUS	4
INTA 1110	INTRO. TO INTERNATIONAL RELATIONS	3
INTA 2030	ETHICS IN INTERNATIONAL AFFAIRS	3
WELLNESS		2
TOTAL SEMESTER HOURS		15

First Year - Second Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II or	
MATH 1711	FINITE MATHEMATICS	4
INTA 2100	GREAT POWER RELATIONS	3
HIST 2111 OR 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
HTS 1031 OR 2033 OR 2036 OR 2062		3
TOTAL SEMESTER HOURS		16

Second Year - First Semester

Course Number/Name		*Hours*
ECON 2106	PRINCIPLES OF MICROECONOMICS	3
MGT 2250	MANAGEMENT STATISTICS	3
INTA 1001	ORIENTATION TO INTERNATIONAL AFFAIRS	1
INTA 2040	SCIENCE, TECHNOLOGY, AND INTERNATIONAL AFFAIRS	3
MODERN LANGUAGE ELECTIVE(S)		3
LAB SCIENCE I		4
TOTAL SEMESTER HOURS		17

Second Year - Second Semester

Course Number/Name		*Hours*
ECON 2105	PRINCIPLES OF MACROECONOMICS	3
INTA 3110	U.S. FOREIGN POLICY	3
MODERN LANGUAGE ELECTIVE(S)		3
INTA ELECTIVE(S)		3
LAB SCIENCE II		4
TOTAL SEMESTER HOURS		16

Third Year - First Semester

Course Number/Name		*Hours*
ECON 3110	ADVANCED MICROECONOMIC ANALYSIS	3
ECON 3161	ECONOMETRIC ANALYSIS	3
INTA 3203	COMPARATIVE POLITICS	3
CS 1315	INTRO. TO MEDIA COMPUTATION or	
CS 1321	INTRO. TO COMPUTING	3
NON-MAJOR CLUSTER ELECTIVE(S)*		3
TOTAL SEMESTER HOURS		15

Third Year - Second Semester

Course Number/Name		*Hours*
ECON 3120	ADVANCED MACROECONOMIC ANALYSIS	3
TECHNICAL REQUIREMENT		3
ECONOMICS ELECTIVE(S)		3
NON-MAJOR CLUSTER ELECTIVE(S)		3
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Fourth Year - First Semester

Course Number/Name		*Hours*
ECON 4350	INTERNATIONAL ECONOMICS	3
INTA 3301	INTERNATIONAL POLITICAL ECONOMY	3
INTA 4400	INTERNATIONAL STRATEGY & POLICY	3
NON-MAJOR CLUSTER ELECTIVE(S)		3
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Fourth Year - Second Semester

Course Number/Name		*Hours*
ECON 4910	INDIVIDUAL RESEARCH IN ECONOMICS	3
ECONOMICS ELECTIVE(S)		3
INTA ELECTIVE(S)		3
FREE ELECTIVE(S)		4
TOTAL SEMESTER HOURS		13

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS
PLUS WELLNESS (2 HOURS)

Bachelor of Science in Global Economics and Modern Language

In partnership with the School of Modern Languages, the School of Economics offers a Bachelor of Science in Global Economics and Modern Language, with separate concentrations in French, German, Japanese, and Spanish. Students in this program receive intensive foreign language training and learn the fundamentals of interacting with foreign societies and cultures. A detailed description of the degree program is found in the School of Modern Languages section.

Electives and Requirements

Computing Requirement

Students must complete either CS 1315, CS 1321, or a computer programming course approved as satisfying the general education requirements in computer literacy.

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Mathematics

The mathematics requirement may be satisfied by one of the following sequences: MATH 1711-2; MATH 1501-2. Students will not receive credit for MATH 1712 and either MATH 1501 or 1502.

Science and Engineering Electives

Students must complete a laboratory sequence in biology, chemistry, physics, or earth and atmospheric sciences, along with three hours of electives chosen from engineering, science, or mathematics, for a total of eleven hours.

Social Sciences Electives

All students must complete twelve hours of electives in the social sciences, including three semester hours from HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200 to satisfy state requirements regarding coursework in the history and constitutions of the United States and Georgia. Also required are nine hours from the list on pages 35-36.

Humanities Electives

Students are required to complete six hours of humanities from the list on pages 35-36.

International Elective

Any course offered by the School of International Affairs satisfies this requirement.

Cluster Electives

Students must complete at least twelve hours of credit in a planned cluster in a discipline other than economics. This requirement is most easily satisfied through a certificate program. Any other concentration must be approved by the faculty of the School of Economics. The student must earn a grade of *C* or better in these courses.

Individual Research Project

Each student is required to take ECON 4901, producing a formal research paper in the senior year.

Free Electives

Students must complete free electives (normally bearing fourteen hours of credit), bringing the number of credit hours received up to 122. Only free electives may be taken on a pass/fail basis, subject to Institute limitations.

Graduate Program

Master of Science

The School of Economics offers a Master of Science degree for those desiring to pursue economics at an advanced level. Grounded in applied economic theory and econometrics, this is a three-semester program that prepares students for professional careers in the private and public sectors as well as for more advanced training in economics doctoral programs. Although the master's curriculum is flexible in allowing students to tailor areas of specialization to their specific interests, the program is particularly well suited to those interested in industrial organization, technology, innovation, international trade, and economic development.

Core courses in the program require that students take microeconomic and macroeconomic theory, research methods, probability and statistics, and econometrics. In addition to the core, students must also complete a total of four courses that reflect two areas of concentration consistent with students' interests. An advantage of the master's program is that it allows students to complete their areas of concentration by taking courses in units outside the School of Economics, including the Sam Nunn School of International Affairs, the School of Public Policy, the School of Industrial and Systems Engineering, and the College of Architecture.

Students admitted into the master's program are also encouraged to pursue a summer internship. This allows students to apply their economic knowledge and statistical tools to problems that are encountered in professional private and public sector environments.

The Master of Science degree requires a minimum of thirty-three semester credit hours of coursework with: 1) at least twelve hours of economic theory and applied economics; 2) at least one additional quantitative methods course beyond econometrics; and 3) a master's thesis or, for a nonthesis option, one additional course offered in the School of Economics.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

ECONOMICS

ECON 2100. Economic Analysis and Policy Problems
3-0-3.
Practice in analysis of decision problems of relevance to students in public policy and personal decision areas. Issues relating to individual decisions to produce, consume, invest, and trade will be explored. Analytical approaches will enable students to use and incorporate basic elements of micro- and macro-economic analysis and to appreciate issues regarding testing and measurement. Credit not allowed for both ECON 2100 and either ECON 2105 or 2106.

ECON 2105. Principles of Macroeconomics
3-0-3.
This principles of economics course is intended to introduce students to concepts that will enable them to understand and analyze economic aggregates and evaluate economic policies. Credit not allowed for both ECON 2105 and ECON 2100.

ECON 2106. Principles of Microeconomics
3-0-3.
This principles of economics course is intended to introduce students to concepts that will enable them to understand and analyze structure and performance of the market economy. Credit not allowed for both Econ 2106 and Econ 2100.

ECON 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

ECON 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

ECON 3110. Advanced Microeconomic Analysis
3-0-3.
Prerequisite(s): ECON 2100 or (ECON 2105 and ECON 2106)
Review of important mathematical tools and techniques used in advanced microeconomics. Advanced topics include the estimation of demand and cost functions; the role of government in the economy (externalities, property rights, and public goods); public choice theory; factor markets (especially labor and capital markets); models of monopoly, pricing techniques used by firms with market power (monopolies and oligopolies), and game theory.

ECON 3120. Advanced Macroeconomic Analysis
3-0-3.
Prerequisite(s): ECON 2100 or (ECON 2105 and ECON 2106)
Integrates issues arising from international economic relationships with the macroeconomic dynamics of domestic economies. Income determination in the open economy and the effect of stabilization policies on the international monetary system.

ECON 3150. Economic and Financial Modeling
3-0-3.
Prerequisite(s): ECON 2100 or (ECON 2105 and ECON 2106)
The course develops student ability to model the essential elements of the investment decision through use of a valuation model and spreadsheet analysis. Expands upon basic knowledge of present value analysis to recognize risk, growth, capital markets, and market valuation of ongoing operations.

ECON 3160. Introduction to Empirical Economics: Data Visualization, Analysis, and Presentation
3-0-3.
Prerequisite(s): ECON 2100 or (ECON 2105 and ECON 2106) and MGT 2250
Develops student abilities to logically formulate economic issues; identify and collect data from traditional and Internet sources; analyze data using spreadsheet and presentation software; generate sound and defensible conclusions and recommendations; and make effective presentations of analysis and conclusions.

ECON 3161. Econometric Analysis
3-0-3.
Prerequisite(s): ECON 3160
Econometric techniques and applications in economic and business analysis. Practical issues involving modeling, estimation, hypothesis testing, and emphasizing computer implementation through econometric software.

ECON 4060. Money and Capital Markets
3-0-3.
Prerequisite(s): ECON 2100 or (ECON 2105 and ECON 2106)
An examination of the role of money in the exchange process, the Federal Reserve's monetary policy strategy, and the impact of monetary policy on financial markets and aggregate economic activity.

ECON 4160. Economic Forecasting
3-0-3.
Prerequisite(s): ECON 3161
An introduction to widely used economic and business forecasting methods, emphasizing quantitative approaches and computer implementation through time-series econometric software.

ECON 4170. Mathematics for Economic Modeling
3-0-3.
Prerequisite(s): ECON 3110 and ECON 3120
The application of mathematical tools to economic analysis. Topics include static analysis, comparative-static analysis, optimization, and dynamic analysis.

ECON 4301. Economics of Information, Transactions Costs, and Contracts
3-0-3.
Prerequisite(s): ECON 2100 or (ECON 2105 and ECON 2106)
Builds from analysis of the individual in a trading or transaction situation to study organizations as groups of affiliated individuals. Assesses the situations when organizations are preferable to markets as forms of organizing economic and social activity. Institutional economics and transaction cost economics are studied. Analysis of corporate restructuring and privatization.

ECON 4311. Strategic Economics for Global Enterprise
3-0-3.
Prerequisite(s): ECON 2100 or (ECON 2105 and ECON 2106)
This introductory course on the multinational enterprise (MNE) will examine from an economic and interdisciplinary perspective the challenges facing MNE's in a fast-changing international business environment. The emphasis will be on the use of economic tools to analyze these issues and understand their managerial implications.

ECON 4321. Economics of Technology, Innovation, and Entrepreneurship
3-0-3.
Prerequisite(s): ECON 2100 or (ECON 2105 and ECON 2106)
Analysis of level and type of entrepreneurial activity. Study of business and economic history, legal, and institutional arrangements.

ECON 4340. Industrial Organization
3-0-3.
Prerequisite(s): ECON 2100 or (ECON 2105 and ECON 2106)
This course examines the theory of the firm, the relationship between market structure, practices, and performance, and the determinants of technological change. The role (and ability) of government policy to solve various market failures, via antitrust enforcement, regulation, etc., is also discussed.

ECON 4345. Economic Regulation
3-0-3.
Prerequisite(s): ECON 4340
This course examines how government economically regulates private industry, how it might regulate more efficiently, and when it should not regulate at all. General theories of antitrust enforcement and economic regulation are developed and applied to a variety of industry cases.

ECON 4350. International Economics
3-0-3.
Prerequisite(s): ECON 2100 or (ECON 2105 and ECON 2106)
This is an introductory course in international economics and will cover important topics in trade theory, trade policy, and international finance. The emphasis will be on using economic tools to analyze a variety of current events in the world economy.

ECON 4360. Network Economics
3-0-3.
Prerequisite(s): ECON 2100 or (ECON 2105 and ECON 2106)
This course will examine alternative network architectures (e.g. simple ring networks, two star networks connected by a trunk line), explore how differences in a network's economic characteristics have different market structure implications and accordingly, lead to alternative public policy stances.

ECON 4411. Economic Development
3-0-3.
Prerequisite(s): ECON 2100 or (ECON 2105 and ECON 2106)
Concepts and studies of developing economies. Selected topics include development experience and theories, growth, agriculture, urbanization, industrialization, and links between trade policy and development.

ECON 4412. Cost-Benefit Analysis
3-0-3.
Prerequisite(s): ECON 2100 or (ECON 2105 and ECON 2106)
This course will acquaint the student with the principles, tools, issues, strengths, and limitations of cost-benefit analysis (CBA); to prepare the student to competently review, criticize, and use CBA studies; and to enable the student to carry out limited CBA studies.

ECON 4421. Urban and Regional Economics
3-0-3.
Prerequisite(s): ECON 2100 or (ECON 2105 and ECON 2106)
Economics of regions, cities, and space. Theories of growth and location, effects of urbanization, agglomeration, and congestion. Public policy relating to urban and regional problems.

ECON 4430. Economics of Transportation and Communication Systems
3-0-3.
Prerequisite(s): ECON 2100 or (ECON 2105 and ECON 2106)
Economic analysis for the design, operation, and management of transportation and communication systems. Study of systems analysis and modeling. Application to industry and study of industrial change and dynamics. Special attention to corporate restructuring and industrial consolidation and merger.

ECON 4440. Economics of Natural Resources and the Environment
3-0-3.
Prerequisite(s): ECON 2100 or (ECON 2105 and ECON 2106)
This course covers three aspects of environmental economics. First, it considers policy interventions appropriate to problems involving environmental externalities. Second, it explains methods used to estimate economic values for environmental goods. Finally, it explains the economics of depletable and renewable resources.

ECON 4450. Topics in African American Entrepreneurship
3-0-3.
Prerequisite(s): ECON 2100 or (ECON 2105 and ECON 2106)
History and dynamics of African American business. Impact of racial segregation on business formation. Case studies and empirical exercises.

ECON 4460. Public Economics
3-0-3.
Prerequisite(s): ECON 2100 or (ECON 2105 and ECON 2106)
The course focuses on public goods, how public decisions regarding public goods are made, the "free-rider" problem, [illegible] and taxation principles, welfare, the Tiebout Hypothesis, [illegible], and fiscal policies.

ECON 4510. Economics of Health and Health Care
3-0-3.
Prerequisite(s): ECON 2100 or (ECON 2105 and ECON 2106)
This course surveys the theoretical and empirical evidence regarding current issues in health and health care. Individual level models of health behaviors and the demand for health and medical insurance are presented. The economic behaviors of physicians, hospitals, and insurance companies are also characterized. The possible role of government in encouraging the equitable and efficient performance of health markets is discussed with a particular emphasis on current debates involving individual health decisions, health care reform, and the diffusion of new medical technologies.

ECON 4610. Seminar in Economic Policy
3-0-3.
Prerequisite(s): ECON 2100 or (ECON 2105 and ECON 2106)
The objective of the course is to enable students to interpret current economic problems and policies using the economic models learned in their theory courses. Students study the current "Economic Report of the President" and apply analytical tools to the data included in the text. Each student selects a current issue for detailed examination and report.

ECON 4620. History of Economic Thought
3-0-3.
Prerequisite(s): ECON 2100 or (ECON 2105 and ECON 2106)
This course is concerned with the economists who interpreted and influenced the development of capitalism and socialism over the last two centuries.

ECON 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

ECON 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

ECON 4803. Special Topics in Economics
3-0-3.
Courses designed to permit students and a professor to pursue a specialized interest in an area of economics not extensively treated in the offerings of the School.

ECON 4811, -12, -13, -14, -15. Special Topics in Economics
Class and credit hours equal last digit in course number.
Courses designed to permit students and a professor to pursue a specialized interest in an area of economics not extensively treated in the offerings of the School.

ECON 4901. Special Problems
Credit hours to be arranged.
Designed to permit independent study with a faculty member.

ECON 4910. Individual Research in Economics
3-0-3.
Prerequisite(s): ECON 2100 or (ECON 2105 and ECON 2106)
Course related to independent student research. Topics determined by instructor and student.

ECON 4990. Internship in Professional Economics
Prerequisite(s): ECON 2100 or (ECON 2105 and ECON 2106)
Credit hours to be arranged. Course projects related to professional internships. Topics and requirements to be arranged by student, instructor, and sponsor.

ECON 6100. Economic Analysis for Managers
3-0-3.
A survey of microeconomic and macroeconomic concepts essential to the academic preparation of prospective managers. Economic theory used as a framework for contemporary managerial decision making.

ECON 6105. Macroeconomics
3-0-3.
Macroeconomic theory, including determination of national income, employment, the general price level, and potential for economic growth. Sources of macroeconomic instability and stabilization policies.

ECON 6106. Microeconomic Analysis
3-0-3.
Microeconomics, resource allocation decisions of households, businesses, and government agencies. Enables the student to understand and apply economic principles to consumer, business, and government decisions.

ECON 6110. Economics of Corporate Strategy
3-0-3.
Prerequisite(s): ECON 3110 or ECON 6100
Applies microeconomic and macroeconomic theory to the development of modern corporate strategy, including organizational boundaries, market structure and competition, industry analysis, and competitive advantage.

ECON 6121. Research Methods
3-0-3.
Introduces students to issues related to conducting research in economics. Topics include the derivation of empirical models from theoretical constructs, causality, experimental and non-experimental data, hypothesis testing, and policy analysis. Students also become familiar with electronic data sources and retrieval and are introduced to several professional software packages.

ECON 6130. Quantitative Methods in Economics
3-0-3.
Prerequisite(s): (ECON 6105 and ECON 6106) or ECON 6100
This course covers fundamental quantitative tools used in economic and econometric analysis, which includes topics in differential calculus, optimization, and linear algebra.

ECON 6140. Probability and Statistics
3-0-3.
This course gives students the necessary background for taking courses in the econometrics sequence. Topics include descriptive statistics, continuous and discrete probability distributions, parameter estimation, one- and two-sample hypothesis testing, and bivariate regression models.

ECON 6150. Cost-Benefit Analysis
3-0-3.
Prerequisite(s): ECON 3110 or ECON 6106
The application of economic, financial, and quantitative reasoning and tools to issues of resource allocation and policy, primarily in the public sector.

ECON 6160. Econometric Analysis
3-0-3.
Prerequisite(s): ECON 6130
This course introduces advanced econmetric methods on estimation and testing, including instrumental variable estimation, panel data analysis, limited dependent variable models, and simultaneous equation system. The course emphasizes applications of these techniques to real-world problems using professional software packages.

ECON 6161. Econometric Modeling and Forecasting
3-0-3.
Prerequisite(s): ECON 6160
This course introduces techniques on economic and business forecasting, focusing on regression analysis and ARIMA models. Testing for unit roots and cointegration are also discussed. Professional software packages for forecasting are used in applications.

ECON 6162. Discrete Choice Econometrics
3-0-3.
Prerequisite(s): ECON 6140
Focuses on econometric methods for which the dependent variable represents an "either-or" choice. Included in the set of topics are binary and multinomial logit, ordered choice, heteroskedastic extreme value, bivariate and multivariate probit, nested logit structures, discrete/continuous, and Poisson models. The course includes numerous applications using professional software programs.

ECON 6200. Money and Capital Markets
3-0-3.
Prerequisite(s): ECON 3120 or ECON 6105
The role of money in the exchange process, Federal Reserve strategy, and the impact of monetary policy on financial markets and aggregate economic activity.

ECON 6310. Public Economics
3-0-3.
Prerequisite(s): ECON 6100 or (ECON 6105 and ECON 6106)
An examination of public goods, public decision making, voting, free riders, taxation principles, welfare, the Tiebout Hypothesis, budgeting, and fiscal policy.

ECON 6330. Urban and Regional Economics
3-0-3.
Prerequisite(s): ECON 6100 or (ECON 6105 and ECON 6106)
Economis of regions, cities, and space. Theories of growth and location, effects of urbanization, agglomeration, and congestion. Public policy relating to urban and regional problems.

ECON 6341. Transportation Economics
3-0-3.
Prerequisite(s): ECON 6106
Examines the economics of transportation markets, including resource allocation, economic welfare, government regulation and public policy. Using an econometric case study approach, the course develops the necessary steps for testing hypotheses, analyzing the finding of recent studies, and exploring implications for the development and implementation of transportation policy.

ECON 6360. Development Economics
3-0-3.
Prerequisite(s): ECON 6100 or ECON 6106
Concepts and models of development and growth in Third World countries, emphasizing modeling and testing of recent changes in the Third World. Topics include economic growth, trade and globalization, poverty and inequity, migration, population growth, unemployment, agricultural development, the environment, and the role of the market versus the state.

ECON 6380. Economics of Natural Resources and the Environment
3-0-3.
Prerequisite(s): ECON 6100 or (ECON 6105 and ECON 6106)
Examines the management of natural resources and the environment from an economic perspective. Topics include resource valuation methods, optimal resource management, regulation of pollution and sustainable development. Issues are studied through economic models and empirical testing.

ECON 6431. Strategic Economics for Global Enterprise
3-0-3.
Prerequisite(s): ECON 6100 or (ECON 6105 and ECON 6106)
This course uses economic tools to examine strategic aspects of competition and collaboration in an integrated global market. Topics include the determinants and changes in the boundaries of global firms, competitive advantage and value creation, the nature of global markets, and strategic positioning in the global market place.

ECON 6440. The Economics of Technology, Innovation, and Entrepreneurship
3-0-3.
Prerequisite(s): ECON 6100 or ECON 6106
This course explores the impact that innovation, technology progress, and R&D activities have upon a firm's pricing and output behavior. Based upon computer case studies, biotechnology, and telecommunications sectors, the course further analyzes the economic role that firm size and entrepreneurial opportunities play in technological development and innovation.

ECON 6450. Topics in African American Entrepreneurship
3-0-3.
Explores African American entrepreneurship from the ante-bellum period to the present. Implications of economic and socio-political developments are given particular attention, including the urbanization of blacks, the rise of benevolent societies following slavery, institutionalization of Jim Crow segregation, desegregation, and affirmative action's role in an emerging class of black entrepreneurs.

ECON 6460. Industrial Organization
3-0-3.
Prerequisite(s): ECON 6100 or ECON 6106
This course examines modern theories of the firm, market power, and competitive strategy. Game theory is employed throughout the course.

ECON 6510. Economics of Health and Health Care
3-0-3.
Prerequisite(s): ECON 6106 and ECON 6160
A critical survey of the current theoretical and empirical issues involving the economics of health and health care.

ECON 6610. Seminar in Economic Policy
3-0-3.
Prerequisite(s): ECON 6100 or (ECON 6105 and ECON 6106)
Interprets current economic problems and policies using fundamental economic principles.

ECON 6620. History of Economic Thought
3-0-3.
Prerequisite(s): ECON 6100 or (ECON 6105 and ECON 6106)
Economists who interpreted and influenced the development of capitalism and socialism over the last two centuries.

ECON 6650. International Economics and Policy Analysis
3-0-3.
Prerequisite(s): ECON 6100 or (ECON 6105 and ECON 6106)
Explores international economic issues. The first part examines aspects of international trade, including specialization and exchange, strategy, labor and capital movements, preferential trading arrangements, and economic development. The second part analyzes international finance, including exchange rates, open economy macro policies, Eurocurrency markets, and the international monetary system.

ECON 7000. Master's Thesis
Credit hours to be arranged.

ECON 8801, -02, -03. Special Topics
Credit and class hours equal last digit in course number.

ECON 8910, -90. Special Problems
Credit hours to be arranged.

ECON 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding teaching assistantships.

ECON 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding research assistantships.

School of History, Technology, and Society

www.hts.gatech.edu

Established in 1990
Location: D. M. Smith Building
Telephone: 404.894.3196
Fax: 404.894.0535

Chair and Professor–Willie Pearson Jr.
Melvin Kranzberg Professor of the History of Technology–John Krige.
Professors–Ronald H. Bayor, Lawrence Foster, August W. Giebelhaus, Hanchao Lu, Robert C. McMath Jr. (Vice Provost for Undergraduate Studies and Academic Affairs), Carole E. Moore, Sue V. Rosser (Dean of Ivan Allen College), Jonathan Schneer.
Associate Professors–Eleanor Alexander, Michael Allen, Alice Bullard, Douglas Flamming, John L. Tone, Stephen W. Usselman.
Assistant Professors–Amanda Damarin, Maren Klawiter, William Winders.

General Information

The School of History, Technology, and Society (HTS), dedicated to the ideal of a well-rounded education at a technological university, provides instruction in the social sciences to every student at the Georgia Institute of Technology. The School offers courses in history and sociology leading to the degrees of Bachelor of Science in History, Technology, and Society; Master in History and Sociology of Technology and Science; and Doctor of Philosophy in History and Sociology of Technology and Science. HTS also offers a variety of minor and certificate programs for students in other undergraduate majors.

Undergraduate Program

Bachelor of Science

The HTS degree is comparable to traditional degrees in history and sociology, but the program has several attributes that make it unique. The degree requires broad-based training in humanities, mathematics, science, and social sciences, giving HTS graduates the advantage of a truly broad, humanistic education. The program's focus on the social origins and impact of industry, science, and technology is also distinctive, providing students with the critical tools needed to understand the complex issues related to the development of the modern world.

Students who wish to pursue careers or graduate study in business, education, government, journalism, law, publishing, and many other fields will benefit from this degree program.

Minor and Certificate Programs

For students in other majors interested in broadening their educational experience at Georgia Tech, HTS offers minors in history and in sociology, and jointly administers a minor in Women, Science, and Technology (WST).

Alone or in conjunction with other units of the Ivan Allen College, HTS offers certificates in five fields:

- African American Studies
- Asian Affairs
- European Affairs
- History
- Sociology

The School of History, Technology, and Society also offers courses that are included in the Pre-Law certificate and minor offered by the School of Public Policy.

Minors are awarded upon completion of six approved courses. Certificates require four approved courses. Certificates and minors will be granted only to students who have satisfied requirements for an undergraduate major degree. For more information on HTS undergraduate programs, contact the director of Undergraduate Studies in HTS at 404.894.3196.

Bachelor of Science in History, Technology, and Society (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501 CALCULUS I or MATH 1712 SURVEY OF CALCULUS		4
LAB SCIENCE ELECTIVE (BIOL, CHEM, EAS, PHYS)		4
HIST 2111 THE U.S. TO 1877 or 2112 THE U.S. SINCE 1877		3
WELLNESS		2
TOTAL SEMESTER HOURS		16

First Year - Second Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502 CALCULUS II or MATH 1711 FINITE MATHEMATICS		4
LAB SCIENCE (BIOL, CHEM, EAS, PHYS)		4
SOC 1101	INTRO. TO SOCIOLOGY	3
COMPUTING REQUIREMENT		3
TOTAL SEMESTER HOURS		17

Second Year - First Semester

Course Number/Name		*Hours*
HTS 1031	EUROPE SINCE THE RENAISSANCE	3
HTS ELECTIVE(S)		3
MODERN LANGUAGE HUMANITIES ELECTIVE(S)		3
FREE ELECTIVE(S)		6
TOTAL SEMESTER HOURS		15

Second Year - Second Semester

Course Number/Name		*Hours*
ECON 2105 or 2106 or 2100		3
HTS ELECTIVE(S) (Technology & Society)		3
MODERN LANGUAGE HUMANITIES ELECTIVE(S)		3
FREE ELECTIVE(S)		6
TOTAL SEMESTER HOURS		15

Third Year - First Semester

Course Number/Name		*Hours*
HTS 3101	LOGIC OF HISTORICAL & SOCIAL RESEARCH	3
HTS ELECTIVE(S)		6
FREE ELECTIVE(S)		6
TOTAL SEMESTER HOURS		15

Third Year - Second Semester

Course Number/Name		*Hours*
HTS 3102	SOCIAL THEORY & SOCIAL STRUCTURE	3
HTS ELECTIVE(S)		6
FREE ELECTIVE(S)		3
HTS ELECTIVE(S) (Technology & Society)		3
TOTAL SEMESTER HOURS		15

Fourth Year - First Semester

Course Number/Name	*Hours*
HTS SEMINAR	4
HTS ELECTIVE(S)	6
FREE ELECTIVE(S)	6
TOTAL SEMESTER HOURS	16

Fourth Year - Second Semester

Course Number/Name	*Hours*
HTS SEMINAR	4
HTS ELECTIVE(S)	3
FREE ELECTIVE(S)	6
TOTAL SEMESTER HOURS	13

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Requirements and Electives

Computing Requirement

Students must complete either CS 1315, CS 1321, or a computer programming course approved as satisfying the general education requirements in computer literacy.

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

History and Government Requirement

The state of Georgia requires all students to take a course on the government and history of the United States and Georgia. Any one of the following courses will fulfill this requirement: HIST 2111, HIST 2112, INTA 1200, POL 1101, or PUBP 3000.

Writing and Communication Intensive Courses

A number of majors require students to complete writing intensive and communication intensive courses. Several HTS classes may be counted

toward this requirement, including many 3000-level courses and all 4000-level seminars. Consult course offerings each semester to determine which courses may be counted toward this requirement.

Requirements for the Bachelor of Science in History, Technology, and Society

- Core Curriculum
- Computing: See "Computing Requirement"
- English: ENGL 1101 and 1102

Humanities and Fine Arts
HTS majors fulfill their humanities requirement by taking six credit hours in a single foreign language.

Mathematics
Students must complete one of the following mathematics sequences: MATH 1711 and 1712, MATH 1501 and 1502, or MATH 1501 and 1711.

Science
Students must take two of the following eight courses. BIOL 1510 and 1520, CHEM 1312 and 1313, EAS 1600 and 1601, or PHYS 2211 and 2212.

Social Science
In the course of earning their degree in HTS, students will earn many more Social Science credits than are required by the Institute.

Courses Related to Major

- **Foreign Language**
  Students must complete a two-course sequence in a foreign language.
- **Economics**
  Students must take one of the following: ECON 2100, 2105, or 2106
- **Sociology**
  SOC 1101
- **European History**
  HTS 1031
- **United States History**
  HIST 2111 or 2112 (when one of these courses is taken, the other may be taken and counted as an HTS Elective)
- **Technology and Society**
  Students must complete two courses from an approved list that includes: HTS 2081, 2082, 2084, 3001, 3007, 3020, 3021, 3082, 3083, 3084, and 3085.
- **Historical Methods**
  HTS 3101
- **Social Theory**
  HTS 3102
- **Research Seminars**
  Students must complete two HTS 4000-level seminars, preferably in their junior and senior years.
- **Additional HTS Electives**
  Students must take twenty-one credit hours of additional HTS courses.
- **Free Electives**
  Students must earn enough credits (from any discipline) to reach the Institute minimum of 122 credit hours (counting the two-hour Wellness credit). Most HTS majors earn thirty hours of free electives.
- **Honor's Thesis**
  Qualifying students may elect to complete the honor's thesis with approval of the department.

Graduate Program

Master of Science

The School offers a program of graduate study in the history and sociology of technology and science at both the master's and doctoral levels. The two-year master's program consists of foundation courses in history, social theory, and research methods, as well as more specialized reading and research seminars. The program emphasizes the understanding of technology and science within a broad social and historical context. Students develop a strong general background in history and sociology, and acquire skills in research, social analysis, and writing.

The basic curriculum of thirty hours (required of both M.S. and Ph.D. candidates) consists of nine hours of required fundamental courses, twelve hours of core electives within HTS, an advanced interdisciplinary seminar, and six hours of free electives. No more than six electives may be counted as an independent study. Students must also complete a major research paper. Comprehensive examinations are normally taken in the third academic year. The examinations will cover material from three fields of study, which will be determined by a student's selection of history or sociology as the area of concentration.

In addition to satisfactory performance in the comprehensive examinations, students must also pass a foreign language examination (normally in French, German, or Spanish) before being admitted to candidacy for the Ph.D. Having met these requirements, the candidate will submit a dissertation proposal, which must meet the approval of his or her dissertation committee. The candidate will then proceed to the final requirement for the degree: the completion of the Ph.D. dissertation and its successful defense by oral examination.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course. This section contains courses in History, Technology, and Society (HTS); History (HIST); and Sociology (SOC).

HISTORY, TECHNOLOGY, AND SOCIETY

HTS 1031. Europe Since the Renaissance
3-0-3.
Social, political, economic, and cultural history of Europe since the Renaissance. Topics include Renaissance; Reformation; political, scientific, and industrial revolutions; nationalism; fascism and communism; decolonization.

HTS 1081. Engineering in History
3-0-3.
Uses historical case studies to examine the relationship between engineers and the larger society in which they function. Often taught jointly with engineering faculty.

HTS 2001. Early American History
3-0-3.
North America to 1763, including native cultures, contacts with European colonizers, settlement strategies and patterns, and foundation of American political and economic institutions.

HTS 2002. The American Revolution and Constitution
3-0-3.
The American Revolution as political debate, war, and social upheaval, with attention to the framing and ratification of the Constitution.

HTS 2006. History of the Old South to 1865
3-0-3.
A study of social, political, and economic developments in the South from the colonial period through the Civil War.

HTS 2007. History of the New South Since 1865
3-0-3.
An examination of social, political, and economic developments from the Reconstruction period to the present.

HTS 2009. The American Civil War
3-0-3.
Social, economic, political, and military aspects of the Civil War, including causes of the war, military campaigns, and long-term consequences.

HTS 2011. The Gilded Age and the Progressive Era
3-0-3.
Populism, the currency question, immigration, the rise of big business, war, and reform in one of the most turbulent periods of American history.

HTS 2013. Modern America: World War II and After
3-0-3.
Dawning of the atomic age, anticommunism, the Civil Rights Movement, New Frontier and Great Society, Vietnam and the tumultuous 1960s, and end of the Cold War.

HTS 2016. Social Issues and Public Policy
3-0-3.
Draws on sociological theory and research to understand the major economic, social, and cultural issues facing American society today.

HTS 2031. Ancient Greece: Gods, Heroes, and Ruins
3-0-3.
Minoan and Mycenaean civilizations, Homer's Greece, Classical Athens and Sparta, myths and legends in historical context. Course ends with Alexander the Great and the rise of Rome.

HTS 2032. Ancient Rome: From Greatness to Ruins
3-0-3.
Growth of the Republic, antics and follies of the emperors, accomplishments of Rome, and causes of decline. Early Christianity and its impact on Europe included.

HTS 2033. Medieval Europe: 350 to 1400
3-0-3.
The rise of barbarian kingdoms from Rome's ashes, the explosion of Islam, the monastic movement, Charlemagne's empire, the blossoming of medieval culture, and developing European monarchies.

HTS 2036. Revolutionary Europe: 1789-1914
3-0-3.
Industrialization and political revolution, the development of political ideologies and labor activism, modern nation-state building, and imperialism from the French Revolution to World War I.

HTS 2037. Twentieth Century Europe: 1914 to Present
3-0-3.
Global war and the Bolshevik Revolution, rise and fall of Mussolini and Hitler, Stalinism, the Holocaust, Cold War, decolonization, and the movement toward European integration.

HTS 2061. Traditional Asia and Its Legacy
3-0-3.
Civilizations of East Asia up to 1850, emphasizing traditional cultures in China and Japan, including religion, science, formation of empires, social life, and commerce.

HTS 2062. Asia in the Modern World
3-0-3.
Civilizations of India, China, and Japan since 1600, emphasizing Western impact and adaptation of these countries' political, economic, and social systems.

HTS 2081. The Scientific Revolution
3-0-3.
A critical approach to the Scientific Revolution, introducing students to primary documents and images from the period and emphasizing interpretive strategies and methods.

HTS 2082. Technology and Science in the Industrial Age
3-0-3.
Surveys major developments in technology and science since 1600 and places them in the broader social context of their times.

HTS 2084. Technology and Society
3-0-3.
Analyzes social conditions that promote or retard technological activity, emphasizing role of business, the state, and scientific and engineering professions, and the emergence of consumerism.

HTS 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

HTS 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

HTS 2803, -13, -23. Special Topics
3-0-3.
Allows a group of students and a professor to study topics not covered in other courses in the department.

HTS 2927, -28, -29. Special Problems
Credit hours to be arranged.

HTS 3001. American Economic History
3-0-3.
U.S. economic history since 1607, including regional specialization, agriculture, industrialization, technology, government and economy, money and banking, labor, international trade, and contemporary economic problems.

HTS 3002. History of American Business
3-0-3.
Evolution of business institutions from colonial period to present, including entrepreneurship, business-government relations, institutional innovation, and twentieth century managerial capitalism.

HTS 3003. Sociology of Economic Institutions
3-0-3.
Examines links between economic structures-markets, regulatory bodies, and labor relations systems and the wider structural and cultural context.

HTS 3005. American Environmental History
3-0-3.
Transformation of the North American environment since 1500, including different notions of nature, romantic responses to wilderness during industrialization, rise of conservation movements, and environmental policy.

HTS 3006. United States Labor History
3-0-3.
The changing nature of work and labor relations, with focus on unionization and government regulation, and equity issues in the workplace.

HTS 3007. Sociology of Work, Industry, and Occupations
3-0-3.
Analyzes paid employment as a decisive social attachment, emphasizing work organizations, technological change and authority relations, and social inequality among diverse groups of employees.

HTS 3008. Class, Power, and Social Inequality
3-0-3.
This course examines how social class and the market economy affect inequality and stratification in the U.S., with additional attention to the roles of race and gender.

HTS 3011. The City in American History
3-0-3.
Examines the historical background of the American city since colonial times, including city planning, urban technology and services, neighborhoods, and race relations.

HTS 3012. Urban Sociology
3-0-3.
Sociological perspectives on the city, urbanization, and problems of community, evolution of cities and problems of urban life in the United States and Third World.

HTS 3015. History of the Vietnam War
3-0-3.
Diplomatic, military, and social aspects of America's war in Vietnam, including antiwar protests, the defense industry boom, and the war's enduring impact on American life.

HTS 3016. Women and Gender in the United States
3-0-3.
Course examines themes and theories of women's and gender history since the colonial period, including work, family, race, sexuality, and politics.

HTS 3017. Sociology of Gender
3-0-3.
Gender as a dimension of social life that shapes and is shaped by the economy, schooling, family, politics, medicine and health, race, and social class.

HTS 3018. New Religions and Cults in America
3-0-3.
Explores controversial and influential new religious movements and cults in America, focusing on their origin, appeal, and impact.

HTS 3019. The Family, Sexuality, and Social Change in America
3-0-3.
Changing patterns of family life and sex roles since colonial times, with a focus on mainstream ideals, utopian alternatives and social criticism.

HTS 3020. Gender and Technology
3-0-3.
Course examines the ways in which the design, development, and application of technologies, as well as cultural responses to them, have been gendered historically.

HTS 3021. Women in Science and Engineering
3-0-3.
Women in science and engineering and gender differences in participation, location, and status. Examines education, access, and apprenticeship, culture of science and engineering.

HTS 3023. Slaves without Masters: Free People of Color before 1865
3-0-3.
Free people of color during the era of slavery, including everyday life, political and social philosophies, literature, community development, and movements for social change.

HTS 3024. African American History to 1865
3-0-3.
The experience of African and African American people in North America from the beginnings of slavery until the era of emancipation in the Civil War.

HTS 3025. African American History Since 1865
3-0-3.
The African American experience since 1865, including Reconstruction, segregation, the African American family, the Harlem Renaissance, the Civil Rights Movement, and Black Power.

HTS 3026. Sociology of Race and Ethnicity
3-0-3.
Nature and significance of dominant/minority relations, including legacies of colonialism and slavery, roots of residential segregation, and effects of race on American politics.

HTS 3031. European Labor History
3-0-3.
The labor movement from 1700s to the present, including an examination of Marx and socialism, unionization, and work conditions, especially in Britain, Germany, and France.

HTS 3032. Modern European Intellectual History
3-0-3.
Introduction to intellectual problems and trends in modern Europe, including loss of faith in progress, evil and ethics, post-colonialism, feminism, linguistics, and psycho-analytic thought.

HTS 3033. Medieval England
3-0-3.
Political, economic, and cultural development of England during the Middle Ages (c. 350-1400). Myths and legends of Stonehenge, the Druids, and King Arthur's Camelot explored.

HTS 3035. Britain from 1815-1914
3-0-3.
Developments in nineteenth-century Britain, including the industrial revolution, the growth of political democracy, imperialism, and movements for Irish Home rule and democratic socialism.

HTS 3036. Britain Since 1914
3-0-3.
Britain's experience of two world wars, the growth of Labour and decline of the Liberals, the Welfare State, Thatcherism, and Tony Blair's "New Labour."

HTS 3038. The French Revolution
3-0-3.
Economic, intellectual, and cultural causes of the French Revolution, Jacobinism and the Terror, careers of Robespierre and Danton, and rise and fall of Napoleon's empire.

HTS 3039. Modern France
3-0-3.
France from 1815 to 1968, emphasizing the continuing project of creating France as a powerful nation within the context of global culture and politics.

HTS 3041. Modern Spain
3-0-3.
Resistance to Napoleon, deformed industrialization, Anarchist and fascist experiments form the background for Spain's transition from dictatorship to democracy after Franco's death.

HTS 3043. Modern Germany
3-0-3.
Consolidation of Germany since Napoleonic wars, Germany's contributions both hideous and glorious to Europe and the West, and recent unification of East and West Germany.

HTS 3045. Nazi Germany and the Holocaust
3-0-3.
Genocide in the twentieth century, emphasizing the extermination of European Jews. Course investigates roots of racism, eugenics, and ideologies of genocide in comparative perspective.

HTS 3061. Modern China
3-0-3.
The decline of Confucian order, the impact of the West, changes and continuities of Chinese culture, the Communist revolution, nationalism, and economic reforms since 1978.

HTS 3062. Modern Japan
3-0-3.
Japan's transformation in one century from a feudal state into an economic superpower and the impact of these changes on the Japanese people.

HTS 3063. Outposts of Empire: Comparative History of British Colonization
3-0-3.
Analysis of four British settlement colonies–Australia, New Zealand, Canada, and South Africa–emphasizing settlement, race relations, and national identity.

HTS 3064. Sociology of Development
3-0-3.
Course examines competing perspectives on international development and surveys some of the crucial issues, including political instability, facing the Third World today.

HTS 3066. Sociology of Politics and Society
3-0-3.
Political sociology studies the way power is distributed in society. This course takes a comparative and historical approach, focusing on the development of the nation-state.

HTS 3067. Revolutionary Movements in the Modern World
3-0-3.
Comparative analysis of the origin, development, and impact of major twentieth century revolutionary movements.

HTS 3068. Social Movements
3-0-3.
Why do social movements emerge? Why might they succeed? This course examines how ordinary people challenge powerful segments of society and contribute to social change.

HTS 3082. Sociology of Science
3-0-3.
The growth of science, its social structure; deviance and norms, the social context of scientific knowledge and practice, and science policy.

HTS 3083. Technology and the Shaping of American Society
3-0-3.
The complex interplay between technical innovation and cultural change in the United States since 1850, with emphasis on the emergence of modern consumer-oriented society.

HTS 3084. Culture and Technology
3-0-3.
Modernism and post-modernism: this course investigates culturally creative responses to modern manufacturing, transportation (trains, cars, airplanes), evolving gender ideals, and new communications.

HTS 3085. Law, Technology, and Politics
3-0-3.
Examines the ways in which courts, legislatures, and regulatory agencies have responded to challenges posed by new technology and shaped the course of technical change.

HTS 3086. Sociology of Medicine and Health
3-0-3.
Relationship between health and society, including health care problems in the United States and culture's role in defining health and sickness and in determining appropriate therapies.

HTS 3101. Logic of Historical and Social Research
3-0-3.
Interdisciplinary survey based on critical readings of the methods historians and social scientists use to generate knowledge about social life. Students engage in "hands-on" research.

HTS 3102. Social Theory and Social Structure
3-0-3.
Introduction to social theory, providing students with skills for reading theory and examining works of major social theorists, including Marx, Weber, Durkheim, Gilman, and Bourdieu.

HTS 3103. Honor's Thesis
3-3-4.
This course is designed to allow honor's students to distinguish themselves by producing a significant, original research paper.

HTS 3803, -13, -23. Special Topics
3-0-3.
Allows a group of students and a professor to study topics not covered in other courses in the department.

HTS 4001, -02, -03, -04, -05. Seminar in United States History
4-0-4.
Advanced undergraduate topics in U.S. history. Designed for HTS majors, but open to other students with junior or senior standing.

HTS 4011, -12, -13, -14, -15. Seminar in Sociology
4-0-4.
Advanced undergraduate topics in sociology. Designed for HTS majors, but open to other students with junior or senior standing.

HTS 4031, -32, -33, -34, -35. Seminar in European History
4-0-4.
Advanced undergraduate topics in European history. Designed for HTS majors, but open to other students with junior or senior standing.

HTS 4061, -62, -63, -64, -65. Seminar in Asian History
4-0-4.
Advanced undergraduate topics in Asian history. Designed for HTS majors, but open to other students with junior or senior standing.

HTS 4081, -82, -83, -84, -85. Seminar in History of Technology
4-0-4.
Advanced undergraduate topics in the history of technology. Designed for HTS majors, but open to other students with junior or senior standing.

HTS 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

HTS 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

HTS 4811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number.
Topics of interest not covered in the regular course offering.

HTS 4823, -33, -43. Special Topics
3-0-3.
Allows a group of students and a professor to study topics not covered in other courses in the department.

HTS 4925, -26, -27, -28, -29. Special Problems in History, Technology, and Society
Credit hours to be arranged.
Individual studies of topics of current interest in history, technology, and society.

HTS 6001. Proseminar in Social Theory
3-0-3.
An introduction to key theoretical traditions in modern social theory, including both classical and contemporary works.

HTS 6002. Proseminar in the History of Technology
3-0-3.
Identifies major areas of interest in the history of technology and introduces a variety of approaches to the discipline.

HTS 6101. Social and Political History of the United States
3-0-3.
Examines the social experiences of Americans and the political contexts in which they lived.

HTS 6102. Social and Political History of Europe
3-0-3.
Classic works and debates in European social history, including transition from feudalism to capitalism, French Revolution, rural history and industrialization, and origins of nationalism.

HTS 6103. Social and Political History of the Nonwestern World
3-0-3.
Covers basic empirical and relevant theoretical literature in English on the social and political history of Africa, Asia, and/or Latin America.

HTS 6105. Urbanization and Comparative Development
3-0-3.
An intensive introduction to the political, social, economic, and technological forces involved in the processes of urbanization and global development.

HTS 6106. Business Organizations and Political Economy
3-0-3.
Examines the historical evolution and contemporary operations of business institutions within the larger context of political economy, emphasis on business, government, and technology.

HTS 6107. Workers and the Labor Process
3-0-3.
Examines subjects such as the meaning of work, working-class movements, and workers' accommodation and resistance to managerial and technological changes in the workplace organization.

HTS 6108. Race, Ethnicity, and Industrialization
3-0-3.
Examines racial and ethnic dimensions of industrializing societies and industrial settings; links industrial change with shifts in race relations, ethnic identities, and minority behavior.

HTS 6109. Gender, Sexuality, and Society
3-0-3.
Explores constructions of gender roles and sexuality in history and in contemporary society.

HTS 6110. Gender, Science, and Technology
3-0-3.
Examines the ways in which gendered relations shape scientific and technological institutions, careers, artifacts, knowledge, and culture.

HTS 6111. Technology and Modern Culture
3-0-3.
Introduces the complex interplay between technological systems and diffuse systems of consumption, social organization, and culture beyond the act of production.

HTS 6112. Studies in Science and Engineering
3-0-3.
Empirical investigation of scientific and engineering practice in historical and contemporary settings.

HTS 7001. Foundations of Sociohistorical Analysis
3-0-3.
Introduces key concepts and methods used in the historical analysis of social phenomena.

HTS 7002. Research and Writing Seminar
3-0-3.
Introduces methods of sociohistorical research and writing; requires preparation of an original research paper based on primary sources.

HTS 8001. Comparative History of Labor, Industry, Technology, and Society
3-0-3.
An intensive, team-taught reading seminar covering major themes and classic works in these fields.

HTS 8002. Social and Cultural Perspectives on Technology and Science
3-0-3.
An intensive, team-taught seminar examining technology and science through techniques and perspectives drawn from social and cultural studies.

HTS 8801, -02, -03, -04, -05, -06. Special Topics
Class and credit hours equal last digit in course number.

HTS 8901, -02, -03, -04, -05, -06. Special Problems
Credit hours to be arranged.

HTS 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding a teaching assistantship.

HTS 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding a research assistantship.

HTS 9000. Doctoral Thesis
Credit hours to be arranged.

HISTORY

HIST 2111. The United States to 1877
3-0-3.
Colonial settlement, the American Revolution and the Constitution, antebellum expansion, slavery and plantation economy, sectional conflict and Civil War, Reconstruction.

HIST 2112. The United States since 1877
3-0-3.
The social, political, and economic history of the United States since Reconstruction. Topics include American industrialization, two world wars, New Deal, and the Civil Rights movement.

SOCIOLOGY

SOC 1101. Introduction to Sociology
3-0-3.
A study of basic social relations, including social structure and functions, analysis of social processes, the foundations of personality, and analysis of social organization.

The Sam Nunn School of International Affairs

www.inta.gatech.edu

Established in 1990
Location: Habersham Building, 781 Marietta Street
Telephone: 404.894.3195
Fax: 404.894.1900

Chair and Professor–William J. Long; *Director of Graduate Programs and Associate Professor*–Brian Woodall; *Director of Undergraduate Programs and Associate Professor*–Molly Cochran.
Professors–John E. Endicott, John W. Garver, Seymour Goodman, Robert Kennedy, Sam Nunn, Daniel S. Papp, Michael D. Salomone.
Associate Professors–Kirk Bowman, Peter Brecke, Fei-Ling Wang, Katja Weber.
Assistant Professors–Michael Best, Vicki Birchfield, Michelle Dion, Edward Keene, Sylvia Maier, Adam Stulberg.
Jointly Appointed Professors–John R. McIntyre, Edmund B. Richmond (emeritus), Richard D. Teach.
Jointly Appointed Associate Professor–Richard P. Barke.

General Information

The Sam Nunn School of International Affairs offers educational programs that provide an enhanced understanding of the factors that shape the world in which we live and work in the twenty-first century. The programs of study equip students with the quantitative and qualitative skills needed to engage in strategic planning and analysis in an international context. A unique interdisciplinary curriculum provides students with an understanding of the increasing importance of technology in a borderless world. Many graduates assume professional positions with business, government, and international organizations. Other graduates pursue postgraduate or professional education in a range of disciplines that includes law, business, international affairs, public administration, and economics.

The Sam Nunn School of International Affairs is the only one of its kind at a leading technological institute. The educational programs administered by the Sam Nunn School at Georgia Tech are designed to equip students with the skills, values, and experience to build bridges between the world of science and technology and the world of international relations.

Undergraduate Programs

The Sam Nunn School offers three outstanding undergraduate degree programs: the Bachelor of Science in International Affairs, the Bachelor of Science in International Affairs and Modern Language, and the Bachelor of Science in Economics and International Affairs. Please note that graduation checklists for these degrees are available on the Sam Nunn School Web site: **www.inta.gatech.edu**

Bachelor of Science in International Affairs

The Bachelor of Science in International Affairs (B.S.I.A.) program includes instruction in international affairs, foreign languages, ethics and philosophy, social and natural sciences, and computer science. Upper-division coursework provides training in four substantive areas:

- technology, ethics, and scientific analysis;
- international security and diplomacy;
- comparative politics, cultures, and societies; and
- international political economy.

Graduates of the B.S.I.A. program are prepared for advanced graduate and professional study and are ready for employment in internationally oriented firms, government agencies, and nonprofit organizations.

International Affairs majors are strongly encouraged to enhance their education through participation in study abroad programs, internships, and a host of on- and off-campus programs. In addition to the numerous opportunities afforded through Georgia Tech's Office of International Education, the Sam Nunn School sponsors rigorous summer study abroad programs in the European Union (Brussels), East Asia (China, Japan, Taiwan), Costa Rica, and Argentina (Buenos Aires). Recognizing the importance of professional experience in enhancing a student's education, the Sam Nunn School encourages majors to pursue an internship or participate in the Cooperative Plan in their field of interest. In addition, students are strongly encouraged to get involved in a range of extracurricular activities, including Model United Nations; the European Union Center; AIESEC; Sigma Iota Rho (the International Affairs honor society); the Center for International Strategy, Technology, and Policy; the International Affairs Student Organization; and student conferences. Students are actively involved in the guest lecture series and participate in the biennial Sam Nunn/Bank of America Policy Forum.

Bachelor of Science in International Affairs (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I or MATH 1712 SURVEY OF CALCULUS	4
INTA 1110	INTRO. TO INTERNATIONAL RELATIONS	3
MODERN LANGUAGE ELECTIVE(S)		3
WELLNESS		2
TOTAL SEMESTER HOURS		15

First Year - Second Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II or MATH 1711 FINITE MATHEMATICS	4
MODERN LANGUAGE ELECTIVE(S)		3
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
CS 1315	INTRO. TO MEDIA COMPUTATION or CS 1321 INTRO. TO COMPUTING	3
TOTAL SEMESTER HOURS		16

Second Year - First Semester

Course Number/Name		*Hours*
INTA 2010	EMPIRICAL METHODS	3
INTA 2030	ETHICS IN INTERNATIONAL AFFAIRS	3
MODERN LANGUAGES ELECTIVE(S)		3
LAB SCIENCE (BIOL, CHEM, EAS, PHYS)		4
ITS 1031 or 2036 or 2037 or 2062		3
INTA 1001	ORIENTATION TO INTERNATIONAL AFFAIRS	1
TOTAL SEMESTER HOURS		17

Second Year - Second Semester

Course Number/Name		*Hours*
INTA 2100	GREAT POWER RELATIONS	3
INTA 2210	COMPARATIVE POLITICAL PHILOSOPHIES & IDEOLOGIES	3
MODERN LANGUAGE ELECTIVE(S)		3
INTA 2040	SCIENCE, TECHNOLOGY, & INTERNATIONAL AFFAIRS	3
LAB SCIENCE (BIOL, CHEM, EAS, PHYS)		4
TOTAL SEMESTER HOURS		16

Third Year - First Semester

Course Number/Name		*Hours*
INTA 3110	U.S. FOREIGN POLICY	3
INTA ELECTIVE(S)		3
TECHNICAL REQUIREMENT		3
ECON 2100 or 2105 or 2106		3
CLUSTER ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Third Year - Second Semester

Course Number/Name		*Hours*
INTA 3203	COMPARATIVE POLITICS	3
INTA ELECTIVE(S)		3
INTA 3301	INTERNATIONAL POLITICAL ECONOMY	3
FREE ELECTIVE(S)		3
CLUSTER ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Fourth Year - First Semester

Course Number/Name	*Hours*
FREE ELECTIVES	3
INTA ELECTIVE(S)	6
CLUSTER ELECTIVE(S)	6
TOTAL SEMESTER HOURS	15

Fourth Year - Second Semester

Course Number/Name		*Hours*
INTA 4400	INTERNATIONAL STRATEGY & POLICY	3
CLUSTER ELECTIVE(S)		3
FREE ELECTIVE(S)		7
TOTAL SEMESTER HOURS		13

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Requirements and Electives

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

The International Affairs Core

Student majors acquire an understanding of the core issues in international affairs by completing the following required courses: INTA 1001, 1110, 2010, 2030, 2040, 2100, 2210, 3110, 3203, and 3301. Students are encouraged to complete INTA 2010 early to make the most of their upper-division studies. In addition, student majors are required to round out their studies with INTA 4400, a capstone senior seminar. Students must achieve a grade of *C* or above in the international affairs core courses.

Humanities and Fine Arts

The ability to communicate effectively is essential to success in almost any meaningful endeavor. To this end, students are required to complete six hours of English, including ENGL 1101 and 1102. All Tech students are required to complete an additional six hours of humanities and fine arts, which INTA students satisfy through their mandatory four-semester modern language requirement.

Social Science Electives

In order to satisfy the U.S./Georgia history and Constitution requirements, students must complete one of the following courses: INTA 1200, HIST 2111, HIST 2112, POL 1101, or PUBP 3000. International Affairs majors are encouraged to take INTA 1200, which examines American government in relation to political and economic systems in countries around the world. INTA students satisfy a required nine hours of social science coursework with their INTA classes.

Mathematics and Sciences

An understanding of scientific methodology and quantitative analytic skills is essential for practitioners and policymakers in today's international arena. The mathematics requirement may be satisfied by one of the following sequences: MATH 1501 and 1502; MATH 1501 and 1711; or MATH 1711 and 1712. In addition, students are required to complete eight hours of laboratory science courses. These courses do not need to be sequential. Any two of the following courses will satisfy the requirement: BIOL 1510, BIOL 1520, CHEM 1310, CHEM 1311 and 1312, EAS 1600, EAS 1601, PHYS 2211, or PHYS 2212.

Computer and Technology Literacy

The information revolution is transforming international affairs. More than ever before, the solution of real-world problems demands an understanding of and the ability to use computers and information technology. In order to gain these essential skills, students are required to complete either CS 1315 or CS 1321. Students must also complete one additional technology elective from the list of technology course options approved by the School of International Affairs.

Courses Related to the Major

The B.S.I.A. curriculum is multidisciplinary, and our students are required to complete a total of eighteen hours of courses in fields related to the major. This requirement is satisfied by completing the following courses: ECON 2100, 2105, or 2106; one of the following courses that survey European or Asian history: HTS 1031, 2036, 2037, or 2062; and twelve credit hours of foreign language study in a single language. No more than one of four courses for the foreign language requirement may be taken on a pass/fail basis and will only count if passed. Language courses taken on a letter grade basis will only count toward the foreign language requirement if they are at a grade of *C* or above. Students may not enroll in 1000-level courses after the successful completion of any 2000-, 3000-, or 4000-level course. Courses at the 2000, 3000, and 4000 level do not need to be taken in

chronological order provided prerequisites are fulfilled.

Major Electives, Non-Major Cluster, and Free Electives

International Affairs majors are encouraged to use electives to tailor-fit the core education they receive with their own specific career and post-graduate objectives. Students are required to complete at least twelve hours of elective courses taught in the Sam Nunn School. Students must achieve a grade of *C* or above in the major electives. Additionally, students must complete a fifteen-hour, non-major cluster taught outside the School. The non-major cluster elective is satisfied either through fifteen hours of coursework in one school or through fifteen hours of coursework comprising a coherent program approved by the School. Free electives are then used to fill the remaining credits needed to reach 122 credits to graduate. B.S.I.A. students typically have thirteen hours of free elective credit.

Bachelor of Science in International Affairs and Modern Language

In partnership with the School of Modern Languages, the Sam Nunn School offers the Bachelor of Science in International Affairs and Modern Language, with separate concentrations in French, German, Japanese, and Spanish. Students in this program receive intensive foreign language training and learn the fundamentals of dealing with foreign cultures and societies. A detailed description of the degree program is found in the School of Modern Languages section of this Catalog.

Bachelor of Science in Economics and International Affairs

In partnership with the School of Economics, the Sam Nunn School offers the Bachelor of Science degree in Economics and International Affairs. Students in this program are provided with an understanding of economic theory and practice in the contemporary world, an understanding of the global, interdependent, and multicultural environment in which they live, and a set of quantitative and qualitative analytical skills centered upon policy-relevant issues in the economic and international arenas. A detailed description of the degree program is found in the School of Economics section of this Catalog.

Certificate Programs

The Sam Nunn School, often in conjunction with other units of the Ivan Allen College, administers five certificate programs. These programs enable students to pursue a focused program of study in a specific area of regional/international specialization. The School awards the following certificates:

- Asian Affairs Certificate (available to majors and non-majors)
- Latin American Affairs Certificate (available to majors and non-majors)
- European Affairs Certificate (available to majors and non-majors)
- European Union Certificate (available to majors and non-majors)
- International Affairs Certificate (available only to non-majors)

A certificate is awarded upon successful completion of a predetermined twelve-hour cluster of courses approved by the academic advisor or a specific faculty member. All courses must be taken on a letter-grade basis, and a grade of *C* or better must be received in each course. Certificates will be granted only to students who, in addition to the Certificate program requirements, have satisfied requirements for an undergraduate degree. Detailed information concerning these programs and their requirements is available through the School.

Minor Program

The School offers a Minor in International Affairs. This program is designed for students who want a concentration outside their major that provides a greater depth of study than a certificate program. The Minor in International Affairs requires a minimum of eighteen hours of coursework, including INTA 1110 (Introduction to International Relations), one 2000-level course (not to include INTA 2010), and at least twelve hours of upper-division (3000-level or higher) coursework. No more than six hours of Special Topics coursework and three credits of Special Problems coursework may be included in the minor program.

All courses must be taken on a letter-grade basis, and a grade of *C* or better must be received in each course. Courses required by name and number in a student's major degree program may

not be included. A student may petition to allow three hours of upper-division non-INTA coursework to count toward completion of the minor if that coursework is clearly relevant to international affairs. More information concerning this program and its requirements is available through the School.

Graduate Course Option

Under the Graduate Course Option, undergraduate students with a final grade point average of 3.5 or higher may count six hours of their undergraduate credits toward a master's degree at Georgia Tech in the same field. This means that qualified students could complete the Master of Science in International Affairs with thirty additional hours rather than thirty-six hours.

Graduate Program

The Master of Science in International Affairs degree program is an eighteen-month program that is adaptable to the interests and needs of a student who intends to immediately enter a professional career requiring advanced training in international affairs or who intends to continue studying at the doctoral level. The program emphasizes both traditional theoretical knowledge of international relations and strategic planning and analysis. The program includes core courses in:

- international relations theory and strategy;
- comparative politics;
- international political economy;
- international security;
- empirical research methods; and
- modeling, forecasting, and decision making.

Students also have the opportunity to design the program to meet their individual interests through elective offerings in the School and interdisciplinary work in the Schools of Economics and Public Policy; and the Colleges of Computing, Engineering, Management, and others. Overseas programs and internships are encouraged and facilitated by the School.

In addition to thirty-six semester hours of coursework, students must demonstrate foreign language familiarity and economics and computer literacy. These abilities are essential tools for professional or scholarly work in international affairs. Students must satisfy these requirements upon admission or during the program.

Foreign language familiarity is defined as a minimum of one year of college-level work in a single language. This requirement can be fulfilled while in residence or can be demonstrated through an examination taken in the School of Modern Languages.

Economics literacy is satisfied by successful completion of a course or courses in microeconomic and macroeconomic principles and a course in international economics undertaken while at Georgia Tech, or by successful completion of equivalent courses at another institution. Students who complete graduate-level courses in price theory (microeconomics) and national income analysis (macroeconomics) will both satisfy that portion of the literacy requirement and receive elective credit toward their degree.

Computer literacy is satisfied by either:

1) successfully completing (*B* or higher) at least one semester of classes with content including at least one of the following:
   - programming computers;
   - database design and operation;
   - development and operation;
   - data analysis (if part of statistics courses, at least two quarters or two semesters);
   - simulation model design and use;
   - development and use of geographic information or cartography systems; or
   - operation of large computer systems/ computer networks.
2) Having held a job for at least six months in which a significant component of the work entailed one of the activities listed above.

The School's master's degree requirements supplement the Institute's master's degree requirements listed in the *General Catalog*. Students must achieve a grade point average of at least 3.0 to graduate, and no course below grade *C* will count toward graduation. For more information about the M.S.I.A. program, visit **www.inta.gatech.edu/graduate**.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

INTERNATIONAL AFFAIRS

INTA 1001. Orientation to International Affairs
1-0-1.
Speakers from industry, government, the nonprofit sector, and academia discuss employment opportunities available to international affairs majors and the skills required to take advantage of those opportunities.

INTA 1002. Effective Study Abroad
1-0-1.
Introduces essential background information concerning countries, concepts, and what to do in order to gain maximum benefit from participation in school-sponsored study abroad programs.

INTA 1110. Introduction to International Relations
3-0-3.
An introduction to the major principles, concepts, actors, and theories of the international system and their application to current issues in world affairs.

INTA 1200. American Government in Comparative Perspective
3-0-3.
Examines American government in relation to other political and economic systems in countries around the world. Credit not allowed for both POL 1101 and INTA 1200.

INTA 2010. Empirical Methods
3-0-3.
Develops skills in research design, model building, and hypothesis construction. Provides experience in using computer software programs to perform statistical tests including t-tests, chi-square, and regression.

INTA 2030. Ethics in International Affairs
3-0-3.
Surveys the main traditions and theories of international ethics with a focus on intervention and the use of force, human rights, self-determination, and global distributive justice.

INTA 2040. Science, Technology, and International Affairs
3-0-3.
An overview of science and technology as a determinant in the development and functioning of states and societies worldwide and the international context for the development of science and technology.

INTA 2100. Theoretical Approaches to Great Power Relations
3-0-3.
Juxtaposes competing explanations for the patterns of conflict and cooperation among nations, illustrated by relations among the great powers of Europe and Asia during the past two centuries.

INTA 2210. Comparative Political Philosophies and Ideologies
3-0-3.
Explores political ideologies and philosophies, including theories of democracy, capitalism, and socialism, as well as rival views of the "good society" in comparative and historical perspective.

INTA 2220. Government and Politics of Western Europe
3-0-3.
A comparative analysis of the politics and major institutions of the countries of contemporary Western Europe.

INTA 2230. Government and Politics of Asia
3-0-3.
An introduction to the major issues and aspects of the politics, societies, and cultures of East Asia, and the changing role of the region in international affairs.

INTA 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

INTA 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

INTA 3010. International Technology Transfer
3-0-3.
Prerequisite(s): INTA 1110
Explores the impact of technology transfer on key contexts such as economic development and the international diffusion of defense production and technology.

INTA 3031. Human Rights in a Technological World
3-0-3.
Explores how processes of globalization and advances in communication and technology have heightened and shaped human rights as a concern in international politics.

INTA 3101. International Institutions
3-0-3.
Scrutinizes the evolution of international institutions, and juxtaposes competing theoretical approaches for understanding the changing roles and functions of institutions in world affairs.

INTA 3102. The Problem of Proliferation
3-0-3.
Prerequisite(s): INTA 1110
Explores the political and economic issues, both international as well as domestic, involved in the spread of the weapons of mass destruction since the end of the Second World War.

INTA 3103. The Challenge of Terrorism
3-0-3.
Examines the contexts that nurture domestic and international terrorism, the variety of terrorist organizations, and alternative approaches to combating the problem.

INTA 3104. International Negotiations
3-0-3.
Prerequisite(s): INTA 1110
Examines the theories of bargaining and negotiation, with an emphasis on explaining success and failure in U.S. foreign policy and national security negotiations.

INTA 3110. U.S. Foreign Policy
3-0-3.
Analyzes the formulation and implementation of America's foreign policy from 1914 to the present, stressing economic, political, and strategic factors.

INTA 3111. U.S. Defense Policy
3-0-3.
Examines contemporary American defense policy, including the formulation of strategy, the defense budget, force structure, and nontraditional uses of military force.

INTA 3120. European Security Issues
3-0-3.
Prerequisite(s): INTA 1110
Explores the contemporary European security environment, including threats, challenges, and various security architectures (e.g., NATO, the WEU, and the OSCE).

INTA 3121. Foreign Policies of Russia and Eurasia
3-0-3.
Examines the many dimensions of the foreign and security policies of Russia and the other new post-Soviet states of Russia and Eurasia.

INTA 3130. Foreign Policy of China
3-0-3.
Analyzes the major dimensions of the foreign policies of the People's Republic of China and the domestic and international influences shaping those policies.

INTA 3131. Pacific Security Issues
3-0-3.
Prerequisite(s): INTA 1110
Examines past, present, and future security concerns in the Pacific, including the Korean peninsula, Japanese defense, the emergence of China as a military power, and the forward basing of American troops and materiel.

INTA 3203. Comparative Politics
3-0-3.
Prerequisite(s): INTA 2010
Contrasts competing theoretical perspectives in the comparative analysis of political systems.

INTA 3220. Government and Politics of Germany
3-0-3.
Examines the government and politics of Germany with an in-depth focus on the post-1945 period. *NOTE: When taught jointly with the School of Modern Languages, all lectures, assignments, and readings are in German.*

INTA 3221. Post-Soviet Government and Politics
3-0-3.
Focuses on the challenge of building new social, political, and economic systems in Russia, but also considers some of the special problems confronting the other fourteen post-Soviet states.

INTA 3230. Government and Politics of China
3-0-3.
Investigates the structure and institutions of political power as well as the patterns and features of political change in the contemporary People's Republic of China.

INTA 3231. Government and Politics of Japan
3-0-3.
Examines the main institutions, policies, and politics of contemporary Japan. Investigates the impact of social, cultural, and economic forces on Japan's government and politics.

INTA 3240. Government and Politics of Africa
3-0-3.
A survey of the history, cultures, social systems, governments, economies, and international roles of Africa. Selected case studies of individual countries are presented.

INTA 3241. Latin American Politics
3-0-3.
Surveys the government and politics of Latin America. The course begins with an overview of the region's geography and history, and then explains why democratic government has had a tenuous existence in this area.

INTA 3301. International Political Economy
3-0-3.
Prerequisite(s): INTA 1110
Analyzes the relationship between political and economic issues in international affairs. Examines the interaction of states and markets in the context of trade, investment, and production.

INTA 3303. Political Economy of Development
3-0-3.
Surveys theories of economic development and political change, and examines a range of cases that include the European-American experience, the East Asian episode, and the transition from socialism.

INTA 3304. International Trade and Production
3-0-3.
Prerequisite(s): INTA 3301
Examines the political economy of international trade and the global production process with particular emphasis on conflict and cooperation in national competition for high-technology industries.

INTA 3321. Political Economy of European Integration
3-0-3.
Explores the processes and problems of political and economic integration in the European Union, the world's largest trading bloc.

INTA 3330. Political Economy of China
3-0-3.
Examines the centuries of stagnation and the recent rapid growth of the Chinese economy, and seeks to understand the current interaction between politics and economic development in the People's Republic of China.

INTA 3331. Political Economy of Japan
3-0-3.
Surveys the political foundations and economic achievements of modern Japan. Explores the interaction of domestic and international forces, and analyzes Japan's changing world role.

INTA 3750. International Language Policies
3-0-3.
Prerequisite(s): INTA 1110
An introduction to the politics, problems, and alternative solutions in national language choices, including a comparative analysis of industrialized and developing nations. Crosslisted with LING 3750.

INTA 3803, -13. Special Topics
3-0-3.
Selected topics will vary from term to term.

INTA 4011. Technology and Military Organization
3-0-3
Addresses the impact of technological developments on the evolution of military organization and on international conflict from the Battle of Agincourt (1415) to the Gulf War (1991).

INTA 4040. Environmental Politics
3-0-3.
Examines the interface between politics and the environment in developing countries. Foci include sustainable development, the politics of the rain forest, eco-tourism, and export agriculture and the environment.

INTA 4050. International Affairs and Technology Policy Making
3-0-3.
International policy issues in which science and technology figure prominently. Topics include: health, environment, information technologies, arms control and defense, critical infrastructure, transportation, and energy. Emphasis placed on policy analysis and formation.

INTA 4060. International Law
3-0-3.
Explores major issues, concepts and cases in public international law and their policy ramifications. Specific topics include human rights, armed conflict, crimes against humanity, and the environment.

INTA 4101. Politics of the Vietnam War
3-0-3.
Strategic approaches and political environments of the United States, North Vietnam, China, and the USSR during 1954-1975 Vietnam War.

INTA 4121. Seminar in Europe: European Security
3-0-3.
Examines the history, institutional structure, and functions, as well as current policy challenges facing NATO and other European security arrangements.

INTA 4230. Seminar in Europe: European Union
3-0-3.
Explores the history and processes of economic and political integration within the framework of the European Union.

INTA 4240. Argentine Politics, History, and Culture
3-0-3.
Survey of the politics, history, and culture of Argentina. Topics include Argentine economic and political failure, the politics of immigration, and the relationship between culture and development.

INTA 4241. Third World Democratization
3-0-3.
Surveys the Third World democratization. Assesses various theories of democratization. Examines various measures of democracy and explores the depth and consolidation of the current democratization boom.

INTA 4330. Chinese Economic Reform
3-0-3.
Addresses the profound and consequential process of the Chinese economic reform that started at the end of the 1970s and has led to China's rapid economic growth.

INTA 4331. Chinese Politics in Transition
3-0-3.
Investigates the organizational apparatus through which the Chinese Communist Party exercises leadership over politics and society, and the way in which reforms have changed those relationships.

INTA 4332. Chinese Institutions and Policy Process
3-0-3.
Supervised field research on the Chinese institutions and policy-making process especially in the areas of economic and social issues.

INTA 4333. Korean Security Policy
3-0-3.
An examination of the principal policy issues facing the United States with regard to the Korean Peninsula and the principal neighboring states, China and Japan.

INTA 4340. Latin American Regional Economic and Political Integration
3-0-3.
Examines institutional, interest group, international, and economic inputs and outputs of regional integration.

INTA 4400. Senior Seminar: International Strategy and Policy
3-0-3.
Capstone experience in which students formulate strategies and policies to cope with international problems. Themes vary from seminar to seminar.

INTA 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

INTA 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

INTA 4803. Special Topics
3-0-3.
Selected topics will vary from term to term.

INTA 4811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number.
Topics of interest not covered in the regular course offerings.

INTA 4823, -33. Special Topics
3-0-3.
Selected topics will vary from term to term.

INTA 4901, -02, -03. Special Problems
Credit hours to be arranged.
Independent study with a faculty member.

INTA 6002. Strategic Decision Making
3-0-3.
Examines the dynamics of individual, group, organizational, cross-cultural, and international interaction.

INTA 6003. Empirical Research Methods
3-0-3.
This course introduces research methods in international affairs. It emphasizes writing research proposals, empirical techniques, gathering and assembling data, and methods for analyzing and reporting results.

INTA 6004. Modeling, Forecasting, and Decision Making
3-0-3.
This course introduces modeling and forecasting in strategic decision making, analysis of long-term developments, path gaming, formal analysis of games, and simulation.

INTA 6011. International Trade and Technology Transfer
3-0-3.
This course examines the relationship between international trade and technology transfer and their effect on national competitiveness, national security, and international cooperation and coercion.

INTA 6013. Technology Forecasting
3-0-3.
Increasingly rapid technological changes impact international relations in various aspects. This course utilizes qualitative and quantitative methods in assessing the direction and magnitude of such changes.

INTA 6022. Ethics and International Affairs
3-0-3.
An overview of the main tradition and theories of international ethics applied to four major issues: intervention and the use of force; human rights; self-determination; and global distributive justice.

INTA 6102. International Relations Theory
3-0-3.
This course provides an introduction to theoretical approaches to understanding international relations. The focus of the course is on system-level theories and sub-systematic-level theories.

INTA 6103. International Security
3-0-3.
Examines traditional and nontraditional issues in international security, including the uses of military force, military strategy and policy, arms control, peacekeeping, the environment, and migration.

INTA 6104. The Changing World Order
3-0-3.
As a seminar for graduate students, this course explores the issues of world order conceptually and empirically. Various political organizations and the major proposals for the world order are critically examined.

INTA 6105. International Institutional Design
3-0-3.
This course examines international institutions and their effect on foreign policy decision makers. Specific topics include: the theoretical study of cooperation; supranatural organizations and informal institutions.

INTA 6106. The State in International Affairs
3-0-3.
Explores various concepts of the state in international affairs as well as the concepts of sovereignty and revolution.

INTA 6107. Development and Demography
3-0-3.
This course examines the role population plays in the development of countries and the international system.

INTA 6111. U.S. Foreign and National Security Strategy
3-0-3.
This course focuses on the design and implementation of U.S. foreign policy and national strategy in the areas of arms control, the Third World, and economic policy.

INTA 6121. Seminar In Europe: European Security
3-0-3.
This course examines the history, institutional structure and functions, and current policy challenges facing the North Atlantic Treaty Organization (NATO) and other European security institutions.

INTA 6202. Comparative Politics
3-0-3.
This course surveys the major political types of the late twentieth century world and explores their various development characteristics.

INTA 6203. Comparative Institutional Design
3-0-3.
This course examines the creation, maintenance, and evolution of political institutions, and the ways in which institutions affect policy choice.

INTA 6204. Comparative Politics and Strategies of Advanced Industrial States
3-0-3.
This course provides an in-depth assessment of the political and economic behavior of the five largest OECD powers.

INTA 6205. Literacy and Development
3-0-3.
This course analyzes the politics, problems, and alternative solutions in national language choices, including a comparative analysis of industrialized and developing nations.

INTA 6302. International Political Economy
3-0-3.
This course is an introduction to the politics of international economic relations. Major theoretical approaches are applied to international trade, international monetary relations, and global production in the modern era.

INTA 6303. Economic Crisis and Democratization
3-0-3.
This course examines the complex relationship between economic transitions and political reform in authoritarian and newly democratic countries.

INTA 6304. Modernization and Development
3-0-3.
This course empirically examines processes in which a country's organizational structure is altered through economic development, political democratization, and/or social liberalization.

INTA 6305. Political Economy of Foreign Direct Investment
3-0-3.
This course examines the impact of foreign direct investment on the world economy and international trade, as well as the political effects of multinational corporations.

INTA 6320. Seminar in Europe: European Union
3-0-3.
This course explores the history and processes of economic and political integration within the framework of the European Union.

INTA 6330. Political Economy of East Asia
3-0-3.
This course explores the politics of economic development in China, Japan, and Korea. Focal issues include: trade patterns, financial institutions, trade-bloc formation, industrial competitiveness, and the status of U.S.-East Asian economic relations.

INTA 6331. Chinese Political Economy
3-0-3.
This course examines the Chinese social and economic development from the seventh century to current day. Specific emphasis is placed on the political economic reforms of Deng Xiaoping and assessing the implications of continued Chinese modernization.

INTA 6753. Comparative Science and Technology Policy
3-0-3.
Examination of the social, political, and cultural contexts of science and technology and how they affect the research, development, and regulatory policies of nations. Crosslisted with PUBP 6753.

INTA 7000, Master's Thesis
Credit hours to be arranged.
Under the direct supervision of one or more faculty members, graduate students will complete an original research design and execute that study.

INTA 8801, -02, -03, -04, -05. Special Topics
Class and credit hours equal last digit in course number.

INTA 8813, -23, -33. Special Topics
3-0-3.
Topics of interest in international affairs.

INTA 8901, -02, -03. Special Problems
Credit hours to be arranged.

INTA 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students with a teaching assistantship.

INTA 8998. Research Assistantship
Credit hours to be arranged.
For graduate students with a research assistantship.

School of Literature, Communication, and Culture

www.lcc.gatech.edu

Established in 1990
Location: 335 Skiles Building
Telephone: 404.894.2730 or 404.894.2731
Fax: 404.894.1287

Chair and McEver Professor–Kenneth Knoespel; *Associate Chair and Professor*–Peter McGuire; *Director of Graduate Studies and Professor*–Janet Murray; *Director of Communications Programs and Wesley Professor of New Media*–Jay David Bolter; *Director of Undergraduate Studies and Professor*–Jay Telotte; *Bourne Professor of Poetry*–Thomas Lux.
Professors Emeriti–Irving E. Foote, Maxine Turner.
Professors–Philip Auslander, Carol A. Colatrella.
Associate Professors Emeriti–Edith H. Blicksilver, Sarah E. Jackson.
Associate Professors–T. Hugh Crawford, Angela DalleVacche, Diane Gromala, TyAnna K. Herrington, Blake T. Leland, Sara M. Putzell, Carol Senf, Robert E. Wood.
Assistant Professors–Ian Bogost, Ron Broglio, Deborah R. Grayson, Narin Hassan, Cindy

Klestinec, Michael Mateas, Michael Nitsche, Colleen Terrell, Eugene Thacker, Sha Xin-Wei, Lisa Yaszek.

Brittain Fellows–Hamilton Carroll, Brian Cliff, Alan R. Clinton, Khalil Elayan, Kristin Girard, Jonathan Goodwin, Karen Head, Reshmi Hebbar, Bridget Heneghan, Rodney Hill, Steven Levin, Tom Lilly, Srikanth Mallavarapu, Elizabeth Mauldin, Connie Monson, David Morgen, Doreen Piano, Petra Schweitzer, Thomas Smith, Robert Stalker, Charles Tryon, Patricia Ventura, Leslie Worthington, Frederick Young.

Technical Communication Fellows–Jeremy Eisenberg, Piper Huguley-Riggins, Michael Laughter, Ben Miller.

Research Scientists–Ute Fischer, Lisa McNair-Dupree.

Academic Professional–Shannon Dobranski.

Director of DramaTech–Gregory Abbott.

General Information

The School of Literature, Communication, and Culture (LCC) is engaged in rethinking the role of humanities education in an increasingly technological and multicultural environment. The faculty is committed to interdisciplinary research in cultural studies and new media studies at the theoretical and applied levels. In providing humanities and communication courses for all Georgia Tech undergraduates, LCC's curriculum focuses on the scientific and technologically oriented aspects of the humanities, as well as on the incorporation of new electronic media (visual, aural, and textual) into humanities and communication education.

LCC offers a B.S. in Science, Technology, and Culture (STAC), which includes the options of Media Studies and Gender Studies, a B.S. in Computational Media jointly administered with the College of Computing, an M.S. in Information Design and Technology (IDT), and a Ph.D. in Digital Media. Graduates from LCC's undergraduate and graduate programs are positioned to assume important roles as leaders in the exciting new fields developing in the interface between technology and culture. STAC majors receive a rigorous, well-rounded education that equips them not only for careers in government, education, and the private sector, but also for postgraduate study in medicine, law, communication, literature and literary studies, or cultural studies. In addition, they find themselves well prepared for the continual learning necessary for their future lives and careers. Most IDT graduates accept positions of responsibility in new media-related careers as Web designers, project managers, new media developers, and educational technologists. Some graduates go on to Ph.D. programs in computing, media studies, communication, and related fields.

Undergraduate Programs

Bachelor of Science in Science, Technology, and Culture (Suggested Schedule)

First Year – First Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501 CALCULUS I or MATH 1712 SURVEY OF CALCULUS		4
LAB SCIENCE ELECTIVE (BIOL, CHEM, EAS, PHYS)		4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
WELLNESS		2
TOTAL SEMESTER HOURS		16

First Year - Second Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502 CALCULUS II or MATH 1711 FINITE MATHEMATICS		4
LAB SCIENCE (BIOL, CHEM, EAS, PHYS)		4
COMPUTING REQUIREMENT		3
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Second Year - First Semester

Course Number/Name		*Hours*
LCC 2100	INTRO. TO SCIENCE, TECHNOLOGY, & CULTURE	3
SOCIAL SCIENCE ELECTIVE(S)		3
HUMANITIES ELECTIVE(S)		3
PST 3115 PHILOSOPHY OF SCIENCE or 3127 SCIENCE, TECHNOLOGY, & HUMAN VALUES		3
SCIENCE or COMPUTER SCIENCE ELECTIVE(S)		4
TOTAL SEMESTER HOURS		16

Second Year - Second Semester

Course Number/Name	*Hours*
LCC ELECTIVE(S) (2100 Series)	3
MODERN LANGUAGE ELECTIVE(S) (2000 Level or Higher)	3
HUMANITIES ELECTIVE(S)	3
SOCIAL SCIENCE ELECTIVE(S) (International)	3
SCIENCE or COMPUTER SCIENCE ELECTIVE(S)	4
TOTAL SEMESTER HOURS	16

Third Year - First Semester

Course Number/Name	*Hours*
LCC ELECTIVE(S) (2100 Series)	3
LCC ELECTIVE(S) (2200 or 3200 Series)	3
LCC ELECTIVE(S) (3400 Series)	3
FREE ELECTIVE(S)	3
NON-MAJOR CLUSTER ELECTIVE(S)	3
TOTAL SEMESTER HOURS	15

Third Year - Second Semester

Course Number/Name	*Hours*
FREE ELECTIVE(S)	3
LCC ELECTIVE(S) (2200 or 3200 Series)	3
LCC ELECTIVE(S) (3300 Series)	3
LCC ELECTIVE(S) (3400 Series)	3
NON-MAJOR CLUSTER ELECTIVE(S)	3
TOTAL SEMESTER HOURS	15

Fourth Year - First Semester

Course Number/Name	*Hours*
LCC ELECTIVE(S) (2200 or 4200 Series)	3
LCC ELECTIVE(S) (3300 Series)	3
LCC ELECTIVE(S) (2000 Level or Higher)	3
NON-MAJOR CLUSTER	3
FREE ELECTIVE(S)	3
TOTAL SEMESTER HOURS	15

Fourth Year – Second Semester

Course Number/Name	*Hours*
LCC ELECTIVE(S) (3400 or 4400 Series)	3
LCC ELECTIVE(S) (3300 Series)	3
LCC ELECTIVE(S) (2000 Level or Higher)	3
LCC 4100 SEMINAR IN SCIENCE, TECHNOLOGY, & CULTURE or 4102 SENIOR THESIS	3
TOTAL SEMESTER HOURS	12

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Bachelor of Science in Science, Technology, and Culture – Media Studies Option (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501 CALCULUS I or MATH 1712 SURVEY OF CALCULUS		4
LAB SCIENCE (BIOL, CHEM, EAS, PHYS)		4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		14

First Year - Second Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502 CALCULUS II or MATH 1711 FINITE MATHEMATICS		4
LAB SCIENCE (BIOL, CHEM, EAS, PHYS)		4
COMPUTING REQUIREMENT		3
WELLNESS		2
TOTAL SEMESTER HOURS		16

Second Year - First Semester

Course Number/Name		*Hours*
LCC 2100	INTRO. TO SCIENCE, TECHNOLOGY, & CULTURE	3
LCC 2400 INTRO. TO MEDIA STUDIES or LCC 2500 INTRO. TO FILM		3
SOCIAL SCIENCE ELECTIVE(S)		3
HUMANITIES ELECTIVE(S)		3
COMPUTER SCIENCE ELECTIVE(S)		4
TOTAL SEMESTER HOURS		16

Second Year - Second Semester

Course Number/Name	*Hours*
PST 3115 PHILOSOPHY OF SCIENCE or 3127 SCIENCE, TECHNOLOGY, & HUMAN VALUES	3
SOCIAL SCIENCE ELECTIVE(S)	3
HUMANITIES ELECTIVE(S)	3
SOCIAL SCIENCE ELECTIVE(S) (International)	3
COMPUTER SCIENCE ELECTIVE(S)	4
TOTAL SEMESTER HOURS	16

Third Year - First Semester

Course Number/Name	*Hours*
LCC ELECTIVE(S) (2100 Series)	3
LCC 3314 TECHNOLOGIES OF REPRESENTATION	3
LCC ELECTIVE(S) (3400 Series)	3
FREE ELECTIVE(S)	3
NON-MAJOR CLUSTER ELECTIVE(S)	3
TOTAL SEMESTER HOURS	15

Third Year - Second Semester

Course Number/Name	*Hours*
LCC ELECTIVE(S) (2100 Series)	3
LCC 3206, 3252, 3256, or 3262	3
LCC 3352 FILM and/AS TECHNOLOGY	3
LCC ELECTIVE(S) (3400 Series)	3
NON-MAJOR CLUSTER ELECTIVE(S)	3
TOTAL SEMESTER HOURS	15

Fourth Year - First Semester

Course Number/Name	*Hours*
LCC 3206, 3214, 3252, 3256, or 3262	3
LCC 3302, 3304, 3306, 3316, or 3318	3
MODERN LANGUAGES ELECTIVE(S)	3
NON-MAJOR CLUSTER ELECTIVE(S) (Computer Science)	3
FREE ELECTIVE(S)	3
TOTAL SEMESTER HOURS	15

Fourth Year - Second Semester

Course Number/Name	*Hours*
LCC ELECTIVE(S) (3400 or 4400 Series)	3
LCC ELECTIVE(S) (3300 or 4400 Series)	
LCC 3206, 3214, 3252, 3256, or 3262	3
LCC 4102, 4400, or 4500	3
FREE ELECTIVE(S)	3
TOTAL SEMESTER HOURS	15

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Bachelor of Science in Science, Technology, and Culture – Gender Studies Option (Suggested Schedule)

First Year - First Semester

Course Number/Name	*Hours*
ENGL 1101 ENGLISH COMPOSITION I	3
MATH 1501 CALCULUS I or MATH 1712 SURVEY OF CALCULUS	4
LAB SCIENCE (BIOL, CHEM, EAS, PHYS)	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200	3
TOTAL SEMESTER HOURS	14

First Year - Second Semester

Course Number/Name	*Hours*
ENGL 1102 ENGLISH COMPOSITION II	3
MATH 1502 CALCULUS II or MATH 1711 FINITE MATHEMATICS	4
LAB SCIENCE (BIOL, CHEM, EAS, PHYS)	4
CS 1321 INTRO. TO COMPUTING or CS 1315 INTRO. TO MEDIA COMPUTATION	3
WELLNESS	2
TOTAL SEMESTER HOURS	16

Second Year - First Semester

Course Number/Name	*Hours*
LCC 2100 INTRO. TO SCIENCE, TECHNOLOGY, & CULTURE	3
SOCIAL SCIENCE ELECTIVE(S)	3
MODERN LANGUAGE ELECTIVE(S) (2000 LEVEL or HIGHER)	3
PST 3115 PHILOSOPHY OF SCIENCE or 3127 SCIENCE, TECHNOLOGY, & HUMAN VALUES	3
SCIENCE or COMPUTER SCIENCE ELECTIVE(S)	4
TOTAL SEMESTER HOURS	16

Second Year - Second Semester

Course Number/Name	*Hours*
LCC 2200 INTRO. TO GENDER STUDIES	3
NON-MAJOR CLUSTER	3
HUMANITIES ELECTIVE(S)	3
SOCIAL SCIENCE ELECTIVE(S) (International)	3
SCIENCE or COMPUTER SCIENCE ELECTIVE(S)	4
TOTAL SEMESTER HOURS	16

Third Year - First Semester

Course Number/Name	*Hours*
LCC ELECTIVE(S) (2100 Series)	3
LCC 3212 WOMEN, LITERATURE, & CULTURE or LCC 3225 GENDER STUDIES IN THE DISCIPLINES	3
LCC ELECTIVE(S) (3400 Series)	3
HUMANITIES ELECTIVE(S)	3
FREE ELECTIVE(S)	3
TOTAL SEMESTER HOURS	15

Third Year - Second Semester

Course Number/Name	*Hours*
LCC ELECTIVE(S) (2100 Series)	3
LCC ELECTIVE(S) (3200 Series)	3
LCC 3304 SCIENCE, TECHNOLOGY, & GENDER	3
LCC ELECTIVE(S) (3400 Series)	3
NON-MAJOR CLUSTER ELECTIVE(S)	3
TOTAL SEMESTER HOURS	15

Fourth Year - First Semester

Course Number/Name	*Hours*
LCC ELECTIVE(S) (3200 Series)	3
LCC 3302, 3306, 3308, 3316, or 3318	3
SOCIAL SCIENCE ELECTIVE(S)	3
NON-MAJOR CLUSTER ELECTIVE(S)	3
FREE ELECTIVE(S)	3
TOTAL SEMESTER HOURS	15

Fourth Year - Second Semester

Course Number/Name	*Hours*
LCC ELECTIVE(S) (3400 or 4400 Series)	3
LCC ELECTIVE(S) (3300)	3
LCC ELECTIVE(S) (2000 Level or Higher)	3
LCC 4100 SEMINAR IN SCIENCE, TECHNOLOGY, & CULTURE or 4102 SENIOR THESIS	3
FREE ELECTIVE(S)	3
TOTAL SEMESTER HOURS	15

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Bachelor of Science in Computational Media

The B.S. in Computational Media is a collaborative effort by the College of Computing and the School of Literature, Communication, and Culture. The program offers a thorough education in all aspects of the computer as a medium: the technical, the historical-critical, and the applied. Program graduates will have both significant hands-on and theoretical knowledge of computing and an understanding of visual design and the history of media. Graduates will be uniquely positioned to plan, create, and critique new digital media forms for entertainment, education, and business communication.

The program requires thirty-six semester hours of courses in computer science and thirty hours of courses in LCC (in addition to the humanities requirement). A substantial number of required courses in each unit ensures that every student has basic competence in:

- computational principles;
- the representation and manipulation of digital media, including graphics and sound;
- software design;
- visual and interactive design;
- digital arts; and
- media theory and history.

After completing required courses, students specialize in a specific area of media computing. Typical specialty areas include:

- **Interactive games design**: This is one of the fastest growing areas of digital media production and is already a $7 billion industry.
- **Special effects:** As special effects become more complex and focused on computer-generated imagery, employment in this area will increasingly require expertise in both media and computer science.
- **Culturally informed program design**: As programming work is increasingly outsourced to nations offering lower labor costs, programming that adds value through a sophisticated response to the needs of specific corporate and group cultures will offer job security to American programmers.

Depending on their coursework within the B.S. program, students will also be qualified to enter graduate studies in computer science, digital arts, digital media studies, and human-computer interface.

Bachelor of Science in Computational Media (Joint Degree with the College of Computing) (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
LAB SCIENCE (BIOL, CHEM, EAS, PHYS)		4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
CS 1315 or 1321 or 1371		3
TOTAL SEMESTER HOURS		17

First Year - Second Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II	4
CS 1050 or 1316 or 1322		6
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

Second Year - First Semester

Course Number/Name		*Hours*
LCC 2700	INTRO. TO COMPUTATIONAL MEDIA	3
MATH 2605	CALCULUS III FOR COMPUTER SCIENCE	4
CS 1050 or 1316 or 1322 or 2260 or 2335 or 2340		3
HUMANITIES ELECTIVE(S)		3
WELLNESS		2
TOTAL SEMESTER HOURS		15

Second Year - Second Semester

Course Number/Name		*Hours*
LCC 2710 or 2720 or 2730		3
LAB SCIENCE (BIOL, CHEM, EAS, PHYS)		4
LCC 2400 or 2500 or 2600		3
CS 2260 or 2335 or 2340 or 4001		3
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

Third Year - First Semester

Course Number/Name		*Hours*
LCC (3254, 3256, 3352) or LCC (2600, 3262, 3362) or LCC (2100, 2116, 3318) or LCC (3202, 3226, 3214)**		3
LCC 2710 or 2720 or 2730 or 3705 or 3710		3
CS 2260 or 2335 or 2340 or 4001		3
LCC ELECTIVE(S)		3
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Third Year - Second Semester

Course Number/Name		*Hours*
LCC 3206	STUDIES IN COMMUNICATION & CULTURE or LCC 3314 TECHNOLOGIES OF REPRESENTATION	3
LCC 2710 or 2720 or 2730 or 3705 or 3710		3
CS 2260 or 2335 or 2340 or 4001		3
SOCIAL SCIENCE ELECTIVE(S)		3
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Fourth Year - First Semester

Course Number/Name	*Hours*
LCC (3254, 3256, 3352) or LCC (2600, 3262, 3362) or LCC (2100, 2116, 3318) or LCC (3202, 3226, 3214)**	3
LCC 4699 or 4720 or 4725 or 4730 or 4731 or 4745	3
CS ELECTIVE(S) (3000 or 4000 Level)*	6
CS 4903 SPECIAL PROBLEMS or LCC 4699 UNDERGRADUATE RESEARCH*	4
TOTAL SEMESTER HOURS	16

Fourth Year - Second Semester

Course Number/Name	*Hours*
LCC (3254, 3256, 3352) or LCC (2600, 3262, 3362) or LCC (2100, 2116, 3318) or LCC (3202, 3226, 3214)**	3
CS ELECTIVE(S) (3000 or 4000 Level)*	6
FREE ELECTIVE(S)	3
TOTAL SEMESTER HOURS	12

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

* Must be approved by an advisor.

** Must complete nine hours in a single area.

Computing Requirement

Students must complete either CS 1315, CS 1321, or a computer programming course approved as satisfying the general education requirements in computer literacy.

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Requirements and Electives

Requirements of the Bachelor of Science in Science, Technology, and Culture:

Basic Distribution	59 hours
Major Hours	45 hours
Non-major Cluster	9 hours
Free electives	9 hours
TOTAL	122 hours

Basic Distribution/Core Requirements

Freshman Composition	6 hours
Mathematics	8 hours
Laboratory Science	8 hours
Computing	3 hours
Science or Computing	8 hours
Humanities and Fine Arts	6 hours
Social Sciences	12 hours

- HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200
- an internationally oriented course from an approved list
- two additional social science courses

Modern language at the 2000 level or higher	3 hours
Philosophy of Science (PST 3115 or 3127)	3 hours

Mathematics

The mathematics requirement may be satisfied by one of the following sequences: MATH 1711 and 1712, MATH 1501 and 1502, or MATH 1501 and 1711.

Science and Computing

The laboratory science sequence may be satisfied with any two lab science courses offered in chemistry, biology, physics, or earth and atmospheric sciences. Courses need not form a sequence. All LCC students are required to take CS 1315 or CS 1321. In addition, STAC majors must take eight additional hours in science or computing.

Freshman Composition/Humanities/Fine Arts

Students are required to complete six hours in humanities or fine arts in addition to six hours in freshman composition (ENGL 1101 and 1102), for a total of twelve hours.

Social Sciences

Students are required to complete twelve hours of social science credit. These include: a) one course from HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200 to satisfy state requirements concerning coursework on the history and constitutions of the United States and Georgia; b) one course with an international focus; and c) two additional social science courses.

Non-major Cluster

All students must take a nine-hour concentration from a unit other than Literature, Communication, and Culture. This requirement may be met through an existing certificate program or by a nine-hour concentration approved by LCC and meeting the following requirements: 1) All courses must be above the required courses and distribution requirements in the course curriculum. 2) All courses must be either in one discipline or part of an interdisciplinary cluster grouped around a particular topic. 3) Students in the Media Studies track must choose courses in CS or a related field as approved by LCC advisors. 4) The cumulative average for the concentration must be at least 2.0.

Designated Courses in the STAC Major

All students must take forty-two hours of STAC courses including the following groups:

1) LCC 2100
2) Six hours of STAC historical courses (LCC 2102, 2104, 2106, 2108, 2110, 2112, 2114, 2116, 2118)
3) Nine hours of STAC literary/cultural courses (LCC 2202, 2204, 2206, 2208, 2210, 2212, 2214, 2216, 2218, 3202, 3204, 3206, 3208, 3210, 3212, 3214, 3216, 3218, 3220, 3222, 3224, 3226, 3252, 3254, 3256, 3262, 4200, 4600)
4) Nine hours of STAC issues courses (LCC 3302, 3304, 3306, 3308, 3310, 3314, 3316, 3318, 3352, 3362)
5) Nine hours of STAC media/communications courses (LCC 3402, 3404, 3406, 3408, 3410, 3412, 4400, 4402, 4404, 4406)
6) Two additional STAC (LCC) courses

With the permission of the School, a student may substitute up to six hours of LCC special topics courses for any of these courses except LCC 2100.

STAC Media Studies Option
Students choosing to follow the Media Studies track must distribute classes required for the major by choosing from among the following options:

- History classes must include two classes chosen from 21XX.
- Literary/cultural studies must include three classes chosen from 2600, 3206, 3214, 3252, 3254, 3256, 3262.
- Issues classes must include: 1) 3352 and 3314; and 2) one additional class chosen from 3302, 3304, 3306, 3316, or 3318.
- Media classes must include three classes chosen from 3402, 3404, 3406, 4402, and 4404.
- Two additional STAC classes must include: 1) 2400 or 2500 taken in the second year; and 2) an additional class chosen from 3408, 3410, 3450, 4400, or 4406 (Media).
- Thesis or seminar must be chosen from 4400, 4500, or 4102.
- Non-major cluster must be chosen from CS or other areas approved by LCC faculty.
- Science and Engineering must be chosen from CS.

STAC Gender Studies Option
Students choosing to follow the Gender Studies track must distribute classes required for the major by choosing from among the following options:

- History classes must include: two classes chosen from 21XX.
- Literary/cultural studies must include LCC 3225 or LCC 3212 plus two classes chosen from 22XX, 32XX, and 42XX.
- LCC issues classes must include 3304 and two additional classes from 33XX; LCC 3302, 3306, 3308, 3316, and 3318 are recommended.
- LCC media classes must include three classes chosen from 34XX and 44XX.
- Additional STAC classes must include: 2200 – Introduction to Gender Studies.
- Thesis or seminar must be chosen from 4100 or 4102.
- Non-major cluster must be approved by LCC faculty advisor.

Senior Seminars/Thesis
Each student must complete a senior seminar (LCC 4100, 4400, 4500) or senior thesis (LCC 4102). A student must have a signed contract with a thesis advisor in order to receive permission to register for thesis credit.

Free Electives
Each student must accumulate at least 122 hours of credit toward the Bachelor of Science in Science, Technology, and Culture. Therefore, in addition to the requirements listed here, a student must complete a sufficient number of elective courses either within or outside LCC to complete 122 hours. Typically, this will be nine hours.

Minors and Certificates
LCC provides a minor in Performance Studies and, together with the School of History, Technology, and Society (HTS), provides a minor in Women, Science, and Technology (WST). Students wishing to pursue either of these minors should consult LCC (or, in the case of the WST minor, either LCC or HTS) for detailed information concerning requirements. Courses for both minors are selected from "Courses of Instruction" and, in the case of the WST minor, in the list offered by HTS.

LCC also sponsors a series of certificate programs: in American Literature and Culture, Film Studies, and Literary and Cultural Studies. Students should consult the LCC director of undergraduate studies for detailed information on requirements. The courses for these certificates are among those listed in "Courses of Instruction," and all fulfill humanities requirements.

LCC and HTS also cooperate in providing a certificate in African American Studies. Students should consult LCC or HTS for detailed information concerning requirements. Courses for this certificate are selected from among those listed in "Courses of Instruction" and from the list offered by HTS.

Advanced Placement
Students with a score of 4 or 5 on the College Board Advanced Placement Exam (taken in conjunction with high school classes) in Composition and Literature or Language and Composition receive credit for English 1101. Students with a score of 750 or higher on the SAT II Subject Test in English receive credit for English 1101. Students with a score of four or higher on the International Baccalaureate Exam receive credit for English 1101. Advanced placement credit is not ordinarily given for English 1102.

Writing and Communication Intensive Courses
A number of majors require students to complete writing intensive and communication intensive courses. Several LCC classes may be counted toward this requirement. Consult course offerings each semester to determine which courses may be counted toward this requirement.

Regents' Examination
This exam measures proficiency in reading and English composition; a passing score is required by the Board of Regents for graduation. Students who have not passed the exam by the time they have completed forty-five hours of degree credit must schedule RGTE 0199 in their next semester in residence. In addition to RGTR 0198, LCC offers short workshops in preparation for the exam, consultation with those who have failed, and an appeal system for those who fail.

Graduate Program

Master of Science in Information Design and Technology
Georgia Tech's M.S. in Information Design and Technology (IDT) is a graduate program of humanities-based professional education for the digital age. IDT students follow a studio- and seminar-based curriculum that places digital design within technical, cultural, aesthetic, and historical contexts. The program rests on the assumption that digital media belong to an historical, aesthetic, and conceptual continuum whose legacy and future must be addressed in order to understand the digital artifact in its own right.

Georgia Tech's IDT program is helping to establish the standard for professional education in information design and to raise the level of professional practice. It is aimed at providing a principled-based education that will guide its graduates over the course of their careers in a rapidly changing technical environment.

Because of its technical and disciplinary diversity, the IDT program can offer students both the practical skills and the theoretical foundation they need to assume leadership roles as designers, producers, and critical analysts of digital media. Graduates of the program pursue careers in commerce, entertainment, art, and education with a variety of national and international organizations. Some go on to Ph.D. work in computer science or the humanities.

The IDT program accepts roughly twenty-five full-time students each fall term. IDT students come from a range of educational backgrounds and have diverse intellectual and creative objectives. Most have significant work experience in a professional field. Students come with academic backgrounds from such fields as acting, anthropology, architecture, communications, computer science, engineering, English studies, graphic design, history, journalism, law, library science, management, marketing, philosophy, social work, software development, technical writing, and television production. The program welcomes a socially diverse and international student body.

Five-year B.S.-M.S. Degree Program
Students who wish to pursue the five-year B.S.-M.S. combination in STAC and IDT must apply to the School after completing at least seventy-five hours of work toward the STAC Media Studies degree. Applicants should have a 3.5 GPA.

Students admitted to the five-year program will select the 4400 seminar option and also take a total of twelve hours of graduate coursework during their final undergraduate year. Six hours of that work, in IDT media courses, will replace the STAC free electives and will count for both undergraduate and graduate credit. During the summer term after their fourth year, students will participate in an approved internship program. During the fifth year, students will take a total of twenty-four hours, including either LCC 6800 (Project) or LCC 7000 (Thesis), and with no more than three courses taken outside the IDT program.

Ph.D. in Digital Media
The Digital Media Ph.D. was inaugurated in fall 2004 and is one of the first of its kind worldwide. The program educates research-oriented theorists/practitioners who bring the traditions of the humanities and arts to the design of digital media. Graduates of the program are prepared to work in industry, public service, and universities, shaping the emerging digital genres and expanding our understanding and mastery of the representational power of the computer.

Curriculum and Course of Study

Required Courses: (36 hours)
- LCC 6310 – The Computer as an Expressive Medium (3 hours)
- LCC 6311 – Visual Culture and Design (3 hours)
- LCC 6312 – Design, Technology, and Representation (3 hours)
- LCC 6313 Principles of Interactive Design – (3 hours)
- LCC 6316 – Historical Approaches to New Media (3 hours)
- LCC 6650 – Project Studio (3 hours)
- LCC 6800 – Master's Project (6 hours)
- LCC 8001 Pro-Seminar I (New Course) (3 hours)
- LCC 8002 – Pro-Seminar II (New Course) (3 hours)
- LCC 9000 – Doctoral Thesis (6 hours)

Minor Concentration (9 hours)
Three related courses outside the School of Literature, Communication, and Culture. These courses may be in other schools of the Ivan Allen College, or in colleges or in interdisciplinary fields of the Institute. Example of a minor concentration in Computer Science:
- CS 6750 – Human Computer Interactions
- CS 6460 – Foundations of Educational Technology
- CS 6470 – Online Communities

5 Elective Courses (15 hours)
- LCC 6213 – Educational Applications of New Media (3 hours)
- LCC 6215 – Issues in Media Studies (3 hours)
- LCC 6314 – Design of Networked Media (3 hours)
- LCC 6315 – Project Production (3 hours)
- LCC 6317 – Interactive Fiction (3 hours)
- LCC 6318 – Experimental Media (3 hours)
- LCC 6319 – Intellectual Property Policy and Law (3 hours)
- LCC 6320 – Globalization and New Media (3 hours)
- LCC 6321 – Architecture of Responsive Spaces (3 hours)
- LCC 6650 – Project Studio (repeatable) (3 hours)
- LCC 7999 – Preparation for Qualifying Examination (variable credit)
- LCC 8803 – Special Topics (variable credit)
- LCC 8910 – Special Problems (variable credit)
- LCC 7999 – Preparation for Qualifying Examination (variable credit)
- LCC 8999 – Preparation of Ph.D. Dissertation (variable credit)

Courses from other units may be substituted with approval of advisor.

Portfolio Review
- Demonstration of programming competency with grounding in foundational principles of software engineering (can be fulfilled with coursework)
- Digital media project design and implementation at level of outstanding IDT master's project

Comprehensive Examination
- Taken only after passing portfolio review
- Based on list of works drawn from the Comprehensive Exam List (see Appendix), with additions proposed as appropriate by candidates in consultation with their Advisory Committees
- Students must obtain approval of their list by the Graduate Faculty Committee by the end of the semester preceding the semester in which they will be examined.
- Examinations include a four-part written component, given over a two-week period, with a two-hour oral to be given within ten days of the last completed written segment.
- The four parts of the examination (based on the four-part Exam List) are:
  1. Media Theory and Related Theoretical Contexts
  2. Traditional Media Technologies and Forms
  3. Digital Media Technologies and Forms
  4. A specialty of the student's choosing

The complete examination list is available online at **http://www.idt.gatech.edu/phd/phD_exam_list.htm**.

Ph.D. Thesis and Defense
After passing the Comprehensive Exam, the student will submit a Thesis Topic Proposal. When the committee chair deems the student is ready, a public oral thesis defense will be scheduled.

Full-time Residency
The program requires a minimum of two semesters in residence with full-time study.

Note: Ph.D. students who choose to can participate in the established internship program of the M.S. program, which customarily takes place between the first and second year.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course. This section includes courses in Literature, Communication, and Culture (LCC), English (ENGL), and Regents' Testing (RGTE and RGTR).

LITERATURE, COMMUNICATION, AND CULTURE

LCC 2100. Introduction to Science, Technology, and Culture
3-0-3.
Prerequisite(s): ENGL 1102
As the introductory course to the major in Science, Technology and Culture, this course explores the ways in which disciplines construct and represent the knowledge they generate.

LCC 2102. Science, Technology, and the Classical Tradition
3-0-3.
Prerequisite(s): ENGL 1102
Explores the definition and transmission of science and technology within Greek, Arabic, and medieval Latin contexts.

LCC 2104. The Age of Scientific Discovery
3-0-3.
Prerequisite(s): ENGL 1102
Examines the relationships among texts representing the literary, artistic, and scientific thought of the fifteenth and sixteenth centuries.

LCC 2106. The Age of Scientific Revolution
3-0-3.
Prerequisite(s): ENGL 1102
Examines interrelation of technological, literary, artistic, and philosophical thought in the late sixteenth and seventeenth centuries.

LCC 2108. Science, Technology, and Enlightenment
3-0-3.
Prerequisite(s): ENGL 1102
Considers the conceptual reformulation of the internal and external world urged by the sciences, technology, and culture of the Enlightenment.

LCC 2110. Science, Technology, and Romanticism
3-0-3.
Prerequisite(s): ENGL 1102
Examines the relationships among romantic ideology, science, and literature, including Romanticism's imaginative responses to Enlightenment science and the Industrial Revolution.

LCC 2112. Evolution and the Industrial Age
3-0-3.
Prerequisite(s): ENGL 1102
Connects later nineteenth century scientific and technological concepts and discoveries, particularly theories of evolution, to the literature and culture of the industrial age.

LCC 2114. Science, Technology, and Modernism
3-0-3.
Prerequisite(s): ENGL 1102
Explores a cross-section of technological, scientific, and cultural production characteristics of the first half of the twentieth century.

LCC 2116. Science, Technology and Postmodernism
3-0-3.
Prerequisite(s): ENGL 1102
Focuses on the relation among information technology, nonlinear physics, and the art, literature, and culture of postmodernism. Explores postmodern critiques of the Enlightenment and modernity.

LCC 2118. Science, Technology, and American Empire
3-0-3.
Prerequisite(s): ENGL 1102
Considers nineteenth and twentieth century science and technology as they shaped American culture with particular attention to the relationship between science, technology, progress, and empire.

LCC 2200. Introduction to Gender Studies
3-0-3.
Prerequisite(s): ENGL 1102
This course introduces the cultural concept of gender, examining topics such as biology and gender, social constructions of gender, and the psychology of sexual roles.

LCC 2202. Ancient and Medieval Literature and Culture
3-0-3.
Prerequisite(s): ENGL 1102
Introduction to Greece, Rome, and Medieval Europe through an examination of one or a few major cultural conflicts expressed in the literary genres and periods.

LCC 2204. Renaissance Literature and Culture
3-0-3.
Prerequisite(s): ENGL 1102
An examination of literature and culture from 1450 to 1650 with an emphasis on both major achievements and divergent voices.

LCC 2206. Enlightenment Literature and Culture
3-0-3.
Prerequisite(s): ENGL 1102
Examines the nature of the age from an initial boldness, optimism, and faith in reason to a recognition of its limits.

LCC 2208. Formations of American Culture
3-0-3.
Prerequisite(s): ENGL 1102
American literature from the Puritan period through the Civil War, including major movements, key authors and texts, study of literary works within broader historical and cultural context.

LCC 2210. Rearticulations of American Culture
3-0-3.
Prerequisite(s): ENGL 1102
Examines representations of the United States from its geographical expansion in the late nineteenth century to the closing of the frontier and emergence as global power.

LCC 2212. British and Continental Romanticism
3-0-3.
Prerequisite(s): ENGL 1102
Examines British and Continental Romanticism as it appeared during the latter part of the eighteenth century and the first half of the nineteenth century.

LCC 2214. Victorian Literature and Culture
3-0-3.
Prerequisite(s): ENGL 1102
Investigates the period 1830-1901 in English literature and culture, focusing on how that period defined key questions, especially ones about human nature, society, and the relation of religion to science.

LCC 2216. Literary and Cultural Modernism
3-0-3.
Prerequisite(s): ENGL 1102
A partial investigation of the aesthetic ferment that characterizes English-language cultural production from the turn of the century to the end of World War II.

LCC 2218. Literary and Cultural Postmodernism
3-0-3.
Prerequisite(s): ENGL 1102
A survey of major themes, representational techniques, and social and cultural concerns of postmodern art and literature.

LCC 2400. Introduction to Media Studies
3-0-3.
Prerequisite(s): ENGL 1102
This course offers an introduction to the historical development and cultural impact of various forms of media print, radio, television, film, and interactive electronic applications.

LCC 2500. Introduction to Film
3-0-3.
Prerequisite(s): ENGL 1102
Introduces film techniques and vocabulary in an historical and cultural context. Written texts are supplemented by viewings of specific shots, scenes, and films.

LCC 2600. Introduction to Performance Studies
3-0-3.
Prerequisite(s): ENGL 1102
An examination of the origins of the field of performance studies in literary study of theatre and drama, anthropological investigations of ritual, and sociological analyses of performance in everyday life.

LCC 2661. Theater Production: Set Design and Construction
0-3-1.
Prerequisite(s): ENGL 1102
In this "hands-on" course, students learn theatrical construction and painting techniques while building scenery for DramaTech productions.

LCC 2662. Theater Production II: Lights, Properties, Costumes
0-3-1.
Prerequisite(s): ENGL 1102
In this "hands-on" course, students create the lighting, property, and costume effects for two DramaTech Theatre productions.

LCC 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

LCC 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

LCC 2700. Introduction to Computational Media
3-0-3.
Prerequisite(s): ENGL 1102 and CS 1050 and CS 1315
Introduction to key concepts, methods, and achievements in computational media, and the convergence of digital technology with cultural traditions of representation.

LCC 2710. Visual Culture and Design
3-0-3.
Prerequisite(s): LCC 2100 or LCC 2700
Studio-based course that provides students with the skills needed to create digital visual designs and to analyze designs from an historical and theoretical perspective.

LCC 2720. Principles of Visual Design
3-0-3.
Prerequisite(s): LCC 2100 or LCC 2700
Studio-based course that provides students with basic skills needed to create digital visual images and to analyze designs from historical and theoretical perspectives.

LCC 2730. Constructing the Moving Image
3-0-3.
Prerequisite(s): LCC 2100 or LCC 2700
Provides the student with the conceptual, formal, aesthetic, and technical approaches to reconsider film, videos, and animation within the context of emerging digital forms.

LCC 2813. Special Topics in Science, Technology, and Culture
3-0-3.
Prerequisite(s): ENGL 1102
Study of one or more topics of current interest in the area of science, technology, and culture.

LCC 2823. Special Topics in Literary and Cultural Studies
3-0-3.
Prerequisite(s): ENGL 1102
Examination of one or more topics of current interest in literary and cultural studies.

LCC 3202. Studies in Fiction
3-0-3.
Prerequisite(s): ENGL 1102
Examines the elements of fiction and what has made fiction, especially the novel, distinctive, popular, and enduring. Readings may include formal, cultural, and historical theories.

LCC 3204. Poetry and Poetics
3-0-3.
Prerequisite(s): ENGL 1102
A study of traditions of poetic practice and poetic theory in English, in conjunction with a weekly workshop session centered on student's own poetry.

LCC 3206. Studies in Communication and Culture
3-0-3.
Prerequisite(s): ENGL 1102
Examines ways in which forms and media of communication create and are created by other cultural constructs.

LCC 3208. African American Literature and Culture
3-0-3.
Prerequisite(s): ENGL 1102
Explores the works of African American writers from the Colonial period to the present and examines a variety of cultural constructs that have fundamentally shaped the African American literary tradition.

LCC 3210. Ethnicity in American Culture
3-0-3.
Prerequisite(s): ENGL 1102
Explores literary and historical works considering ethnic issues in American culture, including immigration, social assimilation, "double consciousness," the development of ethnic identity, pride, and multiculturalism.

LCC 3212. Women, Literature, and Culture
3-0-3.
Prerequisite(s): ENGL 1102
Students in this course will analyze writings by women and examine feminist and other relevant cultural critiques of literature.

LCC 3214. Science Fiction
3-0-3.
Prerequisite(s): ENGL 1102
Examines science fiction texts from the last 200 years to show how they reflect ambiguous reactions to change.

LCC 3216. Theatre I: Classic and Medieval
3-0-3.
Prerequisite(s): ENGL 1102
The dramatic literature, theory, performance practices, and historical and cultural context of the theatre from prehistory through the Medieval period.

LCC 3218. Theatre II: Renaissance-Restoration
3-0-3.
Prerequisite(s): ENGL 1102
The dramatic literature, theory, performance practices, and historical and cultural context of theatre from the Renaissance through Restoration.

LCC 3220. Theatre III: Modern-Contemporary
3-0-3.
Prerequisite(s): ENGL 1102
The dramatic literature, theory, performance practices, and historical and cultural contexts of the theatre from Modernism to our contemporary period.

LCC 3222. Regionalism in American Literature
3-0-3.
Prerequisite(s): ENGL 1102
Explores the literary and cultural representations of a particular American region or locale (the South, the West, California, New York City, etc.) and the role such representations have played in the formation of both regional and national identity.

LCC 3225. Gender Studies in the Disciplines
3-0-3.
Prerequisite(s): ENGL 1102
This course explores the concept of gender and its usefulness as a theoretical category in a variety of disciplines. It includes cultural studies of literature, communication media, cultural anthropology, sociology, history, and science.

LCC 3226. Major Authors
3-0-3.
Prerequisite(s): ENGL 1102
An examination of the works and career of a major author in historical and cultural context.

LCC 3228. Shakespeare
3-0-3.
Prerequisite(s): ENGL 1102
An examination of Shakespeare's works with attention to generic conventions, historical context, and the relationship of text and performance. Major works of Shakespeare's contemporaries are studied as appropriate.

LCC 3234. Creative Writing
3-0-3.
Prerequisite(s): ENGL 1102
This course explores a range of creative literary genres, and combines study and analysis of existing modes of one or more forms in order to establish a basis for original creative work by class members.

LCC 3252. Studies in Film and Television
3-0-3.
Prerequisite(s): LCC 2400 or LCC 2500
Explores in depth a theoretical issue central to film and/or television. Among its concerns are authorship, genre theory, spectatorship, ideology, narrative theory, and the relationship between these media and social history.

LCC 3254. Film History
3-0-3.
Prerequisite(s): LCC 2500
Surveys the history of film from its machine origins to its present digital developments. It focuses on various movements, figures, and narrative developments in world cinema.

LCC 3256. Major Filmmakers
3-0-3.
Prerequisite(s): LCC 2500
Traces in depth an individual artist's career and affords students the opportunity to immerse themselves in the works of an important figure in the world of film.

LCC 3262. Performance Studies
3-0-3.
Prerequisite(s): LCC 2600
An examination of cultural theories of performance and their application to the analysis of specific performative events.

LCC 3302. Science, Technology, and Ideology
3-0-3.
Prerequisite(s): ENGL 1102
Examines specific scientific, philosophical, and literary/cultural texts in order to determine the role ideology plays in the construction of culture, especially scientific and technological culture.

LCC 3304. Science, Technology, and Gender
3-0-3.
Prerequisite(s): ENGL 1102
Examines specific philosophical, scientific, and cultural texts to determine the role that gender has played in the scientific and technological knowledge, currently and historically.

LCC 3306. Science, Technology, and Race
3-0-3.
Prerequisite(s): ENGL 1102
Examines specific historical and contemporary construction of race, within the prevailing scientific theories and ideologies in order to determine the role played by "race" in scientific and technological culture.

LCC 3308. Environmentalism and Ecocriticism
3-0-3.
Prerequisite(s): ENGL 1102
Surveys the emergence of ecocriticism as an analytical framework for interpreting the verbal and visual rhetorics of environmentalism in both western and nonwestern cultures.

LCC 3310. The Rhetoric of Scientific Inquiry
3-0-3.
Prerequisite(s): ENGL 1102
This course takes as its subject the ways in which argumentative and persuasive discourse is used to create and disseminate scientific knowledge.

LCC 3314. Technologies of Representation
3-0-3.
Prerequisite(s): ENGL 1102
Explores historical, cultural, and theoretical issues raised by technologies of representation, including written, spoken, and gestural languages; print, painting and illustration; still and moving photography; recorded sound; and computer-mediated communications and interactive digital media.

LCC 3316. Science, Technology, and Postcolonialism
3-0-3.
Prerequisite(s): ENGL 1102
Surveys the development of Postcolonial literary theory and historiography in order to analyze the interdependent discourses and practices of post-Enlightenment science/technology and European imperialism.

LCC 3318. Biomedicine and Culture
3-0-3.
Prerequisite(s): ENGL 1102
Discusses the history of biology and medicine; popular representations of health, disease, and the medical establishment; and the cultural implications of medical imaging technologies.

LCC 3352. Film and/as Technology
3-0-3.
Prerequisite(s): LCC 2500
Examines the development of film technology and the implications of that technology for cinema's treatment of technology.

LCC 3362. Science, Technology, and Performance
3-0-3.
Prerequisite(s): LCC 2600
Examines contemporary theories of performance in relation to the production of scientific knowledge and technologies of representation.

LCC 3400. Concepts and Principles in Technical Communication
1-0-1.
Prerequisite(s): ENGL 1102
Exposes students to the concepts and principles that drive technical communication. Students will learn about technical communication by studying principles that influence this genre of document production.

LCC 3401. Technical Communication Practices
2-0-2.
Prerequisite(s): ENGL 1102
Designed to introduce students to the types of documents and communication abilities required by their future professions, the course focuses on an understanding of both visual and verbal rhetoric in application to technical documents.

LCC 3402. Graphic and Visual Design
3-0-3.
Prerequisite(s): LCC 2100 or LCC 2400
Introduction to fundamentals of graphic and visual design of print and digital media. Familiarity with use of the World Wide Web, page layout, and computer graphic software recommended.

LCC 3404. Designing for the Internet
3-0-3.
Prerequisite(s): LCC 2100 or LCC 2400
An introduction to the theory and practice of effective communication on the Internet through the design of documents for the World Wide Web.

LCC 3406. Video Production
3-0-3.
Prerequisite(s): LCC 2100 or LCC 2400
An introduction to video production including basic skills in storyboarding, scripting, filming, editing, and sound.

LCC 3408. The Rhetoric of Technical Narratives
3-0-3.
Prerequisite(s): LCC 2100
Focuses on the rhetorical problems posed by such narrative documents as technical proposals, recommendations reports, grant proposals, and marketing studies. Emphasis on document design, graphics, navigation systems, and editing.

LCC 3410. The Rhetoric of Nonlinear Documents
3-0-3.
Prerequisite(s): LCC 2100
Focuses on the rhetorical problems posed by hypertext documents. Emphasis in designing for multiple audiences, page and document design, and navigation in a nonlinear environment.

LCC 3412. Communicating Science and Technology to the Public
3-0-3.
Prerequisite(s): LCC 2100
Examines both the theoretical and practical issues involved in communicating scientific and/or technological material to a variety of lay audiences.

LCC 3661. Theatre Production III: Management
0-3-1.
Prerequisite(s): ENGL 1102
In this "hands-on" course, students will create and execute a publicity campaign and operate the box office for DramaTech Theatre productions.

LCC 3662. Theatre Production IV: Acting
0-3-1.
Prerequisite(s): ENGL 1102
This course provides students an opportunity to perform onstage in a production at DramaTech Theatre. Auditions are required.

LCC 3705. Principles of Information Design
3-0-3.
Prerequisite(s): ENGL 1102 and CS 1315 and CS 1316 and (LCC 2100 or LCC 2700)
Presents principles and practices guiding the development of emerging digital genres. Emphasis on maximizing the affordances of the computer in organizing and communicating complex information.

LCC 3710. Principles of Interaction Design
3-0-3.
Prerequisite(s): CS 1315 and CS 1316 and (LCC 2100 or LCC 2700)
Examines principles of design for shaping the procedural and participatory affordances of digital environments, emphasizing the role of cultural context and media transitions.

LCC 3823. Special Topics in Literature and Culture
3-0-3.
Prerequisite(s): ENGL 1102
Examination of one or more topics of current interest in literary and cultural studies.

LCC 3833. Special Topics in Issues of Science, Technology, and Culture
3-0-3.
Prerequisite(s): ENGL 1102
Study of one or more current issues in science, technology, and culture.

LCC 3843. Special Topics in Communication
3-0-3.
Prerequisite(s): ENGL 1102
Examination of one or more topics of current interest in communication studies.

LCC 3853. Special Topics in Film
3-0-3.
Prerequisite(s): LCC 2500
Examines one or more current topics in film studies.

LCC 3863. Special Topics in Performance
3-0-3.
Prerequisite(s): LCC 2600
Examination of one or more topics of current interest in performance studies.

LCC 4100. Seminar in Science, Technology, and Culture
3-0-3.
Prerequisite(s): LCC 2100
A capstone seminar to the major, this course will ask students to draw upon their training in order to engage topical issues in the cultural studies of science.

LCC 4102. Senior Thesis
3-0-3.
Prerequisite(s): LCC 2100
Preparation for and writing of a thesis through faculty-directed independent study.

LCC 4200. Seminar in Literary and Cultural Theory
3-0-3.
Prerequisite(s): ENGL 1102
Concentration on a single literary or cultural theorist and/or a major school of literary or cultural theory. Schools of theory that will be considered include, among others, Materialist, Feminist, Structuralist, Post-Structuralist, and Cultural Studies.

LCC 4204. Poetry and Poetics II
3-0-3.
Prerequisite(s): ENGL 1102
Advanced study of the traditions of poetic theory and practice with a special emphasis on processes of poetic conception and revision.

LCC 4400. Seminar in Media Studies
3-0-3.
Prerequisite(s): LCC 2400
Offers an in-depth investigation of the historical development and cultural impact of different forms of media including: television, film, and interactive electronic applications.

LCC 4402. Basics of Multimedia Design
3-0-3.
Prerequisite(s): ENGL 1102
Introduces students to client and user needs and technology assessments, the interactive design process, and to creation of proof-of-concept applications using Macromedia Director.

LCC 4404. Advanced Design and Production
3-0-3.
Prerequisite(s): LCC 4402
Intensive studio course dealing with advanced concepts and techniques of the design and production of interactive multimedia.

LCC 4406. Contemporary Issues in Professional Communication
3-0-3.
Prerequisite(s): ENGL 1102
Intended primarily for students planning careers in professional communication, this course will alternate among a number of issues including intellectual property law, integrating print and electronic media, and cultural studies of corporate environments.

LCC 4500. Seminar in Film Studies
3-0-3.
Prerequisite(s): LCC 2100
An in-depth investigation of a major movement, theory, period, or technological development in film studies.

LCC 4600. Seminar in Performance Studies
3-0-3.
Prerequisite(s): LCC 2600
An in-depth investigation of a specific issue or theme in Performance Studies.

LCC 4602. Performance Practicum
3-0-3.
Prerequisite(s): LCC 2600
Practical experience and theoretical investigations in theatre and performance making including acting, directing, designing, playwriting, performance art, performance and new media.

LCC 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

LCC 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

LCC 4720. Interactive Narrative
3-0-3.
Prerequisite(s): CS 1315 and CS 1316 and CS 2340 and (LCC 2100 or LCC 2700)
Examines significant examples of this emerging genre, including its roots in experimental uses of older media, and engages students in creating their own interactive narrative.

LCC 4725. Games Design as Cultural Practice
3-0-3.
Prerequisite(s): CS 1315 and CS 1316 and CS 2340 and (LCC 2100 or LCC 2700)
Emphasis is on the design elements common to games and the expressive possibilities and cultural concerns specific to digital games.

LCC 4730. Experimental Digital Art
3-0-3.
Prerequisite(s): CS 1315 and CS 1316 and CS 3240 and (LCC 2100 or LCC 2700)
Provides students with key conceptual, formal, aesthetic and technical elements needed in creating artifacts in areas ranging from augmented and mixed reality to scientific visualization.

LCC 4731. Game AI
3-0-3.
Prerequisite(s): (LCC 2100 or LCC 2700) and CS 1315 and CS 1316 and CS 3600
Examines expressive possibilities of artificial intelligence techniques in computer games.

LCC 4732. Intelligent Story Systems
3-0-3.
Prerequisite(s): (LCC 2100 or LCC 2700) and CS 1315 and CS 1316 and CS 3600
Examines AI-based approaches to representing, understanding and generating stories.

LCC 4811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number.
Topics of current interest not covered in the regular course offerings.

LCC 4904. Internship
Credit hours to be arranged.
Offers students a workplace-based learning experience that stresses application of principles and skills gained in other LCC classes.

LCC 4906. Special Problems
Credit hours to be arranged.
Study of specialized aspects of literature or cultural studies selected on the basis of current interest.

LCC 6213. Educational Applications of New Media
3-0-3.
This seminar introduces students to a variety of perspectives on learning as they apply to work in educational technology.

LCC 6215. Issues in Media Studies
3-0-3.
This course focuses on the study of mass media from historical, theoretical, and cultural perspectives.

LCC 6310. The Computer as an Expressive Medium
2-3-3.
Explores the development of the representational power of the computer and the interplay between digital technology and culture.

LCC 6311. Visual Culture and Design
2-3-3.
Explores visual media through a mutually instructive and integrated interplay between critical analyses and the creation of digital artifacts.

LCC 6312. Design, Technology, and Representation
2-3-3.
Explores historical, cultural, and theoretical issues raised by technologies of representation through critical analyses and the creation of digital artifacts.

LCC 6313. Principles of Interactive Design
2-3-3.
Design principles of exploiting the affordances of the digital medium, including large information spaces and procedural environments.

LCC 6314. Design of Networked Media
3-0-3.
Issues in hypertextual and multimedia design in networked environments, including the World Wide Web, interactive television, and wireless applications.

LCC 6315. Project Production
3-0-3.
Focuses on defining user and client needs, analysis of competing products, budgeting, scheduling and management of the production process, and the design of the testing process.

LCC 6316. Historical Approaches to Digital Media
3-0-3.
Examines digital media in the context of earlier media, such as handwriting and printing as well as photography, radio, film, and television.

LCC 6317. Interactive Fiction
3-3-3.
Students create interactive fictions in a variety of formats including intersecting story worlds, interactive characters, simulations, and replay worlds.

LCC 6318. Experimental Media
3-0-3.
Students will develop the critical, intellectual, and creative tools necessary to understand, work with, and reimagine design at the developmental stages of emerging technologies.

LCC 6319. Intellectual Property Policy and Law
3-0-3.
Students examine constitutionally informed policy and pragmatic legal issues in intellectual property law, focusing on the effects of power structures and information digitization.

LCC 6320. Globalization and New Media
3-0-3.
Historical and theoretical approach to the connections between modes of global integration and modes of representing information.

LCC 6321. Architecture of Responsive Spaces
3-0-3.
Students explore the architecture of hybrid computational and material spaces, and how we can build habitation configured of material matter and responsive computational media.

LCC 6650. Project Studio
1-6-3.
This course offers students the opportunity to work on focused research within existing long-term projects of the New Media (NM) Center.

LCC 6800. Master's Project: Information Design and Technology
3-0-3.
Final project course in information design and technology.

LCC 7000. Master's Thesis: Information Design and Technology
Credit hours to be arranged.
Final thesis course in information design and technology.

LCC 7999. Preparation for Ph.D. Qualifying Exam
Credit hours to be arranged.

LCC 8000. Proseminar in Media Theory
3-0-3.
Key traditions of media theory that contribute to the study of Digital Media.

LCC 8001. Proseminar in Digital Media Studies
3-0-3.
Advanced work in production and critique of new media forms.

LCC 8801, -02, -03, -04, -05, -06. Special Topics in Information Design and Technology
Class and credit hours equal last digit in course number.

LCC 8910, -20, -30, -40, -50. Special Problems in Information Design and Technology
Credit hours to be arranged.
An independent study course.

LCC 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding teaching assistantships.

LCC 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding research assistantships.

LCC 8999. Preparation for Ph.D. Dissertation
Credit hours to be arranged.

LCC 9000. Doctoral Thesis
Credit hours to be arranged.

ENGLISH

ENGL 1101. English Composition I
3-0-3.
Develops analytical reading and writing skills through the investigation of methods used in cultural and literary studies and the application of those methods to specific texts.

ENGL 1102. English Composition II
3-0-3.
Prerequisite(s): ENGL 1101
Develops communication skills in networked electronic environments, emphasizes interpretation and evaluation of cultural texts, and incorporates research methods in print and on the Internet.

REGENTS' TESTING

RGTR 0198 Regents' Reading Skills
2-0-2.
Special attention given to developing reading skills for students who need additional preparation for the University System Regents' Exam. Cannot be counted for credit toward graduation.

RGTE 0199 Regents' Writing Skills
2-0-2.
Gives special attention to development of basic skills in writing for students who need additional preparation for the University System Regents' Exam. Cannot be counted for credit toward graduation.

Department of Military Science

www.armyrotc.gatech.edu

Established in 1917
Location: Building 041, 620 Cherry Street
Telephone: 404.894.4760

Professor and Head–Lt. Col. Alfred Scott.
Assistant Professors–Lt. Col. David McMickle, Maj. Jeff Carlyle, Capt. Sharlene Pigg.

General Information

The purpose of the Army ROTC is to prepare students for commissioning as officers in the Active Army, Army Reserve, or Army National Guard. The overall program is designed to aid students in developing the abilities and attitudes that will make them academically successful and to develop well educated junior officers.

The curriculum is divided into two courses: a Basic Course open to all freshmen and sophomores, and an Advanced Course for qualified juniors, seniors, and graduate students. Students who are undecided about pursuing a commission have the option of participating in the Basic Course without incurring a military obligation. Successful completion of the Basic Course (or commensurate training), a minimum 2.5 cumulative grade point average, and the appropriate medical and physical qualifications are prerequisites for enrollment in the Advanced Course. Successful completion of both courses and the award of a bachelor's degree constitute the normal progression to gaining a commission as a second lieutenant. Courses are available to both men and women.

The overall Army ROTC curriculum prepares students to become effective leaders and managers in a variety of responsible and challenging commissioned officer fields, thus facilitating early middle-management career development and progression. A description of the course requirements and associated programs is outlined in the following paragraphs.

The Basic Course Curriculum

The Basic Course consists of a four-semester block of instruction taken during the freshman and sophomore years. Successful completion of all four semesters satisfies the military science requirements for progression to the Advanced Course. These courses provide a foundation in basic military subjects such as customs and traditions, history, leadership, and map reading. They round out a student's academic life, provide a challenge, foster confidence, and facilitate personal growth and development.

Courses are offered during fall and spring semesters with two credit hours awarded for each freshman and sophomore course and three credit hours for each junior and senior course. Four hours of basic ROTC courses may be applied as elective credits toward degree requirements at the school. Courses normally meet two hours a week. A one-hour leadership laboratory and participation in physical conditioning training are also required.

Students in the Basic Course do not incur military obligation unless they have received an ROTC scholarship. Scholarship cadets are required to participate in a field training exercise twice per school year. They are issued uniforms and may participate in other ROTC-related events and training, such as Airborne School, Air Assault School, and Northern Warfare Training.

The Basic Course consists of the following:

FIRST YEAR

Course No. & Title		Credit Hours
MS 1021	Introduction to the Army	2
MS 1022	Introduction to Leadership	2

SECOND YEAR

Course No. & Title		Credit Hours
MS 2021	Self/Team Development	2
MS 2022	Individual/Team Military Tactics	2

Leadership Training Camp (LTC)

Those academically qualified students who are unable to fulfill the requirements of the Basic Course during their freshman and sophomore years may qualify for admission to the Advanced Course by successfully completing the Leadership Training Course (LTC). This option is primarily designed to meet the needs of transfer students, those completing the sophomore year, and others, including graduate students, who have four semesters remaining at the Institute. This option provides a two-year program in lieu of the standard four-year curriculum.

The LTC option consists of a four-week training period conducted at Ft. Knox, Kentucky, during the summer months. During each summer, various cycles will be available to meet student needs. Students choosing this option are required to submit a formal application and pass a physical examination.

Students selected to attend the LTC training program will receive approximately $700 in addition to travel expenses to and from the LTC. Uniforms, housing, medical care, and meals are furnished by the government during the training. Interested students should contact the Military Science Department.

The Advanced Course Curriculum

The Advanced Course is designed to fully develop a cadet's leadership and management potential, physical stamina, and self-confidence, as well as those Army values required of an Army officer. The objective is to produce the highest caliber junior officer fully capable of discharging a wide spectrum of command and management responsibilities in the modern Army and in the business world.

The Advanced Course consists of four semesters of instruction normally taken during the junior and senior years. Successful completion of the four courses fulfills the military science academic requirements for award of an officer's commission. Each student must also participate in a regular physical conditioning program and successfully pass the Army Physical Fitness Test. All Advanced Course students must participate in field training exercises twice a school year. Twelve credit hours are earned, six of which may be applied as elective credits toward any degree at the Institute.

Advanced Course students receive a subsistence allowance up to $400 a month. Service veterans and service academy cadets may qualify for direct entry into the Advanced Course. Certain Advanced Course students are eligible to participate in the Simultaneous Membership Program with the Army Reserve and Army National Guard. Students in this program affiliate with an Army unit as officer trainees.

Students enrolled in the Advanced Course are also required to complete a five-week Advanced Camp at Ft. Lewis, Washington, to become eligible for commissioning. Attendance at Advanced Camp normally occurs during the summer between the junior and senior years. Students may also participate in additional voluntary training, such as Airborne School or Cadet Troop Leader Training. In addition to completing the military science academic requirements of both the Basic and Advanced Courses, the student must complete at least one undergraduate course from each of five designated fields of study:

- **Written Communications:** Select any course offered by the Institute in English composition or creative writing.
- **Human Behavior:** Select any course offered by the Institute in psychology, sociology, anthropology, or ethics.
- **Military History/National Security Studies:** Select INTA 3520, INTA 3510, or another similar course approved by the professor of military science.
- **Computer Literacy:** Select any course offered by the College of Computing except CS 1000 (Information and Society).
- **Mathematics Reasoning:** Select any course offered by the School of Mathematics.

Students who successfully complete the Army ROTC curriculum and earn a bachelor's degree can be commissioned as second lieutenants. Subsequent military service may be on active duty or with the Army Reserve or Army National Guard. The following courses constitute the Advanced Course:

THIRD YEAR

Course No. & Title		Credit Hours
MS 3011	Leading Small Organizations I	3
MS 3012	Leading Small Organizations II	3

FOURTH YEAR

Course No. & Title		Credit Hours
MS 4011	Leadership Challenges and Goal Setting	3
MS 4012	Transition to Lieutenant	3
MS 4901	Special Problems (restricted)	3

Scholarship Programs

Each year, the Army offers a variety of full scholarship programs to those young men and women who have demonstrated outstanding academic scholarship and leadership potential. Four-, three-, and two-year scholarships are available to qualified students. Scholarships are competitive and awarded based on the student's merit. The professor of Military Science receives an allocation of scholarships each year. Scholarships provide tuition/fees or room/board to both resident and out-of-state students, an allowance for textbooks and supplies, and a $250 to $400-a-month tax-free stipend. Scholarship students serve either on active duty, in the Army reserves, or Army National Guard.

Options

Students who wish to obtain a commission as an officer but do not want to serve on active duty may request a Guaranteed Reserve Forces Duty (GRFD) scholarship. Reserve Forces Duty scholarships are available, but are limited in number. Affiliation with an Army Reserve or Army National Guard unit is required to participate in either the scholarship or nonscholarship program. In this program, students are guaranteed in writing that they will not be placed on active duty and can fulfill their entire commitment in the Army Reserve or Army National Guard.

Student Advisory Services

Faculty members are available throughout the academic year and during each summer orientation session in the Department of Military Science for academic counseling, schedule planning, and career guidance. Students and their parents are encouraged to seek advice on the overall Army ROTC program, scholarship opportunities, and officer career development. Appointments may be made in person, by calling 404.894.4760, or by e-mail via the ROTC home page, **www.armyrotc.gatech.edu**. Students should also check the homepage for the latest updates on course requirements and other important information.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

MILITARY SCIENCE

MS 1021. Military Science I: Introduction to Army
2-1-2.
General introduction to the total Army structure, scope of the military officer profession, and general introduction to the primary weapon (M16A2) of the United States Army. Instruction on implementing an individual physical training program customs and traditions, assembly and disassembly, maintenance, and the use of the M16A2 rifle. Individual/squad drill and ceremony are required.

MS 1022. Military Science I: Introduction to Leadership
2-1-2.
Prerequisite(s): MS 1021
Learn/apply principles of effective leading. Reinforce self-confidence through participation in physically and mentally challenging exercises with upper-division ROTC students. Develop communication skills to improve individual performance and group interaction. Relate organizational ethical values to the effectiveness of a leader.

MS 2021. Military Science I: Self/Team Development
2-1-2.
Prerequisite(s): MS 1022
Learn/apply ethics-based leadership skills that develop individual abilities and contribute to the building of effective teams of people. Develop skills in oral presentations, writing concisely, planning of events, coordination of group efforts, advanced first aid, land navigation, and basic military tactics.

MS 2022. Military Science II: Individual/Team Military Tactics
2-1-2.
Prerequisite(s): MS 2021
Introduction to individual and team aspects of military tactics in small unit operations. Includes use of radio communications, making safety assessments, movement techniques, planning for team safety/security, and methods of pre-execution checks. Learn techniques for training others as an aspect of continued leadership development.

MS 3011. Military Science III: Leading Small Organizations I
3-1-3.
Prerequisite(s): MS 2022
Series of practical opportunities to lead small groups, receive personal assessments and encouragement, and lead in situations of increasing complexity. Fundamentals of leadership and land navigation, two performance-oriented class periods and one laboratory period a week.

MS 3012. Military Science III: Leading Small Organizations II
3-1-3.
Prerequisite(s): MS 3011
Small unit leadership and basic patrolling, two performance-oriented class periods and one laboratory period a week. Students analyze task; prepare written or oral guidance for team members to accomplish task. Delegate task and supervise. Plan for and adapt to the unexpected in organizations under stress. Examine and apply lessons from leadership case studies, examine importance of ethical decision making in setting a positive climate that enhances team performance.

MS 4014. Military Science IV: Challenges and Goal Setting
3-1-3.
Prerequisite(s): MS 3012
Plan, conduct, and evaluate activities of the ROTC cadet organization. Articulate goals; put plans into action to attain them. Assess organizational cohesion and develop strategies to improve it. Develop confidence in skills to lead people and manage resources. Learn/apply various Army policies and programs in this effort.

MS 4015. Military Science V: Transition to Lieutenant
1-1-3.
Prerequisite(s): MS 4014
Identify and resolve ethical dilemmas. Refine counseling and motivation techniques. Examine aspects of traditional law as it relates to leading as an officer in the Army. Prepare for a future as a successful Army lieutenant.

MS 4901. Special Problems
Credit hours to be arranged.
Permits independent study with a faculty member. Topics and research will pursue areas of military science not extensively treated in any other military science course.

School of Modern Languages

www.modlangs.gatech.edu

Established in 1904
Location: Swann Building
Telephone: 404.894.7327
Fax: 404.894.0955

Professor and Chair–Phil McKnight.
Professor and Associate Chair for Research and Assessment–Vicki B. Galloway.
Associate Professor and Director of Undergraduate Studies–David J. Shook.
Professors–Angela Labarca, Frank Pilipp, Rumiko Shinzato-Simonds.
Associate Professors–Barbara L. Blackbourn-Jansma, Bettina Cothran, Nora Cottille-Foley, Masato Kikuchi, Xiaoliang Li.
Assistant Professors–Paul Foster, Stuart Goldberg, Britta Kallin, Lionel Lemarchand, Marianne Mason, Kyoko Masuda, Cecilia Montes-Alcalá.
Instructors–Masako Kanno, Chao Li.
Professors Emeriti–Jerry Carroll Brooks, Edmun Richmond, Heidi Rockwood.

General Information

The School of Modern Languages collaborates as an interdisciplinary partner with other units in the Ivan Allen College and across campus to prepare future participants in the global workforce through applied studies in foreign languages that are designed to develop advanced communication skills, creative thinking, and professional competency in the language. The School is building bridges between the languages it teaches and engineering as well as technology units at Georgia Tech by integrating into its programs the kind of professional and social language students expect to use after entering the workforce. At the same time, the School offers an opportunity to develop a broad understanding of culture and literature, and of daily life in the countries whose languages are taught. In this task, the School works closely with other units in Ivan Allen College.

Undergraduate Programs

Bachelor of Science in International Affairs and Modern Languages
In partnership with the Sam Nunn School of International Affairs, the School of Modern Languages offers a joint Bachelor of Science in International Affairs and Modern Languages (I.A.M.L.) with separate concentrations in French, German, Japanese, and Spanish. Students in this program take the same required core courses as for the Bachelor of Science in International Affairs, but also receive intensive foreign language training and learn the fundamentals of dealing with foreign cultures and societies.

Bachelor of Science in International Affairs and Modern Languages (French) (Suggested Schedule)

French is used as a model. Other options include German, Japanese, and Spanish. (Modern language courses must be approved by an advisor.)

First Year - First Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501 CALCULUS I or MATH 1712 SURVEY OF CALCULUS		4
CS 1315 INTRO. TO MEDIA COMPUTATION or CS 1321 INTRO. TO COMPUTING		3
FREE ELECTIVE(S) (FRENCH 2001 if needed)		3
WELLNESS		2
INTA 1001	ORIENTATION TO INTERNATIONAL AFFAIRS	1
TOTAL SEMESTER HOURS		16

First Year - Second Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502 CALCULUS II or MATH 1711 FINITE MATHEMATICS		4
COMPUTER and INFORMATION LITERACY (Departmental Approval Required)		3
FREE ELECTIVE(S) (FRENCH 2002 if needed)		3
INTA 1110	INTRO. TO INTERNATIONAL RELATIONS	3
TOTAL SEMESTER HOURS		16

Second Year - First Semester

Course Number/Name		*Hours*
INTA 2010	EMPIRICAL METHODS	3
INTA 2030	ETHICS IN INTERNATIONAL AFFAIRS	3
FRENCH ELECTIVE(S)		3
LAB SCIENCE (BIOL, CHEM, EAS, PHYS)		4
HTS 1031 or 2036 or 2037 or 2062		3
TOTAL SEMESTER HOURS		16

Second Year - Second Semester

Course Number/Name		*Hours*
INTA 2100	GREAT POWER RELATIONS	3
INTA 2210	COMPARATIVE POLITICAL PHILOSOPHIES & IDEOLOGIES	3
FRENCH ELECTIVE(S)		3
INTA 2040	SCIENCE, TECHNOLOGY, & INTERNATIONAL AFFAIRS	3
LAB SCIENCE (BIOL, CHEM, EAS, PHYS)		4
TOTAL SEMESTER HOURS		16

Third Year - First Semester

Course Number/Name		*Hours*
INTA 3110	U.S. FOREIGN POLICY	3
FRENCH ELECTIVE(S) (3000 or 4000 Level)		6
ECON 2100 or 2105 or 2106		3
CLUSTER ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Third Year - Second Semester

Course Number/Name		*Hours*
INTA 3203	COMPARATIVE POLITICS	3
FRENCH ELECTIVE(S) (3000 or 4000 Level)		6
INTA 3301	INTERNATIONAL POLITICAL ECONOMY	3
CLUSTER ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Fourth Year - First Semester

Course Number/Name		*Hours*
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
FRENCH ELECTIVE(S) (3000 or 4000 Level)		9
CLUSTER ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Fourth Year - Second Semester

Course Number/Name		*Hours*
INTA 4400	INTERNATIONAL STRATEGY & POLICY	3
FRENCH ELECTIVE(S) (3000 or 4000 Level)		3
CLUSTER ELECTIVES(S)		6
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Requirements and Electives

Wellness Requirement
All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Computer and Information Literacy Requirement
The information revolution is transforming international affairs and the application methods of foreign language skills used to access information from international sources. More than ever before, the solution of real-world problems demands an understanding of and the ability to use computers and information technology. In order to gain these essential skills, students are required to complete CS 1315 or CS 1321 and one of the following: CS 1322, CS 4235, CP 4510, ICE 2030, MGT 4051, MGT 4052, MGT 4058, or MGT 4661.

The Modern Languages Core
(For International Affairs Core, see the requirements for a Bachelor of Science in International Affairs)
I.A.M.L students must complete a program of twenty-four hours beyond 2002 (beyond 2001 for Chinese and Japanese) in a single language and six free electives (may include 2001, 2002 for students entering Georgia Tech with little or no language preparation in high school).

Graduates of the I.A.M.L. program are prepared for advanced graduate and professional study and are ready for employment in internationally oriented firms, government agencies, and non-profit organizations.

I.A.M.L. majors are strongly encouraged to enroll in the intensive summer programs (LBAT) offered by the School of Modern Languages: FREN 3691-92-93, taught in Toulouse, France; GRMN 3695-96-97, taught in Weimar and Munich, Germany; JAPN 3691-92-93, taught in Fukuoka, Japan; and SPAN 3691-92-93-94, taught in Madrid, Spain, and Mexico City, Mexico.

I.A.M.L. majors are also strongly encouraged to take a capstone class taught jointly by faculty members of International Affairs and Modern Languages in the language of their major.

Classes taken in the Modern Languages core will only count toward degree requirements if they are at a grade of *C* or above.

Humanities and Fine Arts
The ability to communicate effectively is essential to success in almost any meaningful endeavor. To this end, students are required to complete six hours of English, including ENGL 1101 and 1102. All Tech students are required to complete an additional six hours of humanities and fine arts, which I.A.M.L. students automatically satisfy through their mandatory Modern Language required courses.

Social Science Electives
In order to satisfy the U.S./Georgia history and Constitution requirements, students must complete one of the following courses: INTA 1200, HIST 2111, HIST 2112, POL 1101, or PUBP 3000. I.A.M.L. majors are encouraged to take INTA 1200, which examines American government in relation to political and economic systems in countries around the world. I.A.M.L. students satisfy a required nine hours of social science coursework with their INTA classes.

Mathematics and Sciences
An understanding of scientific methodology and quantitative analytic skills is essential for practitioners and policymakers in today's international arena. The mathematics requirement may be satisfied by one of the following sequences: MATH 1501 and 1502; MATH 1501 and 1711; or MATH 1711 and 1712. In addition, students are required to complete eight hours of laboratory science courses. These courses do not need to be sequential. Any two of the following courses will satisfy the requirement: BIOL 1510, BIOL 1520, CHEM 1310, CHEM 1311 and 1312, EAS 1600, EAS 1601, PHYS 2211, or PHYS 2212.

Computer and Technology Literacy
The information revolution is transforming international affairs and the application methods of foreign language skills used to access information from international sources. More than ever before, the solution of real-world problems demands an understanding of and the ability to use computers and information technology. In order to gain these essential skills, students are required to complete either CS 1315 or CS 1321. Additionally, students must complete one technology elective from the list of technology course options available on the INTA Web site: **www.inta.gatech.edu**.

Courses Related to the Major
The B.S. I.A.M.L. curriculum is multidisciplinary, and our students are required to complete some courses in fields related to their major. This requirement is satisfied by completing the following courses: ECON 2100, 2105, or 2106 and one of the following courses that survey European or Asian history: HTS 1031, 2036, 2037, or 2062.

Free Electives
International Affairs and Modern Languages majors are encouraged to use electives to tailor-fit the core education they receive with their own specific career and postgraduate objectives. Students must complete twenty-eight hours of free electives. They should explore and discuss with their INTA and I.A.M.L. advisors the possibilities of pursuing a minor and/or a certificate counting toward their required free electives.

Graduate Course Option

Under the Graduate Course Option, undergraduate students with a final grade point average of 3.5 or higher may count six hours of their undergraduate credits toward a master's degree at Georgia Tech in the same field. This means that qualified I.A.M.L. students could complete the Master of Science in International Affairs with thirty additional hours rather than thirty-six hours if they chose to further their study in International Affairs.

Bachelor of Science in Global Economics and Modern Languages

The School of Modern Languages and the School of Economics offer a joint Bachelor of Science degree in Global Economics and Modern Languages, with separate language concentrations in French, German, Japanese, and Spanish. Students in this program take the same required core courses as for the Bachelor of Science in Economics, but also receive intensive foreign language training and learn the fundamentals of dealing with foreign cultures and societies. The degree will serve the requirements of industry and government agencies with graduates capable of understanding the global, economically interdependent, multilingual, and multicultural environments in which we exist, and who have in-depth knowledge of not just their own cultures, but the capacity to function effectively in a second culture.

Language requirements for the degree are the same as those for the International Affairs and Modern Languages (I.A.M.L.) degree. Students must earn twenty-four credit hours of language electives in a single language (French, German, Japanese, or Spanish) and beyond the level of the 2002 course (beyond 2001 for Japanese and Chinese), and six free electives (may include 2001, 2002 for students entering Georgia Tech with little or no language preparation in high school). Courses that count toward the major will be approved by advisors.

Bachelor of Science in Global Economics and Modern Languages (French) (Suggested Schedule)

French is used as a model. Other options include German, Japanese, and Spanish. (Modern language courses must be approved by an advisor.)

First Year - First Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501 CALCULUS I or MATH 1712 SURVEY OF CALCULUS		4
FREE ELECTIVE(S) (FRENCH 2001 if needed)		3
WELLNESS		2
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		15

First Year - Second Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502 CALCULUS II or MATH 1711 FINITE MATHEMATICS		4
FREE ELECTIVE(S) (FRENCH 2002 if needed)		3
COMPUTER REQUIREMENT		3
ENGINEERING/SCIENCE/MATHEMATICS ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

Second Year - First Semester

Course Number/Name		*Hours*
ECON 2106	PRINCIPLES OF MICROECONOMICS	3
MGT 2250	MANAGEMENT STATISTICS	3
LAB SCIENCE (BIOL, CHEM, EAS, PHYS)		4
FRENCH ELECTIVE(S) (3000 or 4000 Level)		3
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

Second Year - Second Semester

Course Number/Name		*Hours*
ECON 2105	PRINCIPLES OF MACROECONOMICS	3
FRENCH ELECTIVE(S) (3000 or 4000 Level)		6
SOCIAL SCIENCE ELECTIVE(S)		3
LAB SCIENCE (BIOL, CHEM, EAS, PHYS)		4
TOTAL SEMESTER HOURS		16

Third Year - First Semester

Course Number/Name		*Hours*
ECON 3110	ADVANCED MICROECONOMIC ANALYSIS	3
ECON 3161	ECONOMETRIC ANALYSIS	3
FRENCH ELECTIVE(S) (3000 or 4000 Level)		6
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Third Year - Second Semester

Course Number/Name		*Hours*
ECON 3120	ADVANCED MACROECONOMIC ANALYSIS	3
ECON 4150	ECONOMIC & FINANCIAL MODELING	3
ECONOMICS ELECTIVE(S)		3
FRENCH ELECTIVE(S) (3000 or 4000 Level)		3
FREE ELECTIVE(S)		5
TOTAL SEMESTER HOURS		17

Fourth Year - First Semester

Course Number/Name		*Hours*
ECON 4160	FORECASTING	3
FREE ELECTIVE(S)		6
FRENCH ELECTIVE(S) (3000 or 4000 Level)		3
NON-MAJOR CLUSTER ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Fourth Year - Second Semester

Course Number/Name		*Hours*
ECON 4910	INDIVIDUAL RESEARCH IN ECONOMICS	3
ECONOMICS ELECTIVE(S)		3
FRENCH ELECTIVE(S) (3000 or 4000 Level)		3
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		12

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Requirements and Electives

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Language Requirements

See the International Affairs and Modern Languages section.

Computer and Technology Literacy

See the International Affairs and Modern Languages section.

Economics Core Requirement

See the School of Economics Bachelor of Science degree section.

Certificate Programs

Certificates are available in Chinese, French, German, Japanese, and Spanish, as well as in Russian Studies. To receive a certificate in one of these options, students must take twelve semester hours of courses beyond the 2000 level; Chinese, Japanese and Russian students must take twelve semester hours beyond 2001. A certificate in linguistics is also available and consists of twelve semester hours approved by the School of Modern Languages and the School of Psychology. All courses counting toward a minor must be taken on a letter-grade basis, and a grade of *C* or better must be received in each course. Students should consult the Director of Undergraduate Studies in Modern Languages for additional details and for approval of coursework.

Minor Programs

The School of Modern Languages offers minors in Chinese, French, German, Japanese, and Spanish as well as in Russian Studies. This program is designed for students who wish to develop their language skills to at least an intermediate level and to provide themselves with a greater depth than possible with a certificate program. Students must earn eighteen credit hours of language electives in a single language (Chinese, French, German, Japanese, or Spanish) and beyond the level of the 2002 course (beyond 2001 for Chinese, Japanese and Russian). Students pursuing a minor in Russian Studies should take their electives in at least two different departments at different schools including the School of Modern Languages and a school such as International Affairs or the School of Literature, Communication, and Culture.

Students wishing to pursue one or more of these minors should consult with the language advisor in the language of their choice and with the

Director of Undergraduate Studies in Modern Languages for detailed information and for approval of coursework. All courses counting toward a minor must be taken on a letter-grade basis, and a grade of C or better must be received in each course.

Study Abroad

The School of Modern Languages offers special summer immersion programs in France, Germany, Japan, Mexico, and Spain. These intensive programs in Languages for Business and Technology (LBAT) consist of six to eight weeks of study abroad in which classroom lessons in business, culture, and technology are combined with field work, cultural events, excursions, and visits to area businesses – all conducted in the target language. The LBAT experience offers a unique opportunity for rapid growth in proficiency, to build a deeper appreciation for the cultures and lifestyle patterns of other peoples, and to make lifelong social and professional contacts. Students will earn nine semester hours (twelve in Spanish when Mexico and Spain are combined) at the 3000 level. These credits count toward a certificate, a minor, or the joint major with International Affairs or Economics. Program costs vary according to the country visited and the length of the program. In cooperation with Kennesaw State University, Modern Languages offers a similar immersion program in China. The HOPE scholarship applies. See **www.modlangs.gatech.edu** for more information.

Study Abroad and Internships

In collaboration with the Colleges of Engineering and Computing, the School of Modern Languages has initiated a Study Abroad and International Internship program that incorporates intensive applied language acquisition and cultural study. Students who participate in this program can expect to become versed in a foreign culture, fluent in a second language on professional and social levels, and gain advanced practical experience in their field. This program will prepare students for leadership positions in the global workforce in business, industry, and government.

With plans to expand in France, Japan, and China, two programs are currently available: one semester of study at the Technical University of Munich followed by a six-month internship with a global company (for Engineering and Computing students studying German); and one semester of study at Monterrey Tech in Monterrey, Mexico, followed by a six-month internship in a Spanish-speaking country with a global company (for I.A.M.I. majors and for Engineering, Computing, and Management students studying Spanish). The LBAT summer immersion course or equivalent is recommended, since students will need to take classes in the language spoken. HOPE scholarships and other financial aid apply. Additional language classes are available abroad. Students retain regular status at Georgia Tech by enrolling in FS 4000 during the semester of study and in INTN 3011, 3015, 3018, and in the Modern Language or Co-op International Internship (ITN 3011 or COOP 3011) during the internship.

Students participating in this program are encouraged to contact their academic advisors, the International Division in the Division of Professional Practice, the Office of International Education, and Modern Languages advisors. See **www.modlangs.gatech.edu** for more information.

Suggested Placement

Students who have never had any course in the language should choose a 1001 course. If they have had less than three years in high school and feel that they need to start over, they may also take a 1001 level course, except in Spanish (see below). Suggested entry level for students with three years of high school study is the second course of the 1000-level sequence, except in Spanish. Those with three or more years are generally able to go into a 2000-level course in the more frequently taught languages. Usually, two years in high school equal one year at Tech. Counseling and placement examinations are available on request, especially in the less frequently taught languages. In Spanish, students who had three years or less of high school Spanish but do not feel confident enough to start at the 2000 level should take Spanish 1101 followed by Spanish 1102. Spanish 1001 is restricted to true beginners: students with no previous knowledge of the language. Spanish 1002 is restricted to students who have taken 1001 at Georgia Tech or at another college or university. See **www.modlangs.gatech.edu** for more information.

Humanities Credits

Each course is essentially a unit in itself, but beginning students are encouraged to pursue at least the elementary two-semester sequence (1001 and 1002) in order to achieve a minimum level of proficiency and to receive humanities credit. Students enrolled in 1001 may receive humanities credit if and when they complete 1002. Students may not enroll in or receive advanced standing for 1000-level courses after the successful completion of any 2000-, 3000-, or 4000-level course. Courses at the 2000 (Spanish only), 3000, and 4000 level do not have to be taken in chronological order, provided prerequisites are fulfilled.

With minor exceptions, students can fulfill their humanities requirement for graduation by taking courses in the School of Modern Languages, including linguistics courses and courses taught as ML courses such as courses in a language not yet included in the *General Catalog*. Students should consult the Catalog course descriptions and the section of this catalog titled "Humanities and Social Sciences Requirements," pages 35-36, in order to determine which courses are classified as humanities in their respective colleges. With the approval of their major schools, students may take any course offered by the School of Modern Languages on a pass/fail basis.

College Credit for High School Study

Modern Languages will grant six hours of elective credit in French, German, Spanish, Chinese, Japanese, or Russian for high school study in a foreign language, provided the student has two or more years of high school credit in the language in question and has completed six semester hours at the 2000, 3000, or 4000 level with an average grade of C or higher. Transfer students must complete at least three of the six hours at Georgia Tech.

Students submitting a score of four or five on the Advanced Placement (AP) Examination in French, German, or Spanish "Language Level III" or "Literature Level III" may receive free elective credit for courses numbered 2001-2 in the respective language. Students who submit language scores of five or above for courses taken at the higher level from a certified high school international Baccalaureate program may also receive free elective credit for courses numbered 2001-2 in the respective language.

The School will not grant credit for high school study in a foreign language to students who have taken 1000-level courses or the equivalent at Georgia Tech or at other college-level institutions for which they have received transfer credit. To have the free elective credit entered on their records, students must request that the appropriate form be submitted by the School of Modern Languages to the registrar. This elective credit is not applicable toward fulfillment of the humanities requirement for graduation. No grade is attached to this credit.

Courses of Instruction

figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course. An asterisk (*) denotes prerequisite courses that may be taken concurrently. This section includes courses in Modern Languages (ML), Chinese (CHIN), French (FREN), German (GRMN), Japanese (JAPN), Linguistics (LING), Russian (RUSS), and Spanish (SPAN).

MODERN LANGUAGES

ML 1801, -02, -03, -04, -05. Special Topics
Class and credit hours equal last digit in course number. Topics of current interest in modern languages, including Korean and Arabic.

ML 1811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number. Topics of current interest in modern languages.

ML 1821, -22, -23, -24, -25. Special Topics
Class and credit hours equal last digit in course number. Topics of current interest in modern languages.

ML 1831, -32, -33, -34, -55. Special Topics
Class and credit hours equal last digit in course number. Topics of current interest in modern languages.

CHINESE

CHIN 1001. Elementary Chinese I
4-0-4.
Performance-based training in pronunciation, tones, and sentence structure, developing a baseline for listening, speaking, reading, and writing Chinese, as well as fostering a sensitivity to Chinese culture.

CHIN 1002. Elementary Chinese II
4-0-4.
Prerequisite(s): CHIN 1001
Continued performance-based training in phonetics, grammar, sentence structure, and characters; focusing in the similarities and differences between English and Chinese.

CHIN 2001. Intermediate Chinese I
3-0-3.
Prerequisite(s): CHIN 1002
Reinforcing basic language skills and knowledge to enhance students' communication ability including oral dialogue and written correspondence in current Chinese society.

CHIN 2002. Intermediate Chinese II
3-0-3.
Prerequisite(s): CHIN 2001
Continued reinforcement of basic language skills and knowledge to enhance students' communication ability including oral dialogue and written correspondence in current Chinese society.

CHIN 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

CHIN 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

CHIN 3003. Intermediate Chinese III
3-0-3.
Prerequisite(s): CHIN 2002
Continued reinforcement of basic speaking, reading, and writing skills, and cultural knowledge to enhance students' communication ability in topics relating to contemporary life and Chinese society.

CHIN 3004. Advanced Chinese I
3-0-3.
Prerequisite(s): CHIN 3003
Continued reinforcement of intermediate speaking, reading, and writing skills, and cultural knowledge to enhance students' communication ability in topics relating to contemporary life and Chinese society.

CHIN 3021. Chinese Society and Culture I
3-0-3.
Prerequisite(s): CHIN 2002
Comprehension of and discussion about issues in contemporary Chinese culture.

CHIN 3022. Chinese Society and Culture II
3-0-3.
Prerequisite(s): CHIN 3021
Comprehension of and discussion about China news, economic reports, political events, feature stories, and sports on television and in newspapers.

CHIN 3811, -12, -13, -14, -15. Special Topics
Credit and class hours equal last digit in course number.
Prerequisite(s): CHIN 3021
Permits a group of students and a professor to pursue areas of the Chinese language not extensively treated in other courses in the department.

CHIN 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

CHIN 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

CHIN 4811, -12, -13, -14, -15. Special Topics
Credit and class hours equal last digit in course number.
Topics of interest not covered in the regular course offerings.

CHIN 4901. Special Problems in Chinese
Credit hours to be arranged.
Provides special instruction according to special needs.

CHIN 4902. Special Problems in Chinese
Credit hours to be arranged.
Provides special instruction according to special needs.

FRENCH

FREN 1001. Elementary French I
3-0-3.
An introduction to the French language and culture of the French-speaking world. Beginning of a survey of basic French grammar and the development of the four language skills of listening, speaking, reading, and writing French. Some aspects of everyday life in the French speaking world will also be introduced.

FREN 1002. Elementary French II
3-0-3.
Prerequisite(s): FREN 1001
The second part of an introduction to the French language and the culture of the French-speaking world. Completion of the survey of basic French grammar and further development of the four language skills. Aspects of everyday life in the French-speaking world will be introduced.

FREN 2001. Patterns of French Culture I
3-0-3.
Prerequisite(s): FREN 1002
Proficiency-based introduction to selected sociocultural aspects of France: geography, demography, social institutions, history, art, socioeconomic problems, and current events; incorporates grammar review. Conducted in French.

FREN 2002. Patterns of French Culture II
3-0-3.
Prerequisite(s): FREN 1002
Proficiency-based introduction to selected sociocultural aspects of France: geography, demography, social institutions, history, art, socioeconomic problems, and current events; incorporates grammar review. Conducted in French.

FREN 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

FREN 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

FREN 3001. French Literature from 1800 to 1900
3-0-3.
Prerequisite(s): FREN 2002
Romanticism, the reappearance of lyric poetry, the importance of the individual as opposed to classical anonymity. Realism and naturalism with emphasis on the development of the novel. Conducted in French.

FREN 3002. French Literature from 1900 to Present
3-0-3.
Prerequisite(s): FREN 2002
Exploration of currents in modern prose, poetry, and drama. Conducted in French.

FREN 3004. Drama Workshop
3-0-3.
Prerequisite(s): FREN 2001 or FREN 2002
Literary and theatrical aspects of French drama are explored through class discussion and performance of selections from contemporary and classical plays.

FREN 3007. Survey of French Literature I
3-0-3.
Prerequisite(s): FREN 2002
Survey of French literature from the Middle Ages through the seventeenth century. Selected texts by representative authors. All readings and discussions are conducted in French.

FREN 3008. Survey of French Literature II
3-0-3.
Prerequisite(s): FREN 2002
Survey of French literature from the eighteenth century to present times. Selected texts by representative authors. All readings and discussions are conducted in French.

FREN 3011, -12. France Today I, -II
3-0-3.
Prerequisite(s): FREN 2002
Culture, history, and geography of modern France through lectures, videos, downloads from the Internet, audio and video tapes, and class discussions. Short papers, generated by use of a computer software package, treating assigned topics to enhance writing skills. Conducted in French.

FREN 3030. French Phonetics
3-0-3.
Prerequisite(s): FREN 2002
A detailed analysis of the significant features of the French sound system, intonation curves, and graphic representation of individual sounds. Conducted in French.

FREN 3061. France: Culture, Economy, Commerce I
3-0-3.
Prerequisite(s): FREN 2002
Advanced Business French, overview of French commerce, communications, publicity, various social milieus, and the workplace.

FREN 3062. France: Culture, Economy, and Commerce II
3-0-3.
Prerequisite(s): FREN 2002
Advanced Business French. Overview of French commerce, communications, publicity, various social milieus, and the workplace.

FREN 3121. Advanced Composition
3-0-3.
Prerequisite(s): FREN 3002
In-depth study of advanced grammar patterns as used in written expressions. Conducted in French.

FREN 3691. Business Communication and Correspondence in France
3-0-3.
Prerequisite(s): FREN 1002
Co-requisites: FREN 3692 and 3693.
Refinement of accuracy and flexibility in oral/written expression. Focus on appropriate use of strategies, business negotiation protocols, lexical precision. Incorporates grammar review. Part of the French intensive summer language program. See catalog page 26. Admission by application only.

FREN 3692. French for Business and Technology I
3-0-3.
Prerequisite(s): FREN 1002
Co-requisites: FREN 3691 and 3693.
Study of business, technological, and cultural issues, tendencies and patterns of behavior among French speaking people. Value systems and their manifestations. Part of the French intensive summer language program. See catalog page 26. Admission by application only.

FREN 3693. French for Business and Technology II
3-0-3.
Prerequisite(s): FREN 1002
Co-requisites: FREN 3691 and 3692.
Business organizations and use of technology in France. Specialized vocabularies of economics, engineering, and computer science. Attention to geographical and anthropological aspects of selected social and political situations. Part of the French intensive summer language program. See catalog page 26. Admission by application only.

FREN 3694. French for Business and Technology Abroad.
3-0-3.
Two-week seminar in France highlighting business and technology. Field study of technology firms, economic trends, business institutions, and cultural protocols. Journals and papers assigned. Admission by application only.

FREN 3811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number.
Permits a group of students and a professor to pursue areas of the French language not covered in other courses in the department.

FREN 4001. French Stylistics
3-0-3.
Prerequisite(s): FREN 3121
Advanced study of syntax and semantics, aimed at development of stylistic sensitivity. Analysis of representative literary and current interest texts for practice in conversation and composition. Conducted in French.

FREN 4061, -62. French Science and Technology I, -II
3-0-3.
Prerequisite(s): FREN 3062
Introduction to scientific and technical French. Analysis and discussion of scientific and technical material pertaining to current issues in the scientific and technical communities. Background in chemistry, physics, or biology required.

FREN 4101. Literature of the Francophone World I
3-0-3.
Prerequisite(s): FREN 3001
Exploration of the literature of the francophone world. Currents in modern prose, poetry, and drama. Conducted in French.

FREN 4102. Literature of the Francophone World II
3-0-3.
Prerequisite(s): FREN 3001
Continuation of Literature of the Francophone World I. Currents in modern prose, poetry, and drama. Conducted in French.

FREN 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

FREN 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

FREN 4811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number.
Topics of interest not covered in the regular course offerings.

FREN 4901, -02. Special Problems in French
Credit hours to be arranged.
Provides the special instruction required under special programs.

GERMAN

GRMN 1001. Elementary German I
3-0-3.
An introduction to German language and culture. Beginning of a survey of basic German grammar and the development of the four language skills of listening, speaking, reading and writing. Some aspects of everyday life in the German-speaking world will also be introduced.

GRMN 1002. Elementary German II
3-0-3.
Prerequisite(s): GRMN 1001
The second part of an introduction to German language and culture. Survey of more basic German grammar and the development of the four language skills of listening, speaking, reading, and writing. Some aspects of everyday life in the German-speaking world will also be introduced.

GRMN 2001. Intermediate German I
3-0-3.
Prerequisite(s): GRMN 1002*
Review of basic grammatical concepts and vocabulary build-up. Selected readings, audio and video material on the cultural, historical, and intellectual development of Germany. Teaching and class discussion in German.

GRMN 2002. Intermediate German II
3-0-3.
Prerequisite(s): GRMN 1002
Continuation of GRMN 2001.

GRMN 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

GRMN 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

GRMN 3010. Introduction to German Literature
3-0-3.
Prerequisite(s): GRMN 2002
Introduction to the periods and genres of German literature from the Middle Ages to modern times. Conducted in German.

GRMN 3011. Germany Today
3-0-3.
Prerequisite(s): GRMN 2002
Introduction to current issues in contemporary Germany. Lectures, papers, and class discussions. Conducted in German.

GRMN 3024. Conversation and Composition
3-0-3.
Prerequisite(s): GRMN 2001 or GRMN 2002
A combination of conversation, composition, and stylistics, this course is designed to promote listening, speaking, and writing proficiency; expansion of vocabulary; stylistic skills.

GRMN 3025. Advanced Stylistics
3-0-3.
Prerequisite(s): GRMN 2002
Advanced study of syntax and semantics aimed at the development of stylistic sensitivity. Analysis of representative literary and current interest texts.

GRMN 3034. The German Novella
3-0-3.
Prerequisite(s): GRMN 2002
German novellas and short prose from 1800 to the present. Discussion of genre and social, political, and cultural background. All readings and discussions in German.

GRMN 3035. German Dramatic and Lyrical Literature
3-0-3.
Prerequisite(s): GRMN 2002
Introduction to dramatic and lyrical literature in interaction. Conducted in German.

GRMN 3036. German Novel
3-0-3.
Prerequisite(s): GRMN 2002
Readings and discussions from longer works of fiction from 1880 to present. Discussion of the genre, as well as the social, political, and cultural background. All readings and discussions in German.

GRMN 3071. Introductory Business German I
3-0-3.
Prerequisite(s): GRMN 2002
Analysis and discussion of texts and videos pertaining to issues in the current business world.

GRMN 3072. Introduction to Business German II
3-0-3.
Prerequisite(s): GRMN 2002
Continuation of GRMN 3071.

GRMN 3695. German Business and Technology: Structure, Communication, and Correspondence
3-0-3.
Prerequisite(s): GRMN 1002
Co-requisites: GRMN 3696 and 3697.
Overview of Germany's business structure, such as industries, service sector, banking system, relation to the European Union, the United States, and the global economy. Site visits. Admission by application only.

GRMN 3696. German Business and Technology: Current Issues
3-0-3.
Prerequisite(s): GRMN 1002
Co-requisites: GRMN 3695 and 3697.
Themes oriented toward business German, with emphasis on historical, social, cultural, and political questions pertaining to the development of modern Germany. Admissions by application only.

GRMN 3697. German Business and Technology: Communication and Culture
3-0-3.
Prerequisite(s): GRMN 1002
Co-requisites: GRMN 3695 and 3696.
Development of language skills through discussions, compositions, journals, oral reports, and presentations. Individual and group projects use interviews, explore German surroundings, and focus on cross-cultural issues. Admission by application only.

GRMN 3811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number.
Prerequisite(s): GRMN 2001 or GRMN 2002
Permits a group of students and a professor to pursue areas of the German language not covered in other courses in the department. Also used in the development of new courses.

GRMN 3901. Special Problems
Credit hours to be arranged.
Small group or individual instruction.

GRMN 4023. Selected Readings in German Literature
3-0-3.
Prerequisite(s): GRMN 2002
Study of selected authors, movements, genres, in German literature. Selection varies. Conducted in German.

GRMN 4024. German Film and Literature
3-0-3.
Prerequisite(s): GRMN 2002
A survey of German culture and recent past as presented through films and related literary works illuminating Germany's quest for identity since 1945.

GRMN 4061. Advanced Business German I
3-0-3.
Prerequisite(s): GRMN 3072
Advanced principles of German business organization and language. Taught through the use of reading, audio, and video materials. Conducted in German.

GRMN 4062. Advanced Business German II
3-0-3.
Prerequisite(s): GRMN 4061
Continuation of GRMN 4061.

GRMN 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

GRMN 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

GRMN 4811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number.
Topics of interest not covered in the regular course offerings.

GRMN 4901, -02. Special Problems in German
Credit hours to be arranged.
Special problems course for advanced students. Topics to be arranged with instructor.

JAPANESE

JAPN 1001. Elementary Japanese I
4-0-4.
Essential principles of Japanese grammar and phonetics, acquisition of vocabulary through conversational exercises, video, and tape material. Introduction to the kana writing system.

JAPN 1002. Elementary Japanese II
4-0-4.
Prerequisite(s): JAPN 1001
Continuation of JAPN 1001. Introduction to kanji symbols.

JAPN 1803, -13. Special Topics
3-0-3.
Permits a group of students to pursue areas of the Japanese language and culture not extensively treated in other courses.

JAPN 2001. Intermediate Japanese I
3-0-3.
Prerequisite(s): JAPN 1002
Further principles of Japanese grammar and vocabulary. Introduction to different styles and levels of speech. More kanji.

JAPN 2002. Intermediate Japanese II
3-0-3.
Prerequisite(s): JAPN 2001
Continuation of JAPN 2001.

JAPN 3001. Advanced Japanese I
3-0-3.
Prerequisite(s): JAPN 2002
Learn advanced grammar structures and develop the ability to produce longer conversations involving complex styles and levels of speech. More kanji.

JAPN 3002. Advanced Japanese II
3-0-3.
Prerequisite(s): JAPN 3001
Continuation of JAPN 3001.

JAPN 3061. Technical Japanese I
3-0-3.
Prerequisite(s): JAPN 2002
Introduction to technical and scientific Japanese. Specialized vocabulary and concepts of chemistry, electrical engineering, computer science, and biology. Analysis and discussion of scientific issues in society.

JAPN 3062. Technical Japanese II
3-0-3.
Prerequisite(s): JAPN 3061
Continuation of technical and scientific Japanese. Specialized vocabulary and concepts of chemistry, electrical engineering, computer science, and biology. Analysis and discussion of scientific issues in society.

JAPN 3691. Technical and Scientific Japanese
3-0-3.
Prerequisite(s): JAPN 1002
Co-requisites: JAPN 3692 and 3693.
Reading of intermediate/advanced technical and scientific Japanese texts. Analysis and discussion of scientific issues in society. Part of the Japanese intensive summer language program. Admission by application only.

JAPN 3692. Business Japanese
3-0-3.
Prerequisite(s): JAPN 1002
Co-requisites: JAPN 3691 and 3693.
Acquisition of business terminology, protocols, decorum strategies, and improvement of oral communication skills. Reading and writing of notes, correspondence, and reports. Part of the Japanese intensive summer language program. Admission by application only.

JAPN 3693. Japan Today
3-0-3.
Prerequisite(s): JAPN 1002
Co-requisites: JAPN 3691 and 3692
Development of awareness toward cultural differences and potential communication problems through exploration of current socio-economic and corporate-cultural issues in Japan. Part of the Japanese intensive summer language program. Admission by application only.

JAPN 4811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number.
Topics of interest not covered in the regular course offerings.

LINGUISTICS

LING 2001. Introduction to Language I
3-0-3.
Introduction to basic concepts of language analysis: morphology and phonology. Linguistics in relation to other sciences.

LING 2002. Introduction to Language II
3-0-3.
Introduction to modern syntactic and semantic theories of language, as well as to the relationship between language, culture and society.

LING 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

LING 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

LING 2760. Human Language Processing
3-0-3.
Theories and research in psycholinguistics: how people comprehend and speak human languages. Includes speech perception, word recognition, parsing, sentence interpretation, word production, and sentence generation. Crosslisted with PSYC 2760.

LING 3010. Language Evolution
3-0-3.
Prerequisite(s): LING 2001 or LING 2002
Principles of historical evolution of language, illustrated primarily through examples from Indo-European languages.

LING 3750. International Language Policies
3-0-3.
Prerequisite(s): INTA 1110
An introduction to the politics, problems, and alternative solutions in national language choices, including a comparative analysis of industrialized and developing nations. Crosslisted with INTA 3750.

LING 3803, -13. Special Topics
3-0-3.
Permits students to work in languages not treated in other courses and/or engage in special language research.

LING 4002. Current Trends in Linguistic Theory
3-0-3.
Prerequisite(s): LING 2001 or LING 2002
Introduction to developments in contemporary linguistic theory, especially in syntax and semantics.

LING 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

LING 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

LING 4811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number.
Topics of interest not covered in the regular course offerings.

LING 4901, -02. Special Problems in Linguistics
Credit hours to be arranged.
Special problems course for advanced students; topics to be arranged with instructor.

RUSSIAN

RUSS 1001. Elementary Russian I
4-0-4.
An introduction to Russian language and culture. First half of a survey of basic Russian grammar and the development of the four language skills of listening, speaking, reading, and writing. The course includes an orientation to aspects of everyday life in Russia.

RUSS 1002. Elementary Russian II
4-0-4.
Prerequisite(s): RUSS 1001
Second half of an introduction to Russian language and culture. Second half of a survey of basic Russian grammar and the development of the four basic language skills of listening, speaking, reading, and writing. The course includes an orientation to aspects of everyday life in Russia.

RUSS 2001. Intermediate Russian I
3-0-3.
Prerequisite(s): RUSS 1002
A review and extension of basic grammar with intensive vocabulary-building and focus on development of idiom on the basis of conversation, reading, and writing activities. Includes reading and discussion of stories and magazine articles of general cultural interest with follow-up composition assignments.

RUSS 2002. Intermediate Russian II
3-0-3.
Prerequisite(s): RUSS 2001
A review and extension of basic grammar with intensive vocabulary-building and focus on development of idiom on the basis of conversation, reading, and writing activities. Includes reading and discussion of stories and magazine articles of general cultural interest with follow-up composition assignments.

RUSS 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

RUSS 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

RUSS 3001. Advanced Russian I
3-0-3
Prerequisite(s): RUSS 2002
First half of advanced courses in Russian conversation and composition. Discussion of controversial issues with the goal of self-expression in coherent paragraphs. Advanced grammar topics.

RUSS 3002. Advanced Russian II
3-0-3.
Second half of advanced courses in Russian conversation and composition. Discussion of controversial issues with the goal of self-expression in coherent paragraphs. Advanced grammar topics.

RUSS 3803, -13. Special Topics
3-0-3.
Permits a group of students and a professor to pursue areas of the Russian language not extensively treated in other courses in the department.

RUSS 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

RUSS 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

RUSS 4811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number.
Topics of interest not covered in the regular course offerings.

RUSS 4901, -02. Special Problems in Russian
Credit hours to be arranged.
Provides the special instruction required under special programs.

SPANISH

SPAN 1001. Elementary Spanish I
3-0-3.
An introduction to the Spanish language and the cultures of the Spanish-speaking world. Beginning of a survey of basic Spanish grammar and the development of the four language skills of listening, speaking, reading, and writing. Some aspects of everyday life in the Spanish-speaking world will also be introduced. Conducted in Spanish. No native speakers allowed. Credit not allowed for both Span 1001 and 1101.

SPAN 1002. Elementary Spanish II
3-0-3.
Prerequisite(s): SPAN 1001
The second part of an introduction to the Spanish language and cultures of the Spanish-speaking world. Completion of the survey of basic Spanish grammar and the development of the four language skills of listening, speaking, reading, and writing. Aspects of everyday life in the Spanish-speaking world will also be introduced. Conducted in Spanish. No native speakers allowed. Credit not allowed for both SPAN 1002 and SPAN 1102.

SPAN 1101. Patterns of Spanish I
3-0-3.
Focuses on the development of communication and cultural skills, building upon previous elementary Spanish experience. Conducted in Spanish. Credit not allowed for both SPAN 1001 and 1101.

SPAN 1102. Patterns of Spanish II
3-0-3.
Prerequisite(s): SPAN 1101
Focuses on the development of communication and cultural skills, building upon previous elementary Spanish experience. Conducted in Spanish. Credit not allowed for both SPAN 1002 and SPAN 1102.

SPAN 1811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number.
Topics of current interest in Spanish.

SPAN 2001. Intermediate Spanish I
3-0-3.
Review of basic grammatical concepts: conversational, reading, and writing activities; cultural aspects of the Hispanic world. Conducted in Spanish. No native speakers allowed.

SPAN 2002. Intermediate Spanish II
3-0-3.
Prerequisite(s): SPAN 1002 or SPAN 1102
Review of basic grammatical concepts; conversational, reading, and writing activities; cultural aspects of the Hispanic world. Conducted in Spanish. No native speakers allowed.

SPAN 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

SPAN 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

SPAN 2811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number.
Topics of current interest in Spanish.

SPAN 3061. Spanish for Business I: Fundamentals
3-0-3.
Prerequisite(s): SPAN 2002
Introduction to business language in the Hispanic world. Development of linguistic abilities to this end, with emphasis on those cultural factors that lead to commercial success. Conducted in Spanish.

SPAN 3062. Spanish for Business II: Applications
3-0-3.
Prerequisite(s): SPAN 3061
Focus on the oral and written language and cultural context of Hispanic business protocols; themes and situations include banking and finance, marketing and advertising structures and practices. Conducted in Spanish.

SPAN 3101. Spanish Conversation: Issues and Strategies I
3-0-3.
Prerequisite(s): SPAN 2002
Development of communicative ability and cross-cultural awareness through discussion of contemporary issues in the Hispanic world. No native speakers allowed.

SPAN 3102. Spanish Conversation: Issues and Strategies II
3-0-3.
Prerequisite(s): SPAN 2002
Development of communicative ability and cross-cultural awareness through discussion of contemporary issues in the Hispanic world. No native speakers allowed.

SPAN 3111, -12. Composition: Analysis and Development I, -II
3-0-3.
Prerequisite(s): SPAN 2002
Writings from the Hispanic world used as a springboard for analysis and enrichment of self-expression and development of precision in written communication. Incorporates grammar review. No native speakers allowed.

SPAN 3121. The Cultural History of Spain I: Prehistory to Renaissance
3-0-3.
Prerequisite(s): SPAN 2002
History of Spanish culture from prehistoric times to 1700. Conducted in Spanish.

SPAN 3122. Cultural History of Spain II: Nineteenth and Twentieth Century Spain
3-0-3.
Prerequisite(s): SPAN 2002
History of Spanish culture from 1800 to the present. Conducted in Spanish.

SPAN 3170. Spanish Phonetics and Phonology
3-0-3.
Prerequisite(s): SPAN 2002
Study of the phonological system of the Spanish language, including dialectal variations in the Hispanic world.

SPAN 3235. Latin America Today
3-0-3.
Prerequisite(s): SPAN 2002
Selected journalistic and literary writings used as a springboard for discussion of social, economic, and political issues of contemporary Latin America. Conducted in Spanish.

SPAN 3236. Business Communication and Correspondence
3-0-3.
Prerequisite(s): SPAN 3062
Development of culturally appropriate written and oral interaction skills in Hispanic business contexts. Conducted in Spanish.

SPAN 3241. The Individual and the Family in Hispanic Literature
3-0-3.
Prerequisite(s): SPAN 2002
Analysis and discussion of the portrayal of the individual and the family in selected readings from Hispanic literature. Conducted in Spanish.

SPAN 3242. Society in Hispanic Literature
3-0-3.
Prerequisite(s): SPAN 2002
Study of Hispanic society and political thought in selected literary works. Conducted in Spanish.

SPAN 3691. Business Communication and Correspondence in the Hispanic World
3-0-3.
Prerequisite(s): SPAN 1002 or SPAN 1102
Co-requisites: SPAN 3692 and 3693.
Refinement of accuracy/flexibility in oral/written expression. Focus on appropriate use of strategies, business negotiation protocols, lexical precision in business transactions. Incorporates grammar review. Part of the Spanish intensive summer language program. Admission by application only.

SPAN 3692. Business and Culture in the Hispanic World
3-0-3.
Prerequisite(s): SPAN 1002 or SPAN 1102
Co-requisites: SPAN 3691 and 3693.
Study of cultural issues, tendencies, and traditional patterns of behavior in Spanish-speaking people as they relate to business practices. Value systems and formal manifestations. Regional variations, including the U.S. Hispanic culture. Part of the Spanish intensive summer language program. Admission by application only.

SPAN 3693. Science and Technology in the Hispanic World
3-0-3.
Prerequisite(s): SPAN 1002 or SPAN 1102
Co-requisites: SPAN 3691 and 3692.
Study of business organizations and use of technology in the Spanish-speaking world. Specialized vocabularies of business, economics, statistics, and computer science. Geographical and anthropological background. Part of the Spanish intensive summer language program. Admission by application only.

SPAN 3694. Business and Culture in the Hispanic World: Seminar Abroad
3-0-3.
Field study of technology, economic trends, business firms, financial institutions, and cultural protocols in the Spanish-speaking area. Part of the Spanish intensive summer language program. Admission by application only.

SPAN 3811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number.
Topics of current interest in Spanish.

SPAN 4061. Spanish for Science and Technology I: Fundamentals
3-0-3.
Prerequisite(s): SPAN 3062
Introduction to scientific vocabulary and discourse in Spanish, by fields of interest. Study of expository texts, numerical expressions, and graphic aids. Development of some reading and translation strategies. Writing feature descriptions and article/report summaries in Spanish. Conducted in Spanish.

SPAN 4062. Spanish for Science and Technology II: Applications
3-0-3.
Prerequisite(s): SPAN 3062
Advanced analysis of scientific and technological discourse in Spanish. Focus on reading strategies and oral discussion of topics such as use and transfer of technology and the acculturation issues that follow. Further development of comprehension, production, and translation strategies, with emphasis on professional communications and on writing feature descriptions, summaries, and abstracts. Conducted in Spanish

SPAN 4141. Survey of Spanish Literature
3-0-3.
Prerequisite(s): SPAN 3102
Selected works by representative authors from all periods of Spanish literature. Conducted in Spanish.

SPAN 4142. Survey of Latin-American Literature
3-0-3.
Prerequisite(s): SPAN 3102
Selected works by representative authors from all periods of Latin American literature. Conducted in Spanish.

SPAN 4151. Hispanic Fiction: The Short Story in Spain
3-0-3.
Prerequisite(s): SPAN 3102
The short story in the literature of Spain from the Middle Ages to the present. Conducted in Spanish.

SPAN 4152. Hispanic Fiction: The Latin-American Short Story
3-0-3.
Prerequisite(s): SPAN 3102
The short story in the literatures of Latin America, from independence to the present. Conducted in Spanish.

SPAN 4154. Hispanic Fiction: The Modern Drama
3-0-3.
Prerequisite(s): SPAN 3102
Works by representative Hispanic dramatists of the twentieth century. Conducted in Spanish.

SPAN 4170. Spanish Applied Linguistics
3-0-3.
Prerequisite(s): SPAN 3111
Advanced linguistic analysis of the Spanish language, particularly as it contrasts with English.

SPAN 4255. Hispanic Drama Workshop
3-0-3.
Prerequisite(s): SPAN 3102
Literary and theatrical aspects of Hispanic drama are explored through class discussion and performance of a collection of contemporary one-act plays.

SPAN 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

SPAN 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

SPAN 4811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number.
Topics of interest not covered in the regular course offerings.

SPAN 4901, -02. Special Problems in Spanish
Credit hours to be arranged.
Provides the special instruction required under special programs.

Department of Naval Science

http://nrotc.gatech.edu

Established in 1926
Location: Naval Armory, Bobby Dodd Way
Telephone: 404.894.4771 or 404.894.4772
Fax: 404.894.6029
E-mail: erik.hall@rotc.gatech.edu

Commanding Officer and Professor–Capt. Roy Holbrook; *Assistant Professor*–Lt. Col. Robert Weinkle; *Marine Instructor*–Major Richard McCormick; *Assistant Marine Instructor*–Gy. Sgt. Hobbs; *Senior Instructor*–Lt. C. Shipe; *Sophomore/Junior Instructor*–Lt. W. Liebold; *Freshman Instructor*–Lt. I. Garvin.

General Information

The NROTC program offers students the opportunity to qualify for service as commissioned officers in the United States Navy or Marine Corps. The program's objectives are to provide students with an understanding of the basic concepts and principles of naval science, associated professional knowledge, and the requirements for national security. NROTC students receive an educational background that allows them to later undertake advanced education in the naval service.

The NROTC program is an officer ascension program for the unrestricted line communities. Upon graduation, the student is commissioned as an officer in the Naval Reserve or Marine Corps Reserve. Naval officers are ordered to active duty in submarines, surface combatants, or the aviation community. Marines undergo training leading to a variety of specialties. NROTC students are enrolled in one of the following three categories.

Scholarship Students

Four-year and three-year scholarship students are selected through nationwide competition. Selection criteria include SAT or ACT scores, high school academic performance, and extracurricular activities. The selection process is administered by the chief of Naval Education and Training; however, the NROTC unit will provide guidance and information to applicants. An online application is available at **https://www.nrotc.navy.mil**.

The NROTC scholarship pays for tuition, fees, and textbooks. The Navy also provides uniforms and a $250-$400 per month subsistence allowance. The Naval Science Department conducts an orientation program (INFORM) for all new NROTC scholarship students during the week prior to the start of the fall semester. Scholarship students must complete the naval science curriculum and also participate in summer assignments from four to six weeks during the summers between academic years.

College Program Students

Non-scholarship students may seek a naval commission through the NROTC College Program. Interested students may apply at the Naval Armory on campus. The process includes a review of previous academic performance and interviews with staff personnel. Students accepted into the College Program must complete the naval science curriculum and take a summer assignment between the junior and senior years.

The Navy provides uniforms and naval science texts. Students who enter advanced standing in the junior year receive a subsistence allowance of $350-$400 per month. College program students are eligible to compete for scholarships ranging from one to three years. Selection criteria are based on academic performance at Georgia Tech and military performance as a College Program student. For information, contact the Naval Science Department at 404.894.4771.

Two-year Scholarship Program

Sophomores may apply and compete nationally for two-year NROTC scholarships. Those selected attend six weeks of training in Newport, Rhode Island, during the summer between the sophomore and junior years. Upon successful completion, the student joins the NROTC program on an equal footing with other students in the junior year naval science classes. Interested students should contact the Naval Science Department.

Curriculum

In addition to the required naval science courses, all Navy Option Scholarship students must take calculus (MATH 1501-2 or MATH 1511-2), physics (PHYS 2111-2 or 2231-3 series), one term of INTA (contact NROTC unit for required class), and one term of computer science.

Marine Option students must also take the previously listed international affairs courses or their equivalent as approved by the professor of naval science. Any additional requirements are based on whether the student is in a technical or nontechnical major, a Navy Option or Marine Option student, and a scholarship or nonscholarship recipient. Each student must obtain from the NROTC Department a complete description of program requirements since the above statement is only a general outline. Students may apply a maximum of four hours in basic ROTC courses and six hours in advanced ROTC courses toward meeting the free elective requirements for any degree.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

NAVAL SCIENCE

NS 1321. Introduction to Naval Sciences
3-0-3.
This course is an introduction and orientation class designed to give students a broad overview of the roles of the United States Navy and Marine Corps. This course also provides an introduction to the structure, terminology, customs, and uniforms of the Navy and Marine Corps.

NS 1323. Naval Maritime History
3-0-3.
Prerequisite(s): NS 1321
This course surveys U.S. Naval history from its European origin to the present with emphasis on major developments and the geopolitical forces shaping these developments. The course also covers present-day concerns in seapower and maritime affairs, including the economic and political issues of maritime commerce, the law of the sea, and the rise and decline of the Soviet Navy.

NS 2321. Naval Leadership and Management
3-0-3.
Prerequisite(s): NS 1321
Survey of managerial functions, communication, and major theories of leadership and motivation applied to the Navy organization. Culminates with focus on Naval core values.

NS 2322. Naval Systems Engineering I
3-0-3.
Prerequisite(s): NS 1321
This course develops and broadens the student's understanding of basic engineering concepts and principles as applied to naval engineering plants.

NS 3321. Navigation I
3-0-3.
Prerequisite(s): NS 2321
This course develops and broadens the student's understanding of basic piloting and the laws of vessel operations by applying the fundamentals of navigation at sea.

NS 3322. Navigation II
3-0-3.
Prerequisite(s): NS 3321
This course develops and broadens the student's understanding of relative motion, surface ship operations, and naval command, control, and communications.

NS 3323. Evolution of Warfare
3-0-3.
Prerequisite(s): NS 1321
A historical exploration of warfare practiced by great nations. Selected campaigns are studied with emphasis on leadership, evolution of tactics, weaponry, and principles of war.

NS 3324. Marine Weapons and Tactics
3-0-3.
This course is a prepatory course required by all Marines and Marine Options their junior year prior to Officer Candidates School. General military subjects, land navigation, history, tactics drill, leadership, and physical fitness will be taught and tested.

NS 4321. Naval Systems Engineering II
3-0-3.
Prerequisite(s): NS 2322
This course develops and broadens the students understanding of basic engineering concepts and principles as applied to naval weapon systems.

NS 4322. Naval Leadership and Ethics
3-0-3.
Prerequisite(s): NS 2321
Study of Naval values and ethics to include core values, Navy regulations, and military law. Duties and responsibilities of a junior naval officer.

NS 4323. Amphibious Warfare
3-0-3.
Prerequisite(s): NS 1321
A historical exploration of warfare practiced by great nations. Selected campaigns are studied with emphasis on leadership, evolution of tactics, and principles of war.

Philosophy, Science, and Technology

www.spp.gatech.edu

Established in 1990
Location: 107 D. M. Smith Building, 685 Cherry Street
Telephone: 404.894.6822
Fax: 404.385.0504

Director and Assistant Professor–Robert Kirkman.
PST Philosophy Faculty: Professors–Nancy J. Nersessian, Bryan G. Norton.
Associate Professors–Roberta M. Berry, Michael Hoffman.
PST Ethics Program Faculty: Professor–Susan Cozzens.
Associate Professors– Alice Bullard, Molly Cochran, Carol Colatrella, Hans Klein, Juan Rogers, Stephen Usselman.

General Information

Georgia Tech offers undergraduate courses in philosophy, with a particular focus on science and technology. The courses are intended to enable Georgia Tech students to reflect on the nature of their disciplines and to focus their understanding on the context of their lives as professionals and citizens. Philosophy, Science, and Technology (PST) courses can be used to satisfy the distribution requirement in humanities.

Certificate and minor programs in philosophy are available for students who wish to concentrate coursework in this field. The certificate program consists of twelve hours of coursework, and the minor consists of eighteen hours of coursework. PST 3115 and PST 3127 are required for either the certificate or the minor.

Ethics Courses for Engineers

The PST program is responsible for offering a menu of courses that meet an ethics course requirement in several programs in the College of Engineering. PST courses recommended to fulfill the ethics requirement include the following:

- PST 3105 Ethical Theories
- PST 3109 Ethics for Technical Professions
- PST 3127 Science, Technology, and Human Values
- PST 4176 Environmental Ethics

Courses offered in other Ivan Allen College schools recommended to fulfill the ethics requirement include the following:

- INTA 2030 Ethics and International Affairs
- LCC 3318 Biomedicine and Culture
- HTS 1028/EE 1823 Electrical Engineering in American Life

Students should consult the director concerning the schedule of course offerings.

The Program in Philosophy, Science, and Technology participates in the Program in Cognitive Science, which offers a Graduate Certificate in Cognitive Science, an Undergraduate Certificate in Cognitive Science, and an Undergraduate Minor in Cognitive Science. More information on these educational programs is available at **www.cc.gatech.edu/cogsci**.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

PHILOSOPHY, SCIENCE, AND TECHNOLOGY

PST 1101. Introduction to Philosophical Analysis
3-0-3.
An introduction to the nature of philosophy through the critical analysis of selected works, such as Descartes, Hobbes, and Locke. The relationship of philosophy to science, religion, and culture will be emphasized.

PST 2050. Philosophy and Political Theory
3-0-3.
Survey of political thought from ancient times, relating classical and modern political theories to problems of the modern democratic state. Special emphasis on the problems of the individual and state.

PST 2068. Science and Values in the Policy Process
3-0-3.
Normative and logical structures of policy analysis, with applications of moral theories and deductive reasoning to cases in policy analysis. Frameworks include militarianism, benefit/cost analysis, and rights theories.

PST 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

PST 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

PST 3102. Ancient Philosophy
3-0-3.
Development of philosophy from the pre-Socratics to the medieval Christian synthesis and the early development of science in the fourteenth and fifteenth centuries.

PST 3103. Modern Philosophy
3-0-3.
A study of the development of philosophy from the views of Bacon and Descartes to the Tractatus and to existential thought. Traces the philosophic response to modern science in the rational and empirical traditions.

PST 3105. Ethical Theories
3-0-3.
Surveys traditional ethical theories of value, obligation, and rights and applies these theories to contemporary social problems such as abortion, euthanasia, poverty and distributional equity, and environmental problems.

PST 3109. Ethics and Technical Professions
3-0-3.
Ethical reasoning in the context of professional work in science and technology. Prepares future technical professionals to approach decisions with a coherent ethical framework.

PST 3113. Logic and Critical Thinking
3-0-3.
Symbolic logic and applications of logic in critical reading and thinking by exploring modern systems of symbolic logic and their implications for science. Emphasizes skills in critical thinking and writing based on the principles of logic.

PST 3115. Philosophy of Science
3-0-3.
Examination of the nature and processes of scientific inquiry, including the status of scientific knowledge, identification of pseudoscientific claims, and the role of values in generating and using scientific knowledge.

PST 3127. Science, Technology, and Human Values
3-0-3.
Exploration of the boundaries between science, religion, and social values, examining science and technology in a broader social context. Examines claims that science is isolated from social problems and values.

PST 3790. Introduction to Cognitive Science
3-0-3.
Multidisciplinary perspectives on cognitive science. Interdisciplinary approaches to issues in cognition, including memory, language, problem solving, learning, perception, and action. Crosslisted with CS, PSYC, and ISYE 3790.

PST 4110. Theories of Knowledge
3-0-3.
Prerequisite(s): PST 3102 or PST 3103 or PST 3115
Critical examination of perception, verification, apriori and aposteriori knowledge, meaning and criteria of truth, and cognitive significance of scientific and philosophical propositions. Evolution of epistemology.

PST 4112. Philosophic Themes in Asian Thought
3-0-3.
Prerequisite(s): PST 1101
Survey of selected metaphysical and ethical ideas in the religions and philosophic traditions of east Asia, including Hindu conceptions of the self and causality, Buddhism and Zen, and the ethical naturalism of Confucianism and Taoism.

PST 4174. Perspectives in Science and Technology
3-0-3.
Comparative analysis of frameworks for interpreting science and technology, discussed in light of case studies. Selected frameworks include philosophical, historical, cognitive, and sociological.

PST 4176. Environmental Ethics
3-0-3.
Conceptual and normative foundations of environmental attitudes and values. Impacts of traditional and modern beliefs that shape human attitudes toward nature on creating a more compatible relationship between humans and their environment.

PST 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

PST 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

PST 4752. Philosophical Issues in Computation
3-0-3.
Prerequisite(s): PST 3115
Introduction to metaphysical and epistemological issues in foundations, methods, and implications of computing. Issues include: minds, brains, and machines; representation and language; simulating nature. Crosslisted with CS 4752.

PST 4790. Seminar in Cognitive Science
3-0-3.
A seminar-type course in cognitive science focusing on integrating and deepening students' cognitive science knowledge and skills. Topics include memory, language, problem solving, learning, perception, and action. Crosslisted with CS, PSYC, and ISYE 4790.

PST 4791. Integrative Project in Cognitive Science
3-0-3.
An integrative course in cognitive science focusing on the integration and use of concepts and skills from cognitive science. A different integrative project or set of projects will be taken on each semester; students will contribute on the basis of their background and skills. Crosslisted with CS, ISYE, and PSYC 4791.

PST 4792. Design Project in Cognitive Science
3-0-3.
Individual project with a cognitive science faculty member, designed as a supplement to the student's senior design project or thesis in their major area. Crosslisted with CS, ISYE, and PSYC 4792.

PST 4803. Special Topics
3-0-3.

PST 4811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit in course number. Topics of interest not covered in the regular course offerings.

PST 4901, -02, -03. Special Problems
Credit hours to be arranged.

Political Science

www.spp.gatech.edu

Established in 1990
Location: 107 D. M. Smith Building, 685 Cherry Street
Telephone: 404.894.6822
Fax: 404.385.0504
E-mail: richard.barke@pubpolicy.gatech.edu

Professors–Barry Bozeman, John E. Endicott, John W. Garver, Robert Kennedy, William J. Long, Georgia Persons, Michael D. Salomone.
Associate Professors–Richard P. Barke, Peter Brecke, Molly Cochran, John Havick, Gordon Kingsley, Hans Klein, Katja Weber, Brian Woodall.
Assistant Professors–Kirk Bowman, Adam Stulberg, Fei-Ling Wang.

General Information

The discipline of political science is included within the Ivan Allen College within the School of Public Policy and the Sam Nunn School of International Affairs. Undergraduate courses in political science are intended to broaden students' perceptions of political processes and governmental institutions. Many of these courses are taught under the PUBP or INTA prefix. Students should consult with the political science faculty concerning course offerings.

Political science courses may be used to satisfy the distribution requirement in social sciences, including the state-mandated requirement on constitutions of the United States and Georgia. This requirement may be satisfied by completion of POL 1101 or PUBP 3000, or INTA 1200, or HIST 2111 or 2112. The requirement also may be satisfied by examination.

Certificate and minor programs in political science, administered by the School of Public Policy, are available for students who wish to concentrate coursework in this discipline. The certificate in political science requires twelve hours of coursework (at least nine hours at the 3000 level), chosen in consultation with the faculty coordinator. The minor in political science requires eighteen hours of coursework (at least twelve hours at the 3000 level), also chosen with the advice of the faculty coordinator.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

POLITICAL SCIENCE

POL 1101. Government of the United States
3-0-3.
The purposes, structure, and functions of national and state governments, focusing on participation, institutions, and the policy process. Foundations of law, civil rights and civil liberties, role of the media, parties and elections, and policy processes. Credit not allowed for both POL 1101 and INTA 1200.

POL 2101. State and Local Government
3-0-3.
Politics and government processes at the state and local levels.

School of Public Policy

www.spp.gatech.edu

Established in 1990
Location: 107 D. M. Smith Building, 685 Cherry Street
Telephone: 404.894.6822
Fax: 404.385.0504

Chair and Professor–Diana Hicks.
Professors–Barry Bozeman, Susan Cozzens, Bryan G. Norton, Georgia Persons, Philip Shapira.
Associate Professors–Richard P. Barke, Roberta M. Berry, Ann Bostrom, Michael Hoffmann, Gordon Kingsley, Hans Klein, Cheryl Leggon, Juan Rogers.
Assistant Professors–Marco Castillo, Monica Gaughan, Jon J. Johnston, Robert Kirkman, Douglas Noonan, Bhaven Sampat.
Joint Professors–Michael Elliott, Nancy Nersessian, Michael Rodgers, Sue V. Rosser, David Sawicki.
Professors Emeriti–Stanley Carpenter, Alan Porter, J. David Roessner.

General Information

Who will govern the Internet, and by what rules? Which new reproductive technologies will be developed and which prohibited by law? How do we balance economic growth and the needs of ecological systems? How can we map a knowledge economy to plan investments in new technology. Public Policy is the process of defining, debating, and deciding issues like these. At Georgia Tech, the study of public policy centers on such issues; that is, policy issues concerning science and technology. This enables us to provide our graduates with the specialized knowledge that is increasingly essential for effective policy making in a technical world.

At Georgia Tech, public policy students learn how to analyze, study, and solve problems that affect us all. Students explore controversies over technology-intensive issues, and learn how to bring data and analysis into the decision process. Graduates can be found in government, nonprofit organizations, business, or law working as consultants, policy analysts, managers, and lawyers.

The School of Public Policy offers B.S., M.S., and Ph.D. degrees in Public Policy, and there is a five-year program for earning both the B.S.-M.S degrees. Students interested in public policy in the urban context will also find relevant courses offered by the City and Regional Planning Program in the College of Architecture.

Certificates and Minors

The School of Public Policy offers undergraduate certificates and minors in four areas:

- **Public Policy:** featuring courses on government and business decision processes, especially those involving science, technology, environment, or regional development.
- **Pre-Law:** preparing students for decisions about law school and careers in law through two core courses including a pre-law seminar, plus selected courses in computer science, economics, history, international affairs, management, and public policy.
- **Political Science:** focusing on how government works, from the local to the national level.
- **Philosophy, Science, and Technology:** providing broad perspectives and critical thinking about science and technology, emphasizing values and ethics.

The certificates enrich any Georgia Tech degree and particularly serve students who are planning graduate studies in law, medicine, business, or the social sciences. All the certificates require a minimum of twelve semester hours of concentration.

Minors are for students wishing a concentration outside their major that provides greater depth than the certificate programs. Each minor requires a minimum of eighteen hours of credit (twelve semester hours at the 3000 level or higher) with a grade of *C* or better in each. Completion of a minor will be recognized on the student's final university transcript.

Students interested in planning a certificate or minor program in one of the four areas should contact the School of Public Policy for further information. A faculty advisor assists each student in planning a program of study to meet his or her needs and interests.

Law, Science, and Technology Program
The School of Public Policy is home to Georgia Tech's Law, Science, and Technology/Pre-Law Program. This program offers a wide range of curricular opportunities as well as pre-law advising and support services for students considering law school and careers in law. The program welcomes students from every college and major. For more information, see **www.spp.gatech.edu**.

Undergraduate Program

Bachelor of Science

The Bachelor of Science in Public Policy (B.S.P.P.) is designed to provide an education that combines strong analytical skills with understanding of a range of substantive policy issues and the political, social, and cultural forces that shape public policies. The B.S.P.P. core courses provide students with the broad political and philosophical foundations of thought pertinent to public policy, a base of rigorous quantitative and qualitative analytical approaches, and a solid understanding of the political, social, and cultural dynamics that

structure policy debates and policy outcomes. Elective courses are offered in such areas as environmental policy, science and technology policy, information and telecommunication policy, and regional development policy. The program's emphasis on the development of problem-solving and analytical skills constitutes a strong comparative advantage for B.S.P.P. graduates.

Bachelor of Science in Public Policy (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501 CALCULUS I or MATH 1712 SURVEY OF CALCULUS		4
LAB SCIENCE (BIOL, CHEM, EAS, PHYS)		4
POL 1101	GOVERNMENT OF THE UNITED STATES	3
TOTAL SEMESTER HOURS		14

First Year - Second Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502 CALCULUS II or MATH 1711 FINITE MATHEMATICS		4
LAB SCIENCE (BIOL, CHEM, EAS, PHYS)		4
COMPUTING REQUIREMENT		3
WELLNESS		2
TOTAL SEMESTER HOURS		16

Second Year - First Semester

Course Number/Name		*Hours*
PST 2050	PHILOSOPHY & POLITICAL THEORY	3
PUBP 2012	FOUNDATIONS OF PUBLIC POLICY	3
SCIENCE/ENGINEERING ELECTIVE		3
HIST 2111 THE U.S. TO 1877 or HIST 2112 THE U.S. SINCE 1877		3
ECON 2105	PRINCIPLES OF MACROECONOMICS	3
TOTAL SEMESTER HOURS		15

Second Year - Second Semester

Course Number/Name		*Hours*
PUBP 3010	ORGANIZATIONS & POLICY IMPLEMENTATION	3
PST 2068	SCIENCE & VALUES IN THE POLICY PROCESS	3
SCIENCE/ENGINEERING ELECTIVE		3
HISTORY ELECTIVE(S)		3
ECON 2106	PRINCIPLES OF MICROECONOMICS	3
TOTAL SEMESTER HOURS		15

Third Year - First Semester

Course Number/Name		*Hours*
PUBP 3201	INTRO. TO SOCIAL POLICY	3
PUBP 4113	STATISTICAL ANALYSIS	3
PUBLIC POLICY ELECTIVE(S)		3
HUMANITIES ELECTIVE(S)		3
FREE ELECTIVE(S)		4
TOTAL SEMESTER HOURS		16

Third Year - Second Semester

Course Number/Name		*Hours*
PUBP 3110	RESEARCH METHODS & PROBLEM SOLVING	3
PUBP 3600	SUSTAINABILITY, TECHNOLOGY, & POLICY	3
PUBLIC POLICY ELECTIVE(S)		3
HUMANITIES ELECTIVE(S)		3
FREE ELECTIVE(S)		4
TOTAL SEMESTER HOURS		16

Fourth Year - First Semester

Course Number/Name		*Hours*
PUBLIC POLICY ELECTIVE(S)		6
FREE ELECTIVE(S)		9
TOTAL SEMESTER HOURS		15

Fourth Year - Second Semester

Course Number/Name		*Hours*
PUBP 4600	SENIOR THESIS	3
PUBLIC POLICY ELECTIVE(S)	(3000 or 4000 Level)	3
FREE ELECTIVE(S)		9
TOTAL SEMESTER HOURS		15

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Computing Requirement

Students must complete either CS 1315, CS 1321, or a computer programming course approved as satisfying the general education requirements in computer literacy.

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Requirements and Electives

Designated Courses in the Major

The core curriculum for the major consists of:

POL 1101	Government of the U.S.
PUBP 2012	Foundations of Public Policy
PST 2050	Philosophy and Political Theory
PST 2068	Science and Values in the Policy Process
PUBP 3010	Organizations and Policy Implementation
PUBP 3110	Research Methods and Problem Solving
PUBP 3201	Introduction to Social Policy
PUBP 3600	Sustainability, Technology, and Policy
PUBP 4113	Statistical Analysis for Public Policy
PUBP 4600	Senior Seminar/Thesis

Elective Courses in the Major

Students must take an additional fifteen hours of courses in public policy as electives, usually focusing on a concentration in a substantive area of public policy or in policy analytic methods. These courses are selected from among those with PUBP, POL, and PST prefixes, in consultation with an advisor.

Non-major Cluster

Students must take a minimum of twelve hours of courses related to the study of public policy. These courses include HIST 2112, ECON 2105, ECON 2106, and another course chosen in consultation with the student's advisor.

Senior Seminar/Thesis

A capstone course usually taken in the student's last year before graduation, the Senior Seminar and Thesis (PUBP 4600) involves writing an original policy analysis relevant to a public or nonprofit agency.

Mathematics

Previous coursework in calculus is assumed in the core statistics course for majors as well as in economics courses in public policy. To prepare, students are advised to fulfill the mathematics requirement by taking MATH 1501-2. MATH 1711-12, or MATH 1711 with either 1501 or 1502, will also satisfy the requirement. Students cannot receive credit for both MATH 1712 and MATH 1501 or 1502.

Science and Engineering

Public policy majors must take two laboratory science courses and two additional courses in science- or engineering-related fields. These courses must be chosen in consultation with the student's advisor.

Social Sciences

The twelve-hour social sciences requirement may be satisfied by courses in history, economics, international affairs, political science, public policy, sociology, and selected courses in psychology. Public Policy majors must take one of the following: HIST 2111, HIST 2112, POL 1101, or PUBP 3000 (to satisfy state requirements regarding course work on the history and constitutions of the United States and Georgia.) Public Policy majors are strongly urged to take POL 1101 or PUBP 3000. POL 1101 can be counted both as a designated course for the degree and as a social science requirement. Courses must be chosen in consultation with the student's advisor.

Humanities and Fine Arts

Students are required to complete ENGL 1101-2 and an additional six hours in the humanities and fine arts. Additional courses may be chosen from the list of approved humanities courses in this catalog. Public policy majors may not count PST courses for both their degree requirements and the humanities and fine arts requirements.

Free Electives

To graduate, each student must have accumulated at least 120 semester hours of credit toward the Bachelor of Science in Public Policy degree. Therefore, in addition to the requirements listed previously, the student must take a sufficient number of elective courses either within or outside Public Policy to reach 120 hours. Typically, this will allow the student approximately twenty-six hours of free electives.

Graduate Programs

Five-Year B.S.-M.S. Program

The School of Public Policy offers the five-year B.S.-M.S. program for students enrolled in the undergraduate program who demonstrate an interest in and ability for additional education beyond the B.S. degree.

Students in the B.S./M.S. Program will remain undergraduates until they meet requirements for the undergraduate degree, at which point they will receive their B.S. degree and be changed to graduate status. Students will be eligible to apply for the program after completion of thirty semester credit hours at Georgia Tech (i.e., at the end of

their first year) and if they show appropriate progress in their degree program thereafter. Any student in good standing in the B.S.P.P. program is eligible to apply to the five-year program. Admissions decisions will be based on GPA and judgements of the faculty who have served as advisors or instructors. Continuation in the program will require the student to maintain a GPA of 3.0 or higher in public policy courses. The program will not penalize students who opt out after the bachelor's degree. Students participating in this program will be eligible for the six semester-credit-hour "Graduate Course Option" as described in the Catalog.

The graduate-level credits required in the Five-Year B.S./M.S. Program are usually as follows:

Core	22 hours
Electives	12 hours
Research paper	3 hours
Total	37 hours

Specific Requirements for the Five-Year Program include:

PUBP 6001	Introduction to Public Policy (1 semester hour, all other courses are 3 semester hours)
PUBP 6010	Ethics, Epistemology and Public Policy
PUBP 6112	Research Design in Policy Science [NOTE: this course should be taken as an undergraduate instead of PUBP 3110 and will count for both programs]
PUBP 6114	Applied Policy Methods and Data Analysis [NOTE: PUBP 4113 is a prerequisite]
PUBP 6116	Microeconomics in Policy Analysis
PUBP 6118	Public Finance and Policy
PUBP 6210	Public Policy Analysis

Students must also take one of the following three courses:

PUBP 6014	Organization Theory
PUBP 6017	Public Management
PUBP 6018	Policy Implementation

Students are required to develop, in consultation with their advisor, a six-hour concentration in an area or specialty relevant to public policy and management (e.g. environmental policy, science and technology policy, urban policy, economic development, information and communications policy, policy evaluation, public management).

Contact the B.S.P.P. director for further information.

Master's Program

The Master of Science in Public Policy is designed for students with strong analytical backgrounds, such as those received in engineering, natural science, or an analytically oriented social science or humanities curriculum. Graduate studies in public policy focus on areas in which either the consequences of scientific and technological activity have significant public policy implications, or technical and scientific information is a significant input to the policy-making process. Current areas of specialization for the School include science and technology policy, environmental policy, information and telecommunication policy, and regional economic development policy.

The M.S. in Public Policy requires forty-six credit hours of study, including either a) three hours devoted to producing a professional policy research paper or team research project; or b) nine hours for a thesis. In general, it is expected that students planning to enter employment upon completing the degree will choose the paper or project option, while students planning to continue their graduate work will choose the thesis option.

The program requires a twenty-five-credit-hour core curriculum consisting of five substantive elements: policy and organizational analysis; ethics, philosophy, and public policy; economics and public finance; methods of analysis, including quantitative analysis and research design; and a capstone course in public policy analysis. In addition, there is a required one-credit-hour introductory graduate seminar in public policy. Based on prior coursework or a test-out exam, students may request up to six credit hours of exemptions from core courses. In individual cases, students may be required to take pre-core preparatory courses to be ready for graduate studies in particular methodological or analytical areas. Core courses include:

PUBP 6001	Introduction to Public Policy
PUBP 6010	Ethics, Epistemology, and Public Policy
PUBP 6012	Fundamentals of Policy Processes
PUBP 6112	Research Design in Policy Science
PUBP 6114	Applied Policy Methods and Data Analysis
PUBP 6116	Microeconomics for Policy Analysis
PUBP 6118	Public Finance and Policy
PUBP 6201	Public Policy Analysis

Plus one of the following:

PUBP 6014	Organization Theory
PUBP 6017	Public Management
PUBP 6018	Policy Implementation and Administration

Students must achieve a grade of *B* or higher in all core courses. In addition to elective courses in the School of Public Policy, students may develop their own programs of study by taking courses in other Georgia Tech schools, including those in the Ivan Allen College and the Colleges of Architecture, Management, Sciences, and Engineering. A summer internship, work experience, or co-op assignment between the first and second years offers students insight into a research or professional setting related to their career interests.

Doctoral Programs

The Ph.D. in Public Policy is a research-oriented program that prepares students for advanced professional work or for academic careers. Georgia Tech houses two Ph.D. programs in Public Policy, including one offered jointly with Georgia State University. The programs stress intellectual and methodological rigor, building upon the theory and applications of political and organizational analysis, research design, quantitative analysis, and economics.

All students must have completed the equivalent of the core courses for the Master of Science in Public Policy (see description of the M.S. degree) before they begin the doctoral core curriculum. The doctoral core curriculum consists of six three-credit-hour courses (seven in the joint program). These courses are designed to provide students with a theoretical and methodological foundation for conducting public policy research. Core courses include:

PUBP 8200	Advanced Research Methods I
PUBP 8205	Advanced Research Methods II
PUBP 8211	Microeconomic Theory and Applications
PUBP 8500	Research Seminar in Public Policy
PUBP 8510	Logic of Policy Inquiry
PUBP 8520	Scope and Theory of Public Policy

Additionally, for the joint program, students must take PUBP 8813, Advanced Topics in Analysis and Evaluation. Details on the requirements of the joint program, including equivalent courses at Georgia State University, are available on the Web site.

This core is supplemented with in-depth study of a substantive area of public policy. The Georgia Tech program focuses on science and technology policy, environmental policy, and urban and regional economic development policy. The joint program includes several additional majors, including health policy, policy and program evaluation, and public finance. Students may pursue concentrations with groups of courses already developed by the faculty or an individualized concentration with the written approval of the student's advisor and the Graduate Committee.

In the Georgia Tech program, the major area of concentration consists of four courses and has a capstone seminar at the Ph.D. level that majors are required to complete. The minor concentration is a three-course area of study that is taken outside the School of Public Policy.

Other requirements for the Ph.D. include completion of the one-year residency requirement; admission to candidacy for the degree through successful completion of qualifying exams and a dissertation proposal; and completion and successful defense of a doctoral dissertation (nine credit hours).

In summary, the credits required for the Ph.D. are usually as follows:

Core	18 hours (21 for the joint program)
Major	12 hours
Minor	9 hours
Qualifiers	3 hours (written exam)
Colloquium	3 hours (oral exam: presentation of dissertation proposal)
Dissertation	9 hours
Total	54 hours (57 for the joint program)

This total assumes that a student already has satisfied the core requirements of the master's degree (at most an additional twenty-five hours).

Financial Aid

Most Ph.D. students receive financial assistance, chiefly through sponsored research projects and teaching assistantships.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

PUBLIC POLICY

PUBP 2012. Foundations of Public Policy
3-0-3.
An in-depth exploration of American public policy, with emphasis on the dynamics of policymaking in policy areas such as health care, research, energy and environment, income maintenance, and economic development.

PUBP 2014. Legislative Process
3-0-3.
Analysis of the legislative process with a focus on institutional roles and group dynamics, including selection of legislators, interaction with other governmental institutions, and the role of analysis in shaping legislation.

PUBP 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

PUBP 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

PUBP 3000. American Constitutional Issues
3-0-3.
Examines the American social and political system through the prism of Constitutional issues decided by the U.S. Supreme Court.

PUBP 3010. Organizations and Policy Implementation
3-0-3.
An exploration of the roles and activities of bureaucracies in the implementation of policies and programs, with emphasis on practical issues of public management.

PUBP 3016. Judicial Process
3-0-3.
The functions, structures, and procedures of state and federal court systems, including selection and appointment of judges, judicial activism, influences on court decisions, and enforcement of court decisions.

PUBP 3110. Research Methods and Problem Solving
3-0-3.
Conceptual and methodological issues in policy studies, including causality, explanation, models, threats to research, data collection, and assessment of applicability to policy issues. Design of research strategies.

PUBP 3201. Introduction to Social Policy
3-0-3.
A survey of public policies directed toward social problems in America and their evolution and reform. Development of role of government in addressing issues related to poverty and social welfare.

PUBP 3212. State Policymaking
3-0-3.
This course provides an introduction to politics at the state and local levels of government.

PUBP 3214. African American Politics
3-0-3.
An exploration of the organizations, strategies, and issues that have defined African American political life in the post-civil rights era in the United States.

PUBP 3600. Sustainability, Technology, and Policy
3-0-3.
Ethical, scientific, technological, economic, and political dimensions of sustainable human practices, applying multidisciplinary perspectives to challenges facing public and private-sector approaches to sustainability.

PUBP 3610. Pre-Law Seminar
3-0-3.
Examination of the legal profession and areas of legal specialization (e.g., contract, property, intellectual property, international). Emphasizes skills and values that are essential to success in law school and competent lawyering.

PUBP 4111. Internet and Public Policy
3-0-3.
Analyzes policy implications of Internet architecture (Internet protocols, domain name system, packet switching, peer-to-peer) and surveys policy issues about content, privacy, intellectual property, and governance.

PUBP 4113. Statistical Analysis for Public Policy
3-0-3.
Introduction to probability, descriptive statistics, inferential statistics and analysis, and microcomputer spreadsheets. Emphasizes application of basic statistical concepts to typical public policy and administration problems.

PUBP 4120. Survey Research Methods
3-0-3.
Methods for producing and reporting valid surveys, including composition of questions, design and implementation of survey strategies, and analysis and communication of results.

PUBP 4130. Policy Analysis and Program Evaluation
3-0-3.
Prerequisite(s): PUBP 3110
Analytical methods for rational planning and policy analysis, emphasizing "learning by doing" as students examine alternative types of policy analysis, establish evaluation criteria, and evaluate policy implementation.

PUBP 4200. Social Policy Issues
3-0-3.
Prerequisite(s): PUBP 3201
A review of conceptual and analytical perspectives in social policy and coverage of major areas of persistent social problems, including health care, welfare reform, housing, education, reproductive issues, and gerontology.

PUBP 4201. Metropolitan Governance
3-0-3.
Explores fragmented governance, shared problems, and political entrenchment, which pose challenges to regional cooperation in metropolitan areas, focusing on environmental, transportation, and public service issues.

PUBP 4211. Urban Policy
3-0-3.
Prerequisite(s): POL 1101
Urban policy and urban economic development examined historically, nationally, and locally. Approaches to urban development and redevelopment.

PUBP 4212. Women and Public Policy
3-0-3.
The status of women in American society as a function of rights and opportunities conferred upon women by governmental actions and as influenced by forces of social change.

PUBP 4226. Business and Government
3-0-3.
How government regulates business and markets, and how business exercises power and influence on government in areas such as antitrust, financial markets, safety and health, and environmental quality.

PUBP 4314. Environmental Policy and Regulation
3-0-3.
Prerequisite(s): POL 1101
Using case studies of local, national, and international environmental issues, this course examines the roles of economics, law, political institutions, science, and technology in shaping environmental policies.

PUBP 4316. World Food, Population, and Environment
3-0-3.
Prerequisite(s): POL 1101
Interdisciplinary perspectives on relationships among technology, markets, and the structure of social institutions in responding to the challenge of managing an expanding world economy with growing consumption demands.

PUBP 4338. Environmental Impact Assessment
3-0-3.
Examines policy, planning, and methodological issues in the environmental impact assessment of engineering systems. Emphasizes regulatory aspects of environmental analysis and key analytical techniques, and the incorporation of environmental considerations into engineering design processes.

PUBP 4410. Science, Technology, and Public Policy
3-0-3.
Examination of relationships between science, technology, and government, and their mutual influence on public and private decisions.

PUBP 4414. Technology, Innovation, and Policy
3-0-3.
Theories and concepts of technological innovation and diffusion, economic development, and the role of public and private institutions in technological development at the firm, industry, regional, national, and international levels.

PUBP 4416. Critical Issues in Science and Technology
3-0-3.
Exploration of technology and technological society, going beyond utility and functionality to consider justice, meaningfulness, and self-realization. Perspectives include political economy, aesthetics, and social change.

PUBP 4512. Politics of Telecommunication Policy
3-0-3.
Prerequisite(s): POL 1101
A review of the politics and environment of telecommunication policymaking, including the role of communication in society, the impact of government on the evolution of communications technologies, and proposals for reform.

PUBP 4514. Mass Communication Policy
3-0-3.
Prerequisite(s): POL 1101
Examines mass media influences, activities, characteristics, and behavior with respect to the political process and government. Structure of media markets, characteristics of news and advertising, and impacts of changing technologies on political processes.

PUBP 4530. Introduction to Geographic Information Systems
3-0-3.
Overview of GIS concepts, methods, and terminology. Introduction to PC-based GIS software. Applications to marketing, natural resource management, and public information systems. Students use case studies to design and implement actual projects.

PUBP 4532. Advanced GIS Topics: Spatial Analysis, GIS Programming, and Map Internet Server
3-0-3.
Prerequisite(s): PUBP 4530
Introduction to raster-based GIS software, Avenue script language, and map Internet server. Applications to marketing, natural resource management, and public information systems.

PUBP 4600. Senior Seminar/Thesis
3-0-3.
A capstone course usually taken in the student's last term before graduation, the senior seminar and thesis involves writing an original paper entailing policy analysis relevant to a public or nonprofit agency.

PUBP 4609. Legal Practice
3-0-3.
Prerequisite(s): PUBP 3000 or PUBP 3610
This course develops skills in reading and comprehension of legal materials, analysis of legal writing, and document drafting in selected areas of law.

PUBP 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

PUBP 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

PUBP 4756. Technology Forecasting and Assessment
3-0-3.
Develops skills in methods for technology monitoring, forecasting, and assessment; draws on examples in various emerging technologies. Collection and analysis of quantitative and qualitative data on emerging technologies and their implications. Crosslisted with ISYE 4756

PUBP 4803. Special Topics
3-0-3.

PUBP 4811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit of course number.
Topics of interest not covered in the regular course offerings.

PUBP 4823, -33, -43. Special Topics
3-0-3.
Topics of interest not covered in the regular offerings.

PUBP 4901, -02, -03. Special Problems
Credit hours to be arranged.

PUBP 4951. Georgia Internship Program
3-0-3.
Prerequisite(s): POL 1101
Work-study program assigning students to a project in state or local government. Students prepare research papers analyzing their work experiences relative to theory from the social science or policy studies.

PUBP 4952. Legislative Internship Program
3-0-3.
Prerequisite(s): POL 1101
Students work full time for the Georgia General Assembly for elected officials or committees. Students prepare research papers analyzing their work experiences relative to theory from the social science or policy studies. Spring semester only.

PUBP 6001. Introduction to Public Policy
1-0-1.
An introduction to the field of public policy, including an overview of the scope of the field and examples of public policy analysis.

PUBP 6010. Ethics, Epistemology, and Public Policy
3-0-3.
Examination of the role of ethics and epistemology in public decision making including the effects of values of professionals on public institutions and private sector organizations.

PUBP 6012. Fundamentals of Policy Processes
3-0-3.
The political and governmental context of policy is presented, from agenda setting to evaluation. Examines constitutional and federal contexts of policy, the role of various input mechanisms in shaping policy decisions, the processes by which government institutions make decisions (and the interactions among these institutions), and approaches for understanding and anticipating policy decision making.

PUBP 6014. Organization Theory
3-0-3.
A broad overview of the theoretical issues pertaining to the management of organizations. The course explores both "macro" (i.e. external relations, strategies, and structures) organizational issues. While this is a survey course, we will be concentrating much of our attention on current challenges to bureaucracy as a form of organization. In particular, we will be using theories to examine trends toward re-engineering corporations or re-inventing government agencies. Satisfies policy implementation, management, and organization theory requirement.

PUBP 6017. Public Management
3-0-3.
Using case studies and a field exercise, students will examine how public policies are executed and managed. Underlying the course is the assumption that public management, is the management of political authority and that strategic thinking can make for effective public management. Satisfies policy implementation, management, and organization theory requirement.

PUBP 6018. Policy Implementation and Administration
3-0-3.
This course gives special attention to institutional processes in efforts to coordinate policy implementation at the federal level and within the intergovernmental context; the analysis of implementation and enforcement of policy by regulatory agencies with the support of state governments and private sector agents; challenges to implementation by policy type; and the analysis of policy tools and administrative discretion in implementation. Satisfies policy implementation, management, and organization theory requirement.

PUBP 6111. Internet and Public Policy
3-0-3.
Analyzes policy implications of Internet architecture (Internet protocols, domain name system, packet switching, peer-to-peer) and surveys policy issues about content, privacy, intellectual property, and governance.

PUBP 6112. Research Design in Policy Science
3-0-3.
The objectives for this course include: 1) providing a broad overview of research methods and research criteria; 2) giving students the opportunity to conduct data-based research and analysis; 3) providing more specialized knowledge of one set of research techniques (e.g. survey research, case studies, experimentation – varies by term); 4) providing experience in presenting and defending research.

PUBP 6114. Applied Policy Methods and Data Analysis
3-0-3.
This course will focus on how to design, carry out, present and interpret quantitative analyses, of policy problems. Topics include probability, inferential statistics, regression analysis, general linear models, nonparametric analyses and graphical analysis, as time permits. Classes will focus on 1) the course project; 2) discussions of assigned readings and problems; and 3) data analysis using spreadsheets and a standard statistical package. *Note: Students without preparation in basic statistical concepts and computer methods will be required to take appropriate courses at the 4000 level prior to admission.*

PUBP 6116. Microeconomics for Policy Analysis
3-0-3.
Microeconomic theory is studied with applications to public problems. Students will be introduced to price-generating processes in an economy, demand and supply theory, market equilibrium, welfare economics, categories of market failure, and the public sector's role.

PUBP 6118. Public Finance Policy
3-0-3.
Examines the theory, practice, and policy implementations of federal, state, and local government budgeting and finance. Topics include government spending decisions with a focus on aggregate demand and supply, fiscal policy, budgeting practice, introduction to cost/benefit analysis.

PUBP 6201. Public Policy Analysis
3-0-3.
This course provides a capstone experience for public policy students. The course addresses real-world policy issues and various approaches to analyzing them. The course relies heavily on cases and exercises.

PUBP 6218. Quantitative Models in Public Policy
3-0-3.
Prerequisite(s): PUBP 6114
This course lays a foundation for model building, and through the introduction of a variety of software packages will provide some hands-on experience with elementary model-building. Decision models will be emphasized. Some familiarity with data analysis, probability, and statistical models is assumed. The goal of the course is to equip students with basic model building tools, familiarize them with common problems in modeling, and improve their ability to create and evaluate simple models of policy problems.

PUBP 6221. Policy and Program Evaluation
3-0-3.
Approaches to evaluation policies and programs are presented using examples and case studies to contrast evaluation methods as well as the organizational and political context for evaluation.

PUBP 6226. Business and Government
3-0-3.
Examines government regulation of business operations and the economy from a broad perspective.

PUBP 6300. Earth Systems
3-0-3.
Describes the scientific principles and interactions that make up the Earth's environmental system. The course examines the interaction of natural and human influences that shape the development and operation of the Earth system and how public and private decision-making impacts this system.

PUBP 6310. Environmental Issues
3-0-3.
Provides an overview of basic concepts and methods of environmental policy analysis and implementation through a case study approach. Cases will range from local to global environmental policy issues. The goal of the course will be to expose students to the broad range of social and physical problems referred to as "environmental" problems, and to orient the student for future work in the field.

PUBP 6312. Economics of Environmental Policy
3-0-3.
This course addresses key concepts in environmental economics, including externalities, efficiency, social welfare and environmental quality as a public good. Addresses environmental problems (i.e. water resources, air quality, urbanization) and vehicles of collective environmental action.

PUBP 6314. Policy Tools for Environmental Management
3-0-3.
Explores the various regulatory, managerial, and legal mechanisms available to policy analysts and decision makers for protecting environmental quality.

PUBP 6320. Sustainable Systems: Concepts and Measures
3-0-3.
This course is a historical introduction to sustainable development. The ethical, economic, ecological, and technological dimensions of sustainability are examined. Topics include sustainable development in developing and developed countries; ecosystem health and resilience; the global carrying capacity controversy; sustainable communities, new urbanism, regenerative technologies; designs for disassembly; appropriate technologies and the politics of technologies.

PUBP 6324. Environmental and Technological Risk Management
3-0-3.
Introduction to analytical, social, and policy issues that comprise environmental and technological risk management. Provides an understanding of how risk can be incorporated into decision making; and the role of information in quantifying risk. Analyzes case studies to see why it is important to take risk into account, and examines the role of risk management in promoting environmental protection, safety, and health.

PUBP 6326. Environmental Values and Policy Goals
3-0-3.
Examines the goals and objectives of environmentalists, with special attention to the literature of environmental ethics.

PUBP 6329. Environmental Policy and Implementation
3-0-3.
The concepts and methods of environmental policy analysis and implementation are presented through a case study approach.

PUBP 6330. Environmental Law
3-0-3.
Presents the legal and institutional framework within which environmental law is developed and implemented in the United States and internationally. Also examines the major pollution control statutes, and reviews international law and conventions to address trans-boundary environmental issues.

PUBP 6401. Science, Technology, and Public Policy
3-0-3.
Examination of the relationships between science, technology, and government, including policies for support, control, and application of science and technology.

PUBP 6402. Research Policy and Management
3-0-3.
Examines challenges in research policy and management. The research activities of public, private, and not-for-profit organizations are contrasted in examining strategic planning, allocation of resources, technology transfer, and research evaluation practices.

PUBP 6414. Technological Innovation and Government Policy
3-0-3.
Federal and state policies to stimulate innovation; sources and stimuli for innovation; role of universities and industry consortia; comparative innovation policy; evaluation of technology policy.

PUBP 6415. Technology, Regions, and Policy
3-0-3.
Explores concepts, issues, and policies related to regional development, economic development, industrial change, and technology policy.

PUBP 6417. Critical Perspectives on Science and Technology
3-0-3.
This course seeks to stimulate students' critical thinking about science and technology and their relationships to markets, politics and societies. Discussions include topics such as the social organization of scientific and technical communities, the roles of economic and political forces in science and technology, the shaping of the technical workforce, and the implications of science and technology for concepts that go beyond utility and competitiveness to include justice and self-realization.

PUBP 6421. Development of Large-Scale Socio-Technical Systems
3-0-3.
Analyzes development of large systems such as smart highways, computer networks, electrical power, weapons, and space. Teaches practical skills including negotiation, coalition-building, strategy, and innovation politics.

PUBP 6501. Information Policy and Management
3-0-3.
Examination of the information age from policy and management perspectives. The course will explore concepts and issues related to the formation and implementation of information policies.

PUBP 6513. The Politics of Communications Policy
3-0-3.
An examination of the political processes that make communications policy. The course covers the historical origins of government management of communications, Federal Communications Act, Federal Communications Commission, Congress, judiciary, executive, and special interest activity. Communications is compared to other types of policies. The discussions include historical and contemporary communications issues.

PUBP 6514. Mass Communications Policy
3-0-3.
Traces the evolution of broadcasting, cable, and other mass media policies. Examines the functioning/impact of mass communications in a changing technological environment.

PUBP 6530. Introduction to Geographic Information Systems
3-0-3.
Introduction to the application of geographic information systems (GIS) to public policy issues. Students develop an understanding of GIS software and hardware components, develop facility with a desktop GIS software package, explore digital data availability on the Internet, learn data transfer procedures, learn cartographic projection methods, apply GIS and environmental management data to analyze a selected program.

PUBP 6534. Public Information Systems
3-0-3.
Design, development, and management of information systems for the public sector.

PUBP 6600. Foundations of Local Economic Development Planning and Policy
3-0-3.
Introduction to the context, theory, process, and practice of local economic development planning and policy. Topics covered include: differing theoretical and conceptual explanations of the economic development process; international, national, and regional factors affecting local economic development; federal, state, and local roles; key elements in the economic development process; and contrasting economic development approaches.

PUBP 6602. Economic Development Analysis and Practice
3-0-3.
Strategy development, methods of analysis, and approaches to practice for urban and regional economic development policy and planning.

PUBP 6604. Methods of Urban Policy Analysis and Planning
3-0-3.
Applies analytical techniques and practices of public policy and planning to urban issues, synthesizing varied public policy techniques and practices in a case study context.

PUBP 6606. Urban Development Policy
3-0-3.
Introduces elements of urban policy and urban economic development by examining them historically, nationally, and locally. Approaches to urban development and redevelopment are analyzed.

PUBP 6608. Management of Technology: External Environment
3-0-3.
Examines factors in external environment essential to managing technology. Considers technological innovation process in context of international competitiveness and roles of governments.

PUBP 6753. Comparative Science and Technology Policy
3-0-3.
Examination of the social, political, and cultural contexts of science and technology, and how they affect the research, development, and regulatory policies of nations. Crosslisted with INTA 6753.

PUBP 6760. Negotiation and Conflict Management
3-0-3.
Practical and theoretical instruction on techniques of negotiation and consensus building using training exercises and case studies. Emphasizes environmental, policy, planning, and development disputes. Crosslisted with CP 6760.

PUBP 6777. Analysis of Emerging Technologies
3-0-3.
This course develops skills in the use of selected methods for technology monitoring, forecasting, and assessment. Also examines current status and prospects in selected emerging technology domains. Crosslisted with ISYE 6777.

PUBP 6780. Knowledge Management
3-0-3.
Prerequisite(s): MGT 6050
This course enables students to conceptually think about the modern organization as a knowledge-based, information-processing enterprise and to acquire analytical skills necessary to be a successful manager of a knowledge-based organization. Case studies and an organizational audit are used to examine knowledge-based organizations. Crosslisted with MGT 6780.

PUBP 6801. Research Paper
3-0-3.
Either a professional policy research paper or a team research project including a co-authored policy research monograph prepared for a government or public affairs client.

PUBP 7000. Master's Thesis
Credit hours to be arranged.

PUBP 8200. Advanced Research Methods I
3-0-3.
The course will cover advanced policy analysis and modeling methods, including regression models, and other topics as time permits.

PUBP 8205. Advanced Research Methods II
3-0-3.
Prerequisite(s): PUBP 8200
Building on Advanced Research Methods I, the course will cover advanced policy analysis and modeling methods, for example, panel data and nonparametric regression. Other policy research methods may be explored as time permits.

PUBP 8211. Microeconomic Theory and Applications
3-0-3.
Extensions of microeconomic theory-consumer theory, firm theory, and markets-to situations involving many periods and uncertainty. Introduces students to general equilibrium, externality, and welfare economics.

PUBP 8500. Research Seminar in Public Policy
3-0-3.
Prerequisite(s): PUBP 8205 and PUBP 8520
Exploration of the purpose of and approaches used in public policy research. Requires development of original empirical research.

PUBP 8510. Logic of Policy Inquiry
3-0-3.
This course presents the conceptual foundations of models of policy inquiry. Topics include the scientific, rational-actor, and ethical models. The ethical values underlying cost benefit analysis, pareto-optimal models, and market models are also examined.

PUBP 8520. Scope and Theory of Public Policy
3-0-3.
Overview of core literature of public policy including theories of public policy, the history of public policy studies, the institutional structure of policy analysis, the profession of policy research, and the intellectual bases of public policy studies.

PUBP 8530. Advanced Science and Technology Policy
3-0-3.
Overview of core literature of technology and science policy, theories of innovation, intellectual foundations of technology and science policy.

PUBP 8540. Advanced Environmental Policy
3-0-3.
Overview of core literature of environmental policy, theories of environmental policy, intellectual foundations of environmental policy.

PUBP 8550. Advanced Urban and Regional Economic Development Policy
3-0-3.
Overview of core literature of economic development policy, theories of economic development in urban and regional settings, intellectual foundations of economic development policy.

PUBP 8590. Dissertation Colloquium
3-0-3.
Seminar focusing on dissertation research preparation, culminates in public colloquium in which students present preliminary dissertation proposal.

PUBP 8801, -02, -03. Special Topics
Class and credit hours equal last digit in course number.

PUBP 8811, -12, -13. Special Topics
Class and credit hours equal last digit in course number.

PUBP 8821, -22, -23. Special Topics
Class and credit hours equal last digit in course number.

PUBP 8831, -32, -33. Special Topics
Class and credit hours equal last digit in course number.

PUBP 8900, -10, -20, -30, -40, -50. Special Problems
Credit hours to be arranged.

PUBP 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding a teaching assistantship.

PUBP 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding a research assistantship.

PUBP 8999. Preparation for the Doctoral Qualifying Examination
Credit hours to be arranged.

PUBP 9000. Doctoral Thesis

Women, Science, and Technology

Faculty Coordinator–Carol Colatrella, Professor, School of Literature, Communication, and Culture (LCC).
Professors–Lawrence Foster, HTS; John Krige, HTS; Sue Rosser, HTS.
Associate Professors–Michael Allen, HTS; Alice Bullard, HTS; Angela Dalle Vacche, LCC; Carol Senf, LCC.
Assistant Professors–Deborah Grayson, LCC; Narin Hassan, LCC; Maren Klawiter, HTS; Cynthia Klestinec, LCC; Colleen Terrell, LCC; Lisa Yaszek, LCC.

General Information

The Women, Science, and Technology (WST) program does what no other gender studies program does: it links science and technology issues to those issues more traditionally associated with women's studies. The WST minor prepares Tech students–women and men majoring in engineering, science, social sciences, and humanities–to live and work in an increasingly diverse world. The minor helps students develop their understanding of the human side of science and engineering, involving not only gender issues, but inequalities of race and class as well.

WST courses reflect on the theoretical and practical dimensions of diversity. Students are encouraged to explore the values associated with scientific culture and to learn to synthesize knowledge across the disciplines, while viewing science and engineering as social and cultural forces that shape relations among women and men.

A WST minor must take the following Institute prerequisites (or their equivalents): ENGL 1101: English Composition, ENGL 1102: English Composition, and one of the following: HIST 2111: U.S. History to 1877; HIST 2112: U.S. History Since 1877; POL 1101: American Government; PUBP 3000: American Constitutional Issues; INTA 1200: American Government in Comparative Perspective. Each minor must take the following two (2) required courses: HTS 3021: Women in Science and Engineering; LCC 3304: Science, Technology, and Gender.

Each minor must also take four (4) courses from the following HTS and LCC courses, at least one of which should be from the HTS list, and one from the LCC list. With permission of the WST coordinator, a student may substitute one related course (described below). Each student must have at least twelve credit hours of 3000- and/or 4000-level courses, and a total of eighteen credit hours must be presented for the WST minor.

History, Technology, and Society

HTS 2082	Technology and Science in the Industrial Age
HTS 2084	Technology and Society
HTS 3007	Sociology of Work, Industry, and Occupations
HTS 3016	Women and Gender in the United States
HTS 3017	Sociology of Gender
HTS 3082	Sociology of Science
HTS 3084	Culture and Technology
HTS 3086	Sociology of Medicine and Health

Literature, Communication, and Culture

LCC 2100	Introduction to Science, Technology, and Culture
LCC 2200	Introduction to Gender Studies
LCC 3225	Gender Studies in the Disciplines
LCC 3306	Science, Technology, and Race
LCC 3302	Science, Technology, and Ideology
LCC 3308	Environmentalism and Ecocriticism
LCC 3316	Science, Technology, and Postcolonialism
LCC 3318	Biomedicine and Culture

With permission of the WST coordinator, students may substitute one appropriate course not listed above under HTS and LCC. This may be chosen from special topics courses, seminars, and other courses in the Ivan Allen College that focus upon gender and social inequality or social issues of science and technology. Students may register and plan their courses of study for the WST minor by meeting with Carol Colatrella (LCC). Students petition for the minor at the time they petition for their major degree. Minors are conferred upon graduation and appear on students' transcripts.

This version of the *General Catalog* was current as of the date of printing in May 2005. For the most up-to-date version, visit **www.catalog.gatech.edu**. In addition, this is the final printed version of the *General Catalog*. Beginning in May 2006 it will be available online only.

COLLEGE OF MANAGEMENT

http://mgt.gatech.edu

Established in 1913 as School of Commerce
Location: 800 West Peachtree Street
Telephone: 404.894.2600 or 404.894.2624
Fax: 404.894.6030
E-mail: com@mgt.gatech.edu

Dean and Tedd Munchak Chair–Terry C. Blum; *Associate Dean for Corporate and Professional Programs and Professor*–Nate Bennett; *Associate Dean for Faculty and Research and Fuller E. Callaway Chair and Professor*–Eugene E. Comiskey; *Director of Graduate Programs*–Ann Johnston Scott; *Executive Director of Corporate Programs*–James Kranzusch; *Director of M.B.A. Career Development*–Mary McRee; *Director of Undergraduate Programs*–Yvette McDonald; *Faculty Director of E.M.S.M.O.T., Faculty Director for Information Technology, and Associate Professor*–Dennis Nagao; *Director of Master's Admissions*–Paula Wilson; *Regents' Professor*–Naresh K. Malhotra; *Hal and John Smith Chair of Entrepreneurship and Small Business Management, Director, Technology Entrepreneurship and Commercialization, and Professor*–Marie Thursby; *Thomas R. Williams Chair in Finance and Professor*–Cheol Eun; *Invesco Chairholder in Finance and Professor*–Charles Mulford; *Gary T. and Elizabeth R. Jones Chair in Management and Professor*–David Herold; *Director of the Center for International Business Education and Research and Professor*–John R. McIntyre; *Director, Extended Value Chain, Management of Technology and Professor*–Soumen Ghosh; *Clinical Professor of Management*–Michael Cummins; *Director of TI:GER (Technology Innovation: Generating Economic Returns)*–Carolyn Davis; *Executive in Residence for Global Technology, Entrepreneurship, and Commercialization*–Nick Voigt.

Professors–Philip Adler (emeritus), Fred C. Allvine (emeritus), Lloyd Byars, Yih-Long Chang, Bryan Church, Don Fedor, Cheryl Gaimon, Robert Hawkins (emeritus), Narayanan Jayaraman, David Ku, Ferdinand Levy, Sridhar Narasimhan, Charles Parsons, Leonard Parsons, Arnold Schneider, Christina Shalley, Vinod Singhal, Richard Teach.
Associate Professors–Goutam Challagalla, Andrew J. Cooper (emeritus), Kirsten Ely, Ajay Khorana (on leave), Bradley Kirkman, Jackie Kleiner, Luis Martins, Saby Mitra, Deborah Turner, Francis Ulgado, Dongjun Wu.
Assistant Professors–Timothy Carroll, Rajesh Chakrabarti, Alka Citrin, Jonathan Clarke, Rui Dai, Pat Dickson, Mark Ferguson, Stylianos Kavadias, Subhankar Nayak, Gregory Robbins, Frank Rothaermel, Samit Soni, Jeff Stratman, Ajay Subramanian, Koert van Ittersum, Nancy Wong, Han Zhang.

General Information

The College of Management offers a full range of undergraduate and graduate programs. The undergraduate program in management leads to the Bachelor of Science degree. The Master of Business Administration (M.B.A.) is a full-time, two-year program of study. The Executive Master of Science in Management of Technology (E.M.S.M.O.T.) is for professionals who wish to continue their careers while earning a master's degree. The College also offers a Master of Science in Quantitative and Computational Finance as well as an undesignated Master of Science degree. The doctoral program leads to a Ph.D. in management. The College is accredited by the American Assembly of Collegiate Schools of Business (AACSB).

The College is committed to being a recognized leader in developing business leaders to operate in changing technological environments. Programs

combine excellence in the functional areas of business education with the multidisciplinary focus on management of technology, international business, and entrepreneurial and innovative processes and e-business for a global economy. Programs equip students to create value that will make a social and economic difference in the lives of individuals, groups, communities, and societies. Through a curriculum that emphasizes collaborative learning based on real-world experience, the College offers the resources of multidisciplinary centers in international business, entrepreneurship, e-business, and management of technology that foster research, teaching excellence, and dialogue across the major functional areas of management.

The use of computers is an integral part of each program. Both undergraduate and M.B.A. students are required to have their own computers. For more information, visit: **http://mgt.gatech.edu**.

Undergraduate Program

Students with a broad interest in all management activities and operating problems should profit from the management degree program. The program builds upon knowledge of the functional, environmental, behavioral, and legal aspects of business and provides analytical and conceptual tools for analyzing complicated problems. It prepares the student for managerial responsibilities and decision making. The large number of elective hours allows the student to tailor a program to his or her individual educational objectives. Students may take a concentration of electives in areas such as finance, accounting, marketing, operations management, international management, and information technology management.

Pass/Fail Courses

Up to nine credit hours in the named category of free electives may be taken on a pass/fail basis if no nonresident credit has been awarded. (See the table of allowed pass/fail credit hours in "Information for Undergraduate Students" for more information.)

Prerequisites

Management majors should complete all required 2000-level management courses prior to registering for 3000- and 4000-level management courses. Course prerequisites are enforced.

Transfer Credit Policy for Undergraduate Students

Students may transfer courses taken at another accredited institution if the courses are passed with a grade of *C* or better and are deemed by the College of Management to be equivalent to a Georgia Tech course. Such courses will be transferred for the same number of credits as the corresponding College of Management courses, provided they are equal to three or more semester hours of credit.

For institutions within the University System of Georgia, the total number of credit hours transferred for courses within the core curriculum* will match the number of credit hours granted by the originating institution. Hours of credit in excess of the corresponding Georgia Tech course may be transferred only as free electives. For courses taken outside the core curriculum, the rules in the previous paragraph will apply.

Junior- or senior-level courses with three or more semester hours of credit that have no corresponding College of Management course may transfer as electives in management if they are approved by the College of Management.

Because of the difference in the intellectual level of various courses, freshman- or sophomore-level courses taken at other institutions may only be transferred for equivalent freshman- or sophomore-level courses offered at Georgia Tech. (Exception: University System of Georgia schools may transfer the equivalent of MGT 2106, Business Law and Ethics, if taught at the freshman level. Business Law and Ethics has been designated as a core course.)

* Core curriculum for this purpose may be defined as 2000-level management courses plus Business Law and Ethics.

Bachelor of Science in Management (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501 CALCULUS I or MATH 1712 SURVEY OF CALCULUS		4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or ISTA 1200		3
LAB SCIENCE (BIOL, CHEM, EAS, PHYS)		4
TOTAL SEMESTER HOURS		14

First Year - Second Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502 CALCULUS II or MATH 1711 FINITE MATHEMATICS		4
WELLNESS		2
LAB SCIENCE (BIOL, CHEM, EAS, PHYS)		4
COMPUTING REQUIREMENT		3
TOTAL SEMESTER HOURS		16

Second Year - First Semester

Course Number/Name		*Hours*
ECON 2105	PRINCIPLES OF MACROECONOMICS	3
MGT 2250	MANAGEMENT STATISTICS	3
ACCT 2101	ACCOUNTING I: FINANCIAL ACCOUNTING	3
HUMANITIES ELECTIVE(S)		3
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Second Year - Second Semester

Course Number/Name		*Hours*
ECON 2106	PRINCIPLES OF MICROECONOMICS	3
MGT 2106	LEGAL, SOCIAL, & ETHICAL ASPECTS OF BUSINESS	3
ACCT 2102	ACCOUNTING II: MANAGERIAL ACCOUNTING	3
MGT 2251	INTRO. TO MANAGEMENT SCIENCE	3
MGT 2200	MANAGEMENT APPLICATIONS OF INFORMATION TECHNOLOGY	3
TOTAL SEMESTER HOURS		15

Third Year - First Semester

Course Number/Name		*Hours*
MGT 3062	FINANCIAL MANAGEMENT	3
MGT 3101	ORGANIZATIONAL BEHAVIOR	3
MGT 3102	HUMAN RESOURCES	3
HUMANITIES ELECTIVE(S)		3
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Third Year - Second Semester

Course Number/Name		*Hours*
MGT 3300	MARKETING MANAGEMENT I	3
MGT 3501	OPERATIONS MANAGEMENT	3
MGT 3660	INTERNATIONAL BUSINESS	3
MANAGEMENT ELECTIVE(S)		3
NON-MANAGEMENT ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Fourth Year - First Semester

Course Number/Name		*Hours*
MANAGEMENT ELECTIVE(S)		12
NON-MANAGEMENT ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Fourth Year - Second Semester

Course Number/Name		*Hours*
MGT 4195	STRATEGIC MANAGEMENT	3
MANAGEMENT ELECTIVE(S)		3
FREE ELECTIVES(S)		11
TOTAL SEMESTER HOURS		17

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Computing Requirement

Students must complete either CS 1315, CS 1321, or a computer programming course approved as satisfying the general education requirements in computer literacy.

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Electives

Humanities Electives

Students are required to complete twelve hours of humanities including six hours of required courses, ENGL 1101 and ENGL 1102, from CORE AREA A: Essential Skills, listed on pages 35-36 of

this catalog. In addition, they are required to complete six hours of humanities selected from CORE AREA C: Humanities/Fine Arts, also listed on pages 35-36. Humanities electives transferred from other institutions may be used to fulfill this twelve-hour requirement.

Note: Any courses completed that were listed in prior catalogs as satisfying the Humanities requirement and were completed while that catalog was in effect may also be used to satisfy this requirement.

Social Sciences Elective
Students must complete twelve hours of social science electives. Students are required to complete the U.S. and Georgia history and constitution requirement with three semester hours selected from HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200.

Students must complete six hours of economics: ECON 2105 and ECON 2106.

Three additional semester hours of social science are to be completed. This course may be selected from CORE AREA E Social Sciences listed on pages 35-36 of this catalog.

Mathematics Elective
Students must complete eight hours of mathematics electives to be selected from MATH 1501 or MATH 1712 and MATH 1502 or MATH 1711.

School-Specific Electives/College of Management Electives
Students must complete eighteen hours of College of Management electives. Management courses not otherwise required for the degree will satisfy this requirement. These electives may not be taken pass/fail.

Non-College of Management Electives
Students must complete six semester hours of non-College of Management electives. These courses may be selected from any academic area outside the College of Management. HPS and PE courses are not allowed. The courses must be taken on a letter-grade basis.

Free Electives
Students must complete fourteen semester hours of free electives. These electives may be selected from any academic area including the College of Management. These courses may not be required otherwise by this curriculum or used elsewhere in this curriculum. An unlimited number of hours of HPS courses are allowed. A maximum of nine pass/fail hours are allowed. The student must consult the table in "Information for Undergraduate Students" and/or obtain advising in the College of Management Office of Undergraduate Programs regarding allowable pass/fail hours.

Computer Literacy Requirement
Students are allowed to replace CS 1321 from CORE AREA B listed on pages 35-36 with CS 1315 or a computer programming course approved as satisfying the general education requirements in computer literacy.

Certificate Programs

In addition to its degree programs, the College of Management offers students in good standing an opportunity to broaden their areas of expertise or acquire skills or information beyond their major degree requirements. Students who satisfactorily complete this special program will receive a certificate of recognition.

The following certificate programs are available for undergraduate students:

- Accounting
- Engineering Entrepreneurship
- Finance
- Information Technology Management
- International Management
- Marketing
- Technology and Operations Management

Graduate Programs

The College of Management offers graduate programs leading to the Master of Business Administration (M.B.A.), a Master of Science in Quantitative and Computational Finance, the undesignated Master of Science, the Executive Master of Science in Management of Technology (E.M.S.M.O.T.), and the Doctor of Philosophy.

Master of Business Administration (M.B.A.)

The M.B.A. program provides a professional management education for students with baccalaureate degrees in any discipline. Calculus is the only prerequisite. The M.B.A. is an innovative and rigorous two-year, full-time program with a technical and quantitative instructional focus. Highly qualified candidates from all academic backgrounds enter the program, which is designed to foster teamwork and a closely knit class.

Excellence in management education has long been a hallmark of Georgia Tech. The Georgia Tech M.B.A. helps students develop the skills they will need to effectively manage changing technological environments in the twenty-first century, and the vision and ingenuity to become valued leaders in their fields. At Georgia Tech, M.B.A. students are exposed to the social, environmental, political, and international factors shaping the global marketplace. Some of the primary advantages of the M.B.A. program include a close-knit community that promotes enriched student-faculty relationships; classmates with diverse educational and work experiences; intimate class sizes that foster group cooperation and a true understanding of the business environment; an innovative curriculum that keeps pace with the rapidly changing environment of technology management; and a wide range of educational, social, and professional opportunities in the metro-Atlanta area.

In the summer term between the first and second academic years, M.B.A. students work in summer internships with both major employers and small entrepreneurial ventures. Summer internships enhance permanent employment opportunities.

The M.B.A. program requires sixty-one hours; thirty-one semester hours are required core classes. These courses develop a common core of knowledge essential to all M.B.A. students. The remainder of the curriculum consists of electives, which provide flexibility for students to build competence in one or more concentration areas. This freedom permits each student to fashion a curriculum directed toward individual educational and career goals.

M.B.A. concentration areas include accounting, finance, information technology, international business, marketing, operations management, organizational behavior, and strategic management. Students may also earn a certificate in entrepreneurship, international business, or management of technology.

Entry is in the fall semester only, and enrollment is strictly full time. As there are no graduate management courses offered in the summer, students are encouraged to participate in the M.B.A. summer internship program.

Applicants to the M.B.A. program should note that supplementary application materials are required by the College of Management, in addition to those requested by Georgia Tech's Office of Graduate Admissions and Enrollment Services. Prospective M.B.A. applicants may request a viewbook at **www.mgt.gatech.edu/mba** or by e-mailing mba@mgt.gatech.edu. For more information, contact the College of Management, Graduate Office, Georgia Institute of Technology, Atlanta, Georgia 30308-0520, or by calling 404.894.8722. Applications are online at **www.mgt.gatech.edu/mba**.

The **undesignated Master of Science** degree program serves students whose educational and career goals may not be best served by the M.B.A. program. Under these circumstances, the student can pursue a specially tailored master's-level curriculum that satisfies the American Assembly of Collegiate Schools of Business (AACSB) common body of knowledge requirements and provides a coherent concentration of elective courses chosen in consultation with an academic advisor. This specialized degree program is designed primarily for students who are admitted to Georgia Tech on approved foreign education programs. Admission to this program must be approved by the M.B.A. Admission Committee prior to enrollment.

Technology Leadership Program (M.B.A. dual degree option)

Through the Technology Leadership Program, qualified graduate students wishing to pursue an M.B.A. degree and a graduate degree in another Georgia Tech graduate program can efficiently earn two graduate degrees in almost the same time it would take to earn the M.B.A. degree alone. For example, the M.B.A. program is normally sixty-one hours. For students pursuing another graduate degree at Georgia Tech, the length of the M.B.A. program is reduced to forty hours with the area of concentration being the coursework in the other Tech graduate program. Students in the Technology Leadership Program take thirty-one hours of required management core courses, plus nine hours of graduate management electives.

Those interested in dual master's degrees should consult with the respective graduate program directors to determine the feasibility of this approach. Technology Leadership students must complete applications for and meet the admission requirements of both programs.

M.B.A. application materials, as well as a viewbook, may be obtained at **www.mgt.gatech.edu/mba**, or at the College of Management, Graduate Office, Georgia Institute of Technology, Atlanta, Georgia 30308-0520, or by calling 404.894.8722.

Ph.D. Program in Management

The Ph.D. program in Management is designed to produce graduates who can make scholarly contributions to their chosen fields. Most graduates undertake careers as teachers, scholars, and researchers in academic environments. The doctoral degree also may lead to careers in industry and government.

The doctoral program in the College of Management is intended for full-time students who will complete their entire doctoral program prior to leaving the campus. Full-time residence in or near Atlanta is expected. The doctoral program is strongly research oriented and emphasizes early and effective involvement in research, with students experiencing considerable personal attention and close interaction with faculty. The Ph.D. program complements and reflects the technological emphasis of the Institute and places considerable weight on learning outside the classroom. The tutorial model is the basic educational model employed throughout the program.

All doctoral students take comprehensive examinations, which include both a general and a special examination. The student becomes a candidate for the degree after successful completion of both exams and the approval of the prospectus of his or her dissertation. On completion of the dissertation, the student must take a final oral examination as prescribed in the general regulations of the graduate division.

Applicants to the doctoral program in management should note that supplementary application materials are required by the College of Management in addition to those required by Georgia Tech's Office of Graduate Admissions and Enrollment Services. Incomplete applications will not be reviewed. Prospective Ph.D. applicants may request a copy of the viewbook from **www.mgt.gatech.edu**, by writing to the College of Management, Graduate Office, Georgia Institute of Technology, Atlanta, Georgia 30308-0520, or by calling 404.894.8722. Applications are online at **www.mgt.gatech.edu/phd**.

The Executive Master of Science in Management of Technology (E.M.S.M.O.T.)

The curriculum of this program is designed to develop individuals who are capable of leading organizations in technologically intensive and rapidly changing global environments. To do this, the program blends core business knowledge (i.e., M.B.A. core courses), a strategic management of technology emphasis, innovation and entrepreneurship, and leadership and change management skills. These materials are delivered in an active learning, discussion-oriented classroom environment that includes many "hands-on" collaborative projects. Program participants have the maximum opportunity to immediately apply their new knowledge in their jobs as they progress through the curriculum. Graduates possess the knowledge and skills necessary to strategically understand how to identify and quickly leverage technology opportunities throughout the organization for competitive advantage. They also understand how to lead the social side of the organization to facilitate innovation and effectively bring about change.

Other program features include:

- **Leadership and team skills development:** Collaboration is a key skill that participants develop through the varied team projects that are required throughout the curriculum. These teams also serve as a key learning element as participants learn from team members who come from different industries, companies, and functional areas. Leadership, teamwork, conflict management, and communication skills are assessed and developed starting with the first opening residency.
- **Innovative capstone project:** A multiterm team project is used to integrate course knowledge within the context of a technology-oriented new venture business plan. This project requires the team to blend its knowledge about technology forecasting, intellectual property, innovations, entrepreneurship principles, marketing, accounting and finance, and strategy within the context of a tightly crafted proposal. The project is then judged and evaluated by an outside panel of experts.
- **Technology usage:** Classes take place in the College's Huang Executive Center. Classrooms are equipped with state-of-the-art technology with both wired and wireless network access. A suite of collaboration technologies is used to link participants to one another and permits dynamic electronic collaborations outside of class. These technologies also provide linkages to database resources participants are expected to use in their analyses. A state-of-the-art communications lab is open twenty-four hours a day, seven days a week to help participants improve their communications skills.

Degree Requirements and Schedule

The E.M.S.M.O.T. degree requires thirty-six semester credit hours of study consisting of a fixed sequence of courses over a nineteen-month period. The curriculum sequence begins with a weeklong residency on campus followed by classes on alternating weekends (all day Friday and Saturday) during the term. A second weeklong campus residency begins the second half of the program. The program concludes with a two-week international residency. A new class begins the sequence each summer semester. The grading basis for most classes is on a traditional *A, B, C, D, F* scale. To graduate, students must have no more than three grades of *C* or lower and must have a cumulative grade point average of 3.0.

Master of Science in Quantitative and Computational Finance

The master's degree in Quantitative and Computational Finance (M.S.Q.C.F.) is a collaboration of the College of Management, the School of Mathematics, and the School of Industrial and Systems Engineering. This is a sixteen-month interdisciplinary degree program that provides students with the practical skills and theoretical understanding they need to become experts in the formulation, implementation, and evaluation of the models used by the financial sector to structure transactions, manage risk, and construct investment strategies. Students require a thorough understanding of the principles, structures, and everyday activities of finance, an understanding of the mathematics used to model these financial activities, and knowledge of the techniques used to implement these models in finance – techniques in programming, numerical analysis, statistics, and optimization – along with the intuition within finance itself. Contact Dr. Robert Kertz, director, at 404.894.4311, kertz@math.gatech.edu, or **www.qcf.gatech.edu**.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course. An asterisk (*) denotes prerequisite courses that may be taken concurrently. This section includes courses in Management (MGT), Accounting (ACCT), International Executive Master's in Business Administration (IMBA), and Executive Master of Science in the Management of Technology (MOT).

MANAGEMENT

MGT 2106. Legal, Social, Ethical Aspects of Business
3-0-3.
Development and function of the law, court organization, procedure, and substantive law in contracts, business organizations, and agencies. Also exposes social responsibility and ethics in business.

MGT 2200. Management Applications of Information Technology
3-0-3.
An introduction to management computing with a focus on the support of management functions through information technology. Students are introduced to database and spreadsheet applications.

MGT 2250. Management Statistics
3-0-3.
Prerequisite(s): MATH 1712 or MATH 17X2 or MATH 1501 or MATH 15X1
This is the introduction to basic statistics for management students.

MGT 2251. Introduction to Management Science
3-0-3.
Prerequisite(s): MGT 2250
This course focuses on the problem-solving and decision-making processes that use quantitative management science concepts and techniques.

MGT 2598. Management Internship
Credit hours to be arranged.
Recognition for a paid, full, or part time employment experience that is relevant to a student's management education.

MGT 2599. Internship and Independent Study
Credit hours to be arranged.
Independent study conducted for one student under the guidance of a faculty member in association with an unpaid internship.

MGT 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

MGT 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

MGT 2910, -11, -12. Special Problems
Credit hours to be arranged.
Independent study conducted for one student under the guidance of a faculty member.

MGT 3000. Financial and Managerial Accounting
3-0-3.
A foundation course in measuring and reporting the financial performance and status of the firm as well as basic concepts in cost and managerial accounting. No credit allowed for MGT majors. No credit allowed for MGT 3000 and ACCT 2101. Credit not allowed for MGT 3000 and ACCT 2102.

MGT 3062. Financial Management
3-0-3.
Prerequisite(s): ACCT 2101
An introduction to finance. Topics include: time value of money, capital budgeting, risk and return, capital structure, dividend policy, and working capital management. No credit allowed for MGT 3062 and MGT 3078.

MGT 3075. Security Valuation
3-0-3.
Prerequisite(s): MGT 3062 or MGT 3078
The valuation of securities using fundamental and technical analysis. Topics include: DCF valuation, price multiples, free cash flow, and the construction of quantitative trading models.

MGT 3076. Investments
3-0-3.
Prerequisite(s): MGT 3062
Introduction to the securities markets and a study of the theory and practice of security analysis and portfolio management as applied to stocks and bonds. Credit not allowed for MGT 3076 and MGT 3078.

MGT 3078. Finance and Investments
3-0-3.
An introduction to finance and to the securities markets. Topics include: time value of money, risk and return, capital budgeting, security analysis and portfolio management of stocks, bonds, and derivatives. No credit allowed for MGT majors. Credit not allowed for MGT 3078 and MGT 3062. Credit not allowed for MGT 3078 and MGT 3076.

MGT 3079. Management of Financial Institutions
3-0-3.
Prerequisite(s): MGT 3062 or MGT 3078
Introduction to the various risks faced by financial institutions and a detailed analysis of the tools used to manage these risks.

MGT 3084. Derivative Securities
3-0-3.
Prerequisite(s): MGT 3062 or MGT 3078
An introduction to options, futures, and swaps is provided. Concepts of arbitrage, index trading, and portfolio insurance are discussed.

MGT 3101. Organizational Behavior
3-0-3.
Introduction to how the behavior of individuals, groups, and organizations affects organizational effectiveness.

MGT 3102. Managing Human Resources within a Regulatory Environment
3-0-3.
Analysis of various frameworks for understanding the social regulatory environments of human resources management and how they influence management decision making.

MGT 3150. Principles of Management
3-0-3.
Course explores functions of management: planning, organizing, staffing, leading, and controlling. Lectures, case studies, and business exercises are used to reinforce principles that are taught.

MGT 3300. Marketing Management I
3-0-3.
The course presents and develops the primary marketing variables that are used in designing an overall marketing program. A systems approach is taken with the variables managed to optimize overall results.

MGT 3310. Marketing Research: Qualitative Aspects
3-0-3.
Prerequisite(s): MGT 3300
This course covers the fundamentals of the qualitative aspects of marketing research. The course has an applied orientation with application to contemporary issues in marketing.

MGT 3325. Product Planning
3-0-3.
Prerequisite(s): MGT 2250 and MGT 3300
Overviews issues inherent in product development and product management. These include product strategy, idea generation, market development, product positioning, test marketing, launch, and brand management.

MGT 3501. Operations Management
3-0-3.
Prerequisite(s): MGT 2251
This course focuses on the issues and techniques relevant to the management of the operations function within an organization, emphasizing its strategic significance.

MGT 3510. Management of Technology
3-0-3.
Prerequisite(s): MGT 3501
Focus on managing the design, assessment, and implementation-change strategy of a firm's manufacturing and information-based technological capabilities to improve competitive performance.

MGT 3660. International Business
3-0-3.
Prerequisite(s): MGT 3101 or MGT 3150
Examines the position of the U.S. in world markets, various types of international business transactions, and the relationship of business to global economic, political-legal, and cultural forces.

MGT 3661. Advanced Concepts in International Business
3-0-3.
Prerequisite(s): MGT 3660
Covers significant aspects of international business with a particular focus on the challenges associated with transnational corporations.

MGT 4010. Business Taxation
3-0-3.
Prerequisite(s): MGT 3000
Comprehensive survey of federal taxation of business. A focus on tax planning and decision making will extend to the study of the tax code and regulations.

MGT 4015. Advanced Managerial Accounting
3-0-3.
Prerequisite(s): MGT 3000
The course will examine current issues in managerial accounting.

MGT 4026. Financial Reporting and Analysis I
3-0-3.
Prerequisite(s): MGT 3000
Intermediate-level treatment of revenue recognition, inventories, contracts, interest capitalization, property and equipment, intangibles, long-term liabilities, and shareholder's equity. Significant emphasis on financial analysis.

MGT 4027. Financial Reporting and Analysis II
3-0-3.
Prerequisite(s): MGT 3000
Advanced topics including tax reporting, leases, pensions, foreign currency transactions, hedging, statement translation, and business combinations and consolidations. Significant emphasis in financial analysis.

MGT 4028. Financial Analysis and Reporting of Technology Firms
3-0-3.
Prerequisite(s): MGT 3000
An in-depth look at reporting standards for and the financial characteristics of technology firms, with an emphasis on the financial analysis of such firms.

MGT 4030. International Accounting
3-0-3.
Prerequisite(s): MGT 3000
An overview of accounting issues arising from the increased internationalization of business. Topics include comparative financial reporting among countries and accounting treatments of international transactions.

MGT 4041. Auditing and Financial Control Systems
3-0-3
Prerequisite(s): MGT 3000
This course covers professional issues surrounding auditing and financial control systems. Topics include management fraud, legal liability, audit evidence, etc.

MGT 4045. Seminar in Advanced Accounting
3-0-3.
Prerequisite(s): MGT 3000
An intensive treatment of a selection of contemporary accounting topics. Topical coverage may span subject matter ranging across the fields of auditing, systems, and managerial and tax accounting.

MGT 4051. Decision Support and Expert Systems
3-0-3.
Prerequisite(s): MGT 2200
This course discusses the basic features of decision support systems and expert systems. It covers the development tools and business applications.

MGT 4052. Systems Analysis and Design
3-0-3.
Prerequisite(s): MGT 2200
An introductory course on the development life cycle of business information systems. It covers analysis and design tools and methodology.

MGT 4053. Business Data Communications
3-0-3.
Prerequisite(s): MGT 2200
Introductory data communication concepts. Data communication applications in organizations. Overview of data communication products and services available from a technology consumer perspective.

MGT 4055. International Issues in Information Technology Management
3-0-3.
Prerequisite(s): MGT 2200
An overview of international issues in the Information Technology Management (ITM) area. Topics include: offshore software development, transborder data flow restrictions, and global connectivity issues.

MGT 4056. Electronic Commerce
3-0-3.
This course examines the business and technical issues related to electronic commerce applications, such as the Internet, WWW, EDI, and electronic linkages between trading partners.

MGT 4057. Business Process Analysis and Design
3-0-3.
Prerequisite(s): MGT 2200
Business processes are the mechanisms by which work is organized and performed. This course covers the analysis of business processes and efficient redesign through technology.

MGT 4058. Database Management Systems
3-0-3.
Prerequisite(s): MGT 2200
An introductory course on databases providing hands-on experience with a DBMS. Topics include data modeling, relational database design, and SQL.

MGT 4066. Corporate Restructuring
3-0-3.
Prerequisite(s): MGT 3062 or MGT 3078
This course examines the finance, economics, law, and business strategies that underlie major corporate restructuring transactions. Topics include valuation, acquisitions, divestitures, and high-leveraged transactions.

MGT 4070. International Finance
3-0-3.
Prerequisite(s): MGT 3062 or MGT 3078
Financial management in an international setting. Topics include: foreign exchange markets, exchange risk management, international portfolio investment, and foreign direct investment.

MGT 4071. Multinational Financial Management
3-0-3.
Prerequisite(s): MGT 3062 or MGT 3078
This course emphasizes decision making for the multimedia firm amidst exchange rate fluctuations, differing tax structures across countries, and political risk via lectures, case-discussion and analysis, and project-based learning.

MGT 4190. Strategic Quality Management and Competitiveness
3-0-3.
Prerequisite(s): MGT 3150
This course examines the philosophy and techniques of strategic quality management (e.g. cycle time mgt., learning organizations, quality control) as a means to promote individual productivity and improve organizational competitiveness.

MGT 4191. The Entrepreneurship Forum
3-0-3.
This course provides an understanding of the entrepreneurial process, explores the role of the entrepreneur, and identifies the critical issues in starting ventures and working in entrepreneurial organizations.

MGT 4195. Strategic Management
3-0-3.
Prerequisite(s): MGT 3062 and MGT 3300 and MGT 3501 and (MGT 3101 or MGT 3150)
The use of cases, guest lecturers, and gaming to integrate analysis and measurement tools, functional areas, and public policy issues. The objective is to develop skills in broad areas of rational decision-making in the administrative context of uncertainty.

MGT 4303. Personal Selling and Sales Management
3-0-3.
Prerequisite(s): MGT 3300
Students will obtain an understanding of the management of the sales function. The importance of the marketing-sales interface will be stressed.

MGT 4305. Business-to-Business Marketing
3-0-3.
Prerequisite(s): MGT 3300
This course studies the marketing of products and services for resale, for use in producing other goods and services, and for the operations of an enterprise.

MGT 4307. Strategic Marketing
3-0-3.
Prerequisite(s): MGT 3300
Students will obtain an understanding of strategic marketing development and alternatives. Analysis and implementation through functional marketing strategies will be stressed.

MGT 4310. Electronic Commerce and Marketing
3-0-3.
Marketing implications of e-commerce and customer-relationship management are explored through an examination of marketing exchange using the information highway, multimedia techniques, database-marketing, and interactive telecommunications.

MGT 4331. Consumer Behavior
3-0-3.
Prerequisite(s): MGT 3300
An applied course that provides a basic understanding of the behavioral science concepts to explain the behavior of consumers in the marketplace.

MGT 4335. International Marketing
3-0-3.
Prerequisite(s): MGT 3300
Students will obtain an understanding of marketing across national borders and cultures. The differences and similarities throughout the marketing functions are explored.

MGT 4352. Operations Resource Planning and Execution
3-0-3.
Prerequisite(s): MGT 3501
The management of material flows within an enterprise will be covered by tracking the evolution of operational planning and execution systems through the enterprise resource planning (ERP) framework.

MGT 4353. Operations Strategy
3-0-3.
Prerequisite(s): MGT 3501
This course provides knowledge about developing, implementing, and evaluating operations strategy. It stresses the relationships between the operations and other functions of the organization.

MGT 4360. Global Operations and Supply Chain Management
3-0-3.
Prerequisite(s): MGT 3501
This course is designed to present issues critical to the globalization of operations, and addresses strategic and tactical issues pertaining to an organization's global operations and supply chain activities.

MGT 4365. Quality Control and Improvement
3-0-3.
Prerequisite(s): MGT 3501
This course focuses on statistical process control, acceptance sampling, robust design, and other general methodologies for quality improvement.

MGT 4366. Service Operations Management
3-0-3.
Prerequisite(s): MGT 3501
This course analyzes operational performance for the service and service-support functions of manufacturers. Industries include information services, health care, parking, transportation, distribution, and retail.

MGT 4598. Management Internship
Credit hours to be arranged.
Recognition for a paid, full or part time, employment experience that is relevant to a student's management education.

MGT 4599. Internship and Independent Study
Credit hours to be arranged.
Independent study conducted for one student under the guidance of a faculty member in association with an unpaid internship.

MGT 4610. Law, Management, and Economics
3-0-3.
Interrelationships among law, economics, and management. Focuses on the legal and economic aspects of management decisions.

MGT 4611. Integrative Management Analysis
3-0-3.
Integrates the functional areas of management, economics, and the external environment in which businesses operate. The course is designed to broaden the student's perspective on management.

MGT 4660. Entrepreneurship for Engineers
3-0-3.
Prerequisite(s): ACCT 2101 and MGT 3062 and MGT 3300
Provides engineering students with an understanding of the process of establishing a technology-based venture. Students learn how to evaluate market opportunities, conduct feasibility studies, create venture teams, and write business plans.

MGT 4661. Database Management
3-0-3.
Prerequisite(s): MGT 2200
An introductory course on databases providing hands-on experience with a DBMS. Topics include data modeling, relational database design, and SQL.

MGT 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

MGT 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

MGT 4803. Special Topics
3-0-3.
Permits a group of students and a professor to pursue areas of management not extensively treated in any other course.

MGT 4811, -12, -13, -14, -15. Special Topics in Management
Class and credit hours equal last digit in course number.
Permits a group of students and a professor to pursue areas of management not extensively treated in other courses.

MGT 4823. Special Topics
3-0-3.
Permits a group of students and a professor to pursue areas of management not extensively treated in any other course.

MGT 4910, -11, -12. Special Problems
Credit hours to be arranged.
Independent study conducted for one student under the guidance of a faculty member.

MGT 6000. Financial and Managerial Accounting I
3-0-3.
A foundation course in measuring and reporting the financial performance and status of the firm, as well as basic concepts in cost and managerial accounting.

MGT 6010. Business Taxation
3-0-3.
Prerequisite(s): MGT 6000
Comprehensive survey of federal taxation of business. A focus on tax planning and decision making will extend the study of the tax code regulations.

MGT 6015. Managerial Accounting II
3-0-3.
Prerequisite(s): MGT 6000
The course covers cost estimation, standard costs, variable costing, relevant costs, transfer pricing, performance evaluation, cost of quality, and activity-based costing for service.

MGT 6020. Financial Reporting and Analysis I
3-0-3.
Prerequisite(s): MGT 6000
Intermediate-level treatment of revenue recognition, inventories, contacts, interest capitalization, property and equipment, intangibles, long-term liabilities, and shareholders' equity. Significant emphasis on financial analysis.

MGT 6022. Financial Reporting and Analysis II
3-0-3.
Prerequisite(s): MGT 6000
Advanced topics including tax reporting, leases, and pensions.

MGT 6028. Financial Analysis and Reporting of Technology Firms
3-0-3.
Prerequisite(s): MGT 6000
An in-depth look at reporting standards for, and the financial characteristics of, technology firms with an emphasis on the financial analysis of such firms.

MGT 6030. International Accounting
3-0-3.
Prerequisite(s): MGT 6000
An overview of accounting issues arising from the increased internationalization of business. Topics include comparative financial reporting among countries and accounting treatments of international transactions.

MGT 6042. Auditing and Financial Control Systems
3-0-3.
Prerequisite(s): MGT 6000
This course covers professional issues surrounding auditing and financial control systems. Topics include management fraud, legal liability, audit evidence, etc.

MGT 6045. Seminar in Advanced Accounting Topics
3-0-3.
Prerequisite(s): MGT 6000
An intensive treatment of a selection of contemporary accounting topics. Topical coverage may span subject matter ranging across the fields of auditing, systems, managerial, and tax accounting.

MGT 6050. Management Information Systems
3-0-3.
This course provides an introduction to the use of information systems in modern organizations. Various issues relating to the management of information technology are discussed.

MGT 6051. Database Development and Applications
3-0-3.
Prerequisite(s): MGT 6050
The role of databases in the modern enterprise. Design and development of database systems. Applications in accounting marketing, operations, and human resource systems.

MGT 6052. Systems Analysis and Design
3-0-3.
Prerequisite(s): MGT 6050
An introduction to the development life cycle of business information systems. It covers analysis and design tools and methodology.

MGT 6053. Business Data Communications
3-0-3.
Prerequisite(s): MGT 6050
Introductory data communication concepts. Data communication applications in organizations. Overview of data communications products and services available from a technology consumer perspective.

MGT 6054. International Issues in Information Technology Management
3-0-3.
Prerequisite(s): MGT 6050
An overview of international issues in the information technology management area. Topics include: offshore software development, transborder data flow restrictions, global connectivity.

MGT 6055. Decision Support and Expert Systems
3-0-3.
Prerequisite(s): MGT 6050
This course discusses the basic features of decision support systems and expert systems. It covers the development tools and business applications.

MGT 6056. Electronic Commerce
3-0-3.
Prerequisite(s): MGT 6050
This course examines the business and technical issues related to electronic commerce applications, such as the Internet, WWW, EDI, and electronic linkages between trading partners.

MGT 6057. Business Process Analysis and Design
3-0-3.
Prerequisite(s): MGT 6050
Business processes are the mechanisms by which work is organized and performed. This course covers the analysis of business processes and efficient redesign through technology.

MGT 6060. Financial Management
3-0-3.
Prerequisite(s): MGT 6000
An introduction to finance. Topics include time value of money, capital budgeting, risk and return, capital structure dividend policy, and working capital management.

MGT 6066. Corporate Restructuring
3-0-3.
Prerequisite(s): MGT 6060
This course seeks to give students an understanding of issues in corporate restructuring. Topics include valuation, mergers, acquisitions, spin-offs, financial distress, corporate governance, and high-leveraged transactions.

MGT 6067. Financial Aspects of Commercial Real Estate
3-0-3.
Prerequisite(s): MGT 6060
The course will examine commercial real estate assets from two perspectives: the unique nature of the financing and ownership structures and their role as an asset class in investment portfolios.

MGT 6070. International Finance
3-0-3.
Prerequisite(s): MGT 6060
Financial management in an international setting. Topics include: foreign exchange markets, exchange risk management, international portfolio investment, and foreign direct investments.

MGT 6071. Multinational Financial Management
3-0-3.
Prerequisite(s): MGT 6060
This course emphasizes decision making for the multinational firm amidst exchange rate fluctuations, differing tax structures across countries, and political risk via case discussion and analysis.

MGT 6078. Basic Finance and Investments
3-0-3.
An introduction to finance, including the fundamental concepts of financial accounting, corporate finance and portfolio optimization. This course emphasizes basic concepts related to both equities and fixed income securities. Credit not allowed for MGT 6078 and MGT 6080.

MGT 6080. Investments
3-0-3.
Prerequisite(s): MGT 6060
Introduction to securities markets and study of theory and practice of security analysis and portfolio management concepts as applied to equities and fixed-income securities. Credit not allowed for MGT 6078 and MGT 6080.

MGT 6081. Derivative Securities
3-0-3.
Prerequisite(s): MGT 6060
An introduction to options, futures, and swaps is provided. Concepts of arbitrage, index trading, and portfolio insurance are discussed.

MGT 6085. Entrepreneurial Finance
3-0-3
Prerequisite(s): MGT 6060
This course teaches future managers and entrepreneurs the financial perspectives in value creation.

MGT 6090. Management of Financial Institutions
3-0-3.
Prerequisite(s): MGT 6060
Introduction to the various risks faced by financial institutions and a detailed analysis of the tools used to manage these risks.

MGT 6100. Leadership and Organizational Behavior
3-0-3.
The focus of this course is on behavioral issues in the management of individual, team, and organizations' performance.

MGT 6101. Managing Human Resources
3-0-3.
An examination of the tools and procedures used by organizations to attract, select, and retain employees within the context of the legal and regulatory environment.

MGT 6106. Teamwork in Organizations
3-0-3.
Prerequisite(s): MGT 6100
The focus of the course is on understanding the use, management, and performance of teams and teamwork in organizational settings.

MGT 6107. Leadership and Organizational Change
3-0-3.
Prerequisite(s): MGT 6100
An examination of theories and practices for designing and implementing major organizational change and the role played by leadership, power, and influence in change process.

MGT 6109. Management Aspects of Advanced Manufacturing Technology
3-0-3.
Examines organizational and human resources management implications of advanced manufacturing technology. Focuses on key management choices that impact the successful implementation of the new technologies.

MGT 6110. Negotiation and Conflict Resolution
3-0-3.
Prerequisite(s): MGT 6100
This course covers the theory and process of negotiation and conflict resolution as it is practiced in different settings.

MGT 6111. Innovation and Entrepreneurial Behavior
3-0-3.
An examination of organizational policies, practices, and cultures that foster innovative and entrepreneurial behavior even in the context of large organizations.

MGT 6112. Managing Organizational Learning, Quality, and Business Process Improvement
3-0-3.
An examination of theories and methods used by organizations to achieve higher levels of product and service quality through improvements in learning and work processes.

MGT 6120. Financial Accounting
1.5-0-1.5.
Introductory course in accounting for business transactions in accordance with generally accepted accounting principles focusing on the use of financial statements by external decision makers.

MGT 6121. Managerial Accounting
1.5-0-1.5.
Introduction to management activities of planning, control, and decision making. Topics covered include cost calculation and behavior, performance evaluation, and relevant costs in special decision settings.

MGT 6122. Analytical Tools for Management
4-0-4.
An introductory course dealing with statistical and management science concepts for the fundamental concepts of statistical thinking, involving common statistical and modeling tools for the scientific analysis of data pertaining to different decision situations.

MGT 6123. Information Technology Management
2-0-2.
A study in understanding and managing information technology, strategic uses of IT, and electronic commerce.

MGT 6124. Legal Environment of Business
2-0-2.
This course involves an examination of laws, rules, and standards of regulation and conduct, guidelines, and systems of conflict resolution relating to business operations and administration.

MGT 6125. Strategic Management
2-0-2.
Designed to provide a view of business organizations, with the focus on the total enterprise – the industry and competitive environment in which the organization operates.

MGT 6126. Integrative Management Experience (IME)
1-0-1.
IME is a team-based and project-based course that requires students to draw on all core skills areas for successful completion.

MGT 6127. Business Communications
1-0-1.
Designed to improve verbal and written communication skills and the use of effective visuals for presentation through the understanding and application of a wide range of techniques.

MGT 6128. Business Ethics
1-0-1.
A participative class consisting of lectures by the instructor, case analysis, discussion of contemporary ethical business issues, and presentations by speakers.

MGT 6129. Financial Warnings
3-0-3.
The use of financial analysis techniques to detect improper accounting practices and operational problems with the objective of anticipating and avoiding negative earnings surprises.

MGT 6130. Managerial Economics
1.5-0-1.5.
This course is designed to provide students with an understanding of basic economic concepts and an ability to apply these concepts to business decision-making and public policy analysis.

MGT 6131. The Macroeconomic Environment of Business
1.5-0-1.5.
This course is designed to provide future managers with an understanding of the underpinnings of macroeconomic analysis, including an understanding of the policy debates over alternative macroeconomic issues.

MGT 6132. Financial Reporting and Analysis of Technology Firms
1.5-0-1.5.
An in-depth look at reporting standards for, and the financial characteristics of, technology firms with an emphasis on the financial analysis of such firms.

MGT 6165. Venture Creation
3-0-3.
Focuses on creating a new business venture. Requires completing a business plan, which describes and analyzes a proposed venture.

MGT 6176. Managing the Growing Firm
3-0-3.
This course examines the challenges associated with the successful management of growth. Models and theories of firm growth will be reviewed.

MGT 6184. International Trade/Export-Import Management
3-0-3.
An examination of U.S. trade policy, laws, and regulations as well as the mechanics of export and import management.

MGT 6185. International Business Environments
3-0-3.
This graduate course explores international, environmental factors impacting firms' globalizing operations. Factors covered range from economic, political, and legal, to socio-cultural and technology forces.

MGT 6195. Strategic Management
3-0-3.
This course examines the environmental and organizational factors that affect the performance of firms as well as the role of top managers in the organizational governance process.

MGT 6197. Global Strategic Management
3-0-3.
This course provides a forum for the in-depth examination of the managerial and organizational demands associated with effectively competing in global industries.

MGT 6198. Corporate Entrepreneurship for Global Competitiveness
3-0-3.
This course examines how strategic pioneering actions and innovation are used by organizations to renew themselves, their markets, and their industries.

MGT 6300. Marketing Management I
3-0-3.
This course focuses on the activities of managers who make the everyday decisions that guide the marketing of goods and services. Students take the principles that they learn and apply them directly to solving relevant case problems.

MGT 6302. Consumer Behavior
3-0-3.
This course exposes students to behavior science concepts and approaches in understanding and predicting the behavior of consumers.

MGT 6303. Sales Management
3-0-3.
Prerequisite(s): MGT 6300
Students will obtain an understanding of the management of the sales function. The importance of the marketing-sales interface will be stressed.

MGT 6305. Strategic Marketing
3-0-3.
Prerequisite(s): MGT 6300
Students will obtain an understanding of integration of marketing planning into the strategic planning process. Focuses on concepts that facilitate the development of a strategic plan.

MGT 6306. Business-to-Business Marketing
3-0-3.
Prerequisite(s): MGT 6300
This course studies the marketing of products or services for resale, for use in producing other goods and service operations of an enterprise.

MGT 6308. Strategic Brand Management
3-0-3.
Prerequisite(s): MGT 6300
This course teaches students about the importance of brands, and makes them knowledgeable about and able to apply instruments to create, monitor, and manage brands.

MGT 6310. Marketing Research: Qualitative Aspects
3-0-3.
A state-of-the-art course focusing on the qualitative aspects of marketing research. The course has a strong managerial orientation emphasizing applications in several areas including international marketing research.

MGT 6315. Marketing Analysis
3-0-3.
Prerequisite(s): MGT 6300 and MGT 6600
This course seeks to impart an understanding of the various applied multivariate techniques available for analyzing and interpreting marketing data.

MGT 6318. Marketing Technology
3-0-3.
Prerequisite(s): MGT 6600
This course deals with one of the biggest impacts of technological developments on marketing: customer data. It covers, techniques and terminology associated with database marketing and data mining.

MGT 6320. Building Implementable Market Response Models
3-0-3.
Knowing that a company can take actions that affect its own sales market response models can be used to aid in planning and forecasting. The models are estimated by regression techniques.

MGT 6325. Product Planning
3-0-3.
Prerequisite(s): MGT 6300
Examines issues inherent in product development and product management. These include product strategy, idea generation, market development, product positioning, test marketing, and launched brand management.

MGT 6326. Collaborative Product Development
3-0-3.
Examines issues inherent in product development and product management. These include product strategy, idea generation, market development, product positioning, test marketing, and launched brand management.

MGT 6335. International Marketing
3-0-3.
Students will obtain an understanding of marketing across national borders and cultures. The differences and similarities throughout marketing functions are explored.

MGT 6340. Electronic Commerce and Marketing
3-0-3.
This course examines the impact that the Internet is having on business-to-consumer and business-to-business marketing of goods and services, and considers appropriate corporate strategies.

MGT 6350. Operations Management
3-0-3.
Prerequisite(s): MGT 6600
This course focuses on the issues and techniques relevant to the management of the organization within and recognizing its strategic significance.

MGT 6351. Operations Resource Planning and Execution
3-0-3.
Prerequisite(s): MGT 6350
The management of material flows within an enterprise will be covered by tracking the evolution of operational planning and execution systems through the enterprise resource planning (ERP) framework.

MGT 6353. Operations Strategy
3-0-3.
Prerequisite(s): MGT 6350
This course provides knowledge about developing, implementing, and evaluating operations strategy. It stresses the relationships between the operations and other functions of the organization.

MGT 6357. Service Operations Management
3-0-3.
Prerequisite(s): MGT 6350
This course analyzes operational performance for the service sector and service support functions of manufacturers. Industries include information services, health care, banking, transportation, distribution, and retail.

MGT 6358. Quality Control and Improvement
3-0-3.
Prerequisite(s): MGT 6350
This course focuses on statistical process control, acceptance sampling, robust design, and other general methodologies for quality improvement.

MGT 6360. Global Operations and Supply Chain Management
3-0-3.
Prerequisite(s): MGT 6350
This course is designed to present issues critical to the globalization of operations, and addresses strategic and tactical issues pertaining to an organization's global operations and supply chain activities.

MGT 6362. Supply Chain Modeling and Revenue Management
3-0-3.
Prerequisite(s): MGT 6122
Focus on increasing profit by reducing cost and increasing revenue. Topics include forecasting, supply chain modeling using simulation, and revenue management.

MGT 6600. Analytical Tools for Decision Support
3-0-3.
Exposes students to the most commonly used statistical and optimization-based analytical tools for decision support. The knowledge of these tools enables the decision maker to make informed decisions based on the data available.

MGT 6753. Principles of Management for Engineers
3-0-3.
The course will provide an introduction to selected topics needed to be successful in the technology industries. Crosslisted with ME 6753.

MGT 6769. Fixed Income Securities
3-0-3.
Prerequisite(s): MATH 3215 or MATH 3225 and (MGT 6060 or MGT 6078)
Description, institutional features, and mathematical modeling of fixed-income securities. Use of both deterministic and stochastic models. Crosslisted with ISYE 6769 and MATH 6769.

MGT 6772. Managing Resources of the Technological Firm
3-0-3.
This course explores the competitive advantage manufacturing and service firms derive from effective management of their technology, workforce, materials, and information resources. Crosslisted with ISYE 6772.

MGT 6773. Strategic Management of Technology-Based Ventures
3-0-3.
This course provides a forum for the in-depth examination of issues involving the strategic management of high-tech corporate start-ups and small technology-based businesses. Crosslisted with ISYE 6773.

MGT 6774. Management of Technology Project
3-0-3.
This course organizes students into multidisciplinary teams devoted to solving a real problem for a technology-based firm. Crosslisted with ISYE 6774.

MGT 6775. Management of Technology Seminar
1-0-1.
This course introduces the frontiers of key technologies, provides a forum for visiting speakers from the corporate world, and supplements topics from other MOT courses. Crosslisted with ISYE 6775.

MGT 6777. Analysis of Emerging Technologies
3-0-3.
The course develops skills in the use of selected methods for technology monitoring, forecasting, and assessment. Also examines current status and prospects in selected emerging technology domains. Crosslisted with ISYE and PUBP 6777.

MGT 6780. Knowledge Management
3-0-3.
Prerequisite(s): MGT 6050
The purpose of this course is to enable students to think conceptually about the modern organization as a knowledge-based, information-processing organization. Crosslisted with PUBP 6780.

MGT 6785. The Practice of Quantitative and Computational Finance
3-0-3.
Case studies, visiting lecturers from financial institutions, student group projects of an advanced nature,and student reports, all centered around quantitative and computational finance. Crosslisted with ISYE and MATH 6785.

MGT 6789. Technology Ventures
3-0-3.
Team discussion and case studies in biomedical engineering technology transfer, including licensing, financial capital, safety and efficacy studies, clinical trials, and strategic planning. Crosslisted with BMED, ECE, CHE, and ME 6789.

MGT 6793. Advanced Topics in Quantitative and Computational Finance
3-0-3.
Advanced foundational material and analysis techniques in quantitative and computational finance.

MGT 6799. Legal Issues in Technology Transfer
3-0-3.
Study and analysis of U.S. law as it applies to the patenting and licensing processes. Crosslisted with BMED, CHE, ECE, and ME 6799.

MGT 6811. Integrative Management Analysis
3-0-3.
Integrates the functional areas of management, economics, with the external environment of businesses. Provides understanding of the current surroundings and pressures under which managers operate.

MGT 6813. Economic Analysis for Managers
3-0-3.
Economic reasoning and principles useful in understanding and solving managerial and public policy questions. Practice in analyzing major domestic and international economic events is included.

MGT 6814. Law, Management, and Economics
3-0-3.
Prerequisite(s): MGT 6100
The interrelationships among law, economics, and managerial decision making. Focuses on the legal and economic environments that impinge on the profit-seeking enterprises.

MGT 6820. Unstructured Managerial Problems
3-0-3.
Prerequisite(s): ECON 6100 and MGT 6813
Solving unstructured managerial problems. Emphasis is placed on understanding the behavioral and economic theories that impinge on the environment of the firm and affect managerial choice.

MGT 6901. Consulting
3-0-3.
Students work in teams for client firms in a consulting capacity. The client firms are preselected, but the problem definition is derived from client-team negotiations.

MGT 7000. Master's Thesis
Credit hours to be arranged.

MGT 7060. Theory of Finance
3-0-3.
This Ph.D. course is an introduction to theoretical financial economics. This course focuses on individuals' consumption and investment decisions under uncertainty and their implications on the valuation of securities.

MGT 7061. Empirical Finance
3-0-3.
This Ph.D. course is a survey of selected current empirical research topics in finance and related econometric issues.

MGT 7062. Corporate Restructuring
3-0-3.
This Ph.D. course is an analysis of empirical research in corporate finance with a focus on issues related to corporate restructuring.

MGT 7063. International Finance
3-0-3.
This Ph.D. course is an introduction to the foundations of modern international finance. Topics include: international portfolio diversification, design of country funds, tests of asset pricing, and international corporate finance.

MGT 7064. Microeconomics Theory for Management
3-0-3.
This course focuses on behavior of individual economic agents and how they interact to form markets. Topics include organizations, efficiency, and equilibria with incomplete information.

MGT 7101. Human Resources Management
3-0-3.
A Ph.D. course that covers an analysis of advanced practice, research, and theory in human resource management. Topics will vary by instructor and student interest.

MGT 7102. Organization Behavior Research Methods
3-0-3.
This Ph.D. course is an overview and analysis of research methodologies used in conducting scientific research of organizational behavior.

MGT 7105. Individual Behavior in Organizations
3-0-3.
This Ph.D. course is designed to investigate organizational behavior research topics at the individual level of analysis.

MGT 7106. Group Dynamics
3-0-3.
This Ph.D. course provides a fundamental understanding of group processes in organizations by analyzing and critiquing classic and contemporary theories and research on groups.

MGT 7107. Organizational Theory
3-0-3.
This Ph.D. course provides a review of contemporary organizational theories, and empirical studies of them to provide a framework to understand organizational structures, environments, and goals.

MGT 7305. Marketing Management and Strategy
3-0-3.
This Ph.D. course provides a survey of research and theory in the marketing management and strategy literature.

MGT 7306. Buyer Behavior
3-0-3.
Doctoral course in consumer behavior. Provides an introduction to the major theories in consumer behavior and discusses current research and methodology on theory development.

MGT 7307. Marketing Theory
3-0-3.
Doctoral course in marketing theory. Provides a perspective on philosophy of science and theory development, and evaluation in marketing.

MGT 7320. Marketing Science
3-0-3.
This doctoral course addresses the literature on the state-of-the-art research on quantitative approaches to marketing problems.

MGT 7350. Operations Strategy I
3-0-3.
This Ph.D. seminar will discuss research papers dealing with strategic issues in operations management.

MGT 7351. Operations Strategy II
3-0-3.
This Ph.D. seminar is a continuation of MGT 7350 and will deal with more advanced strategic issues in operations management.

MGT 7352. Operations Planning and Control I
3-0-3.
This doctoral seminar will discuss research papers dealing with tactical and operational (planning and control) issues in operations management.

MGT 7353. Operations Planning and Control II
3-0-3.
This doctoral seminar is a continuation of MGT 7352 and will discuss advanced papers dealing with tactical and operational (planning and control) issues in operations management.

MGT 7354. Research Methods in Operations Management
3-0-3.
This doctoral seminar will discuss papers dealing with research methods in operations management.

MGT 8803. Special Topics in Management
3-0-3.
Topics of current interest in the field of management.

MGT 8811, -12, -13. Special Topics
Class and credit hours equal last digit in course number.
Topics of current interest.

MGT 8853. Research Topics in Marketing
3-0-3.
Coverage of special research topics of current interest in marketing.

MGT 8863. Special Topics in Finance
3-0-3.
Special research topics of current interest in finance.

MGT 8873. Special Topics in Organizational Behavior
3-0-3.
Special research topics of interest in organizational behavior.

MGT 8883. Special Topics in Operations Management
3-0-3.
Special research topics of current interest in operations management.

MGT 8903. Special Problems in Management
Credit hours to be arranged.
Provides project work experience in the field of management.

MGT 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding graduate teaching assistantships.

MGT 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding graduate research assistantships.

MGT 9000. Doctoral Thesis
Credit hours to be arranged.

ACCOUNTING

ACCT 2101. Accounting I: Financial Accounting
3-0-3.
An introduction to the measurement and financial reporting of organizations and the interpretation of the resulting financial statements. Credit not allowed for MGT 3000 and ACCT 2101.

ACCT 2102. Accounting II: Managerial Accounting
3-0-3.
Prerequisite(s): ACCT 2101
The course deals with determining the costs of products and services and using cost information for planning and decision making. Credit not allowed for MGT 3000 and ACCT 2102.

INTERNATIONAL EXECUTIVE MASTER'S IN BUSINESS ADMINISTRATION

IMBA 6000. Strategic Decision Making and Compromise Game
1-0-1.
A multifirm, competitive management simulation. The objective is to sharpen intra-firm communications skills using the internet as the communications channel and the art of compromise.

IMBA 6010. Cross-cultural Communications for Management
2-0-2.
Participants learn tools and information to improve communications skills with new approaches and increased understanding while taking into account the effects of cross-cultural differences on communications.

IMBA 6020. Analytical Tools for International Business
3-0-3.
Widely used organization and simulation techniques that are useful for analyzing decision situations. Emphasis is placed on the application and use of theoretical knowledge.

IMBA 6030. Organizational Behavior and Theory
3-0-3.
Students learn the basic concepts and principles of organizational behavior and utilize such to analyze and solve organizational decision-making problems.

IMBA 6040. Economic Analysis of Decisions in a Global Economy
3-0-3.
Participants are provided with a non-traditional approach using an analytical method with a global perspective to the concepts and role of economics in the world environment.

IMBA 6050. Financial and Managerial Accounting
3-0-3.
Course covers financial reporting and analysis issues facing firms, and managerial accounting information necessary for planning, controlling, and decision making within such firms.

IMBA 6060. Information Systems for Management
3-0-3.
Students focus on managing the information technology function and make extensive use of cases to illustrate key IT decisions that need to be made by organizations.

IMBA 6070. Managerial Finance in World Markets
4-0-4.
A two-part course providing an understanding of finance concepts and how they are used. The course then further integrates international and ethical considerations wherever applicable.

IMBA 6080. Operations and Logistics Management
3-0-3.
Concepts and issues critical to the globalization of manufacturing and services operations.

IMBA 6090. Marketing and Consumer Behavior
3-0-3.
Students are provided with an understanding of marketing and consumer behavior concepts and tools with an international environment approach.

IMBA 6100. New Product Design and Marketing Research
1-0-1.
The interdisciplinary nature of product development and management, and market research. The students cover product issues that emerge during the product life cycle.

IMBA 6110. Risk Management and Technology Transfer
2-0-2.
A course based upon a combination of cases, historical data, and theoretical interpretation on the analysis and allocation of risk in international investment and technology transfer.

IMBA 6120. Human Resource Management
3-0-3.
Participants learn how to manage people to gain global competitive advantage and are exposed to international cases.

IMBA 6130. Strategy, Policy, and Planning
3-0-3.
Teaches the design and implementation of corporate business and functional strategies that will achieve sustainable competitive advantage in the international arena.

IMBA 6140. Comparative Management Systems
2-0-2.
This course utilizes case studies of companies in various industries and in national cultures to highlight organizational and cultural differences between major economies in the global environment.

IMBA 6150. Entrepreneurship and Entrepreneurial Firms
1-0-1.
Participants explore the increasing importance of small and medium-sized businesses and new ventures in international business.

IMBA 6160. National and International Regulation of Business
2-0-2.
Deals with learning how to control the legal aspects of international decisions.

IMBA 6170. Quality, Sustainable Technology, Competitiveness
1-0-1.
Students learn the philosophy and techniques of strategic quality management while focusing on assessment and group decisions centered on sustaining technology and competitiveness.

IMBA 6180. Leadership Skills and Processes
1-0-1.
Focuses on identifying and developing the attributes of successful leadership.

IMBA 6200. Strategic Business Simulation
2-0-2.
A unifying course providing a simulated application of the material taught in the core courses of the program.

IMBA 6210. Analysis of Emerging Technology
2-0-2.
A case-based course dealing with the role and impact of digital technology in large and small organizations, with special emphasis on multinational companies.

IMBA 6220. Applied Entrepreneurship Seminar
1-0-1.
A case course building an information bank of theory and practice on start-up enterprises. Several entrepreneurs will co-teach the course with a faculty leader.

IMBA 6230. International Business Negotiations
1-0-1.
A role-play course involving the complex international negotiations simulation dealing with an international business enterprise and its relationship with one or more governments.

EXECUTIVE MASTER OF SCIENCE IN THE MANAGEMENT OF TECHNOLOGY

MOT 6101. Frameworks for Managing Technology
1-0-1.
The sociotechnical aspects of organizations are examined, and participants' technological and people skills (communications, teamwork, conflict resolution) are enhanced.

MOT 6102. Economic Analysis for Managers
2-0-2
Studies the economic concepts that describe and explain the environment within which firms operate.

MOT 6103. Financial and Managerial Accounting
2-0-2.
Covers the basic concepts that underlie the use of accounting information. Includes balance sheet, income statement, alternative costing systems.

MOT 6104. Financial Management in an Environment of Technological Change
2-0-2.
Course focuses on financial concepts and how they are used to maximize the value of the firm and choose among alternative courses of action.

MOT 6105. Analytical Tools for Decision Support
2-0-2.
This course focuses on statistics and mathematical modeling of use to decision makers in technology environments with significant uncertainty.

MOT 6106. Processes of Technological Innovation
2-0-2.
This course addresses the processes involved in technological innovation, focusing on models, sources, flows, and the protection of innovation.

MOT 6107. Technology Strategies in Information Systems
2-0-2.
This course examines information systems and their impact in manufacturing and service operations.

MOT 6108. Concepts and Practice of Project Management and Quality Management
1-0-1.
This course introduces basic issues and techniques relevant to project and quality management.

MOT 6109. Managing People in a Technical Environment
2-0-2.
This course focuses on the management and leadership of people and human resource systems in modern organizations.

MOT 6110. Technology and Transformational Work Processes
2-0-2.
This course focuses on how work processes within organizations can be designed and managed to optimize output effectiveness.

MOT 6111. Organizational Transformation Methods
2-0-2.
This course introduces methods to adapt, evolve, or create change in the way organizations structure themselves to increase effectiveness in responding to competitive demands.

MOT 6112. Marketing in a Technical Environment
2-0-2.
This course focuses on the marketing function, its relationship to other functions within the firm, and its strategic significance to high-tech organizations.

MOT 6113. International Issues in the Management of Technology
2-0-2.
The impact of globalization on the management of technology is explored through a two-week study tour in Europe.

MOT 6114. Seminar in the Management of Technology
2-0-2.
This seminar features senior executives from organizations that develop or use technology discussing current practices, policies, and issues.

MOT 6115. Forecasting and Analysis of Emerging Technologies
2-0-2.
This course examines key emerging technologies, their development patterns, and the associated impact on industries, industrial competitiveness, and society.

MOT 6116. Strategy in Management of Technology
2-0-2.
This course examines and discusses how technology-based firms develop and implement business, functional, and technology strategies.

MOT 6120. Management of Technology Project I
2-0-2.
Participants develop and present a proposal for a technology-based research project of interest to them and of importance to their organization.

MOT 6121. Management of Technology Project II
2-0-2.
Participants execute their MOT project research proposals, including data collection and preliminary analysis.

MOT 6122. Management of Technology Project III
2-0-2.
Participants complete their MOT project research, submit a written report, and present their results to their organization.

College of Sciences

www.cos.gatech.edu

This version of the *General Catalog* was current as of the date of printing in May 2005. For the most up-to-date version, visit **www.catalog.gatech.edu**. In addition, this is the final printed version of the *General Catalog*. Beginning in May 2006 it will be available online only.

Dean–Gary B. Schuster; *Associate Deans*–E. Kent Barefield, Anderson D. Smith; Randall W. Engle, *College of Sciences Honors Program*; *Director of Development*–Philip Bonfiglio; *Director of Finance*– David L. Moore; *Director of Facilities*–Gerald E. O'Brien.

General Information

The College of Sciences comprises seven schools – Applied Physiology, Biology, Chemistry and Biochemistry, Earth and Atmospheric Sciences, Mathematics, Physics, and Psychology. All schools except Applied Physiology offer B.S., M.S., and Ph.D. degree programs. Applied Physiology offers an M.S. degree in prosthetics and orthotics. The Center for Education Integrating Science, Mathematics, and Computing (CEISMC), which works with K-12 schools and teachers in the state of Georgia to improve science and mathematics education, is also a unit of the College of Sciences.

The College of Sciences provides the courses in mathematics and the natural sciences that are necessary for all Tech undergraduates to acquire skills and basic principles for their majors. A detailed description of each degree program in the College of Sciences is located under the appropriate school heading, as are descriptions of the courses offered. College of Sciences' courses required or recommended by degree programs in the other five colleges at Georgia Tech are listed under the curricula for those degrees.

The College of Sciences currently offers minors in biology, earth and atmospheric sciences, and mathematics, along with a number of certificate programs that provide similar opportunities for students to develop their expertise or acquire skills or information in specific areas in addition to their major area. Students who satisfactorily complete a certificate program will receive a certificate of recognition from the department that offers the program. Certificate programs available in the College of Sciences are as follows:

(Certificate programs offered by the other colleges at Georgia Tech are also available to students in the College of Sciences.)

Certificate Programs in the College of Sciences

Applied Physiology
- Applied Physiology

Biology
- Environmental Biology
- Microbiology
- Molecular Biology/Genetics

Chemistry and Biochemistry
- Biochemistry/Organic Chemistry
- Chemical Analysis
- Physical/Inorganic Chemistry

Earth and Atmospheric Sciences
- Geochemistry
- Geophysics

Physics
- Applied Optics
- Atomic, Molecular, and Chemical Physics
- Computer-based Instrumentation

Psychology
- Biopsychology
- Cognitive Psychology
- Engineering Psychology
- Experimental Psychology
- Industrial/Organizational Psychology
- Social/Personality Psychology

School of Applied Physiology

www.ap.gatech.edu

Established in 2002 (formerly Department of Health and Performance Sciences, established 1990; and Physical Education and Recreation, established 1942)
Location: Weber/SST Building, Centennial Research Building
Telephone: 404.894.3986
Fax: 404.894.9982

Chair and Professor–Robert J. Gregor; *Associate Chair and Professor*–Phil Sparling; *Professor*–Mindy Millard-Stafford; *Associate Professor*–Thomas Burkholder, Stephen Sprigle; *Adjunct Associate Professor*–Nael McCarty; *Assistant Professors*–Jay Alberts, Edward Balog, Young-Hui Chang; *Research Associate II*–Linda Rosskopf; *Academic Professional*–Teresa Snow; *Director MSPO*–Chris Hourorka.

General Information

Faculty in the School of Applied Physiology are focused on understanding the science of movement, the physiological basis of movement control, and on instruction related to the importance of maintaining sound physiological systems. Our approach to these tasks involves every biological level utilizing both basic and applied sciences. For example, attempts to understand how molecules transmit signals in skeletal muscle have a foundation in basic molecular biology and ultimately relate to the applied science of movement control. Faculty interests range from the behavioral (Alberts, Sparling) to the systemic (Chang, Gregor, Sprigle, Millard-Stafford) to the molecular levels (Balog, Burkholder, McCarty). At the undergraduate level, the School instructs all Georgia Tech students in their health and wellness requirement and offers a Certificate in Applied Physiology addressing students' desire for basic medical science education. At the graduate level, the School recently developed a Focused Master's Program in Prosthetics and Orthotics. Together with units in the College of Engineering, the School offers cutting-edge instruction coupled with sound clinical training and a foundation in movement science. The MSPO program graduated its first class in 2004. A graduate program offering a Ph.D. in Applied Physiology is currently under review by the Board of Regents. The School is unique to the Georgia Tech community but founded in interdisciplinary teaching and research fundamental to the mission of the Institute.

The Health Sciences Requirement

All Georgia Tech students must satisfactorily complete the health and wellness requirement. The requirement consists of one two-hour course, HPS 1040, Health Concepts and Strategies. The School may grant credit to transfer students for comparable courses completed at other institutions. Students who have completed their health and wellness requirement are encouraged to elect additional courses of interest in health and movement science.

Other Applied Physiology (APPH) courses may be used as free electives or technical electives, if approved by the major school. Individual schools may allow up to three hours of courses to be counted toward degree requirements. Students should check the curricula of their individual schools to determine the number of hours they may apply toward the degree.

Certificate Program in Applied Physiology

The School of Applied Physiology offers a multidisciplinary certificate program in applied physiology. It is designed for students from any major who wish to broaden or supplement their educational experiences and career opportunities in areas related to the health sciences, human biology, bioengineering, or biomedical engineering. The certificate program is based in human anatomy, physiology, and human movement sciences, but allows students the flexibility to elect courses in specific areas of interest. Specific information regarding the certificate may be obtained by contacting the School Office, 113 Weber/SST building.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course. This section includes courses in Applied Physiology (APPH) and Health and Performance Sciences (HPS).

APPLIED PHYSIOLOGY

APPH 2698. Undergraduate Research Assistantship
Credit hours to be arranged. Independent research conducted under the guidance of a faculty member.

APPH 2699. Undergraduate Research
Credit hours to be arranged. Independent research conducted under the guidance of a faculty member.

APPH 3300. Health Promotion
3-0-3.
Prerequisite(s): HPS 1040 or HPS 1062 or HPS 1063 or HPS 1064
Through small group discussions and lectures, this class examines contemporary health issues facing college students and the theory and skill required to conduct health promotion activities.

APPH 3500. Nutrition and Health
2-0-2.
Prerequisite(s): HPS 1040 or HPS 1062 or HPS 1063 or HPS 1064
Study of human nutrition as an applied science. Nutrition physiology: metabolism, energy, production, biochemical aspect, role of nutrients, weight control mechanisms, and preventative nutrition in health management will be covered.

APPH 3751. Human Anatomy and Physiology
3-0-3.
Prerequisite(s): BIOL 1510 or CHEM 1310
The study of human anatomy and fundamental physiological mechanisms with concentration in skeletal, muscular, nervous, circulatory, respiratory, digestive, urinary, endocrine, and reproductive systems. Crosslisted with BIOL 3751.

APPH 3801, -02, -03, -04. Special Topics
Credit and class hours equal last digit in course number.
Topics of current interest in applied physiology.

APPH 3901, -02, -03, -04. Special Problems
Credit hours to be arranged.
Individual studies in applied physiology.

APPH 4100. Exercise Physiology
2-3-3.
Prerequisite(s): APPH 3751 or BIOL 3751
Physiology of human movement with emphasis on metabolic, cardiorespiratory, and musculoskeletal aspects; associated topics include body composition, thermoregulation, and ergogenic aids.

APPH 4200. Kinesiological Basis of Human Movement
2-3-3.
Prerequisite(s): BIOL 3751 or APPH 3751
Analysis of human movement from the broad perspectives of kinesiology, neural control, and human anatomy, to include the study of locomotion in both healthy and clinical populations; tasks and various movements of the upper extremities.

APPH 4600. Muscle Structure and Plasticity
3-0-3.
Prerequisite(s): BIOL 1510
To provide an in-depth understanding of the biological processes underlying skeletal muscle structure and function.

APPH 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

APPH 4699. Undergraduate Research
Credit hours to be arranged.
Independent research under the guidance of a faculty member.

APPH 6201. Biomechanics and Kinesiology in Prosthetics and Orthotics
3-0-3.
Mechanics of human movement applied to the study of artificial limbs and braces. Emphasis on neuromuscular control. Newtonian mechanics, kinematics, and kinetics.

APPH 6202. Clinical Gait Analysis
2-3-3.
Analysis of normal and pathological human locomotion. Study of theory and instrumentation for measurement of temporal and spatial kinematics and kinetics, electromyography, and plantar pressure.

APPH 6210. Clinical Pathology
3-0-3.
Systems level overview of human pathology with emphasis on the effect of disease on human movement and neuromechanical function.

APPH 6211. Systems Physiology I: Cellular Mechanisms of Plasticity
3-0-3.
The course will focus on adaptations of skeletal, muscular, and neural systems at the cellular level.

APPH 6212. Systems Physiology II: Physiology of Neuromotor Tissues
3-0-3.
Prerequisite(s): APPH 6211
The course will focus on function and adaptations of skeletal, muscular, and neural systems. Interactions among the various systems and their plasticity will be emphasized.

APPH 6213. Systems Physiology III: Integrated Systems and Adaptation
3-0-3.
Prerequisite(s): APPH 6212
The course will focus on integrative mechanism impacting motor system performance. Interactions among the various systems and their plasticity will be emphasized.

APPH 6223. CAD/CAM in Prosthetics and Orthotics Laboratory
0-3-1.
Theoretical and practical analysis of the application of computer-aided design and manufacturing to prosthetics and orthotics. Includes methods of digitization and multiple manufacturing processes.

APPH 6225. Biostatistics
3-0-3.
Introductory statistical principles and methods of experimental design, sampling, power estimation, and hypothesis testing using ANOVA and regression.

APPH 6230. Exercise Metabolism
3-0-3.
Prerequisite(s): APPH 6211 and APPH 6212
The course will focus on the biochemical pathways that provide fuel for the human body during rest and various levels of physical activity.

APPH 6231. Biomechanical Aspects of Human Motor Control
3-0-3.
The course will examine selected motor control problems that the nervous system faces in the process of managing this mechanical complexity.

APPH 6232. Locomotion Neuromechanics
3-0-3.
This is a course that will introduce topics on the biomechanical and neural aspects of the control of limbed locomotion and movement.

APPH 6233. The Aging Movement Control System
3-0-3.
The aim of this course is to review research literature dealing with the effects of advances in age on the CNS and motor performance.

APPH 6234. Physical Activity as a Human Behavior
3-0-3.
Focus is on understanding physical activity as a behavior using health behavior change models. An interdisciplinary perspective integrating research from the fields of epidemiology, physiology, and psychology.

APPH 6235. Mechanics and Pathomechanics of Movement Control
3-0-3.
This course is designed to understand the potential effects of selected disorders of the neuromuscular system on movement control.

APPH 6600. Muscle Structure and Plasticity
3-0-3.
Covers the biological processes underlying skeletal muscle structure and function, as well as rigorous mathematical models of those processes.

APPH 6897. Lower Limb Orthotics I
1-1-1.
This course is the first part in a two-course series and sets the essential elements of theory, technical design, and patient management.

APPH 6898. Lower Limb Orthotics
1-2-1.
Prerequisite(s): APPH 6897
This course is the second part in a two-part course series and applies more advanced elements for theory, technical design, and patient management.

APPH 6991. Upper Limb Prosthetics
1-3-2.
Clinical training for the practice of prosthetics emphasizing adult and pediatric upper extremity prostheses.

APPH 6992. Spinal Orthotics
1-3-2.
Clinical training for the practice of orthotics emphasizing adult and pediatric spinal orthoses.

APPH 6994. Upper Limb Orthotics
1-0-1.
Clinical training for the practice of orthotics emphasizing adult and pediatric upper extremity orthoses.

APPH 6995. Transtibial Prosthetics
1-3-2.
Clinical training for the practice of prosthetics emphasizing adult and pediatric transtibial (below knee) prostheses.

APPH 6996. Transfemoral Prosthetics
1-3-2.
Clinical training for the practice of prosthetics emphasizing adult and pediatric transfemoral (above knee) prostheses.

APPH 6997. Assistive Technology
1-0-1.
Theories and devices associated with assistive technology and mobility aids, emphasizing topics important to clinical practice in prosthetics and orthotics.

APPH 6999. Clinical Practicum in Prosthetics and Orthotics
Credit hours to be arranged.
Clinical observation of the practice of prosthetics and orthotics and related medical disciplines.

APPH 8000. Seminar
3-0-3.
The purpose of this course is for students to learn the research process from the early stage of identifying a question through publication of work.

APPH 8010. Seminar in Prosthetics and Orthotics
1-0-1.
A forum for graduate students in prosthetics and orthotics to present and discuss topics related to their research interests.

APPH 8011. Research Seminar
3-0-3.
A forum for graduate students in prosthetics and orthotics to present topics related to their research interests.

APPH 8801, -02, -03, -04. Special Topics
Credit and class hours equal last digit in course number.
Topics of special interest not covered in the regular course offerings.

APPH 8813, -23, -33. Special Topics
3-0-3.
Topics of current interest not covered in other courses.

APPH 8901, -02, -03, -04. Special Problems
Credit hours to be arranged.
Individual studies and/or experimental investigations of problems of current interest.

APPH 8997. Teaching Assistantship
Credit hours to be arranged.
This course is for students holding a graduate teaching assistantship.

APPH 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding research assistantships.

APPH 9000. Doctoral Thesis
Credit hours to be arranged.

HEALTH AND PERFORMANCE SCIENCES

HPS 1040. Health Concepts and Strategies
2-0-2.
Scientifically based and current medical information presented through lecture, laboratory, and self-directed study enabling increased knowledge, the development of strategies, and the promotion of self-responsibility for enhancing personal health.

School of Biology

www.gatech.edu/biology

Established in 1960
Location: Cherry Emerson Building
Telephone: 404.894.3700
Fax: 404.894.0519

Chair and Professor–John D. McDonald; *Georgia Research Alliance Eminent Scholar in Structural Biology and Professor*–Stephen Harvey; *Harry and Linda Teasley Chair in Environmental Biology and Professor*–Mark Hay; *Smithgall Chair in Molecular Cell Biology and Professor*–Alfred Merrill Jr.; *Regents' Professor*–Mark Borodovsky.
Professors–Thomas J. DiChristina, Joseph Montoya, Jerry Pullman, Terry W. Snell, Roger Wartell, Jeannette Yen.
Associate Professors–John Cairney, Yury Chernoff, Jung Choi, Paul Edmonds, Nael McCarty, Patricia Sobecky, Stephen Spiro, Marc Weissburg.
Assistant Professors–Michael Goodisman, Igor Jouline, John Kirby, Christopher Klausmeier, Julia Kubanek, Krill Lobachev, Harish Radhakrishna, Marion Sewer, Todd Streelman, Soojin Yi.
Adjunct Faculty–Leonid Bunimovich, Marc Frischer, Michael Keehan, Eugene Koonin, Frank Loeffler, Mindy Millard-Stafford, Valerie Paul, Peter Verity.

General Information

Programs of study offered by the School of Biology allow students to gain competence in several different areas of modern biological sciences. The curricula in all degree programs in the School encourage breadth by incorporating course selections from other schools and departments. The Institute, with its strengths in science, computing, mathematics, and engineering, provides unique opportunities for careers in the biological sciences and related areas.

The Bachelor of Science degree program consists of a combination of requirements and electives that ensure a balanced background in the fundamental areas of biology, while providing an opportunity to emphasize an area of interest in the junior and senior years. The School also offers graduate programs leading to the M.S. and Ph.D. degrees. The degree programs include coursework, faculty and student seminars, and independent research. Faculty members are actively engaged in research fields such as bioinformatics, biophysics, chemical ecology, microbiology, and molecular cell biology/genetics.

Undergraduate Program

The undergraduate curriculum for the Bachelor of Science in Biology degree is well suited to prepare students for employment in research and other technical positions; for graduate studies in the biological sciences; or for admission to medical, dental, veterinary, or other professional schools. The minimum number of total hours required for a bachelor's degree is 122. Most students also participate in faculty-directed research through undergraduate research courses, which may be used for technical elective credit. The School also offers a minor in biology, as well as certificate programs in environmental biology, microbiology, and molecular cell biology/genetics.

Bachelor of Science in Biology (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
BIOL 1510	BIOLOGICAL PRINCIPLES	4
CHEM 1310	GENERAL CHEMISTRY	4
TOTAL SEMESTER HOURS		15

First Year - Second Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II	4
BIOL 1520	INTRO. TO ORGANISMAL BIOLOGY	4
CHEM 1311	INORGANIC CHEMISTRY I	3
CHEM 1312	INORGANIC CHEMISTRY LAB I	1
TOTAL SEMESTER HOURS		15

Second Year - First Semester

Course Number/Name		*Hours*
BIOL 2344	GENETICS	3
BIOL 2400	MATHEMATICAL MODELS IN BIOLOGY	3
CHEM 2311	ORGANIC CHEMISTRY I	3
COMPUTING REQUIREMENT		3
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Second Year - Second Semester

Course Number/Name		*Hours*
BIOL 2335	GENERAL ECOLOGY	3
BIOL 2336	GENERAL ECOLOGY LAB*	1
BIOL 3600	INTRO. TO EVOLUTION	3
PHYS 2211	INTRODUCTORY PHYSICS I	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
FREE ELECTIVE(S)		2
TOTAL SEMESTER HOURS		16

Third Year - First Semester

Course Number/Name		*Hours*
BIOL 3340	CELL BIOLOGY	3
BIOL 3341	CELL BIOLOGY LAB*	1
CHEM 2312	ORGANIC CHEMISTRY II	3
CHEM 2380	SYNTHESIS LAB I	2
PHYS 2212	INTRODUCTORY PHYSICS II	4
WELLNESS		2
TOTAL SEMESTER HOURS		15

Third Year - Second Semester

Course Number/Name	*Hours*
BIOLOGY ELECTIVE(S)	9
FREE ELECTIVE(S)	3
SOCIAL SCIENCE ELECTIVE(S)	3
TOTAL SEMESTER HOURS	15

Fourth Year - First Semester

Course Number/Name	*Hours*
RESEARCH REQUIREMENT (Honors Thesis BIOL 4910 or Project Lab 4290, 4390 or 4490)	3
BIOLOGY ELECTIVE(S)	6
FREE ELECTIVE(S)	3
SOCIAL SCIENCE ELECTIVE(S)	3
TOTAL SEMESTER HOURS	15

Fourth Year - Second Semester

Course Number/Name		*Hours*
BIOL 4450	SENIOR SEMINAR	1
BIOLOGY ELECTIVE(S)		6
FREE ELECTIVE(S)		3
SOCIAL SCIENCE ELECTIVE(S)		3
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

* BIOL 2345 (Genetics Lab) may substitute for either of these courses.

Bachelor of Science in Biology – Business Option (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
BIOL 1510	BIOLOGICAL PRINCIPLES	4
CHEM 1310	GENERAL CHEMISTRY	4
TOTAL SEMESTER HOURS		15

First Year - Second Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II	4
BIOL 1520	INTRO. TO ORGANISMAL BIOLOGY	4
CHEM 1311	INORGANIC CHEMISTRY I	3
CHEM 1312	INORGANIC CHEMISTRY LAB I	1
TOTAL SEMESTER HOURS		15

Second Year - First Semester

Course Number/Name		*Hours*
BIOL 2344	GENETICS	3
BIOL 2400	MATHEMATICAL MODELS IN BIOLOGY	3
CHEM 2311	ORGANIC CHEMISTRY I	3
COMPUTING REQUIREMENT		3
ECON 2106	PRINCIPLES OF ECONOMICS	3
TOTAL SEMESTER HOURS		15

Second Year - Second Semester

Course Number/Name		*Hours*
BIOL 2335	GENERAL ECOLOGY	3
BIOL 2336	GENERAL ECOLOGY LAB*	1
BIOL 3600	INTRO. TO EVOLUTION	3
PHYS 2211	INTRODUCTORY PHYSICS I	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
FREE ELECTIVE(S)		2
TOTAL SEMESTER HOURS		16

Third Year - First Semester

Course Number/Name		*Hours*
BIOL 3340	CELL BIOLOGY	3
BIOL 3341	CELL BIOLOGY LAB*	1
CHEM 2312	ORGANIC CHEMISTRY II	3
CHEM 2380	SYNTHESIS LAB I	2
PHYS 2212	INTRODUCTORY PHYSICS II	4
WELLNESS		2
TOTAL SEMESTER HOURS		15

Third Year - Second Semester

Course Number/Name		*Hours*
BIOLOGY ELECTIVE(S)		6
PSYCH 2220	INDUSTRIAL/ORGANIZATIONAL PSYCHOLOGY	3
MGT 3000	ACCOUNTING	3
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Fourth Year - First Semester

Course Number/Name		*Hours*
RESEARCH REQUIREMENT (Honors Thesis BIOL 4910 or Project Lab 4290, 4390, or 4490)		3
BIOLOGY ELECTIVE(S)		6
HUMANITIES ELECTIVE(S)		3
MGT 3300	MARKETING	3
TOTAL SEMESTER HOURS		15

Fourth Year - Second Semester

Course Number/Name		*Hours*
BIOL 4450	SENIOR SEMINAR	1
BIOLOGY ELECTIVE(S)		5
MANAGEMENT ELECTIVE (3062, 3150, 3076, 4191, or 4660)		3
SOCIAL SCIENCE ELECTIVE(S)		3
HUMANITIES ELECTIVE(S)		3
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

* BIOL 2345 (Genetics Lab) may substitute for either of these courses.

Computing Requirement

Students must complete either CS 1315, CS 1321, or a computer programming course approved as satisfying the general education requirements in computer literacy.

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Bachelor of Science in Biology – Business Option

The curriculum and suggested course schedule for the B.S. in Biology – Business Option are similar to the one described previously, with the following exceptions. Students take PSYC 2220 (Industrial/ Organizational Psychology) and ECON 2106 (Principles of Economics) in partial fulfillment of social science electives in the second and third years. In the third and/or fourth years, students must take MGT 3000 (Accounting) and MGT 3300 (Marketing). One additional management elective course is taken from a list that includes MGT 3062, 3150, 3076, 4191, and 4660. Biology majors in this option still select a project lab course or Honors Thesis, fifteen hours of Biology technical electives, and eight hours of free electives.

Electives

Humanities and Social Sciences Electives
See "Core Curriculum," Information for Undergraduate Students, pages 35-36, for lists of approved courses. All students are required to take one course from HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200 to satisfy state requirements regarding the history and Constitutions of the United States and Georgia; an additional nine hours of social sciences; and six hours of humanities.

Technical and Free Electives

Technical electives: Twenty-one hours must be earned in courses chosen from a list approved by the School of Biology (available in the School of Biology's main office). The list includes upper-level biology courses, up to four hours of Special Problems research experience, as well as courses in other schools. Courses must be taken for a letter grade.

Free electives: The remaining eleven hours beyond courses required for humanities, social sciences, and physical education are free electives and may be taken on a pass/fail basis to the extent allowed under the catalog "Rules and Regulations" section.

Minor and Certificate Programs

A minor in biology is available to all non-biology majors. The minor program provides a concentration in modern biological sciences and is especially valuable for students considering biomedical or environmental fields. The basic requirement is eighteen semester hours in biology, of which twelve hours must be at the 3000 level or higher. Further information is available from the School's undergraduate coordinator.

Certificate programs are available in Molecular Biology/Genetics, Environmental Biology, and Microbiology/Microbial Technology. A certificate requires a minimum of twelve hours in biology, at least nine of which must be at the 3000 level or higher. Courses required by name and number in a student's major program of study shall not be counted toward the certificate. Further information is available from the undergraduate coordinator in the School of Biology.

Graduate Programs

The School of Biology provides advanced training and research opportunities in various aspects of systems biology, ranging from molecular biology to ecology. Some current research areas include genomic sequence analysis, mechanisms of gene expression and DNA replication, evolutionary mechanisms, sphingolipids and metabolomics, signal transduction in plant and animal cells, environmental microbiology, bioremediation, sensory mechanisms in small animals, biological oceanography, ecosystem toxicology, and theoretical ecology.

Master of Science in Bioinformatics

This is a three-semester focused professional master's degree program combining thirty-seven semester hours of courses in computer science, advanced molecular biology and biochemistry, statistics, and bioinformatics. A full-time summer internship in a corporate or academic bioinformatics group is an essential part of the curriculum. With input and assistance from corporate partners, the program is geared to training and placing graduates into lucrative jobs in the high-demand specialty field of bioinformatics. More information is available from the coordinator of the M.S. bioinformatics program.

Master of Science

The requirements for the M.S. degree are a research thesis and thirty semester hours of coursework, which includes twelve credit hours in a major field. Twelve of the semester hours must be in formal graduate-level courses. The thesis must be defended in an oral examination. A non-thesis master's degree is available for students unable to carry out a thesis project; information on its requirements is available from the graduate coordinator in the School of Biology.

Doctor of Philosophy

Each Ph.D. student must acquire a thorough knowledge of a selected area of specialization, a broad knowledge of the field, and competence in the basic sciences. The main emphasis is on the successful completion of an original and independent research project. Credit hour requirements total forty, including twelve research credit hours and nine credit hours in an approved minor. Admission to candidacy requires passing a written comprehensive examination and an oral exam based on a written research proposal. Each Ph.D. student must write a comprehensive dissertation based on the student's scholarly research.

Additional information on the graduate program is available from the graduate coordinator in the School of Biology.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

BIOLOGY

BIOL 1510. Biological Principles
3-3-4.
An introduction to the basic principles of modern biology, including biomacromolecules, bioenergetics, cell structure, genetics, homeostasis, evolution, and ecological relationships.

BIOL 1511. Honors Biological Principles
3-3-4.
Prerequisite(s): AP20 4
An advanced introduction to the principles of modern biology, including biomacromolecules, bioenergetics, cell structure, genetics, homeostasis, evolution, and ecological relationships.

BIOL 1520. Introduction to Organismal Biology
3-3-4.
An introduction to biology at the organ and organismal levels, with emphasis on physiological processes and integration of growth and development.

BIOL 1521. Honors Introduction to Organismal Biology
3-3-4.
Prerequisite(s): AP20 4
Introduction to biology at the organ and organismal levels, with emphasis on biodiversity, physiological processes, and integration of growth, reproduction, and development.

BIOL 2335. General Ecology
3-0-3.
Prerequisite(s): BIOL 1520
Introduction to ecological process at individual, population, and community levels that occur in plant, animal, and microbial taxa, and their relevance to current environmental problems.

BIOL 2336. General Ecology Laboratory
0-3-1.
Prerequisite(s): BIOL 1520
Co-requisite: BIOL 2335.
The companion laboratory for BIOL 2335 (Ecology). This course stresses understanding ecological concepts through a combination of lab and field experiments, and computer simulations.

BIOL 2344. Genetics
3-0-3.
Prerequisite(s): BIOL 1510 or BIOL 1511
Mendelian and molecular genetics; principles of inheritance, gene structure and function, foundations of recombinant DNA technology, genetic basis of variation and evolution.

BIOL 2345. Genetics Laboratory
0-3-1.
Prerequisite(s): BIOL 1510 or BIOL 1511
Co-requisite: BIOL 2344.
A laboratory course in the fundamental techniques of genetic analysis.

BIOL 2400. Mathematical Models in Biology
3-0-3.
Prerequisite(s): MATH 1502
Introductory probability and deterministic models in biology, including discrete and continuous probability distributions and dynamic models from molecular and cellular biology to ecology and epidemiology.

BIOL 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

BIOL 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

BIOL 2801, -02, -03, -04, -05. Special Topics
Credit and class hours equal last digit in course number. This designation enables the School of Biology to provide new lecture courses dealing with areas of current interest in biological sciences.

BIOL 2811, -12, -13, -14, -15. Special Topics
Credit and class hours equal last digit in course number. This designation enables the School of Biology to provide new lecture courses dealing with areas of current interest in biological sciences.

BIOL 2901, -02, -03, -04, -05. Special Problems
Credit hours to be arranged.
Research problems in biology under the supervision of a faculty member.

BIOL 3300. Tropical Ecology
1-6-3.
Prerequisite(s): BIOL 1510
Ecological processes in the tropics including community organizations, biotic interactions, biodiversity, coevolution. Students perform research projects in rain forest, cloud forest and seashore.

BIOL 3332. Statistical and Mathematical Biology
3-3-4.
Prerequisite(s): MATH 1502 or MATH 1512 or (MATH 1X2 and MATH 1522)
An introduction to statistical methods and their applications in the preparation and interpretation of biological experiments. Laboratory sessions emphasize numerical problem solving.

BIOL 3340. Cell Biology
3-0-3.
Prerequisite(s): BIOL 1510 and BIOL 1520
An introduction to the structure and function of cells and their organelles with emphasis on eucaryotic cellular processes.

BIOL 3341. Cell Biology Laboratory
0-3-1.
Prerequisite(s): BIOL 1510 and BIOL 1520
Co-requisite: BIOL 3340.
An introduction to experimental methods of cell biology research that will cover some fundamental topics of cell biology.

BIOL 3380. Introductory Microbiology
3-0-3.
Prerequisite(s): (BIOL 1510 or BIOL 1511) and (BIOL 1520 or BIOL 1521)
Basic biology of bacteria, fungi, algae, and viruses, with emphasis on bacteriology.

BIOL 3381. Introductory Microbiology Laboratory
0-3-1.
Prerequisite(s): (BIOL 1510 or BIOL 1511) and (BIOL 1520 or BIOL 1521)
Co-requisite: BIOL 3380.
Fundamental laboratory techniques in microbiology.

BIOL 3600. Introduction to Evolutionary Biology
3-0-3.
Prerequisite(s): (BIOL 1510 or BIOL 1511) and BIOL 2344
Comprehensive introduction to evolutionary biology. Includes focus on processes (natural selection, genetic drift) and resulting patterns (genome organization, phylogeny) illustrated with prokaryote and eukaryote examples.

BIOL 3751. Human Anatomy and Physiology
3-0-3.
Study of human anatomy and fundamental physiological mechanisms. Topics include nervous, musculoskeletal, and cardiorespiratory systems. Free elective for biology majors. Cross-listed with AP 3751.

BIOL 3813. Special Topics
3-0-3.
Topics of current interest not covered in other courses in the department.

BIOL 4010. Aquatic Ecology
4-0-3.
Prerequisite(s): BIOL 2335
Physics, chemistry, and ecology of aquatic communities and ecosystems. Physical, chemical, and biological investigations of lakes, streams, and estuaries.

BIOL 4101. Sensory Ecology
3-0-3.
Prerequisite(s): BIOL 2335
A quantitative analyses of communication channels and information acquisition involving visual, auditory, mechanosensory, and olfactory modalities across a range of species and habitats.

BIOL 4221. Biological Oceanography
3-0-3.
Prerequisite(s): BIOL 1510 and BIOL 1520
An introduction to the major biological processes in the ocean including primary production, elemental cycling, food webs, and fisheries.

BIOL 4290. Recombinant DNA Project Laboratory
1-6-3.
Prerequisite(s): BIOL 2344 and BIOL 2345
Project lab focused on the methods of recombinant DNA technology, including preparation and cloning of DNA, PCR amplification, and biochemical methods of analysis.

BIOL 4340. Medical Microbiology
3-0-3.
Prerequisite(s): BIOL 3380 and BIOL 3381
Advanced study of bacteria, protoza, fungi, and viruses that cause human diseases; emphasis on epidemiology, mechanisms of disease causation, prevention, and treatment.

BIOL 4390. Microbiology Project Laboratory
1-6-3.
Prerequisite(s): BIOL 3380 and BIOL 3381
This project lab involves investigations on the physiology of growth and metabolic activities of microorganisms.

BIOL 4400. Experimental Design and Statistical Methods in Biology
3-3-4.
Prerequisite(s): BIOL 2400 and (ISYE 2028 or MATH 3215 or PSYC 2020)
Introductory course on experimental design, hypothesis testing and basic statistical techniques commonly applied in biological research. Laboratory exercises based on computer statistical software packages.

BIOL 4410. Microbial Ecology
3-0-3.
Prerequisite(s): BIOL 2335 and BIOL 3380 and BIOL 3381
Advanced studies of microbial ecosystems, the specific roles of bacteria in maintaining ecological balance, and the evolution of the ecosystem in response to changing environments.

BIOL 4418. Microbial Physiology
3-0-3.
Prerequisite(s): BIOL 2335 and BIOL 3380 and BIOL 3381
Study of the physiology of growth and metabolic activities of microorganisms.

BIOL 4422. Theoretical Ecology
3-0-3.
Prerequisite(s): BIOL 2335 and MATH 1502
Theoretical foundations of ecology, from the population to the community and ecosystem levels.

BIOL 4430. Environmental Sustainability
3-0-3.
Prerequisite(s): BIOL 1510 and BIOL 1520 and CHEM 1311
A general survey of the responses of biological systems to various kinds of radiation and air or water pollution.

BIOL 4440. Plant Physiology
3-0-3.
Prerequisite(s): BIOL 3331 and CHEM 2312
Chemical transformation in photosynthesis, photophysiology and water relationships, organic nutrition and effects of hormones on growth and development of plants.

BIOL 4442. Plant Physiology Laboratory
0-6-2.
Prerequisite(s): BIOL 3331 and CHEM 2312
Experiments designed to familiarize students with current methods used in plant physiology and plant molecular biology. One or more weekend trips are usually included.

BIOL 4446. Animal Physiology
3-0-3.
Prerequisite(s): BIOL 3331
Systems physiology including nerves, muscles, kidney, digestion, circulation, endocrinology, reproduction, and respiration.

BIOL 4450. Senior Seminar
1-0-1.
Senior students present seminars on recent research topics based on their own research experience and/or literature research.

BIOL 4464. Developmental Biology
3-0-3.
Prerequisite(s): BIOL 2344 and BIOL 2345
Investigations of cell differentiation and development using the tools of molecular genetics and cell biology.

BIOL 4471. Behavioral Biology
3-0-3.
Prerequisite(s): BIOL 1510 and (MATH 1502 or MATH 1512) or (MATH 15X2 and MATH 1522) and PHYS 2212
An introduction to the study of the principles of behavior of all kinds of organisms, from microbes to mammals.

BIOL 4478. Biophysics
3-0-3.
Prerequisite(s): BIOL 1510 and PHYS 2212
Biophysical aspects of nucleic acids, proteins, and their interactions.

BIOL 4490. Ecology Project Laboratory
1-6-3.
Prerequisite(s): BIOL 2335
This project lab is an introduction to the analytical techniques and physical and chemical methods useful in modern ecological studies.

BIOL 4570. Immunology and Immunochemistry
3-0-3.
Prerequisite(s): BIOL 3331 and BIOL 2344 and BIOL 2345
A survey of modern immunology and its applications.

BIOL 4571. Immunochemistry Laboratory
0-3-1.
Co-requisite: BIOL 4570.
Laboratory techniques in immunology and immunochemistry.

BIOL 4600. Evolution
3-0-3.
Prerequisite(s): BIOL 2335 and BIOL 2344 and BIOL 2345
Basic evolutionary biology including adaptation and evolution, evolution of species and higher taxa, molecular evolution, evolution of developmental systems, life history traits, and sexual reproduction.

BIOL 4608. Prokaryotic Molecular Genetics
3-0-3.
Prerequisite(s): BIOL 2344
The molecular genetics of bacteria and their viruses, with emphasis in the organization, replication, expression, transfer and experimental manipulation of prokaryotic genes and genomes. Credit not allowed for both BIOL 4220 and BIOL 4608.

BIOL 4668. Eukaryotic Molecular Genetics
3-0-3.
Prerequisite(s): BIOL 2344
Topics in molecular genetics, including genetic engineering techniques, gene expression and regulation, genetic structure, stability and evolution, with emphasis on eukaryotic organisms.

BIOL 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

BIOL 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

BIOL 4746. Signaling Molecules
3-0-3.
Prerequisite(s): CHEM 2311
The diversity of chemical signals between organisms and their structural specifications will be presented along with chemical and biological methods for isolating signaling molecules.

BIOL 4755. Mathematical Biology
3-0-3.
Prerequisite(s): CS 1321 and BIOL 3332 and (MATH 1502 or MATH 1512) or (MATH 15X2 and MATH 1522)
An introduction to practical applications of mathematical models to help unravel the underlying mechanisms involved in biological processes. Crosslisted with MATH 4755.

BIOL 4801, -02, -03, -04, -05. Special Topics
Credit and class hours equal last digit in course number. This designation enables the School of Biology to provide new lecture courses dealing with areas of current interest in biological science.

BIOL 4901, -02, -03, -04, -05. Special Problems
Credit hours to be arranged.
Research problem in biology under supervision of a faculty member. To be offered any term with credit to be arranged. Seven hours (four hours technical electives plus three hours free electives) are the maximum credits allowed toward the Bachelor of Science in Biology degree.

BIOL 4910. Honors Undergraduate Research Thesis
0-9-3.
Prerequisite(s): (BIOL 4901 or BIOL 4902) and (BIOL 2698 or BIOL 2699 or BIOL 4698 or BIOL 4699)
Co-requisite: BIOL 4450.
Writing and submission of an Undergraduate Research Thesis describing research accomplishments with a biology faculty member.

BIOL 6180. Biological Applications of Environmental Fluid Mechanics Laboratory
0-3-1.
Co-requisite: BIOL 7101.
Provides students with hands-on experimental demonstrations of the basic principles of environmental fluid mechanics regarding chemical and hydrodynamic signals produced and sensed by organisms.

BIOL 6221. Biological Oceanography
3-0-3.
Prerequisite(s): BIOL 1510 and BIOL 1520
An introduction to the major biological processes in the ocean, including primary production, elemental cycling, food webs, and fisheries.

BIOL 6410. Microbial Ecology
3-0-3.
Prerequisite(s): BIOL 3380 and BIOL 3381
Advanced studies of microbial ecosystems, the specific roles of bacteria in maintaining ecological balance, and the evolution of the ecosystem in response to changing environments.

BIOL 6417. Marine Ecology
3-0-3.
Prerequisite(s): BIOL 2335
An overview of the ecological and evolutionary patterns, processes, and mechanisms affecting the organization, structure, and function of a broad variety of marine communities.

BIOL 6418. Microbial Physiology
3-0-3.
Prerequisite(s): BIOL 3380 and BIOL 3381
Study of the physiology of growth and metabolic activities of microorganisms.

BIOL 6422. Theoretical Ecology
3-0-3.
Prerequisite(s): BIOL 2335 and MATH 1502
Theoretical foundations of ecology, from the population to the community and ecosystem levels.

BIOL 6570. Immunology
4-0-4.
Prerequisite(s): BIOL 2344 and BIOL 2345 and BIOL 3331
A survey of modern immunology and its applications, with emphasis on immunological methods used in molecular and cell biological research.

BIOL 6600. Evolution
3-0-3.
Prerequisite(s): BIOL 2335 and BIOL 2344 and BIOL 2345
An introduction to evolutionary patterns and processes, including the history of life, phylogenetics, population genetics, quantitative genetics, molecular evolution, and other important topics in evolutionary biology.

BIOL 6608. Prokaryotic Molecular Genetics
3-0-3.
Prerequisite(s): BIOL 2344 and BIOL 2345
Molecular mechanisms of bacterial and plasmid genetic processes. Topics covered include genome organization, DNA replication, transcription, and translation.

BIOL 6611. Advanced Microbial Physiology
3-0-3.
Prerequisite(s): BIOL 4418 and CHEM 4511
Advanced studies of selected aspects of the physiology of prokaryotic and eukaryotic microorganisms.

BIOL 6612. Advanced Bacterial Metabolism
3-0-3.
Prerequisite(s): BIOL 6611
A study of microbial chemistry with emphasis on catabolic events.

BIOL 6620. Aquatic Chemical Ecology
3-0-3.
The course focuses on understanding the chemical mechanisms of aquatic signaling and the cascading effects on population regulation, community organization, and ecosystem function.

BIOL 6621. Aquatic Chemical Ecology Laboratory
0-3-1.
Laboratory approaches to testing hypotheses of aquatic chemical ecology will be applied to theory and methods from Aquatic Chemical Ecology (BIOL 6620) and Discovery of Signaling Molecules (BIOL/CEE/CHEM 6756).

BIOL 6623. Experiments in Aquatic Chemical Signaling
2-12-6.
A full-time commitment to student-originated, but faculty-guided, interdisciplinary research in aquatic chemical signaling using field, lab, and flume facilities at Skidaway Institution of Oceanography on the coast.

BIOL 6626. Physiological Ecology
3-0-3.
Prerequisite(s): BIOL 4010
Study of the basic physiological processes and systems in vertebrates and invertebrates. Comparative study on how these systems are adapted for specific environments and functions.

BIOL 6628. Aquatic Toxicology
3-0-3.
Prerequisite(s): BIOL 4010
Study of the biological effects of toxicants on aquatic organisms-mechanisms of toxicity, biotransformation, toxicity tests, ecological risk assessment.

BIOL 6630. Advanced Microbial Ecology
3-0-3.
Prerequisite(s): BIOL 4010
Advanced studies of selected aspects of the ecology of prokaryotic and eukaryotic organisms.

BIOL 6756. Discovery of Signaling Molecules
3-0-3.
Prerequisite(s): CHEM 2311
The diversity of chemical signals between organisms and their structural specificities will be presented along with chemical and biological methods for isolating signaling molecules. Crosslisted with CEE 6756 and CHEM 6756.

BIOL 6764. Biological Applications of Environmental Fluid Mechanics Laboratory
0-3-1.
Co-requisite: BIOL 7101. Co-requisite: CEE 6263.
Provides students with hands-on experimental demonstrations of the basic principles of environmental fluid mechanics regarding chemical and hydrodynamic signals produced and sensed by organisms. Crosslisted with CEE 6764.

BIOL 6765. Geomicrobiology
3-0-3.
Prerequisite(s): (BIOL 4410 or BIOL 4418) and EAS 3620
Interactions between microorganisms and the geosphere, microbial energetics and genetics; geochemical controls on microbial diversity and activity. Crosslisted with EAS 6765.

BIOL 7000. Master's Thesis
Credit hours to be arranged.

BIOL 7001. Foundations in Molecular and Cell Biology
4-0-4.
The goal of this course is to provide new students with fundamental knowledge in the general areas of prokaryotic and eukaryotic molecular biology, biochemistry, structural biology, and bioinformatics.

BIOL 7010. Advanced Cell Biology
3-0-3.
Prerequisite(s): BIOL 3331
Current topics in eukaryotic cell biology including membrane functions, intracellular sorting and compartmentalization, cell signaling, cell cycle, cytoskeleton, cell adhesion, motility, and current experimental approaches.

BIOL 7023. Bioinformatics
2-3-3.
Prerequisite(s): MATH 3215 or MATH 3225
Introduction to mathematical, statistical, and computer methods of nucleic acid and protein sequence analysis and interpretation. Algorithms for gene finding, protein structure and function prediction, constructing phylogenetic trees.

BIOL 7101. Advanced Sensory Ecology
3-0-3.
A quantitative analysis of how organisms of all kinds obtain information about their environment, and how they use it to guide locomotion.

BIOL 7668. Eukaryotic Molecular Genetics
3-0-3.
Topics in molecular genetics of eukaryotic organisms, including: gene structure and expression, protein processing and folding, genome stability, and molecular evolution.

BIOL 7670. Advances in Biomolecular Separation Techniques
3-0-3.
Introduction to modern biomolecular separation methods. Topics include theory of chromatography, discussion of chromatography and electrophoretic techniques for protein, nucleic acid separations, and other biological substances.

BIOL 7913. Advances in Microbiology
2-0-2.
Topics of current interest in microbial physiology, applied microbiology, microbial ecology, and medical microbiology.

BIOL 7914. Advances in Bacteriology
2-0-2.
Topics of current interest in the physiology and ecology of bacteria and applications to practical problems.

BIOL 7923. Advances in Ecology
2-0-2.
Topics of current interest in the general areas of population growth and limitation, and the structure and stability of ecosystems.

BIOL 7924. Advances in Environmental Biology
2-0-2.
Topics of current interest in environmental biology.

BIOL 7963. Advances in Molecular Biology
2-0-2.
Topics of current interest in molecular biology.

BIOL 7964. Advances in Genetics
2-0-2.
Topics of current interest in genetics.

BIOL 8000. Integrative Biology Seminar
2-0-2.
A reading and discussion course structured around the School of Biology weekly seminar.

BIOL 8001. Seminar
2-0-2.
Presentation of research seminar.

BIOL 8005. Signals in the Sea Seminar
2-0-2.
Students and invited authorities in the field will present seminars and lead discussions focused on currently emerging topics in aquatic chemical ecology and signaling.

BIOL 8006. Integrative Approaches to Biological Systems
2-0-2.
This course will investigate, using samples from the literature and faculty research, the general principles of biological systems, from gene expression circuits to ecological communities.

BIOL 8101. Introduction to Research, Biology Instrumentation, and Safety
2-0-2.
Introduction to biology faculty research, explanation and demonstration of biology instrumentation and laboratory safety.

BIOL 8106. Tools of Science Seminar
2-0-2.
This course addresses issues important to all successful scientists and engineers such as: research ethics; collaborations between industry, academics, and government; women and minorities in science; balancing research, teaching and service; writing, editing, and reviewing presentations; job interviews; time management; speaking to the public and media; and scientific and university politics.

BIOL 8801, -02, -03, -04, -05. Special Topics
Credit and class hours equal last digit in course number.
New graduate lecture courses in areas of current interest.

BIOL 8901, -02. Special Problems
Credit hours to be arranged.
Research problems in biology under the supervision of a faculty member.

BIOL 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding a teaching assistantship.

BIOL 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding research assistantships.

BIOL 9000. Doctoral Thesis
Credit hours to be arranged.

School of Chemistry and Biochemistry

www.chemistry.gatech.edu

Established in 1906
Location: Boggs Chemistry Building
Telephone: 404.894.4002
Fax: 404.894.7452

Chair and Professor–Thomas Orlando; *Director of Graduate Studies and Professor*–David M. Collard; *Director of Undergraduate Studies and Professor*–Lawrence Bottomley; *Vice Provost and Dean of Graduate Studies and Regents' Professor*–Charles L. Liotta; *Dean of the College of Sciences, Vasser Woolley Chair, and Professor*–Gary B. Schuster; *Associate Dean and Professor*–E. Kent Barefield; *Julius Brown Chair and Professor*–Mostafa A. El-Sayed; *Eminent Scholar and Professor*–Jiri (Art) Janata.
Regents' Professors–Sheldon W. May, James C. Powers.
Professors–Bridgette Barry, Jean-Luc Brédas, Uwe Bunz, Seth Marder, Joseph Perry, William S. Rees Jr., Laren M. Tolbert, Robert L. Whetten, Loren D. Williams, Angus Wilkinson, Paul H. Wine, Z. John Zhang.
Associate Professors–Robert M. Dickson, Christoph J. Fahrni, Rigoberto Hernandez, Nicholas V. Hud, L. Andrew Lyon, Boris Mizaikoff, Arthur Ragauskas, C. David Sherrill.
Assistant Professors–Donald Doyle, Facundo Fernandez, Nils Kroger, Julia Kubanek, Allen Pulle, Marcus Weck.
Adjunct Faculty–Haskell W. Beckham, Andreas Bommarius, Charles A. Eckert, Steve Harvey, Gregory Buey, Christopher W. Jones, Alfred Merrill, Mohan Srinivasarao, Yadong Wang, Z.L.Wang, C.P. Wong.
Senior Academic Professionals–William J. Baron, Toby F. Block, Robert A. Braga.
Academic Professionals–George McKelvy, Mary Peek, J. Cameron Tyson.

General Information

The School offers courses in chemistry required for various engineering and science curricula, as well as for students interested in medical school, for the degree Bachelor of Science in Chemistry, and for graduate work leading to the degrees Master of Science in Chemistry, Paper Science and Engineering, and Doctor of Philosophy in Chemistry, Bioinformatics, and Paper Science and Engineering.

Undergraduate Program

The Bachelor of Science in Chemistry degree program consists of a combination of requirements and electives that ensure a strong foundation in physical, inorganic, organic, and analytical chemistry while providing the flexibility to tailor the curriculum to satisfy specific interests or career goals. Biochemistry, Polymers, Materials, and Business Options are available for students who wish to include these fields as substantial components of their program. The judicious use of free electives also enables the student to achieve considerable knowledge of other disciplines at Georgia Tech, such as chemical and biomolecular engineering, materials engineering, computing, physics, mathematics, management, textiles, and biology. The chemistry curriculum options enable majors who are interested in medical, dental, or law school to meet admission requirements of these schools.

Certificate Programs

The School of Chemistry and Biochemistry offers, for non-chemistry majors, programs of study leading to certificates in three areas: biochemistry/organic chemistry, chemical analysis, and physical/inorganic chemistry. These certificate programs should be of interest to students considering careers in medicine or chemical-related industries, as well as those who wish to strengthen their background in areas of chemistry that are not required by their major.

Each certificate program requires a minimum of twelve hours in a coherent program with at least nine hours at the 3000 level or higher. These courses must be chosen from the list of courses in the given emphasis area and must be completed with a grade of *C* or better. Courses required by the student's major may not be used in the certificate program. Courses which may be taken to satisfy the certificate requirements are as follows:

- **Biochemistry/Organic Chemistry Certificate:** CHEM 2312, 2313, 2380, 3511, 4311, 4341, 4511, 4512, 4581
- **Chemical Analysis Certificate**: CHEM 2380, 3211, 3411, 3412, 4341, 4401
- **Physical/Inorganic Chemistry Certificate:** CHEM 2380, 3111, 3380, 3411, 3412, 3481, 4452

Additional information regarding undergraduate programs is available by writing to the Director of Undergraduate Studies, School of Chemistry and Biochemistry, Georgia Institute of Technology, Atlanta, Georgia 30332-0400.

Bachelor of Science in Chemistry (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
CHEM 1310	GENERAL CHEMISTRY	4
CS 1321	INTRO. TO COMPUTING	3
WELLNESS		2
TOTAL SEMESTER HOURS		16

First Year - Second Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II	4
BIOL 1510	BIOLOGICAL PRINCIPLES	4
CHEM 1311	INORGANIC CHEMISTRY I	3
CHEM 1313	QUANTITATIVE ANALYSIS	3
TOTAL SEMESTER HOURS		17

Second Year - First Semester

Course Number/Name		*Hours*
CHEM 2311	ORGANIC CHEMISTRY I	3
MATH 2401	CALCULUS III	4
PHYS 2211	INTRODUCTORY PHYSICS I	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Second Year - Second Semester

Course Number/Name		*Hours*
CHEM 2312	ORGANIC CHEMISTRY II	3
CHEM 2380	SYNTHESIS LAB I	2
PHYS 2212	INTRODUCTORY PHYSICS II	4
SOCIAL SCIENCE ELECTIVE(S)		3
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Third Year - First Semester

Course Number/Name		*Hours*
CHEM 3411	PHYSICAL CHEMISTRY I	3
CHEM 3111	INORGANIC CHEMISTRY II	3
CHEM 3380	SYNTHESIS LAB II	3
SOCIAL SCIENCE ELECTIVE(S)		3
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Third Year - Second Semester

Course Number/Name		*Hours*
CHEM 3412	PHYSICAL CHEMISTRY II	3
CHEM 3481	PHYSICAL CHEMISTRY LAB I	2
CHEM 3211	ANALYTICAL CHEMISTRY	5
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		13

Fourth Year - First Semester

Course Number/Name		*Hours*
CHEM 4681	ADVANCED CHEMISTRY LAB	5
CHEM 3511 or 4511 or 4512 (Biochemistry)		3
CHEMISTRY ELECTIVE(S)		3
TECHNICAL ELECTIVE(S)		3
TOTAL SEMESTER HOURS		14

Fourth Year - Second Semester

Course Number/Name	*Hours*
CHEMISTRY ELECTIVE(S)	3
TECHNICAL ELECTIVE(S)	3
FREE ELECTIVE(S)	9
TOTAL SEMESTER HOURS	15

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Electives

Social Sciences Electives

See "Information for Undergraduates" for information on the Institute requirement of twelve hours of humanities and twelve hours of social sciences (pages 35-36). All students must satisfy state requirements regarding coursework in the history and constitutions of the United States and Georgia. HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200 fulfill these requirements.

Chemistry Electives

Chemistry electives include CHEM 3482 and all CHEM 4000-level courses except CHEM 4681, specifically required biochemistry courses, and CHEM 4699. With approval, graduate chemistry courses may also be used as chemistry electives.

Technical Electives

The technical elective requirement may be fulfilled by courses in science, engineering, and computing at the 3000 level or higher. A maximum of three hours toward the technical elective requirement may be chosen from CHEM 4699.

Biochemistry Option

Students who wish to prepare for careers that require proficiency in biochemistry may choose the Biochemistry Option under the Bachelor of Science in Chemistry curriculum. This option may be of interest to students who plan careers in medicine, teaching, or research, as well as those who wish to broaden their curriculum by including courses in this rapidly growing field.

Bachelor of Science in Chemistry - Biochemistry Option (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
CHEM 1310	GENERAL CHEMISTRY	4
CS 1321	INTRO. TO COMPUTING	3
WELLNESS		2
TOTAL SEMESTER HOURS		16

First Year - Second Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II	4
BIOL 1510	BIOLOGICAL PRINCIPLES	4
CHEM 1311	INORGANIC CHEMISTRY I	3
CHEM 1313	QUANTITATIVE ANALYSIS	3
TOTAL SEMESTER HOURS		17

Second Year - First Semester

Course Number/Name		*Hours*
CHEM 2311	ORGANIC CHEMISTRY I	3
MATH 2401	CALCULUS III	4
PHYS 2211	INTRODUCTORY PHYSICS I	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Second Year - Second Semester

Course Number/Name		*Hours*
CHEM 2312	ORGANIC CHEMISTRY II	3
CHEM 2380	SYNTHESIS LAB I	2
PHYS 2212	INTRODUCTORY PHYSICS II	4
SOCIAL SCIENCE ELECTIVE(S)		3
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Third Year - First Semester

Course Number/Name		*Hours*
CHEM 3411	PHYSICAL CHEMISTRY I	3
CHEM 3111	INORGANIC CHEMISTRY II	3
CHEM 3380	SYNTHESIS LAB II	3
CHEM 4511	BIOCHEMISTRY I	3
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Third Year - Second Semester

Course Number/Name		*Hours*
CHEM 3412	PHYSICAL CHEMISTRY II	3
CHEM 3481	PHYSICAL CHEMISTRY LAB I	2
CHEM 4512	BIOCHEMISTRY II	3
CHEM 4581	BIOCHEMISTRY LAB I	3
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		14

Fourth Year - First Semester

Course Number/Name		*Hours*
BIOCHEMISTRY ELECTIVE(S)		3
CHEM 4601	CHEMISTRY SEMINAR	2
FREE ELECTIVE(S)		9
TOTAL SEMESTER HOURS		14

Fourth Year - Second Semester

Course Number/Name		*Hours*
BIOCHEMISTRY ELECTIVE(S)		3
CHEM 3211	ANALYTICAL CHEMISTRY	5
FREE ELECTIVE(S)		6
TOTAL SEMESTER HOURS		14

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Biochemistry Electives

At least one of the biochemistry electives chosen must contain a laboratory component. The biochemistry electives are: CHEM 4521, 4582, and biology courses BIOL 3310, 3331, 3332, 3340/3341, 3380/3381, 4220, 4290, 4340, 4418, 4440, 4464, 4469, 4478, 4570, 4571.

Polymers and Materials Option

Students who wish to prepare for careers where a knowledge of polymers and/or materials would be beneficial may do so by choosing the Polymers Option or the Materials Option under the Bachelor of Science in Chemistry curriculum. These options may be of interest to students who plan careers in industry, teaching, or research, as well as those who wish to broaden their curriculum by including these important fields.

Bachelor of Science in Chemistry - Business Option (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
CHEM 1310	GENERAL CHEMISTRY	4
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
CS 1321	INTRO. TO COMPUTING	3
WELLNESS		2
TOTAL SEMESTER HOURS		16

First Year - Second Semester

Course Number/Name		*Hours*
CHEM 1311	INORGANIC CHEMISTRY I	3
CHEM 1313	QUANTITATIVE ANALYSIS	3
MATH 1502	CALCULUS II	4
ENGL 1102	ENGLISH COMPOSITION II	3
BIOL 1510	BIOLOGICAL PRINCIPLES	4
TOTAL SEMESTER HOURS		17

Second Year - First Semester

Course Number/Name		*Hours*
CHEM 2311	ORGANIC CHEMISTRY I	3
MATH 2401	CALCULUS III	4
PHYS 2211	INTRODUCTORY PHYSICS I	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Second Year - Second Semester

Course Number/Name		*Hours*
CHEM 2312	ORGANIC CHEMISTRY II	3
CHEM 2380	SYNTHESIS LAB I	2
PHYS 2212	INTRODUCTORY PHYSICS II	4
PSYC 2220	INDUSTRIAL/ORGANIZ. PSYCH.	3
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Third Year - First Semester

Course Number/Name		*Hours*
CHEM 3411	PHYSICAL CHEMISTRY I	3
CHEM 3111	INORGANIC CHEMISTRY II	3
CHEM 3380	SYNTHESIS LAB II	3
MGT 3000	ACCOUNTING FOR DECISION MAKING	3
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Third Year - Second Semester

Course Number/Name		*Hours*
CHEM 3412	PHYSICAL CHEMISTRY II	3
CHEM 3481	PHYSICAL CHEMISTRY LAB I	2
CHEM 3211	ANALYTICAL CHEMISTRY	5
ECON 2106	PRINCIPLES OF MICROECONOMICS	3
TOTAL SEMESTER HOURS		13

Fourth Year - First Semester

Course Number/Name		*Hours*
CHEM 4681	ADVANCED CHEMISTRY LAB	5
CHEM 3511 or 4511 or 4512 (Biochemistry)		3
CHEM ELECTIVE(S)		3
MGT 3300	MARKETING MANAGEMENT I	3
TOTAL SEMESTER HOURS		14

Fourth Year - Second Semester

Course Number/Name		*Hours*
MGT ELECTIVE(S)		3
SOCIAL SCIENCE ELECTIVE(S)		3
FREE ELECTIVES(S)		9
TOTAL SEMESTER HOURS		15

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Polymer Electives

The polymer electives may be fulfilled by polymer courses in science and engineering at the 3000 level or higher.

Bachelor of Science in Chemistry - Materials Option (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
CHEM 1310	GENERAL CHEMISTRY	4
CS 1321	INTRO. TO COMPUTING	3
WELLNESS		2
TOTAL SEMESTER HOURS		16

First Year - Second Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II	4
BIOL 1510	BIOLOGICAL PRINCIPLES	4
CHEM 1311	INORGANIC CHEMISTRY I	3
CHEM 1313	QUANTITATIVE ANALYSIS	3
TOTAL SEMESTER HOURS		17

Second Year - First Semester

Course Number/Name		*Hours*
CHEM 2311	ORGANIC CHEMISTRY I	3
MATH 2401	CALCULUS III	4
PHYS 2211	INTRODUCTORY PHYSICS I	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Second Year - Second Semester

Course Number/Name		*Hours*
CHEM 2312	ORGANIC CHEMISTRY II	3
CHEM 2380	SYNTHESIS LAB I	2
PHYS 2212	INTRODUCTORY PHYSICS II	4
SOCIAL SCIENCE ELECTIVE(S)		3
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Third Year - First Semester

Course Number/Name		*Hours*
CHEM 3411	PHYSICAL CHEMISTRY I	3
CHEM 3111	INORGANIC CHEMISTRY II	3
CHEM 3380	SYNTHESIS LAB II	3
MSE 2001	PRINCIPLES & APPLICATIONS OF ENGINEERING MATERIALS	3
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Third Year - Second Semester

Course Number/Name		*Hours*
CHEM 3412	PHYSICAL CHEMISTRY II	3
CHEM 3481	PHYSICAL CHEMISTRY LAB I	2
CHEM 3211	ANALYTICAL CHEMISTRY	5
MSE 3000	CHEMICAL THERMODYNAMICS OF MATERIALS	3
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

Fourth Year - First Semester

Course Number/Name		*Hours*
CHEM 4681	ADVANCED CHEMISTRY LAB	5
CHEM 3511 or 4511 or 4512 (Biochemistry)		3
MSE 2020	CHARACTERIZATION OF MATERIALS	3
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		14

Fourth Year - Second Semester

Course Number/Name		*Hours*
MSE 3020	MATERIALS LAB	3
FREE ELECTIVE(S)		9
TOTAL SEMESTER HOURS		12

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Bachelor of Science in Chemistry – Polymer Option (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
CHEM 1310	GENERAL CHEMISTRY	4
CS 1321	INTRO. TO COMPUTING	3
WELLNESS		2
TOTAL SEMESTER HOURS		16

First Year - Second Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II	4
BIOL 1510	BIOLOGICAL PRINCIPLES	4
CHEM 1311	INORGANIC CHEMISTRY I	3
CHEM 1313	QUANTITATIVE ANALYSIS	3
TOTAL SEMESTER HOURS		17

Second Year - First Semester

Course Number/Name		*Hours*
CHEM 2311	ORGANIC CHEMISTRY I	3
MATH 2401	CALCULUS III	4
PHYS 2211	INTRODUCTORY PHYSICS I	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Second Year - Second Semester

Course Number/Name		*Hours*
CHEM 2312	ORGANIC CHEMISTRY II	3
CHEM 2380	SYNTHESIS LAB I	2
PHYS 2212	INTRODUCTORY PHYSICS II	4
SOCIAL SCIENCE ELECTIVE(S)		3
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Third Year - First Semester

Course Number/Name		*Hours*
CHEM 3411	PHYSICAL CHEMISTRY I	3
CHEM 3111	INORGANIC CHEMISTRY II	3
CHEM 3380	SYNTHESIS LAB II	3
SOCIAL SCIENCE ELECTIVE(S)		3
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Third Year - Second Semester

Course Number/Name		*Hours*
CHEM 3412	PHYSICAL CHEMISTRY II	3
CHEM 3481	PHYSICAL CHEMISTRY LAB I	2
CHEM 3211	ANALYTICAL CHEMISTRY	5
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Fourth Year - First Semester

Course Number/Name		*Hours*
CHEM 4681	ADVANCED CHEMISTRY LAB	5
CHEM 3511 or 4511 or 4512 (Biochemistry)		3
CHEM 4775	POLYMER SCIENCE & ENGINEERING I	3
POLYMER ELECTIVE(S)		3
TOTAL SEMESTER HOURS		14

Fourth Year - Second Semester

Course Number/Name		*Hours*
CHEMISTRY ELECTIVE(S)		3
CHEM 4776	POLYMER SCIENCE & ENGINEERING II	3
FREE ELECTIVE(S)		9
TOTAL SEMESTER HOURS		15

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Management Electives

Management electives include MGT 3150, 3076, 4191, 4660; the latter three courses have a prerequisite of MGT 3062.

Graduate Programs

The School of Chemistry and Biochemistry offers programs for doctoral and master's degrees in chemistry with coursework and research opportunities in biochemistry; and analytical, inorganic, organic, physical, and polymer chemistry. In addition, the School participates in the degree programs in bioinformatics, and in paper science and engineering.

The goal of the doctoral program is to provide proficient knowledge in a specialized area of chemistry, with particular emphasis being placed on original, independent, and scholarly research. Students working toward a Ph.D. must complete fifteen credit hours of courses and a series of seminar courses. Students should complete all course requirements in the first year of graduate study and present a seminar in the second year. The Ph.D. candidacy examination consists of a series of examinations in the major area based on a reading assignment from the recent literature and an original research proposal to be completed by the end of the second year. Independent research for the Ph.D. is demonstrated by completion of published work.

Two different programs of study leading to a master's degree are offered by the School of Chemistry and Biochemistry. The formal requirements for the M.S. degree (thesis option) are twenty-four credit hours of approved coursework beyond the bachelor's degree, along with an approved M.S. thesis. The formal requirement for the M.S. degree (non-thesis option) is thirty credit hours of approved coursework beyond the bachelor's degree. The M.S. degree (non-thesis option) is a terminal degree in this department. Current research includes multidisciplinary initiatives in: biomolecular structure, molecular biophysics, computational and theoretical chemistry, materials chemistry, nanochemistry, bio-organic chemistry, photochemistry and photobiology, polymer chemistry, sensors, and environmental chemistry.

Financial Aid

Financial support is available for graduate study in the School of Chemistry and Biochemistry. The usual form of financial aid for first-year students is the teaching assistantship. Most students beyond the first year are appointed as research assistants. Both teaching and research assistants receive full tuition waivers. Additional information on the graduate program is available by writing the Graduate Coordinator, School of Chemistry and Biochemistry, Georgia Institute of Technology, Atlanta, Georgia 30332-0400, or by visiting **www.chemistry.gatech.edu**.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course. An asterisk (*) denotes prerequisite courses that may be taken concurrently.

CHEMISTRY AND BIOCHEMISTRY

CHEM 1310. General Chemistry
3-3-4.
Fundamental laws and theories of chemical reactions. Topics include atomic structure; bonding theory; stoichiometry; properties of solids, liquids and gases; chemical thermodynamics; electrochemistry; and kinetics.

CHEM 1311. Inorganic Chemistry I
3-0-3.
Prerequisite(s): CHEM 1310
Inorganic topics covering: bonding models including molecular orbitals and solid state structures, descriptive inorganic chemistry of s- and p-block elements, Lewis acids/bases, and coordination chemistry.

CHEM 1312. Inorganic Chemistry Lab I
0-3-1.
Prerequisite(s): CHEM 1311*
Laboratory to accompany Inorganic Chemistry I. Topics include qualitative and quantitative analysis of inorganic and organic compounds.

CHEM 1313. Quantitative Analysis
2-4-3.
Prerequisite(s): CHEM 1311*
Laboratory experimentation emphasizing quantitative chemical analysis.

CHEM 1315. Survey of Organic Chemistry
3-0-3.
Prerequisite(s): CHEM 1310
Survey of organic chemistry as the basis for biochemical processes and commercial applications.

CHEM 2311. Organic Chemistry I
3-0-3.
Prerequisite(s): CHEM 1311
An introduction to structure and reactivity of organic molecules.

CHEM 2312. Organic Chemistry II
3-0-3.
Prerequisite(s): CHEM 2311
The second course in the series dealing with the structure and reactivity of organic molecules.

CHEM 2313. Organic and Bioorganic Chemistry
3-0-3.
Prerequisite(s): CHEM 2311
A second course in organic chemistry that extends the study to topics in biochemistry.

CHEM 2380. Synthesis Laboratory I
1-4-2.
Prerequisite(s): CHEM 2311 and (CHEM 1312 or CHEM 1313) and (CHEM 2312* or CHEM 2313*)
Methods for preparation, isolation, and characterization of complex organic molecules, natural products, and polymers.

CHEM 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

CHEM 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

CHEM 2801, -02, -03. Special Topics
Credit and class hours equal last digit in course number.
Prerequisite(s): CHEM 1311
Lecture course in current special topics in chemistry and biochemistry. Topics will vary from year to year.

CHEM 2901, -02, -03. Special Problems in Chemistry
Prerequisite(s): CHEM 1311
Credit hours to be arranged.
Course of individual instruction, which will include library conference and laboratory experience.

CHEM 3111. Inorganic Chemistry II
3-0-3.
Prerequisite(s): CHEM 1311
A study of the reactions and structures of inorganic compounds and principles, generalizations and theories that assist in understanding their behavior.

CHEM 3211. Analytical Chemistry
3-5-5.
Prerequisite(s): CHEM 2380 and CHEM 3412*
Introduction to the theory and practice of modern chemical analysis.

CHEM 3281. Instrumental Analysis for Engineers
3-3-4.
Prerequisite(s): CHEM 2380 and CHEM 3412*
Provides a background to modern analytical chemistry and instrumental methods of analysis with applications to engineering and other areas.

CHEM 3371. Organic Chemistry Laboratory
1-4-2.
Prerequisite(s): CHEM 2380
Multi-step organic synthesis and inorganic synthesis. Use of chemical literature and advanced spectroscopic techniques.

CHEM 3380. Synthesis Laboratory II
1-6-3.
Prerequisite(s): CHEM 2380 and CHEM 3111*
Multi-step organic and inorganic synthesis. Use of the chemical literature and advanced spectroscopic techniques.

CHEM 3411. Physical Chemistry I
3-0-3.
Prerequisite(s): CHEM 1311
Chemical thermodynamics, energetics of chemical reactions, changes of state, and electrochemistry.

CHEM 3412. Physical Chemistry II
3-0-3.
Prerequisite(s): CHEM 1311 and PHYS 2212
Quantum mechanics, atomic and molecular structure, bonding theory, molecular spectroscopy, statistical mechanics.

CHEM 3481. Physical Chemistry Laboratory I
0-6-2.
Prerequisite(s): (CHEM 2380 and CHEM 3411) or (CHEM 2380 and CHBE 3110*)
Laboratory investigations of physical principles applied to chemical systems.

CHEM 3482. Physical Chemistry Laboratory II
0-6-2.
Prerequisite(s): CHEM 3481
Laboratory investigations of physical principles applied to chemical systems.

CHEM 3511. Survey of Biochemistry
3-0-3.
Prerequisite(s): CHEM 1315 or CHEM 2312
Introductory course in biochemistry dealing with the chemistry and biochemistry of proteins, lipids, carbohydrates, nucleic acids, and other biomolecules.

CHEM 4311. Advanced Organic Chemistry
3-0-3.
Prerequisite(s): CHEM 2312
Construction reactions and functional group interconversions as applied to multi-step organic synthesis.

CHEM 4341. Applied Spectroscopy
3-0-3.
Prerequisite(s): CHEM 2312
Theory and application of NMR, mass spectrometry, and infrared spectroscopy in the determination of organic structures.

CHEM 4401. Molecular Spectroscopy
3-0-3.
Prerequisite(s): CHEM 3412
Introduction to the theory and applications of molecular spectroscopy, including electronic, vibrational, rotational transitions, and selections rules.

CHEM 4452. Chemistry of the Solid State
3-0-3.
Prerequisite(s): CHEM 3111 and CHEM 3412
Application of the concepts of physical and inorganic chemistry to the structure of solids and their chemical and physical properties.

CHEM 4511. Biochemistry I
3-0-3.
Prerequisite(s): CHEM 2312
The chemistry and biochemistry of proteins, lipids, carbohydrates, nucleic acids, and other biomolecules.

CHEM 4512. Biochemistry II
3-0-3.
Prerequisite(s): CHEM 4511
The chemistry and biochemistry of proteins, lipids, carbohydrates, nucleic acids, and other biomolecules.

CHEM 4521. Biophysical Chemistry
3-0-3.
Prerequisite(s): CHEM 3412 and CHEM 4511
The physical chemistry of biological systems, biological macromolecules, and biological aggregates.

CHEM 4581. Biochemistry Laboratory I
1-6-3.
Prerequisite(s): (CHEM 3511 or CHEM 4511) and (CHEM 3371 or CHEM 3380)
Modern biochemical techniques including methods for protein, nucleic acid, and lipid isolation and characterization; enzyme assays; chromatography; electrophoresis; and use of databases.

CHEM 4582. Biochemistry Laboratory II
1-6-3.
Prerequisite(s): CHEM 4512 and CHEM 4581
Laboratory techniques in the isolation and characterization of biological molecules with special emphasis on modern techniques.

CHEM 4601. Chemistry Seminar
2-0-2
Prerequisite(s): CHEM 4511 and CHEM 4512
Student presentations of recent research topics in chemistry or biochemistry based on lab experience and/or literature searches.

CHEM 4681. Advanced Chemistry Laboratory
1-10-5.
Prerequisite(s): CHEM 3211 and CHEM 3380
A molecular laboratory involving a series of multipart experiments that build upon chemical principles and experimental techniques introduced in earlier courses and instructional laboratories.

CHEM 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

CHEM 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

CHEM 4775. Polymer Science and Engineering I: Formation and Properties
3-0-3.
Prerequisite(s): CHEM 2312 and CHEM 3411
An introduction to the chemistry, structure, and formation of polymers, physical states and transitions, physical and mechanical properties of polymer fluids and solids. Crosslisted with CHE, ME, MSE, and PTFE 4775.

CHEM 4776. Polymer Science and Engineering II: Analysis, Processing, and Laboratory
2-3-3.
Prerequisite(s): CHBE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or PTFE 4775
Polymer fabrication processes and methods of characterization and identification of polymers are presented. Experiments in polymerization, processing, and property evaluation of polymers. Crosslisted with CHE, ME, MSE, and TFE 4776.

CHEM 4801, -02, -03, -04, -05. Special Topics
Class and credit hours equal last digit of course number.
Topics of current interest not included in the regular course offerings. No prerequisites.

CHEM 4901, -02, -03. Special Problems in Chemistry
Credit hours to be arranged.
Course of individualized instruction, which will include library, conference, and laboratory investigations.

CHEM 6170. Inorganic Chemistry I
3-0-3.
A series of key topics in inorganic chemistry will be reviewed: acids/bases, redox processes, bonding and structure, transition metal chemistry, coordination complexes.

CHEM 6171. Inorganic Chemistry II
3-0-3.
Contemporary topics in inorganic chemistry including bioinorganic chemistry, reaction mechanisms and kinetics, optical and magnetic properties of molecular species, and inorganic materials.

CHEM 6172. Physical Methods in Inorganic Chemistry
3-0-3.
An introduction to the use of physical methods in inorganic chemistry including vibrational spectroscopy, multinuclear NMR, EST, Mossbauer, magnetometery, NQR, PES, diffraction, and EXAFS.

CHEM 6181. Chemical Crystallography
3-0-3.
The collection and interpretation of diffraction data. Single crystal structure analysis, powder diffraction for phase identification and quantitative analysis, and Rietveld refinement.

CHEM 6182. Chemistry of the Solid State
3-0-3.
An introduction to the chemistry of the solid state. Synthetic methods, measurement of properties, structure of solids, theory of electrical, optical, and magnetic properties.

CHEM 6183. Organometallic Chemistry
3-0-3.
The chemistry of main group and transition metal organometallics. Including synthetic methods, homogeneous catalysis and catalytic cycles, and synthetically useful organometallic reagents.

CHEM 2313. Organic and Bioorganic Chemistry
3-0-3.
Prerequisite(s): CHEM 2311
A second course in organic chemistry that extends the study to topics in biochemistry.

CHEM 2380. Synthesis Laboratory I
1-4-2.
Prerequisite(s): CHEM 2311 and (CHEM 1312 or CHEM 1313) and (CHEM 2312* or CHEM 2313*)
Methods for preparation, isolation, and characterization of complex organic molecules, natural products, and polymers.

CHEM 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

CHEM 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

CHEM 2801, -02, -03. Special Topics
Credit and class hours equal last digit in course number.
Prerequisite(s): CHEM 1311
Lecture course in current special topics in chemistry and biochemistry. Topics will vary from year to year.

CHEM 2901, -02, -03. Special Problems in Chemistry
Prerequisite(s): CHEM 1311
Credit hours to be arranged.
Course of individual instruction, which will include library conference and laboratory experience.

CHEM 3111. Inorganic Chemistry II
3-0-3.
Prerequisite(s): CHEM 1311
A study of the reactions and structures of inorganic compounds and principles, generalizations and theories that assist in understanding their behavior.

CHEM 3211. Analytical Chemistry
3-5-5.
Prerequisite(s): CHEM 2380 and CHEM 3412*
Introduction to the theory and practice of modern chemical analysis.

CHEM 3281. Instrumental Analysis for Engineers
3-3-4.
Prerequisite(s): CHEM 2380 and CHEM 3412*
Provides a background in modern analytical chemistry and instrumental methods of analysis with applications to engineering and other areas.

CHEM 3371. Organic Chemistry Laboratory
1-4-2.
Prerequisite(s): CHEM 2380
Multi-step organic synthesis and inorganic synthesis. Use of chemical literature and advanced spectroscopic techniques.

CHEM 3380. Synthesis Laboratory II
1-6-3.
Prerequisite(s): CHEM 2380 and CHEM 3111*
Multi-step organic and inorganic synthesis. Use of the chemical literature and advanced spectroscopic techniques.

CHEM 3411. Physical Chemistry I
3-0-3.
Prerequisite(s): CHEM 1311
Chemical thermodynamics, energetics of chemical reactions, changes of state, and electrochemistry.

CHEM 3412. Physical Chemistry II
3-0-3.
Prerequisite(s): CHEM 1311 and PHYS 2212
Quantum mechanics, atomic and molecular structure, bonding theory, molecular spectroscopy, statistical mechanics.

CHEM 3481. Physical Chemistry Laboratory I
0-6-2.
Prerequisite(s): (CHEM 2380 and CHEM 3411) or (CHEM 2380 and CHBE 3110*)
Laboratory investigations of physical principles applied to chemical systems.

CHEM 3482. Physical Chemistry Laboratory II
0-6-2.
Prerequisite(s): CHEM 3481
Laboratory investigations of physical principles applied to chemical systems.

CHEM 3511. Survey of Biochemistry
3-0-3.
Prerequisite(s): CHEM 1315 or CHEM 2312
Introductory course in biochemistry dealing with the chemistry and biochemistry of proteins, lipids, carbohydrates, nucleic acids, and other biomolecules.

CHEM 4311. Advanced Organic Chemistry
3-0-3.
Prerequisite(s): CHEM 2312
Construction reactions and functional group interconversions as applied to multi-step organic synthesis.

CHEM 4341. Applied Spectroscopy
3-0-3.
Prerequisite(s): CHEM 2312
Theory and application of NMR, mass spectrometry, and infrared spectroscopy in the determination of organic structures

CHEM 4401. Molecular Spectroscopy
3-0-3.
Prerequisite(s): CHEM 3412
Introduction to the theory and applications of molecular spectroscopy, including electronic, vibrational, rotational transitions, and selections rules.

CHEM 4452. Chemistry of the Solid State
3-0-3.
Prerequisite(s): CHEM 3111 and CHEM 3412
Application of the concepts of physical and inorganic chemistry to the structure of solids and their chemical and physical properties.

CHEM 4511. Biochemistry I
3-0-3.
Prerequisite(s): CHEM 2312
The chemistry and biochemistry of proteins, lipids, carbohydrates, nucleic acids, and other biomolecules.

CHEM 4512. Biochemistry II
3-0-3.
Prerequisite(s): CHEM 4511
The chemistry and biochemistry of proteins, lipids, carbohydrates, nucleic acids, and other biomolecules.

CHEM 4521. Biophysical Chemistry
3-0-3.
Prerequisite(s): CHEM 3412 and CHEM 4511
The physical chemistry of biological systems, biological macromolecules, and biological aggregates.

CHEM 4581. Biochemistry Laboratory I
1-6-3.
Prerequisite(s): (CHEM 3511 or CHEM 4511) and (CHEM 3371 or CHEM 3380)
Modern biochemical techniques including methods for protein, nucleic acid, and lipid isolation and characterization; enzyme assays; chromatography; electrophoresis; and use of databases.

CHEM 4582. Biochemistry Laboratory II
1-6-3.
Prerequisite(s): CHEM 4512 and CHEM 4581
Laboratory techniques in the isolation and characterization of biological molecules with special emphasis on modern techniques.

CHEM 4601. Chemistry Seminar
2-0-2.
Prerequisite(s): CHEM 4511 and CHEM 4512
Student presentations of recent research topics in chemistry or biochemistry based on lab experience and/or literature searches.

CHEM 4681. Advanced Chemistry Laboratory
1-10-5.
Prerequisite(s): CHEM 3211 and CHEM 3380
A molecular laboratory involving a series of multipart experiments that build upon chemical principles and experimental techniques introduced in earlier courses and instructional laboratories.

CHEM 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

CHEM 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

CHEM 4775. Polymer Science and Engineering I: Formation and Properties
3-0-3.
Prerequisite(s): CHEM 2312 and CHEM 3411
An introduction to the chemistry, structure, and formation of polymers, physical states and transitions, physical and mechanical properties of polymer fluids and solids. Crosslisted with CHE, ME, MSE, and PTFE 4775.

CHEM 4776. Polymer Science and Engineering II: Analysis, Processing, and Laboratory
2-3-3.
Prerequisite(s): CHBE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or PTFE 4775
Polymer fabrication processes and methods of characterization and identification of polymers are presented. Experiments in polymerization, processing, and property evaluation of polymers. Crosslisted with CHE, ME, MSE, and TFE 4776.

CHEM 4801, -02, -03, -04, -05. Special Topics
Class and credit hours equal last digit of course number.
Topics of current interest not included in the regular course offerings. No prerequisites.

CHEM 4901, -02, -03. Special Problems in Chemistry
Credit hours to be arranged.
Course of individualized instruction, which will include library, conference, and laboratory investigations.

CHEM 6170. Inorganic Chemistry I
3-0-3.
A series of key topics in inorganic chemistry will be reviewed: acids/bases, redox processes, bonding and structure, transition metal chemistry, coordination complexes.

CHEM 6171. Inorganic Chemistry II
3-0-3.
Contemporary topics in inorganic chemistry including bioinorganic chemistry, reaction mechanisms and kinetics, optical and magnetic properties of molecular species, and inorganic materials.

CHEM 6172. Physical Methods in Inorganic Chemistry
3-0-3.
An introduction to the use of physical methods in inorganic chemistry including vibrational spectroscopy, multinuclear NMR, EST, Mossbauer, magnetometery, NQR, PES, diffraction, and EXAFS.

CHEM 6181. Chemical Crystallography
3-0-3.
The collection and interpretation of diffraction data. Single crystal structure analysis, powder diffraction for phase identification and quantitative analysis, and Rietveld refinement.

CHEM 6182. Chemistry of the Solid State
3-0-3.
An introduction to the chemistry of the solid state. Synthetic methods, measurement of properties, structure of solids, theory of electrical, optical, and magnetic properties.

CHEM 6183. Organometallic Chemistry
3-0-3.
The chemistry of main group and transition metal organometallics. Including synthetic methods, homogeneous catalysis and catalytic cycles, and synthetically useful organometallic reagents.

CHEM 6271. Analytical Chemistry I
3-0-3.
Discussion of chemical equilibrium, separations, and bioanalytical methods.

CHEM 6272. Analytical Chemistry II
3-0-3.
Topics include experimental design, electronics, and spectroscopy.

CHEM 6281. Mass Spectrometry
3-0-3.
Topics include sample handling, ionization methods, MS/MS, and quantitative analysis.

CHEM 6282. Chemical Sensors
3-0-3.
Origins of selectivity, principles of transduction mechanisms, construction and applications of modern chemical sensors.

CHEM 6283. Electroanalytical Chemistry
3-0-3.
Coulometry, electrolytic separations, polargraphy chronopotentiometry, coulometric titrations, voltammetry, and hydrodynamic electrochemical methods of analysis.

CHEM 6284. Environmental Analytical Chemistry
3-0-3.
Application of techniques from analytical chemistry in monitoring the environment.

CHEM 6285. Analytical Spectroscopy
3-0-3.
Modern analytical spectroscopy and use of analytical techniques in chemistry and chemical engineering.

CHEM 6371. Identification of Organic Compounds
3-0-3.
Description of molecular structure and identification of organic compounds using spectroscopic techniques.

CHEM 6372. Physical Organic Chemistry
3-0-3.
Physical methods in organic chemistry; determination of reaction pathways.

CHEM 6373. Organic Synthesis
3-0-3.
Methods and strategy for the preparation of complex organic compounds.

CHEM 6381. Advanced Organic Synthesis
3-0-3.
Advanced topics in the synthesis of complex organic molecules.

CHEM 6382. Computational Methods in Organic Chemistry and Biochemistry
2-3-3.
The development of approximate methods in molecular orbital theory and molecular mechanics and their application to problems in organic and biochemistry.

CHEM 6471. Chemical Thermodynamics and Kinetics
3-0-3.
Laws of classical thermodynamics and their chemical applications. Introduction to statistical mechanics and chemical kinetics.

CHEM 6472. Quantum Chemistry and Molecular Spectroscopy
3-0-3.
Introduction to quantum mechanics and its application to molecular systems, atomic and molecular spectroscopy.

CHEM 6481. Statistical Mechanics
3-0-3.
Statistical thermodynamics, lattice statistics, molecular distribution and correlation functions, the theories of liquids and solutions, phase transitions, cluster theory, and measurement.

CHEM 6482. Chemical Kinetics and Reaction Dynamics
3-0-3.
Modern theoretical and experimental methods for studying macroscopic and microscopic bimolecular and unimolecular processes are discussed, as are methods for describing complex kinetic systems.

CHEM 6491. Quantum Mechanics
3-0-3.
Important concepts and applications of quantum mechanics at the intermediate level, including operators, perturbation and variational methods applied to atoms and molecules.

CHEM 6492. Molecular Spectroscopy
3-0-3.
Study of energy of electronic transitions in molecules, selection rules, excitation processes, and laser spectroscopy.

CHEM 6501. Biochemistry I
3-0-3.
The chemistry and biochemistry of proteins, lipids, carbohydrates, nucleic acids, and other biomolecules.

CHEM 6502. Biochemistry II
3-0-3.
The chemistry and biochemistry of proteins, lipids, carbohydrates, nucleic acids, and other biomolecules.

CHEM 6571. Enzymology
3-0-3.
Structure and chemistry of enzymes, enzyme mechanism, enzyme kinetics, enzyme inhibitors, and medicinal chemistry.

CHEM 6572. Macromolecular Structure
3-0-3.
Principles of protein, nucleic acid, and membrane structure. Major emphasis on protein folding, detailed description of three-dimensional structure of proteins and nucleic acids.

CHEM 6573. Molecular Biochemistry
3-0-3.
Current topics in molecular biology including eukaryotic transcriptions, RNA processing, repair and recombination, immunity, viruses, DNA fingerprinting, and genome sequencing.

CHEM 6581. Protein Crystallography
3-0-3.
Application of crystallographic principles to the structure determination of macromolecules by molecular replacement, multiple isomorphous replacements. High-speed data collection methods and cryocrystallography.

CHEM 6582. Biophysical Chemistry
3-0-3.
Applications of the principles and techniques of physical chemistry in biochemistry, with emphasis in the equilibrium and dynamic behavior of macromolecules in solution.

CHEM 6583. Drug Design and Discovery
3-0-3.
Application of principles of chemistry and biology to the creation of knowledge leading to the introduction of new therapeutic agents.

CHEM 6584. Contemporary Biochemistry
3-0-3.
Topics vary but will include subjects from the biochemical literature, such as in *Journal of Biological Chemistry*.

CHEM 6750. Preparation and Reaction of Polymers
3-0-3.
Prerequisite(s): CHBE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or PTFE 4775
A detailed treatment of the reactions involved in the synthesis of both human-made and natural polymers, including preparation and degradative reactions of polymer systems. Crosslisted with CHE and PTFE 6750.

CHEM 6751. Physical Chemistry of Polymer Solutions
3-0-3.
Prerequisite(s): (CHBE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or PTFE 4775) or (ME 4777 or MSE 4777 or PTFE 4777)
Study of polymer solutions, polymer miscibility, absorptions, sorptions, plasticization, molecular weights, molecular weight distributions, and interfacial phenomena using thermodynamics and statistical mechanics. Crosslisted with CHE, MSE, and PTFE 6751.

CHEM 6752. Polymer Characterization
3-3-4.
Prerequisite(s): (CHBE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or PTFE 4775) or (ME 4777 or MSE 4777 or PTFE 4777)
This course introduces the student to surface, near-surface, and structural methods of polymer characterization. Specialized techniques critical to physical structure are emphasized. Crosslisted with CHE, MSE, and PTFE 6752.

CHEM 6755. Theoretical Chemistry of Polymers
3-0-3.
Prerequisite(s): CHEM 6471 and (CHBE 6751 or CHEM 6751 or MSE 6751 or PTFE 6751)
Thermodynamics and microscopic dynamics of polymers. Fundamental concepts, including scaling concepts, governing anisotropy of polarizability, phase transitions, morphology, time-dependent correlations, etc. are discussed. Crosslisted with MSE and PTFE 6755.

CHEM 6756. Discovery of Signaling Molecules
3-0-3.
Prerequisite(s): CHEM 2311
The diversity of chemical signals between organisms and their structural specificities will be presented along with chemical and biological methods for isolating signaling molecules. Crosslisted with BIOL 6756 and CEE 6756.

CHEM 7000. Master's Thesis
Credit hours to be arranged.

CHEM 7001. Introduction to Research
1-6-3.
Introduction to laboratory techniques, experimental design, library and database searching, presentations.

CHEM 8000. Seminar in Chemistry
1-0-1.

CHEM 8001. Faculty Seminar
2-0-2.

CHEM 8002. Information Resources for Chemists and Biochemists
2-0-2.

CHEM 8003. Student Seminar
2-0-2.

CHEM 8813. Special Topics in Inorganic Chemistry
3-0-3.
Topics from the inorganic chemistry research literature.

CHEM 8823. Special Topics in Analytical Chemistry
3-0-3.
Topics from the analytical chemistry research literature.

CHEM 8833. Special Topics in Organic Chemistry
3-0-3.
Topics from the organic chemistry research literature.

CHEM 8843. Special Topics in Physical Chemistry
3-0-3.
Topics from the physical chemistry research literature.

CHEM 8853. Special Topics in Biochemistry
3-0-3.
Topics from the biochemistry research literature.

CHEM 8873. Special Topics in Polymer Chemistry
3-0-3.
Topics from the polymer chemistry research literature.

CHEM 8901, -02, -03. Special Problems
Credit hours to be arranged.

CHEM 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding graduate teaching assistantships.

CHEM 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding graduate research assistantships.

CHEM 9000. Doctoral Thesis
Credit hours to be arranged

School of Earth and Atmospheric Sciences

www.eas.gatech.edu

Established in 1970
Location: 311 Ferst Drive
Telephone: 404.894.3893
E-mail: ugradcor@eas.gatech.edu (undergraduate coordinator); gradcor@eas.gatech.edu (graduate coordinator)

Chair and Professor–Judith A. Curry; *Graduate Coordinator, Undergraduate Coordinator, and Professor*–Derek M. Cunnold; *Regents' Professor and Smithgall Chair*–William L. Chameides; *Georgia Research Alliance Eminent Scholar and Professor*–Robert E. Dickinson.
Professors–George Chimonas, Douglas D. Davis (emeritus), L. Timothy Long, Robert P. Lowell, E. Michael Perdue, Irina N. Sokolik, Charles E. Weaver (emeritus), Peter J. Webster, Paul H. Wine.
Associate Professors–Robert Black, Rong Fu, L. Gregory Huey, Ellery D. Ingall, Jean Lynch-Stieglitz, Carolyn D. Ruppel, Mark Stieglitz, David Tan, Yuhang Wang, Rodney J. Weber.
Assistant Professors–Michael H. Bergin, Kim Cobb, Emanuele Di Lorenzo, Daniel Lizarralde, Athanasios Nenes, Martial Taillefert.
Senior Research Scientists–Karsten Baumann, Carlos A. Cardelino, Hai-Ru Chang, Michael E. Chang, Robert E. Stickel, Viatcheslav V. Tatarskii, Hsiang-Jui (Ray) Wang, Hui Wang.
Research Scientists II–Mingxuan Chen, Claire Cosgrove, Jun Inoue, Jinlong Li, James C. St. John, David J. Tanner, Wenyue Xu, Eun-Su Yang, Jing-Zhi Zhao, Mei Zheng.
Adjunct Faculty–Jack Blanton, Paul Crutzen, Heidi Cullen, Thomas DiChristina, James Gaherty, Leonid Germanovich, Gary Gimmestad, Richard Jahnke, Joseph Montoya, Carmen Nappo, Leonard Smith, Armistead Russell, Stuart Wakeham, Herbert Windom.

General Information

The School of Earth and Atmospheric Sciences (EAS) is an interdisciplinary program that studies the Earth's physical and chemical environment. EAS takes an integrated Earth system science approach in which all components of the Earth system are studied and analyzed as parts of the larger coupled system. The curriculum is designed to provide its graduates with the intellectual insights needed to understand the evolution of the Earth's environment and its possible future changes. This integrated approach provides the context for professional training in environmental science and meteorology, as well as specialization for research careers in climate dynamics, atmospheric chemistry and air quality, aqueous geochemistry and biogeochemistry, oceanography, geophysics, and geohydrology.

Undergraduate Program

The program leading to the degree Bachelor of Science in Earth and Atmospheric Sciences is based on forty-five hours of core courses within the School and forty-one hours of required courses in mathematics/computing and science. The EAS degree is comparable to traditional degrees in meteorology and environmental sciences, but the program has several unique attributes. EAS courses provide "hands-on" experiences in collection and interpretation of environmental data and in predictive modeling. The integrated approach of the program gives a broad environmental background, while still allowing students to specialize in meteorology, earth science, education, or a business option. The program prepares students for graduate study or immediate employment in fields such as meteorology, air quality, environmental chemistry, exploration geophysics, geological engineering, geological hazards, impact assessment, and environmental policy. Electives (twenty-seven hours), both within the School and in other units of Georgia Tech, allow students considerable flexibility in tailoring their degree programs according to individual career goals. The School provides incentives and encouragement for undergraduate students to participate in ongoing research with the faculty.

In addition to campuswide academic requirements for graduation, a grade of *C* or better is required in the following courses for the bachelor's degree in Earth and Atmospheric Sciences: MATH 1501, MATH 1502, PHYS 2211, CHEM 1310, BIOL 1510 or 1520, and CS 1371.

Minor in Earth and Atmospheric Sciences

A minor in Earth and Atmospheric Sciences may be obtained by completing specified EAS courses.

Certificate Programs

The School of Earth and Atmospheric Sciences offers programs of study for non-School majors leading to certificates in two areas of emphasis: geochemistry and solid earth geophysics. Each course must be completed with a grade of *C* or better.

Additional information regarding undergraduate programs, the minor, and the certificate programs is available by contacting Undergraduate Coordinator, School of Earth and Atmospheric Sciences, Georgia Institute of Technology, Atlanta, Georgia 30332-0340.

Bachelor of Science in Earth and Atmospheric Sciences (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
CHEM 1310	GENERAL CHEMISTRY	4
EAS 1600	INTRO. TO ENVIRONMENTAL SCIENCE	4
GT 1000	FRESHMAN SEMINAR	1
TOTAL SEMESTER HOURS		16

First Year - Second Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II	4
CHEM 1311	INORGANIC CHEMISTRY I	3
CHEM 1312	INORGANIC CHEMISTRY LAB I	1
CS 1371	COMPUTING FOR ENGINEERS	3
TOTAL SEMESTER HOURS		14

Second Year - First Semester

Course Number/Name		*Hours*
MATH 2401	CALCULUS III	4
PHYS 2211	INTRODUCTORY PHYSICS I	4
EAS 2600	EARTH PROCESSES	4
TECHNICAL ELECTIVE(S)**		3
TOTAL SEMESTER HOURS		15

Second Year - Second Semester

Course Number/Name		*Hours*
MATH 2403	DIFFERENTIAL EQUATIONS	4
PHYS 2212	INTRODUCTORY PHYSICS II	4
WELLNESS		2
EAS 2655	QUANTITATIVE TECHNIQUES	3
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		16

Third Year - First Semester

Course Number/Name		*Hours*
EAS 3603	THERMODYNAMICS OF EARTH SYSTEMS	3
EAS CORE ELECTIVE(S)*		3
TECHNICAL ELECTIVE(S)**		3
BIOL 1510	BIOLOGICAL PRINCIPLES or 1520 INTRO. TO ORGANISMAL BIOLOGY	4
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

Third Year - Second Semester

Course Number/Name		*Hours*
EAS CORE ELECTIVE(S)*		3
TECHNICAL ELECTIVE(S)**		3
HUMANITIES ELECTIVE(S)		3
FREE ELECTIVE(S)		3
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Fourth Year - First Semester

Course Number/Name		*Hours*
EAS 4610	EARTH SYSTEM MODELING	3
EAS 4651	PRACTICAL INTERNSHIP or EAS 4900 SPECIAL PROBLEMS	3
TECHNICAL ELECTIVE(S)**		3
SOCIAL SCIENCE ELECTIVE(S)		3
FREE ELECTIVE(S)		4
TOTAL SEMESTER HOURS		16

Fourth Year - Second Semester

Course Number/Name		*Hours*
EAS 4420	ENVIRONMENTAL FIELD METHODS	4
TECHNICAL ELECTIVE(S)**		3
HUMANITIES ELECTIVE(S)		3
FREE ELECTIVE(S)		4
TOTAL SEMESTER HOURS		14

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

* To satisfy EAS core electives, at least two courses must be selected from the following: EAS 3620 or 4630 or 4640 or 4655.

** All upper division courses in EAS can count as technical electives, as well as other new courses introduced by EAS faculty, Special Problems (up to three credit hours), or upper division courses in Math, Physics, Biology, Chemistry, and CEE, if approved by the Undergraduate Coordinator.

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Electives

EAS students are required to complete fifteen hours of technical electives in science, engineering, and math. Those students who choose the business option may substitute two management courses for EAS technical electives. All EAS students are required to complete an additional twelve hours of free electives in areas of their choice. Students should consult the School's undergraduate coordinator for advice on their electives.

Humanities and Social Sciences

Students are referred to "Information for Undergraduate Students" for information regarding the Institute requirements of six hours of English, six hours of humanities, and twelve hours of social sciences. The twelve semester hours of social sciences must include a course that satisfies the state requirement regarding course work in the history and constitutions of the United States and Georgia. Suitable courses include HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200.

Graduate Programs

Master's Degree Programs

Students can choose a program of study leading to either the designated master's degree (with thesis) or the undesignated master's degree (without thesis). General requirements for these degrees are found in this catalog under "Information for Graduate Students." In either program of study, students can specialize in atmospheric chemistry and air pollution, atmospheric dynamics and climate, geochemistry, solid earth and environmental geophysics, ocean sciences, or the hydrologic cycle. With approval of the School's faculty, multidisciplinary programs of study are also permitted. Students entering the master's degree program need an academic background that includes a minimum of one year of university-level courses in calculus, chemistry, and physics. Students who lack this academic background are required to complete appropriate remedial courses, for which they will not receive graduate credit.

Students can satisfy the requirements for the designated master's degree by completing a faculty-approved set of courses and a master's thesis in earth and atmospheric sciences. With approval of the School chair, students can satisfy the requirements for the undesignated master's degree by completing a faculty-approved set of courses and a three-hour Special Problems course. This course must take the form of a research project supervised by the student's advisor and culminating in a written final report.

Doctoral Program

Doctoral students are engaged primarily in original, independent research that culminates in the doctoral dissertation. In this School, students can specialize in atmospheric chemistry and air pollution, atmospheric dynamics and climate, geochemistry, solid earth and environmental geophysics, ocean sciences, or the hydrologic cycle. With approval of the School's faculty, multidisciplinary programs of study are also permitted. In each area of specialization, doctoral students are required to complete a faculty-approved set of core courses and a comprehensive examination. Students are also required to complete nine semester hours of coursework in an academic minor.

Certificate Program in Geohydrology

Students completing the master's degree or doctoral degree requirements of the School may be awarded a Multidisciplinary Geohydrology Certificate if their program of study satisfies the requirements of the Multidisciplinary Geohydrology program. Additional details can be found in this catalog under "Multidisciplinary Certificate Programs in Engineering."

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course. An asterisk (*) denotes prerequisite courses that may be taken concurrently.

EARTH AND ATMOSPHERIC SCIENCES

EAS 1600. Introduction to Environmental Science
3-5-4
Prerequisite(s): MATH 1501* or MATH 1511* or MATH 15X1
Introduction to environmental field science. Case study approach. Exposure to basic field equipment and techniques, analysis of data.

EAS 1601. Habitable Planet
3-3-4
Introduction to the origin and evolution of Planet Earth, creation of the universe and the elements, early history of Earth, radioisotope geochemistry and the timing of events in the universe, the galaxy, and on Earth. Formation of the atmosphere and oceans. Climate.

EAS 2420. Environmental Measures of Urban and Regional Change
3-0-3
Identify and quantify nature's physical and chemical contributions to human-made urban environments, and measure the aspects of urban area feedback on these natural systems.

EAS 2601. Earth Processes
3-3-4
Prerequisite(s): PHYS 2211* and (MATH 1502 or MATH 1512)
Broad perspective on the processes of the Earth that impact humankind. Project-based and problem-solving laboratory exercises.

EAS 2602. Earth through Time
3-0-3
Prerequisite(s): EAS 1600 and EAS 2601
Dynamic processes affecting the Earth system on all time scales.

EAS 2655. Quantitative Techniques in Earth and Atmospheric Sciences
3-0-3
Prerequisite(s): CHEM 1310 and MATH 2401 and MATH 2403* and PHYS 2212*
Integrated course in mathematical, physical, and computing techniques for applications in earth and atmospheric sciences.

EAS 2750. Physics of the Weather
3-0-3
An introductory treatment of the application of the basic physical laws to the understanding of weather phenomena. Cross-listed with PHYS 2750.

EAS 2801, -02, -03, -04. Special Topics
Class and credit hours equal last digit of course number.

EAS 2900. Special Problems
Credit hours to be arranged.

EAS 3620. Geochemistry
3-3-4
Prerequisite(s): CHEM 1312 and EAS 2655
A quantitative treatment of geochemical processes in the Earth and natural waters, with emphasis on chemical reactions among atmospheric gases, minerals, and aqueous solutions.

EAS 3630. Physics of the Earth's Interior
3-0-3
Prerequisite(s): MATH 2403 and PHYS 2212
A study of solid Earth dynamics, including the processes driving surface deformation and plate tectonics, and the observational techniques employed to understand these processes.

EAS 3640. Atmospheric Chemistry
2-0-2
Prerequisite(s): CHEM 1312 and EAS 3650
A general chemistry description of the planetary atmospheric system is developed, with major focus on the two lowest layers of the atmosphere, the troposphere and stratosphere.

EAS 3641. Atmospheric Chemistry Laboratory
0-3-1
Prerequisite(s): CHEM 1312
Co-requisite: EAS 3640
An introduction to field and laboratory techniques in atmospheric chemistry.

EAS 3650. Atmospheric Physics and Dynamics
3-0-3
Prerequisite(s): PHYS 2212 and MATH 2401 and MATH 2403*
An introduction to the atmospheric physical and dynamic processes that control the weather and climate.

EAS 4200. Structural Geology and Continuum Mechanics
3-3-4
Prerequisite(s): EAS 2601 and PHYS 2211
Structural geology and continuum mechanics for scientists and civil engineers. Stress and strain in rocks; faults, joints, and folds; basic field mapping; laboratory exercises.

EAS 4500. Oceanography
3-0-3
Chemistry and physics of the ocean. Distributions of temperature, salinity, and density. Equations of state and motion. Surface and deep-water circulation. Waves and tides. Composition of seawater: Dissolved salts, gases, and nutrients. Biological processes. Marine sediments.

EAS 4420. Environmental Field Methods
2-6-4
Prerequisite(s): EAS 2600 and (EAS 3620 or EAS 4630 or EAS 4640 or EAS 4655)
Semester-long focus on single environmental project in the local area. Chemical and physical techniques for parameterizing environmental problems, data analysis, report writing, and interpretation of results in societal context.

EAS 4430. Remote Sensing and Data Analysis
2-3-3
Prerequisite(s): PHYS 2212
Introduction to the remote sensing of the atmosphere and the Earth. Laboratory examples of data and image analysis for remote sensing applications.

EAS 4450. Synoptic Meteorology
2-3-3.
Prerequisite(s): EAS 2750 and EAS 3650
A description of physical and mathematical procedures used in weather forecasting. Students will practice forecasting.

EAS 4460. Satellite and Radar Meteorology
3-0-3.
Prerequisite(s): PHYS 2212 and MATH 2403
Interpretation of satellite and radar data for meteorological forcasting based on understanding radiative transfer and the resulting strengths and limitations of the imagery.

EAS 4470. Large-scale Atmospheric Circulations
3-0-3.
Prerequisite(s): EAS 4655 or EAS 6502
Structure and dynamics of phenomena including weather regimes, storm tracks, El Nino-Southern Oscillations, teleconnections, monsoons, Arctic Oscillation, stratospheric polar vortex, and stratosphere-troposphere coupling.

EAS 4510. Exploration Geophysics
3-3-4.
Prerequisite(s): EAS 3630
Methods of exploration geophysics, including refraction and reflection seismology, resistivity, gravity, magnetics, and ground penetrating radar. Includes laboratory work and introduction to operation of field equipment.

EAS 4515. Fluids in the Earth's Crust I
3-0-3.
Prerequisite(s): (MATH 2403 or MATH 2413 or MATH 24X3) and EAS 2601
Fundamentals of porosity and permeability in soils, sediments, and crystalline rocks; basic physics of fluid flow through interconnected pore spaces and cracks; introductory analysis of fluid flow as an agent of heat and chemical transport in geological systems.

EAS 4520. Seismic Methods in Exploration Geophysics
3-0-3.
Prerequisite(s): MATH 2403 or MATH 2413 or MATH 24X3
A study of seismic reflection exploration methods and theory. Examples are taken from oil industry exploration and production and near-surface environmental imaging.

EAS 4602. Biogeochemical Cycles
3-0-3.
Prerequisite(s): EAS 3620 and EAS 3630 and EAS 3640 and (BIOL 1510 or BIOL 1520)
An investigation of global change focusing on the chemical, physical, geological, and biological processes that cycle the elements through the Earth system.

EAS 4610. Earth System Modeling
3-0-3.
Prerequisite(s): EAS 3620 or EAS 3630 or EAS 3650
An introduction to computer modeling in Earth system science.

EAS 4651. Practical Internship
0-9-3.
Faculty-supervised and approved independent internship, employment, or research project related to earth and atmospheric sciences.

EAS 4795. Groundwater Hydrology
3-0-3.
Prerequisite(s): (MATH 2403 and PHYS 2212 and CEE 3040) or EAS 3630
Dynamics of flow and solute transport in groundwater, including theory, implementation, and case studies. Crosslisted with CEE 4795.

EAS 4801, -02, -03, -04. Special Topics
Class and credit hours equal last digit of course number.

EAS 4900. Special Problems
Credit hours to be arranged.

EAS 6111. The Earth System
2-0-2.
Exploration of processes linking the Earth and atmosphere.

EAS 6120. Environmental Field Methods
3-3-4.
Environmental site characterization through a field-based project that advances student's research. Theory, field data acquisition, and data fusion using geochemical, geophysical, hydrologic, and related methods.

EAS 6122. Biogeochemical Cycles
3-0-3.
A multidisciplinary exploration of the chemical, physical, geological, and biological processes that cycle the nutrient elements through the Earth system and thereby maintain a habitable planet.

EAS 6124. Principles of Oceanography
3-0-3.
Chemistry and physics of the ocean. Distributions of temperatures, salinity, and density. Equations of state and motion. Surface and deep-water circulation, waves, and tides. Composition of seawater: dissolved salts, gases, and nutrients. Biological processes. Marine sediments.

EAS 6128. Fluids in the Earth's Crust
3-0-3.
Prerequisite(s): EAS 4515
Advanced treatment of fluid flow, heat transfer, and reactive transport in porous and cracked rocks; stability of flow; double-diffusive systems; evolution of permeability in geologic systems; introduction to multiphase flow.

EAS 6130. Earth System Modeling
3-0-3.
An introduction to computer modeling in earth system science.

EAS 6132. Introduction to Climate Change
3-0-3.
The climate of the Earth, its radiation budget, greenhouse gases and their sources and sinks, potential changes due to anthropogenic activities, detection of climate changes.

EAS 6134. Inverse Methods and Time Series Analysis in Earth and Atmospheric Sciences
3-0-3.
Theory of data acquisition, time series analysis, and discrete inverse theory, with applications in the earth and atmospheric sciences.

EAS 6211. Geochemical Thermodynamics
3-0-3.
Fundamental principles of chemical equilibria in geochemical systems with emphasis on solution properties and mineral water equilibria.

EAS 6212. Geochemical Kinetics
3-0-3.
Prerequisite(s): EAS 6211
Fundamental principles of biogeochemical kinetics and mathematical treatment of coupled transport and reaction in natural environments. Interpretation of field and experimental data using kinetic theory.

EAS 6214. Aqueous Geochemistry
3-0-3.
Prerequisite(s): EAS 6211
Chemical processes that regulate compositions of natural waters at or near the Earth's surface, with emphasis on quantitative calculations of acid-base, solubility, and redox equilibria.

EAS 6216. Isotope Geochemistry
3-0-3.
Biogeochemical significance of nuclear isotopes, both radioactive and stable.

EAS 6240. Organic Geochemistry
3-0-3.
Origin and transformation of organic matter in the Earth's environments, with emphasis on properties and reactions of highly complex mixtures such as humic substances.

EAS 6311. Physics of the Earth
3-0-3.
Physics of the Earth's interior. Composition and structure of core, mantle, crust. Introduction to seismic wave propagation, gravitational, geomagnetic, and temperature fields.

EAS 6312. Geodynamics
3-0-3.
Prerequisite(s): EAS 6311
Quantitative discussion of dynamical processes in the solid Earth; viscous flow, glacial rebound, fluid dynamical instabilities, thermal convection; lithospheric dynamics; evolution of the core.

EAS 6314. Seismology
3-0-3.
The propagation of seismic waves, the description of earthquake motion, and evaluation of earthquake damage. Examples provide experience in the interpretation of seismic data.

EAS 6320. Structural Geology and Continuum Mechanics
3-3-4.
Prerequisite(s): EAS 2601
Structural geology and continuum mechanics for scientists and civil engineers. Stress and strain in rocks; faults, joints, and folds; basic field mapping, laboratory exercises.

EAS 6401. Introduction to Atmospheric Chemistry
3-0-3.
Introduction to basic chemical principles related to chemical processes in the atmosphere.

EAS 6410. Atmospheric Chemistry
3-0-3.
Application of fundamental principles of chemistry to understanding the critical factors controlling the levels and distributions of atmospheric trace gases and their variation in time.

EAS 6412. Introduction to Physical Meteorology
3-0-3.
Prerequisite(s): MATH 2403 or MATH 2413 or MATH 24X3
Application of the fundamental principles of thermodynamics to the atmosphere; including hydrostatic equilibrium and static stability, derivation of Claussius-Clapeyron Equation, cloud microphysics, radiative transfer, and the Earth's energy budget.

EAS 6420. Introduction to Principles of Atmospheric Chemical Instrumentation
3-3-4.
Introduction to the mechanical, electrical, and optical aspects of modern instrumentation used in atmospheric chemical research.

EAS 6501. Introduction to Atmospheric Dynamics
2-0-2.
Introduction to the basic fundamental fluid dynamics that control atmospheric motions.

EAS 6502. Introductory Fluid Dynamics and Synoptic Meteorology
3-0-3.
Prerequisite(s): MATH 2403 or MATH 2413
Fundamental principles of atmospheric fluid dynamics, analysis of meteorological codes, weather data and patterns, and numerical weather prediction.

EAS 6512. Dynamic Meteorology
2-3-3.
Prerequisite(s): EAS 6502
An introduction to the use of geophysical fluid dynamics to describing and modeling the atmosphere.

EAS 6522. Dynamics of the Tropical Atmosphere and Oceans
3-0-3.
Prerequisite(s): EAS 6502
Explores the dynamics of the tropical atmosphere and ocean and how they interact to produce climatic features such as the monsoons, El Nino, and La Nina.

EAS 6532. Large-scale Atmospheric Circulations
3-0-3.
Prerequisite(s): EAS 4655 or EAS 6502
Structure and dynamics of phenomena including weather regimes, storm tracks, El Nino-Southern Oscillation, teleconnections, monsoons, Artic Oscillation, stratospheric polar vortex, and stratosphere-troposphere coupling.

EAS 6751. Physical Properties and Rheology of Rocks
2-3-3.
Structure, physical properties, and rheology of minerals and rocks with applications to engineering structures and natural phenomena in the Earth. Fundamentals of rock mechanics and crack propagation. Crosslisted with CEE 6751.

EAS 6761. Contaminated Sediment Geochemistry
3-0-3.
Prerequisite(s): EAS 6214
Acquaints students with fate of major pollutants, nutrients, organic compounds such as pesticides, PAH's, and trace metals in sedimentary systems. Crosslisted with CEE 6761.

EAS 6765. Geomicrobiology
3-0-3.
Prerequisite(s): EAS 3620 and (BIOL 4410 or BIOL 4418)
Interactions between microorganisms and the geosphere; microbial energetics and genetics; geochemical controls on microbial diversity and activity; redox and acid-base balances; biogeochemical cycles; evolution. Crosslisted with BIOL 6765.

EAS 6790. Air Pollution Physics and Chemistry
3-0-3.
Interaction to the physical and chemical processes affecting the dynamics and fate of air pollutants at the local, regional, and global scales. Particular emphasis is on tropospheric pollutant chemistry and transport. Crosslisted with CEE 6790.

EAS 6792. Air Pollution Meteorology and Chemistry
3-0-3.
Air pollution history, atmospheric stability and boundary layer dynamics, atmospheric dispersion, atmospheric transport, air pollution modeling. Crosslisted with CEE 6792.

EAS 6793. Atmospheric Boundary Layer
3-0-3.
Structure and dynamics of atmospheric boundary layers. Introduction to turbulence and turbulent transport. Crosslisted with CEE 6793.

EAS 6794. Atmospheric Chemical Modeling
3-0-3.
Prerequisite(s): EAS 6410 and (EAS 6790 or CEE 6790)
Application of modern numerical methods to the prediction of atmospheric chemical and physical compositions; specific applications using computer models developed by the students are included. Crosslisted with CEE 6794.

EAS 6795. Atmospheric Aerosols
3-0-3.
Prerequisite(s): EAS 6410 or CEE 6790 or EAS 6790
Chemical and physical properties of natural and anthropogenic aerosols. Sources, transport, transformation, and fate of primary/secondary, organic/inorganic, atmospheric semi-volatiles and aerosols. Crosslisted with CEE 6795.

EAS 7000. Master's Thesis
Credit hours to be arranged.

EAS 7999. Preparation for Ph.D. Qualifying Exam
Credit hours to be arranged.

EAS 8001. Seminar
1-0-1.
A forum for graduate students in earth and atmospheric sciences to present and discuss topics related to their research interests.

EAS 8011, -12, -13. Seminar
Class and credit hours equal last digit of course number.
A forum for graduate students in earth and atmospheric sciences to present and discuss topics related to their research interests.

EAS 8801, -02, -03, -04, -05, -06. Special Topics
Class and credit hours equal last digit of course number.

EAS 8823. Special Topics with a Laboratory
3-3-3.

EAS 8824. Special Topics with a Laboratory
3-3-4.

EAS 8825. Special Topics with a Laboratory
3-6-5.

EAS 8901, -02, -03, -04. Special Problems
Credit hours to be arranged.

EAS 8997. Teaching Assistantship
Credit hours to be arranged.

EAS 8998. Research Assistantship
Credit hours to be arranged.

EAS 8999. Preparation for Doctoral Dissertation
Credit hours to be arranged.

EAS 9000. Doctoral Thesis
Credit hours to be arranged.

An asterisk (*) denotes prerequisite courses that may be taken concurrently.

School of Mathematics

www.math.gatech.edu

Established in 1952
Location: Skiles Building
Telephone: 404.894.2700
Fax: 404.894.4409

Chair and Professor–William T. Trotter; *Coordinator of Graduate Programs and Professor*–Evans M. Harrell II; *Coordinator of Undergraduate Programs and Professor*–Yang Wang; *Director of Advising and Assessment*–Enid Steinbart; *Assistant Coordinator of Undergraduate Programs*–Rena Brakebill; *Director of Information Technology*–Lew E. Lefton.
Regents' Professors–William F. Ames (emeritus), Leonid Bunimovich, Jack K. Hale (emeritus).

Professors–Alfred D. Andrew, Johan G.F. Belinfante, Jean Bellissard, George L. Cain Jr. (emeritus), Eric A. Carlen, Shui-Nee Chow, William J. Cook (adjunct), Luca Dieci, Richard A. Duke, Laszlo Erdös, Wilfrid Gangbo, Stavros Garoufalidis, Jeffrey S. Geronimo, Jamie J. Goode (emeritus), William L. Green, Christopher Heil, James V. Herod (emeritus), Theodore P. Hill (emeritus), Christian Houdré, Robert H. Kasriel (emeritus), Robert P. Kertz, Michael T. Lacey, Thang Le, Wing Suet Li, Michael Loss, Doron Lubinsky, Gunter H. Meyer (emeritus), Konstantin Mischaikow, Thomas D. Morley, Daniel A. Robinson (emeritus), Ronald W. Shonkwiler (emeritus), M. Carl Spruill, Michael P. Stallybrass (emeritus), Andrzej Swiech, Prasad Tetali, Robin Thomas, Yung L. Tong (emeritus), Yingfei Yi, Xingxing Yu.
Associate Professors–Saguata Basu, Nathaniel Chafee (emeritus), Xu-Yan Chen, Mihai Ciucu, Mohammad Ghomi, M. Dar-Vieg Ho (emeritus), Roger D. Johnson (emeritus), John P. Line (emeritus), John McCuan, James M. Osborn (emeritus), Dana Randall (adjunct), Frank W. Stallard (emeritus).
Assistant Professors–Matthew Baker, Igor Belegradek, Federico Bonetto, Ernest Croot, Guillermo Goldsztein, Serge Guillas, Plamen Iliev, Yingjie Liu, Heinrich Matzinger, Gerd Mockenhaupt, Peter J. Mucha, Ronghua Pan, Liang Peng, Anurag Singh, Margaret Symington, Hao Min Zhou.
Academic Professional–Mona Meddin.
Instructors–Steven Demko, John Elton, Klara Grodzinsky, Cathleen Jacobson.

General Information

Mathematics forms an integral part of the curricula of most students at Georgia Tech. Consequently, the School of Mathematics offers a wide range of courses serving students in the various engineering, science, and management disciplines. In addition, the School offers programs of study leading to the bachelor's, master's, and doctoral degrees in mathematics.

Such programs of study serve as preparation for mathematics careers, professional schools, and graduate studies.

In addition to basic courses in mathematics, the School offers a variety of specialized courses at the undergraduate and graduate levels, emphasizing areas related to the research activities of the faculty. These include mathematical analysis, applied mathematics, differential equations and partial differential equations, geometry, scientific computing, probability, statistics, combinatorics, mathematical physics, topology, and algebra.

The School of Mathematics has excellent computer facilities that are used in conjunction with an increasing number of courses and programs of study. A cooperative plan for students who wish to combine practical experience with academic work is available for mathematics majors.

Undergraduate Programs

The School of Mathematics offers programs leading to two undergraduate degrees: the Bachelor of Science in Applied Mathematics and the Bachelor of Science in Discrete Mathematics. Both programs emphasize the study of core mathematics as well as its applications. They provide excellent preparation for employment as well as graduate study in mathematics and related fields.

Applied Mathematics

Reflecting the scientific environment at Georgia Tech, the bachelor's program in applied mathematics trains students in the traditional core mathematics curriculum, as well as in its applications. The undergraduate program is sufficiently flexible to accommodate the wide variety of interests of undergraduate majors, and yet by its scientific breadth, it prepares the student for the extensive employment opportunities that exist for applied mathematicians. Students are encouraged to develop an expertise in another field related to mathematics. This can be accomplished by developing a program of study involving technical electives and an appropriate concentration within mathematics. Some of the more popular fields include physics, computer science, electrical engineering, industrial engineering, operations research, and economics. The School of Mathematics has a large, well networked computer lab that is utilized in courses throughout the undergraduate curriculum.

In addition to the institutional requirement of at least a 2.0 grade point average for the entire academic program, the School of Mathematics requires a grade of *C* or better in each of MATH 4107, 4317, 4318, and 4320. Students may count

no more than two hours of coursework in physical education toward graduation. Only free electives or MATH 4999 in the degree program may be taken on a pass/fail basis, and no more than nine hours are allowed under this option.

Bachelor of Science in Applied Mathematics (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
WELLNESS		2
CS 1321	INTRO. TO COMPUTING	3
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		15

First Year - Second Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II	4
LAB SCIENCE (BIOL, CHEM, EAS)		4
CS 1322	OBJECT-ORIENTED PROGRAMMING	3
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Second Year - First Semester

Course Number/Name		*Hours*
MATH 2401	CALCULUS III	4
PHYS 2211	INTRODUCTORY PHYSICS I	4
HUMANITIES ELECTIVE(S)		3
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		14

Second Year - Second Semester

Course Number/Name		*Hours*
MATH 2406	ABSTRACT VECTOR SPACES	3
MATH 2403	DIFFERENTIAL EQUATIONS	4
PHYS 2212	INTRODUCTORY PHYSICS II	4
HUMANITIES ELECTIVE(S)		3
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Third Year - First Semester

Course Number/Name		*Hours*
MATH 3012	APPLIED COMBINATORICS	3
ENGINEERING or SCIENCE ELECTIVE(S) (3000 Level)		3
MATH ELECTIVE(S)		6
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Third Year - Second Semester

Course Number/Name		*Hours*
MATH 3215	PROBABILITY & STATISTICS	4
MATH ELECTIVE(S) (3000 Level)		9
ENGINEERING or SCIENCE ELECTIVE(S) (3000 Level)		3
TOTAL SEMESTER HOURS		15

Fourth Year - First Semester

Course Number/Name		*Hours*
MATH 4107	ABSTRACT ALGEBRA I	3
MATH 4640	NUMERICAL ANALYSIS I	3
MATH 4317	ANALYSIS I	3
PHYS ELECTIVE(S) (3000 Level)		3
FREE ELECTIVE(S)		2
TOTAL SEMESTER HOURS		14

Fourth Year - Second Semester

Course Number/Name		*Hours*
MATH 4518	ANALYSIS II	3
MATH 4320	COMPLEX ANALYSIS	3
FREE ELECTIVE(S)		9
TOTAL SEMESTER HOURS		15

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Substitutions

Honors physics and mathematics courses may be substituted for the corresponding regular courses.

Electives

Math Electives

Mathematics courses at the 3000 level or higher, with the exception of MATH 3770, and certain Special Topics Classes.

Engineering or Science Electives

The School of Mathematics requires that students complete two courses (total six hours) of engineering or science electives at the 3000 level or higher. These courses must be taken from the same approved school. The following schools are approved: College of Sciences–Biology, Chemistry and Biochemistry, Earth and Atmospheric Sciences, Physics, and Psychology; College of Engineering–all engineering schools; College of Computing; and Ivan Allen College–Economics.

Humanities and Social Sciences Electives

Six credit hours of humanities are required in addition to ENGL 1101 and ENGL 1102. The School of Mathematics recommends that students take a one-year sequence of courses in a modern language. All students must satisfy a state requirement regarding coursework in the history and constitutions of the United States and Georgia by taking one course from HIST 2111, HIST 2112, INTA 1200, POL 1101, or PUBP 3000. An additional nine credit hours of social sciences are required.

Discrete Mathematics

Certain areas of mathematics have become increasingly important over the past twenty years due to the introduction of computing into nearly every aspect of science, technology, and business. These are the branches of mathematics that are devoted to the study of "discrete" as opposed to "continuous" structures. The methods of discrete mathematics are used whenever objects are to be counted, when the relationships between finite sets are examined, and when processes involving a finite number of steps are studied. These methods become essential when, for example, computer algorithms are analyzed, transportation networks or communications systems are designed, or when optimal schedules are sought. Many problems associated with the transmission and storage of information, the design of complicated circuits, or the identification of organic chemicals require the tools of discrete mathematics. Several fields of application, most notably operations research and computer science, not only use the techniques of discrete mathematics, but have also contributed significantly to the development of the subject. For this reason, the curriculum for this bachelor's degree program combines basic work in mathematics and science and advanced studies in discrete mathematics with substantial training in these areas of application. After completion of the program's core requirements in the first two years, students take fifteen hours of mathematics, nine to ten hours of computer science, and six hours of industrial and systems engineering. The program requires nine hours of approved technical electives. The list of approved technical electives includes mathematics, computing, electrical engineering, and operations research. Four hours for the senior research project and twelve hours of free electives complete the program. In addition to the Institute requirement of a grade point average of at least 2.0, the School of Mathematics requires a *C* or better in each of MATH 4022, 4107, and 4317. Students may count no more than two hours of coursework in physical education toward graduation. Only free electives or MATH 4999 in the degree program may be taken on a pass/fail basis, and no more than nine hours are allowed under this option.

Bachelor of Science in Discrete Mathematics (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
WELLNESS		2
CS 1321	INTRO. TO COMPUTING	3
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		15

First Year - Second Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II	4
LAB SCIENCE (BIO, CHEM, EAS)		4
CS 1322	OBJECT-ORIENTED PROGRAMMING	3
CS 1050	UNDERSTANDING & CONSTRUCTING PROOFS	3
TOTAL SEMESTER HOURS		17

Second Year - First Semester

Course Number/Name		*Hours*
MATH 2401	CALCULUS III	4
PHYS 2211	INTRODUCTORY PHYSICS I	4
HUMANITIES ELECTIVE(S)		3
SOCIAL SCIENCE ELECTIVE(S)		6
TOTAL SEMESTER HOURS		17

Second Year - Second Semester

Course Number/Name		*Hours*
MATH 2406	ABSTRACT VECTOR SPACES	3
MATH 2602	LINEAR & DISCRETE MATHEMATICS	4
PHYS 2212	INTRODUCTORY PHYSICS II	4
HUMANITIES ELECTIVE(S)		3
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Third Year - First Semester

Course Number/Name		*Hours*
MATH 3012	APPLIED COMBINATORICS	3
CS 3510	DESIGN & ANALYSIS OF ALGORITHMS	3
CS 2335 (3) & FREE ELECTIVE(S) (7) or CS 2110 (4) & FREE ELECTIVE(S) (6)		10
TOTAL SEMESTER HOURS		16

Third Year - Second Semester

Course Number/Name		*Hours*
MATH 3215	PROBABILITY & STATISTICS	3
ISYE 4231	ENGINEERING OPTIMIZATION	3
CS 4510	AUTOMATA & COMPLEXITY THEORY	3
TECHNICAL ELECTIVE(S)		3
TOTAL SEMESTER HOURS		12

Fourth Year - First Semester

Course Number/Name		*Hours*
MATH 4080	SENIOR PROJECT I	2
MATH 4107	ABSTRACT ALGEBRA I	3
MATH 4022	INTRO. TO GRAPH THEORY	3
MATH 4317	ANALYSIS I	3
TECHNICAL ELECTIVE(S)		3
TOTAL SEMESTER HOURS		14

Fourth Year - Second Semester

Course Number/Name		*Hours*
MATH 4090	SENIOR PROJECT II	2
ISYE 3232	STOCHASTIC MANUFACTURING & SERVICE SYSTEMS	3
TECHNICAL ELECTIVE(S)		5
FREE ELECTIVE(S)		6
TOTAL SEMESTER HOURS		14

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Substitutions

MATH 4580 may be substituted for ISYE 4231. Honors physics and math courses may be substituted for the corresponding regular courses.

Electives

Technical Electives

Students must complete nine hours of technical electives from the following list: MATH 2403, 4012, 4032, 4150, 4221, 4222, 4255, 4261, 4262, 4280, 4318, 4320, 4431, 4432, 4640, 4641, 4777; CS 2220, 3220, 3251, 4240, 4260, 4451; ISYE 3103, 3104, 3044, 4833; ECE 2025, 2030, 2031, 3055, 3075, 3085, 4270.

Humanities and Social Sciences Electives

Six credit hours of humanities are required in addition to ENGL 1101 and ENGL 1102. The School of Mathematics recommends that students take a one-year sequence of courses in a modern language. All students must satisfy a state requirement regarding coursework in the history and constitutions of the United States and Georgia by taking one course from HIST 2111, HIST 2112, INTA 1200, POL 1101, or PUBP 3000. An additional nine credit hours of social sciences are required.

Minor in Mathematics

A student may earn a Minor in Mathematics by fulfilling, in addition to the general Institute requirements, the requirements in one of the two tracks specified below.

Track I

MATH 4317, Math 4107, Math 4305, and nine additional hours of 3000-level or higher mathematics courses.

Track II

At least nine hours in one of the following fields:

i) Analysis: MATH 4317, 4318, 4320, 4581, 4640, 4641

ii) Algebra and Number Theory: MATH 4012, MATH 4107, 4108, 4150, 4305

iii) Probability and Statistics: MATH 3215, 3770, 4221, 4222, 4225, 4261, 4262, 4280

iv) Dynamics and Differential Equations: MATH 4347, 4348, 4541, 4542, 4581

v) Discrete Mathematics: MATH 3012, 4012, 4022, 4032, 4580

vi) Geometry and Topology: MATH 4431, 4432, 4441

Nine additional hours of 3000-level or higher mathematics courses are also required.

For further information, consult the departmental advisor.

Further Rules

1. No more than four semester hours of Special Topics courses may be used.
2. No Special Problems or Internship coursework may be used.
3. All coursework in the program must be completed with an overall grade point average of at least 2.0.
4. Courses must be completed on a letter grade mode.
5. No more than two minors may be awarded with a degree. Each must contain eighteen semester hours not used in the other minor.
6. Courses required by name and number in a student's major degree program may not be used in satisfying the minor requirement.

For further information, consult the departmental advisor.

Business Option

The School of Mathematics offers a Business Option variant of both undergraduate degree programs. This option is designed for students who wish to acquire and document the skills and knowledge needed for success as a scientific entrepreneur. Students electing this option complete the degree requirements for Applied Mathematics or for Discrete Mathematics as listed above, except that:

- two of their social science electives must be PSYC 2220 Industrial/Organic Psychology (3) and ECON 2106 Principles of Microeconomics (3);
- the two courses MGT 3000 accounting (3) and MGT 3300 Marketing Management I (3) replace the six hours of Engineering or Science Electives in the Applied Mathematics program, and replace six hours of the nine hours of Technical Electives in the Discrete Mathematics program; and
- MGT 3150 Principles of Management (3) replaces three hours of free electives.

For further information, consult a School of Mathematics advisor.

Bachelor of Science in Applied Mathematics – Business Option (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
WELLNESS		2
CS 1321	INTRO. TO COMPUTING	3
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		15

First Year - Second Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II	4
LAB SCIENCE (BIOL, CHEM, EAS)		4
CS 1322	OBJECT-ORIENTED PROGRAMMING	3
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Second Year - First Semester

Course Number/Name		*Hours*
MATH 2401	CALCULUS III	4
PHYS 2211	INTRODUCTORY PHYSICS I	4
HUMANITIES ELECTIVE(S)		3
PSYC 2220	INDUSTRIAL/ORGANIZ. PSYCH.	3
TOTAL SEMESTER HOURS		14

Second Year - Second Semester

Course Number/Name		*Hours*
MATH 2406	ABSTRACT VECTOR SPACES	3
MATH 2403	DIFFERENTIAL EQUATIONS	4
PHYS 2212	INTRODUCTORY PHYSICS II	4
ECON 2106	PRINCIPLES OF MICROECONOMICS	3
TOTAL SEMESTER HOURS		14

Third Year - First Semester

Course Number/Name		*Hours*
MATH 3012	APPLIED COMBINATORICS	3
MGT 3000	ACCOUNTING FOR DECISION MAKING	3
MATH ELECTIVE(S) (3000 Level)		6
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Third Year - Second Semester

Course Number/Name		Hours
MATH 3215	PROBABILITY & STATISTICS	3
MATH ELECTIVE(S) (3000 Level)		9
MGT 3300	MARKETING MANAGEMENT I	3
TOTAL SEMESTER HOURS		15

Fourth Year - First Semester

Course Number/Name		Hours
MATH 4107	ABSTRACT ALGEBRA I	3
MATH 4640	NUMERICAL ANALYSIS I	3
MATH 4317	ANALYSIS I	3
PHYS ELECTIVE(S) (3000 Level)		3
MGT 3150	PRINCIPLES OF MANAGEMENT	3
TOTAL SEMESTER HOURS		15

Fourth Year - Second Semester

Course Number/Name		Hours
MATH 4318	ANALYSIS II	3
MATH 4320	COMPLEX ANALYSIS	3
FREE ELECTIVE(S)		8
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Bachelor of Science in Discrete Mathematics - Business Option (Suggested Schedule)

First Year - First Semester

Course Number/Name		Hours
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
WELLNESS		2
CS 1321	INTRO. TO COMPUTING	3
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		15

First Year - Second Semester

Course Number/Name		Hours
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II	4
LAB SCIENCE (BIOL, CHEM, EAS)		4
CS 1322	OBJECT-ORIENTED PROGRAMMING	3
CS 1050	UNDERSTANDING & CONSTRUCTING PROOFS	3
TOTAL SEMESTER HOURS		17

Second Year - First Semester

Course Number/Name		Hours
MATH 2401	CALCULUS III	4
PHYS 2211	INTRODUCTORY PHYSICS I	4
HUMANITIES ELECTIVE(S)		3
PSYC 2220	INDUSTRIAL/ORGANIZ. PSYCH.	3
SOCIAL SCIENCE ELECTIVE(S)		6
TOTAL SEMESTER HOURS		17

Second Year - Second Semester

Course Number/Name		Hours
MATH 2406	ABSTRACT VECTOR SPACES	3
MATH 2602	LINEAR & DISCRETE MATHEMATICS	4
PHYS 2212	INTRODUCTORY PHYSICS II	4
ECON 2106	PRINCIPLES OF MICROECONOMICS	3
TOTAL SEMESTER HOURS		17

Third Year - First Semester

Course Number/Name		Hours
MATH 3012	APPLIED COMBINATORICS	3
CS 2335 (3) & FREE ELECTIVE(S) (4) or CS 2110 (4) & FREE ELECTIVE(S) (3)		7
CS 3510	DESIGN & ANALYSIS OF ALGORITHMS	3
MGT 3000	ACCOUNTING FOR DECISION MAKING	3
TOTAL SEMESTER HOURS		16

Third Year - Second Semester

Course Number/Name		Hours
MATH 3215	PROBABILITY & STATISTICS	3
CS 4510	AUTOMATA & COMPLEXITY THEORY	3
ISYE 4231	ENGINEERING OPTIMIZATION	3
MGT 3300	MARKETING MANAGEMENT I	3
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Fourth Year - First Semester

Course Number/Name		Hours
MATH 4080	SENIOR PROJECT I	2
MATH 4107	ABSTRACT ALGEBRA I	3
MATH 4022	INTRO. TO GRAPH THEORY	3
MATH 4317	ANALYSIS I	3
MGT 3150	PRINCIPLES OF MANAGEMENT	3
TOTAL SEMESTER HOURS		14

Fourth Year - Second Semester

Course Number/Name		Hours
MATH 4090	SENIOR PROJECT II	2
ISYE 3232	STOCHASTIC MANUFACTURING & SERVICE SYSTEMS	3
TECHNICAL ELECTIVE(S)		3
FREE ELECTIVES(S)		6
TOTAL SEMESTER HOURS		14

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Graduate Programs

The School of Mathematics provides opportunities for study in a wide range of mathematical disciplines. First-year graduate sequences include algebra, analysis, differential equations, geometry, numerical analysis, probability, quantitative finance, statistics, and topology in addition to courses in methods of applied mathematics.

A program of study leading to a master's degree in applied mathematics should include analysis consisting of MATH 6327 and either MATH 6580 or MATH 7334. In addition, students should take six hours of coursework, subject to the approval of the School of Mathematics, at the 4000 level or higher outside the School. The remaining eighteen hours required may be taken under a thesis option or under a non-thesis option. Under the thesis option, the program must include a thesis (nine thesis hours) and nine additional hours of coursework at the 4000 level or higher, six hours of which must be in mathematics at the 6000 level or higher. Under the non-thesis option, the program must include eighteen additional hours of coursework at the 4000 level or higher, with at least twelve hours at the 6000 level or higher in mathematics. Under the non-thesis option, the program must also include a concentration consisting of six hours of coursework at the 6000 level or higher in a field of mathematics chosen in consultation with the student's advisor, and a sufficient number of hours at the 6000 level or higher to ensure that the program includes a total of at least twenty-one hours at this level. Under either of these options, MATH 6701 and 6702, as well as all courses required by number for the Bachelor of Science in Applied Mathematics (MATH 3012, 3215, 4107, 4317, 4318, 4320, and 4640), do not carry degree credit for graduate mathematics majors and may not be used to fulfill these degree requirements.

Students must maintain an overall grade point average of at least 3.0 and receive a grade of *C* or better in each mathematics course in the program of study.

Before admission to candidacy for the master's degree, each student must pass either a master's oral comprehensive examination or the written portion of the mathematics doctoral comprehensive examination.

The doctoral program in Mathematics requires fifty-one hours of coursework, with grades of *C* or better, beyond the undergraduate degree. At least thirty-six hours, chosen to the satisfaction of the student's research advisor and the School's Graduate Committee, must be taken at the 6000 level in mathematics, and a further nine hours must be taken outside the School of Mathematics at the 4000 level or higher in the student's minor field of study. The program must also include six additional hours at the 6000 level. Work on a master's thesis (thesis hours) may not be counted toward any of the fifty-one hours specified above, but coursework for the master's degree may be counted. At least six hours of the minor should be completed within three years of the student's admission to the doctoral program.

Prior to admission to candidacy for the doctoral degree, each student must pass the comprehensive examination, which consists of a written examination in real analysis and algebra and an oral examination in the student's proposed area of specialization. Doctoral students must also satisfy the Institute requirements with respect to the dissertation and final oral examination.

Center for Dynamical Systems and Nonlinear Studies

As part of the research and graduate programs in the School of Mathematics, the Center for Dynamical Systems and Nonlinear Studies sponsors distinct but interrelated activities in dynamical systems, differential equations, and algebra and applications. The Center, directed by Professor Konstantin Mischaikow, offers postdoctoral and visiting faculty appointments as well as financial aid to graduate students affiliated with the Center.

Southeastern Applied Analysis Center

Georgia Tech's Southeastern Applied Analysis Center, directed by Professor Leonid Bunimovich,

is a regional resource for research and education in applied mathematics, and for outreach to industry. The Center sponsors regional and international conferences and organizes focused research in many areas of mathematics and applications.

Doctoral Programs

Algorithms, Combinatorics, and Optimization

One of the most rapidly growing areas of research in applied mathematics, computer science, and operations research has been dealing with discrete structures. This has been most evident in the fields of combinatorics, discrete optimization, and the analysis of algorithms. Increasingly, work in each of these subjects has come to depend on knowledge of all of them. Indeed, many of the most significant advances have resulted from the efforts of researchers in more than one, if not all three, of these areas.

In response to these developments, Georgia Tech has introduced a doctoral degree program in Algorithms, Combinatorics, and Optimization (ACO). This multidisciplinary program is sponsored jointly by the School of Mathematics, the School of Industrial and Systems Engineering, and the College of Computing. Faculty for the program are drawn from these three sponsoring units, as well as from the School of Electrical and Computer Engineering and the College of Management.

The ACO program is arranged to bring together the study of discrete structures and the design and analysis of algorithms in areas such as graph theory, integer programming, combinatorial optimization, and polyhedral theory. It is intended for students possessing a strong background in one or more of the fields represented by the three sponsoring units. Each student in the program has a single home department chosen from the School of Mathematics, the School of Industrial and Systems Engineering, and the College of Computing. Courses for the program are drawn from all three of these units, and include study in such areas as combinatorial methods, algebraic structures, probability, the analysis of algorithms, computational complexity, linear programming, discrete optimization, and convex analysis.

Bioinformatics

For information concerning the doctoral program in bioinformatics, refer to page 355.

Interdisciplinary Master's Degree Programs

Program in Statistics

For information concerning the graduate program in statistics, refer to page 191.

Program in Quantitative and Computational Finance

The Master of Science degree program in Quantitative and Computational Finance (M.S.Q.C.F.) is a multidisciplinary program under the provost of the Georgia Institute of Technology, with home units of the College of Management, the School of Mathematics, and the School of Industrial and Systems Engineering.

The main objective of the M.S.Q.C.F. degree program is to provide students with the practical skills and theoretical understanding they need to be leaders in the formulation, implementation, and evaluation of the models used by the financial sector to structure transactions, manage risk, and construct investment strategies.

The M.S.Q.C.F. program is well structured both to cover the fundamentals needed to understand and model a wide variety of problems in finance, and to allow specialization to build expertise in specific approaches, techniques, and problem areas. For the fundamentals, the M.S.Q.C.F. program emphasizes both foundational concepts within finance and also the principles and techniques needed for the formulation, implementation, and testing of financial models. The program is not just centered on one type of problem; students develop expertise for a range of career paths that use quantitative and computational reasoning. For their area of specialization, students are encouraged to develop expertise that draws on the strengths present in the many related quantitative, computational, and mathematical areas present at Georgia Tech.

The prerequisites of the M.S.Q.C.F. program include:

- interest in the problems of finance, and a high level of mathematical ability that has been demonstrated within past performance on appropriate coursework and standardized testing;
- mathematical background – a working knowledge of calculus (differential and integral calculus of one variable, the multivariate calculus, fundamentals of linear algebra and linear systems of equations, and differential equations)
  and undergraduate calculus-based probability and statistics;
- basic programming background – basic knowledge of a programming language such as MatLab programming, Visual Basic, C, or Fortran; and
- Institute and academic unit requirements for admission to graduate study

Master of Science in Quantitative and Computational Finance Curriculum Requirements

Required Core Courses (eighteen semester hours)
- MGT 6078
  Finance and Investments
- MGT 6081
  Derivative Securities
- MATH 6635
  Numerical Methods in Finance
- ISYE/MATH 6759
  Stochastic Processes in Finance I
- ISYE/MATH 6767
  Design and Implementation of Systems to Support Computational Finance
- ISYE/MATH/MGT 6769
  Fixed Income Securities

Three semester hours from the following:
- ISYE 6673
  Financial Optimization Models
- MATH 6235
  Stochastic Processes in Finance II
- MGT 6090
  Management of Financial Institutions

Six semester hours from the following:
- ISYE/MATH 6783
  Statistical Techniques of Financial Data Analysis
- ISYE/MATH/MGT 6785
  The Practice of Quantitative and Computational Finance
- MGT 7061
  Empirical Finance

Nine semester hours of free electives at the 6000 level or higher

Total semester hours: Thirty-six

For the nine semester hours of free electives at the 6000 level or higher, students choose at least three additional electives from the above electives categories or from other courses. Students are encouraged to choose electives to develop expertise within a specific area such as statistical data analysis, economic analysis, finance, risk management/optimization, or model implementation. It is strongly recommended that students who do not have previous coursework in economics take ECON 6100 Economic Analysis for Managers (or its equivalent).

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

MATHEMATICS

MATH 1113. Precalculus
4-0-4.
Analytic geometry, the function concept, polynomials, exponential, logarithms, trigonometric functions, mathematical induction, and the theory of equations. May only be used for degree credit with departmental approval.

MATH 1501. Calculus I
4-0-4.
Prerequisite(s): MATH 1113 or 802 550
Differential calculus and basic integral calculus including the fundamental theorem of calculus and Taylor's theorem with remainder. Credit not allowed for both MATH 1501 and 1712.

MATH 1502. Calculus II
4-0-4.
Prerequisite(s): MATH 1501 or MATH 1511 or MATH 15X1
This course concludes the treatment of single variable calculus and begins linear algebra, the linear basis of the multivariable theory.

MATH 1511. Honors Calculus I
4-0-4.
The topics covered parallel those of 1501 with a somewhat more intensive and rigorous treatment. Credit not allowed for both honors calculus and the corresponding regular calculus course.

MATH 1512. Honors Calculus II
4-0-4.
Prerequisite(s): MATH 1501 or MATH 1511
The topics covered parallel those of 1502 with a somewhat more intensive and rigorous treatment. Credit not allowed for both honors calculus and the corresponding regular calculus course.

MATH 1522. Linear Algebra for Calculus
2-0-2.
Prerequisite(s): MATH 15X2
Basic topics in linear algebra, such as covered in MATH 1502, and needed for MATH 2401. May not be taken for credit by students who have taken MATH 1502.

MATH 1601. Introduction to Higher Mathematics
3-0-3.
Prerequisite(s): MATH 1501 or MATH 1511 or MATH 15X1
This course is designed to teach problem solving and proof writing. Mathematical subject matter is drawn from elementary number theory and geometry.

MATH 1711. Finite Mathematics
4-0-4.
Prerequisite(s): S02 550
Linear equations, matrices, linear programming, sets and counting, probability, and statistics.

MATH 1712. Survey of Calculus
4-0-4.
Prerequisite(s): MATH 1113 or S02 550
Techniques of differentiation, integration, application of integration to probability and statistics, multidimensional calculus. Credit not allowed for both MATH 1712 and 1501.

MATH 2401. Calculus III
4-0-4.
Prerequisite(s): MATH 1502 or MATH 1512 or (MATH 15X2 and MATH 1522)
Multivariable calculus: Linear approximation and Taylor's theorems, Lagrange multiples and constrained optimization, multiple integration and vector analysis including the theorems of Green, Gauss, and Stokes.

MATH 2403. Differential Equations
4-0-4.
Prerequisite(s): MATH 1502 or MATH 1512 or (MATH 15X2 and MATH 1522)
Methods for obtaining numerical and analytic solutions of elementary differential equations. Applications are also discussed with an emphasis on modeling.

MATH 2406. Abstract Vector Spaces
3-0-3.
Prerequisite(s): MATH 1502 or MATH 1512 or (MATH 15X2 and MATH 1522)
A proof-based development of linear algebra and vector spaces, with additional topics such as multilinear algebra and group theory.

MATH 2411. Honors Calculus III
4-0-4.
Prerequisite(s): MATH 1502 or MATH 1512
The topics covered parallel those of MATH 2401 with a somewhat more intensive and rigorous treatment. Credit is not allowed for both honors calculus and the corresponding regular calculus course.

MATH 2413. Honors Differential Equations
4-0-4.
Prerequisite(s): MATH 2401 or MATH 2411 or MATH 2605
The course treats the theory of ordinary differential equations from an advanced perspective, delving into the theory as well as computational aspects. It is designed for mathematics majors and others who wish to take advanced courses in the area.

MATH 2602. Linear and Discrete Mathematics
4-0-4.
Prerequisite(s): MATH 2401 or MATH 2411 or MATH 24X1 or MATH 2605
Topics in linear algebra, sequences, differences, finite sums and difference equations, multivariate optimization with an emphasis in discrete and recursive methods.

MATH 2605. Calculus III for Computer Science
4-0-4.
Prerequisite(s): MATH 1502 or MATH 1512 or (MATH 15X2 and MATH 1522)
Topics in linear algebra and multivariate calculus and their applications in optimization and numerical methods, including curve fitting, interpolation, and numerical differentiation and integration.

MATH 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

MATH 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

MATH 2801, -02, -03, -04, -05. Special Topics
Class and credit hours equal last digit of course number.
Courses on special topics of current interest in mathematics.

MATH 3012. Applied Combinatorics
3-0-3.
Prerequisite(s): MATH 1502 or MATH 1512 or (MATH 15X2 and MATH 1522) or MATH 1711
Elementary combinatorial techniques used in discrete problem solving: counting methods, solving linear recurrences, graph and network models, related algorithms, and combinatorial designs. Must have at least twelve hours of mathematics to take this course.

MATH 3022. Honors Applied Combinatorics
3-0-3.
Prerequisite(s): MATH 1502 or MATH 1512 or (MATH 15X2 and MATH 1522)
Topics are parallel to those of MATH 3012 with a more rigorous and intensive treatment. Credit is not allowed for both MATH 3012 and 3022.

MATH 3215. Introduction to Probability and Statistics
3-0-3.
Prerequisite(s): MATH 2401 or MATH 2411 or MATH 24X1 or MATH 2605
This course is a problem-oriented introduction to the basic concepts of probability and statistics, providing a foundation for applications and further study.

MATH 3225. Honors Probability and Statistics
3-0-3.
Prerequisite(s): MATH 2401 or MATH 2411 or MATH 2605
The topics covered parallel those of MATH 3215, with a more rigorous and intensive treatment. Credit is not allowed for both MATH 3215 and 3225.

MATH 3770. Statistics and Applications
3-0-3
Prerequisite(s): MATH 2401 or MATH 2411 or MATH 24X1
Introduction to probability, probability distributions, point estimation, confidence intervals, hypothesis testing, linear regression, and analysis of variance. Math majors may not take this course for credit. Crosslisted with ISYE 3770 and CEE 3770.

MATH 3801, -02, -03, -04, -05. Special Topics
Class and credit hours equal last digit of course number.
Courses on special topics of current interest in mathematics.

MATH 4012. Algebraic Structures in Coding Theory
3-0-3.
Prerequisite(s): MATH 1502 or MATH 1512 or (MATH 15X2 and MATH 1522)
Introduction to linear error correcting codes with an emphasis on the algebraic tools required, including matrices vector spaces, groups, polynomial rings, and finite fields.

MATH 4022. Introduction to Graph Theory
3-0-3.
Prerequisite(s): MATH 3012 or MATH 3022
The fundamentals of graph theory: trees, connectivity, Euler tours, Hamilton cycles, matchings, colorings, and Ramsey theory.

MATH 4032. Combinatorial Analysis
3-0-3.
Prerequisite(s): MATH 3012 or MATH 3022
Combinatorial problem-solving techniques including the use of generating functions, recurrence relations, Polya theory, combinatorial designs, Ramsey theory, matroids, and asymptotic analysis.

MATH 4080. Senior Project I
2-0-2.
The first of a two-course sequence of faculty-directed independent research culminating in the writing of a senior thesis and its presentation.

MATH 4090. Senior Project II
2-0-2.
The second course of a two-course sequence of faculty-directed independent research culminating in the writing of a senior thesis and its presentation.

MATH 4107. Abstract Algebra I
3-0-3.
Prerequisite(s): MATH 2406
This course develops in the theme of "Arithmetic congruence and abstract algebraic structures." Strong emphasis on theory and proofs.

MATH 4108. Abstract Algebra II
3-0-3.
Prerequisite(s): MATH 4107
Continuation of Abstract Algebra I, with emphasis on Galois theory, modules, polynomial fields, and the theory of linear associative algebra.

MATH 4150. Introduction to Number Theory
3-0-3.
Prerequisite(s): MATH 2406
Primes and unique factorization, congruences, Chinese remainder theorem, Diophantine equations, Diophantine approximations, quadratic reciprocity. Applications such as fast multiplication, factorization, and encryption.

MATH 4221. Stochastic Processes I
3-0-3.
Prerequisite(s): MATH 3215 or MATH 3225
Simple random walk and the theory of discrete time Markov chains.

MATH 4222. Stochastic Processes II
3-0-3.
Prerequisite(s): MATH 4221
Renewal theory, Poisson processes and continuous time Markov processes, including an introduction to Brownian motion and martingales.

MATH 4255. Monte Carlo Methods
3-0-3.
Prerequisite(s): (MATH 3215 or MATH 3225) and CS 1322
Probability distributions, limit laws, and applications through the computer.

MATH 4261. Mathematical Statistics I
3-0-3.
Prerequisite(s): MATH 3215 or MATH 3225
Sampling distributions, Normal, t, chi-square, and f distributions. Moment-generating function methods, Bayesian estimation, and introduction to hypothesis testing.

MATH 4262. Mathematical Statistics II
3-0-3.
Prerequisite(s): MATH 4261
Hypothesis testing, likelihood ratio tests, nonparametric tests, bivariate, and multivariate normal distributions.

MATH 4280. Introduction to Information Theory
3-0-3.
Prerequisite(s): MATH 3215 or MATH 3225
The measurement and quantification of information. These ideas are applied to the probabilistic analysis of the transmission of information over a channel along which random distortion of the message occurs.

MATH 4305. Topics in Linear Algebra
3-0-3.
Prerequisite(s): MATH 1502 or MATH 1512 or (MATH 15X2 and MATH 1522)
Finite dimensional vector spaces, inner product spaces, least squares, linear transformations, the spectral theorem for normal transformations. Applications to convex sets, positive matrices, difference equations.

MATH 4317. Analysis I
3-0-3.
Prerequisite(s): MATH 2406
Real numbers, topology of Euclidean spaces, Cauchy sequences, completeness, continuity and compactness, uniform continuity, series of functions, Fourier series.

MATH 4318. Analysis II
3-0-3.
Prerequisite(s): MATH 4317
Differentiation of functions of one real variable, Riemann-Stieltjes integral, the derivative in Rn, and integration in Rn.

MATH 4320. Complex Analysis
3-0-3.
Prerequisite(s): MATH 1502 or MATH 1512 or (MATH 15X2 and MATH 1522)
Topics from complex function theory, including contour integration and conformal mapping.

MATH 4347. Partial Differential Equations I
3-0-3.
Prerequisite(s): MATH 2406 and (MATH 2403 or MATH 2413 oor MATH 24X3)
Method of characteristics for first- and second-order partial differential equations, conservation laws and shocks, classification of second-order systems and applications.

MATH 4348. Partial Differential Equations II
3-0-3.
Prerequisite(s): MATH 4347
Green's functions and fundamental solutions. Potential, diffusion, and wave equations.

MATH 4431. Introduction to Topology
3-0-3.
Prerequisite(s): MATH 4317
Point set topology, topological spaces and metric spaces, continuity and compactness, homotopy, and covering spaces.

MATH 4432. Introduction to Algebraic Topology
3-0-3.
Prerequisite(s): MATH 4317
Introduction to algebraic methods in topology. Includes homotopy, the fundamental group, covering spaces, simplicial complexes. Applications to fixed-point theory and group theory.

MATH 4441. Differential Geometry
3-0-3.
Prerequisite(s): MATH 2401 or MATH 2411 or MATH 24X1 or MATH 2605
The theory of curves, surfaces, and more generally, manifolds. Curvature, parallel transport, covariant differentiation, Gauss-Bonet theorem.

MATH 4541. Dynamics and Bifurcations I
3-0-3.
Prerequisite(s): MATH 2403 or MATH 2413 or MATH 24X3
A broad introduction to the local and global behavior of nonlinear dynamical systems arising from maps and ordinary differential equations.

MATH 4542. Dynamics and Bifurcations II
3-0-3.
Prerequisite(s): MATH 4541
A continuation of Dynamics and Bifurcations I.

MATH 4580. Linear Programming
3-0-3.
Prerequisite(s): MATH 1502 or MATH 1512 or (MATH 15X2 and MATH 1522) or MATH 1712
A study of linear programming problems, including the simplex method, duality, and sensitivity analysis with applications to matrix games, interger programming, and networks.

MATH 4581. Classical Mathematical Methods in Engineering
3-0-3.
Prerequisite(s): MATH 2403 or MATH 2413
The Laplace transform and applications, Fourier series, boundary value problems for partial differential equations.

MATH 4640. Numerical Analysis I
3-0-3.
Prerequisite(s): MATH 2403 or MATH 2413 or MATH 24X3 or MATH 2602
Introduction to numerical algorithms for some basic problems in computational mathematics. Discussion of both implementation issues and error analysis.

MATH 4641. Numerical Analysis II
3-0-3.
Prerequisite(s): MATH 4640
Introduction to the numerical solution of initial and boundary value problems in differential equations.

MATH 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

MATH 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

MATH 4755. Mathematical Biology
3-0-3.
Prerequisite(s): MATH 1502 or MATH 1512 or (MATH 15X2 and MATH 1522)
Problems from the life sciences and the mathematical methods for solving them are presented. The underlying biological and mathematical principles and the interrelationships are emphasized. Crosslisted with BIOL 4755.

MATH 4777. Vector and Parallel Scientific Computation
3-0-3.
Prerequisite(s): MATH 1502 or MATH 1512 or (MATH 15X2 and MATH 1522)
Scientific computational algorithms on vector and parallel computers. Speed-up and algorithm complexity, interprocesses communication, synchronization, modern algorithms for linear systems, programming techniques, code optimization. Crosslisted with CS 4777.

MATH 4782. Quantum Information and Quantum Computing
3-0-3.
Prerequisite(s): (MATH 2401 or MATH 2411 or MATH 2601 or MATH 24X1)
Introduction to quantum computing and quantum information theory, formalism of quantum mechanics, quantum gates, algorithms, measurements, coding, and information. Physical realizations and experiments.

MATH 4801, -02, -03, -04, -05. Special Topics
Class and credit hours equal last digit of course number.
Courses on special topics of current interest in mathematics.

MATH 4999. Special Problems
Credit hours to be arranged.
Reading or research in topics of current interest.

MATH 6014. Graph Theory
3-0-3.
Prerequisite(s): MATH 4022
Fundamentals, connectivity, matchings, colorings, extremal problems, Ramsey theory, planar graphs, perfect graphs. Applications to operations research and the design of efficient algorithms.

MATH 6021. Topology of Euclidean Spaces
3-0-3.
Prerequisite(s): MATH 4317 and (MATH 2406 or MATH 4305)
Metric spaces, normed linear spaces, convexity, and separation, polyhedra and simplicial complexes, surfaces, Brouwer fixed-point theorem.

MATH 6121. Algebra I
3-0-3.
Prerequisite(s): MATH 4107 and (MATH 2406 or MATH 4305)
Graduate-level linear and abstract algebra including groups, finite fields, classical matrix groups and bilinear forms, multilinear algebra, and matroids. First of two courses.

MATH 6122. Algebra II
3-0-3.
Prerequisite(s): MATH 6121
Graduate-level linear and abstract algebra including rings, fields, modules, some algebraic number theory and Galois theory. Second of two courses.

MATH 6221. Advanced Classical Probability Theory
3-0-3.
Prerequisite(s): MATH 4221
Classical introduction to probability theory including expectation, notions of convergence, laws of large numbers, independence, large deviations, conditional expectation, martingales, and Markov chains.

MATH 6235. Stochastic Processes in Finance II
3-0-3.
Prerequisite(s): MATH 2403 and (ISYE 6759 or MATH 6759)
Advanced mathematical modeling of financial markets, derivative securities pricing, and portfolio optimization. Concepts from advanced probability and mathematics are introduced as needed.

MATH 6241. Probability I
3-0-3.
Prerequisite(s): MATH 6327
Develops the probability basis requisite in modern statistical theories and stochastic processes. Topics of this course include measure and integration foundations of probability, distribution functions, convergence concepts, laws of large numbers, and central limit theory. First of two courses.

MATH 6242. Probability II
3-0-3.
Prerequisite(s): MATH 6241
Develops the probability basis requisite in modern statistical theories and stochastic processes. Topics of this course include results for sums of independent random variables, Markov processes, martingales, Poisson processes, Brownian motion, conditional probability and conditional expectation, and topics from ergodic theory. Second of two classes.

MATH 6262. Statistical Estimation
3-0-3.
Prerequisite(s): MATH 4262
Basic theories of statistical estimation, including optimal estimation in finite samples and asymptotically optimal estimation. A careful mathematical treatment of the primary techniques of estimation utilized by statisticians.

MATH 6263. Testing Statistical Hypotheses
3-0-3.
Prerequisite(s): MATH 4262
Basic theories of testing statistical hypotheses, including a thorough treatment of testing in exponential class families. A careful mathematical treatment of the primary techniques of hypothesis testing utilized by statisticians.

MATH 6266. Linear Statistical Models
3-0-3.
Prerequisite(s): MATH 3215 or MATH 3225
Basic unifying theory underlying techniques of regression, analysis of variance and covariance, from a geometric point of view. Modern computational capabilities are exploited fully. Students apply the theory to real data through canned and coded programs.

MATH 6267. Multivariate Statistical Analysis
3-0-3.
Prerequisite(s): MATH 4262
Multivariate normal distribution theory, correlation and dependence analysis, regression and prediction, dimension-reduction methods, sampling distributions and related inference problems, selected applications in classification theory, multivariate process control, and pattern recognition.

MATH 6300. Fractal Geometry
3-0-3.
Prerequisite(s): MATH 6327
Hausdorff dimension, box-counting dimension, iterated function systems, continued fractions, number theory, Julia sets.

MATH 6307. Ordinary Differential Equations I
3-0-3.
Prerequisite(s): MATH 4542
This sequence develops the qualitative theory for systems of ordinary differential equations. Topics include stability, Lyapunov functions, Floquet theory, attractors, invariant manifolds, bifurcation theory, normal forms. First of two courses.

MATH 6308. Ordinary Differential Equations II
3-0-3.
Prerequisite(s): MATH 6307
This sequence develops the qualitative theory for systems of differential equations. Topics include stability, Lyapunov functions, Floquet theory, attractors, invariant manifolds, bifurcation theory, and normal forms. Second of two courses.

MATH 6321. Complex Analysis
3-0-3.
Prerequisite(s): MATH 4317 and MATH 4320
Complex integration, including Goursat's theorem; classification of singularities, the argument principle, the maximum principle; Riemann Mapping theorem; analytic continuation and Riemann surfaces; range of an analytic function, including Picard's theorem.

MATH 6327. Real Analysis
3-0-3.
Prerequisite(s): MATH 4318
Measure and integration theory. Topics include measurable functions, Lebesgue integration on Rn, general measure spaces, differentiation on Rn, functions of bounded variation, and Lp-spaces.

MATH 6328. Introduction to Functional Analysis
3-0-3.
Prerequisite(s): MATH 6327
Introduction to functional analysis. Basic topics include the Hahn-Banach theorems, the Baire Category theorem and its consequences, duality in Banach spaces, distributions, Fourier transforms, and applications to differential equations.

MATH 6341. Partial Differential Equations I
3-0-3.
Prerequisite(s): MATH 4318
Introduction to the mathematical theory of partial differential equations covering the basic linear models of science and exact solution techniques.

MATH 6342. Partial Differential Equations II
3-0-3.
Prerequisite(s): MATH 6341
This course covers the general mathematical theory of linear stationary and evolution problems plus selected topics chosen from the instructor's interests.

MATH 6421. Algebraic Geometry I
3-0-3.
Prerequisite(s): MATH 4107 and MATH 6121*
The study of zero sets of polynomials; algebraic varieties, regular and rational mappings, the Zariski topology.

MATH 6422. Algebraic Geometry II
3-0-3.
Prerequisite(s): MATH 6421
A continuation of Algebraic Geometry I.

MATH 6441. Algebraic Topology I
3-0-3.
Prerequisite(s): MATH 4107 and (MATH 4431 or MATH 6451)
Simplicial homology. Chain complexes and acyclic carriers. Simplicial approximation. The exact homology sequence. Maps of spheres. Mayer-Victoris sequence.

MATH 6442. Algebraic Topology II
3-0-3.
Prerequisite(s): MATH 6441
Continuation of MATH 6441. Singular homology. Local homology and manifolds. CW complexes. Cohomology. Duality in manifolds.

MATH 6451. General Topology
3-0-3.
Prerequisite(s): MATH 4317 or MATH 4431
Introduction to topological and metric spaces. Continuity, compactness, convergence, completion. Product and quotient spaces. Elementary homotopy.

MATH 6452. Differential Topology
3-0-3.
Prerequisite(s): MATH 4431 or MATH 6451
Manifolds. Differentiable structures. Tangent bundles. Embeddings and immersions. Maps on manifolds. Transversality. Morse-Sard Theorem. Vector bundles.

MATH 6453. Geometric Topology
3-0-3.
Prerequisite(s): MATH 6441 or MATH 6452 or MATH 6455
Characteristic classes, Morse theory, three-manifolds, four-manifolds, symplectic and contact manifolds, knot theory.

MATH 6455. Differential Geometry I
3-0-3.
Prerequisite(s): MATH 4441
Core topics in differential, including: Lie groups, curvature, and relations with topology.

MATH 6456. Differential Geometry II
3-0-3.
Prerequisite(s): MATH 6455
Introduces students to topics of current interest in geometry.

MATH 6514. Industrial Mathematics I
3-0-3.
Prerequisite(s): (MATH 2403 or MATH 2602) and MATH 4640
Applied mathematics techniques to solve real-world problems. Topics include mathematical modeling, asymptotic analysis, differential equations and scientific computation. Prepares the student for MATH 6515.

MATH 6515. Industrial Mathematics II
3-0-3.
Prerequisite(s): MATH 6514
Applications of mathematical techniques from MATH 6514 to solve real-world problems. Group projects to solve industrial problems in topics chosen by the instructor.

MATH 6580. Introduction to Hilbert Spaces
3-0-3.
Prerequisite(s): MATH 2403 and (MATH 2406 or MATH 4305)
Geometry, convergence, and structure of linear operators in infinite dimensional spaces. Applications to science and engineering, including integral equations and ordinary partial differential equations.

MATH 6583. Integral Equations and Transforms
3-0-3.
Prerequisite(s): MATH 6701 or (MATH 2406 and MATH 2403) or (MATH 2403 and MATH 4305)
Volterra and Fredholm linear integral equations; relation to differential equations; solution methods; Fourier, Laplace, and Mellin transforms; applications to boundary value problems and integral equations.

MATH 6584. Special Functions of Higher Mathematics
3-0-3.
Prerequisite(s): MATH 4320
Gamma function; exponential function; orthogonal polynomials; Bessel, Legendre, and hypergeometric functions; application to singular ordinary differential equations; and separation of variables for partial differential equations.

MATH 6635. Numerical Methods in Finance
3-0-3.
Prerequisite(s): MATH 2403 and (MATH 3215 or MATH 3225)
Basic numerical and simulation techniques used in the pricing of derivative securities and in related problems in finance. Some programming experience required.

MATH 6640. Introduction to Numerical Methods for Partial Differential Equations
3-0-3.
Prerequisite(s): MATH 4347
Introduction to the implementation and analysis of numerical algorithms for the numerical solution of the classic partial differential equations of science and engineering. Must have knowledge of a computer programming language, familiarity with partial differential equations and elements of scientific computing.

MATH 6641. Advanced Numerical Methods for Partial Differential Equations
3-0-3.
Analysis and implementation of numerical methods for nonlinear partial differential equations including elliptic, hyperbolic, and/or parabolic problems. Must have knowledge of classic linear partial differential equations and exposure to numerical methods for partial differential equations at the level of MATH 6640 or numerical linear algebra at the level of MATH 6643.

MATH 6643. Numerical Linear Algebra
3-0-3.
Prerequisite(s): MATH 2406 or MATH 4305
Introduction to the numerical solution of the classic problems of linear algebra including linear systems, least squares, singular value decomposition, eigen value problems.

MATH 6644. Iterative Methods for Systems of Equations
3-0-3.
Prerequisite(s): MATH 6643
Iterative methods for linear and nonlinear systems of equations including Jacobi, G-S, SOR, CG, multigrid, Newton quasi-Newton, updating, and gradient-based methods.

MATH 6645. Numerical Approximation Theory
3-0-3.
Prerequisite(s): MATH 4317 and MATH 4640
Theoretical and computational aspects of polynomial, rational, trigonometric, spline, and wavelet approximation.

MATH 6646. Numerical Methods for Ordinary Differential Equations
3-0-3.
Prerequisite(s): MATH 2403 and MATH 4640
Analysis and implementation of numerical methods for initial and two-point boundary value problems for ordinary differential equations.

MATH 6647. Numerical Methods for Dynamical Systems
3-0-3.
Prerequisite(s): MATH 4640 and MATH 4641
Approximation of the dynamical structure of a differential equation and preservation of dynamical structure under discretization. Must be familiar with dynamical systems and numerical methods for initial and boundary value problems in ordinary differential equations.

MATH 6701. Math Methods of Applied Sciences I
3-0-3.
Prerequisite(s): MATH 2403 and (MATH 2406 or MATH 4305)
Review of linear algebra and ordinary differential equations, brief introduction to functions of a complex variable.

MATH 6702. Math Methods of Applied Sciences II
3-0-3.
Prerequisite(s): MATH 6701 or (MATH 2406 and MATH 2403) or (MATH 2403 and MATH 4305)
Review of vector calculus and its applications to partial differential equations.

MATH 6705. Modeling and Dynamics
3-0-3.
Prerequisite(s): MATH 1502 or MATH 1512
Mathematical methods for solving problems in the life sciences. Models-based course on basic facts from the theory of ordinary differential equations and numerical methods of their solution. Introduction to the control theory, diffusion theory, maximization, minimization and curve fitting. Math majors may not use this course toward any degree in the School of Mathematics.

MATH 6759. Stochastic Processes in Finance I
3-0-3.
Prerequisite(s): MATH 3215 or MATH 3225
Mathematical modeling of financial markets, derivative securities pricing, and portfolio optimization. Concepts from probability and mathematics are introduced as needed. Crosslisted with ISYE 6759.

MATH 6761. Stochastic Processes I
3-0-3.
Prerequisite(s): MATH 3215 or MATH 3225
Discrete time Markov chains, Poisson processes, and renewal processes. Transient and limiting behavior. Average cost and utility measures of systems. Algorithms for computing performance measures. Modeling of inventories, and flows in manufacturing and computer networks. Crosslisted with ISYE 6761.

MATH 6762. Stochastic Processes II
3-0-3.
Prerequisite(s): MATH 6761 or ISYE 6761
Continuous time Markov chains. Uniformization, transient and limiting behavior. Brownian motion and martingales. Optional sampling and convergence. Modeling of inventories, finance, flows in manufacturing and computer networks. Crosslisted with ISYE 6762

MATH 6767. Design and Implementation of Systems to Support Computational Finance
3-0-3.
Introduction to large-scale system design to support computational finance for options, stocks, or other financial instruments. Some programming experience, and previous exposure to stocks, bonds, and options required. Crosslisted with ISYE 6767

MATH 6769. Fixed-Income Securities
3-0-3.
Prerequisite(s): MATH 3215 or MATH 3225 and (MGT 6060 or MGT 6078)
Description, institutional features, and mathematical modeling of fixed income securities. Use of both deterministic and stochastic models. Crosslisted with ISYE 6769.

MATH 6781. Reliability Theory
3-0-3.
Prerequisite(s): MATH 3215 or MATH 3225
Reliability systems and related distributions, failure rate functions and nonparametric classes, accelerated life testing, dependent failure analysis, statistical inference of reliability data. Crosslisted with ISYE 6781.

MATH 6783. Statistical Techniques of Financial Data Analysis
3-0-3.
Prerequisite(s): MATH 3215 or MATH 3225
Fundamentals of statistical inference for models used in the modern analysis of financial data. Crosslisted with ISYE 6783.

MATH 6785. The Practice of Quantitative and Computational Finance
3-0-3.
Case studies, visiting lecturers from financial institutions, student group projects of an advanced nature, and student reports, all centered around quantitative and computational finance. Crosslisted with ISYE and MGT 6785.

MATH 6793. Advanced Topics in Quantitative and Computational Finance
3-0-3.
Advanced foundational material and analysis techniques in quantitative and computational finance. Crosslisted with ISYE 6793.

MATH 7000. Master's Thesis
Credit hours to be arranged.

MATH 7012. Enumerative Combinatorics
3-0-3.
Prerequisite(s): MATH 4032
Fundamental methods of enumeration and asymptotic analysis, including the use of inclusion/exclusion, generating functions, and recurrence relations. Applications to strings over a finite alphabet and graphs.

MATH 7016. Combinatorics
3-0-3.
Prerequisite(s): MATH 4022
Fundamental combinatorial structures including hypergraphs, transversal sets, colorings, Sperner families, intersecting families, packings and coverings, perfect graphs, and Ramsey theory. Algebraic and topological methods, applications.

MATH 7018. Probabilistic Methods in Combinatorics
3-0-3.
Prerequisite(s): MATH 4022 and MATH 6221
Applications of probabilistic techniques in discrete mathematics, including classical ideas using expectation and variance as well as modern tools, such as martingale and correlation inequalities.

MATH 7244. Stochastic Processes and Stochastic Calculus I
3-0-3.
Prerequisite(s): MATH 6242
An introduction to the Ito stochastic calculus and stochastic differential equations through a development of continuous-time martingales and Markov processes. First of two courses.

MATH 7245. Stochastic Processes and Stochastic Calculus II
3-0-3.
Prerequisite(s): MATH 7244
An introduction to the Ito stochastic calculus and stochastic differential equations through a development of continuous-time martingales and Markov processes. Continuation of MATH 7244.

MATH 7334. Operator Theory Applications
3-0-3.
Prerequisite(s): MATH 6327
Theory of linear operators on Hilbert space. Spectral theory of bounded and unbounded operators.

MATH 7337. Harmonic Analysis
3-0-3.
Prerequisite(s): MATH 6327
Fourier analysis in Euclidean space. Basic topics including L1 and L2 theory; advanced topics such as distribution theory, uncertainty, Littlewood-Paley theory.

MATH 7581. Calculus of Variations
3-0-3.
Prerequisite(s): MATH 4317
Minimization of functionals, Euler-Lagrange equations, sufficient conditions for a minimum; geodesic, isoperometric, and time of transit problems; variational principles of mechanics; applications to control theory.

MATH 7586. Tensor Analysis
3-0-3.
Prerequisite(s): MATH 2403 and (MATH 2406 or MATH 4305)
Review of linear algebra, multilinear algebra, algebra of tensors, co- and contravariant tensors, tensors in Riemann spaces, geometrical interpretation of skew tensors.

MATH 7999. Preparation for Doctoral Comprehensive Examination
Credit hours to be arranged.

MATH 8801, -02, -03, -04, -05. Special Topics
Class and credit hours equal last digit of course number.
This course enables the School of Mathematics to comply with requests for courses in selected topics.

MATH 8811, -12, -13, -14, -15. Special Topics
Class and credit hours equal last digit of course number.
This course enables the School of Mathematics to comply with requests for courses in selected topics.

MATH 8821, -22, -23, -24, -25. Special Topics
Class and credit hours equal last digit of course number.
This course enables the School of Mathematics to comply with requests for courses in selected topics.

MATH 8831, -32, -33, -34, -35. Special Topics
Class and credit hours equal last digit of course number.
This course enables the School of Mathematics to comply with requests for courses in selected topics.

MATH 8841, -42, -43, -44, -45. Special Topics
Class and credit hours equal last digit of course number.
This course enables the School of Mathematics to comply with requests for courses in selected topics.

MATH 8851, -52, -53, -54, -55. Special Topics
Class and credit hours equal last digit of course number.
This course enables the School of Mathematics to comply with requests for courses in selected topics.

MATH 8863. Advanced Topics in Graph Theory
3-0-3.
Prerequisite(s): MATH 6014
Selection of topics vary with each offering.

MATH 8900, -01, -02, -03. Special Problems
Credit hours to be arranged.

MATH 8997. Teaching Assistantship
Credit hours to be arranged.
For students holding graduate teaching assistantships.

MATH 8998. Research Assistantship
Credit hours to be arranged.
For students holding graduate research assistantships.

MATH 9000. Doctoral Thesis
Credit hours to be arranged.

School of Physics

www.physics.gatech.edu

Established in 1939
Location: Howey Building
Telephone: 404.894.5201
Fax: 404.894.9958

Chair and Regents' Professor–Ronald Fox; *Associate Chair for Graduate Programs and Professor*–Andrew Zangwill; *Associate Chair for Undergraduate Programs and Associate Professor*–Michael Schatz; *Callaway Chair and Regents' Professor*–Uzi Landman; *Georgia Research Alliance Eminent Scholar Chair and Professor*–Rick Trebino; *Glen Robinson Chair and Professor*–Predrag Cvitanovic; *Regents' Professors*–M. Ray Flannery, Turgay Uzer.
Professors–Jean Bellissard, Helmut Biritz, Michael Chapman, Mei-Yin Chou, Walt deHeer, Ahmet Erbil, James Gole, T.A. Brian Kennedy, Kurt Wiesenfeld, John Wood, Li You.
Adjunct Professor–Robert Whetten.
Professors Emeriti–Tino Ahrens, David Finkelstein, Ian Gatland, Don Harmer, Donald O'Shea, Eugene Patronis, Edward Thomas, Henry Valk, R.A. Young.
Associate Professors–Edward Conrad, Phillip First, Carlos Sa de Melo.
Assistant Professors–Dragomir Davidovic, Roman Grigoriev, Alex Kuzmich, Alexei Marchenkov, Michael Pustilnik, Chandra Raman, Elisa Riedo.
Senior Research Scientists–Robert Barnett, Edward Bogachek, Charles Cleveland, Jianping Gao, William Luedtke, Constantine Yannouleas.
Research Scientists II–Andrew Scherbakov, Bokwon Yoon.
Academic Professionals–Martin Jarrio, Eric Murray, James Sowell.

General Information

Physics is primarily a basic science, and fundamental research into the principles of physics continues to occupy the attention of many physicists. The study of physics also has become increasingly important as a basis for fundamental research in interdisciplinary areas such as biophysics, chemical physics, and materials science, and as an

applied science in government and industrial labs. Furthermore, as society becomes more technically oriented, an education in physics can provide an advantageous preprofessional foundation.

The School of Physics offers basic service courses to freshmen and sophomores, some advanced service courses for students in other units of the Institute, and advanced studies leading to the bachelor's, master's, and Ph.D. degrees in physics. The School seeks to provide elective freedom in its degree programs in order to enable students with a wide variety of goals to construct programs of study suitable for them.

In addition to offering courses in the fundamentals of physics, the School provides numerous specialized courses at all levels, particularly in those areas related to the research interests of the faculty. These areas of research currently include: atomic, molecular, and chemical physics; biophysics; computational materials science; nonlinear mechanics and chaos; nuclear and particle physics; optics and laser physics; condensed matter physics; quantum computing; relativity; statistical mechanics; physics instruction; and interdisciplinary areas of biophysics and materials science. Opportunities exist in all these areas and in other areas through collaboration with faculty of other schools and colleges for Special Problems courses, master's theses, and doctoral dissertations.

Supplementary program planning is available from the School of Physics. Opportunities for graduate study and research are also available at **www.physics.gatech.edu**.

Undergraduate Programs

The School of Physics offers two undergraduate degrees, the Bachelor of Science in Physics and the Bachelor of Science in Applied Physics. The basis of the former degree is the traditional preparation of a student for graduate study in physics.

The degree program in applied physics may be better suited for entry into industry or government upon graduation, preparation for further professional training (medicine, law, dentistry, or business), or preparation for graduate study in some other discipline. The applied physics program differs from the traditional one in that a few courses intended primarily as preparation for graduate study in physics are replaced by courses oriented toward the applications of physics.

Each of the baccalaureate programs contains the following: a) courses needed to meet general institutional degree requirements; b) a core of technical courses intended to give a strong background in mathematics and the physical principles of mechanics, electricity and magnetism, thermodynamics, and the quantum theory that governs physical phenomena at the microscopic level of molecules, atoms, and nuclei; c) technical electives that enable the student to explore areas of his or her choice in greater depth; d) courses involving undergraduate research; and e) free electives, about fifteen percent of the total hours, which may be employed to schedule additional technical or nontechnical courses.

The considerable flexibility inherent in the physics curricula is advantageous to students who wish to work out individual programs of study. At the same time, this flexibility suggests the need for consultation with advisors so students can make the best use of elective hours and avoid scheduling difficulties that may arise in later semesters. Students may utilize their elective freedom in the physics curricula to specialize in particular areas of physics, to prepare for careers in interdisciplinary areas of science, to compose a preprofessional program, or to gain a background in other technical or nontechnical disciplines. To assist students in planning programs of study with emphasis directed toward a particular objective, the School has formulated suggestions for the use of elective hours. Supplementary materials, available from the School office, include suggestions relevant to the following areas of study: preparation for graduate study in physics; acoustics; applied optics; atomic, molecular, and chemical physics; biophysics; computational physics; nonlinear dynamics and chaos; solid state physics; and preparation for teaching secondary education. Attention is also directed to the possibility of using elective hours for Undergraduate Research (PHYS 2699 or 4699) conducted under the supervision of a faculty member.

Since some students who earn a degree in physics have transferred from other disciplines, the School has planned its degree programs to enable most students to transfer into physics with little or no loss of credit.

A total of 120 credit hours (exclusive of wellness) and a grade point average of at least 2.0 in physics courses numbered 3000 and higher are requisites for the bachelor's degree in physics.

Bachelor of Science in Physics (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
CHEM 1310	GENERAL CHEMISTRY	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		14

First Year - Second Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II	4
PHYS 2211	INTRODUCTORY PHYSICS I	4
CS 1321	INTRO. TO COMPUTING	3
WELLNESS		2
TOTAL SEMESTER HOURS		16

Second Year - First Semester

Course Number/Name		*Hours*
MATH 2401	CALCULUS III	4
PHYS 2212	INTRODUCTORY PHYSICS II	4
SOCIAL SCIENCE ELECTIVE(S)		6
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Second Year - Second Semester

Course Number/Name		*Hours*
MATH 2403	DIFFERENTIAL EQUATIONS	4
PHYS 2213	INTRO. TO MODERN PHYSICS	3
PHYS 2201	CLASSICAL MECHANICS I	3
SOCIAL SCIENCE ELECTIVE(S)		3
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

Third Year - First Semester

Course Number/Name		*Hours*
PHYS 3113	QUANTUM MECHANICS I	3
PHYS 4122	ELECTROSTATICS & MAGNETOSTATICS	3
PHYSICS or TECHNICAL ELECTIVE(S)		6
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Third Year - Second Semester

Course Number/Name		*Hours*
PHYS 3141	THERMODYNAMICS	3
PHYS 3123	ELECTRODYNAMICS	3
PHYSICS or TECHNICAL ELECTIVE(S)		3
FREE ELECTIVE(S)		6
TOTAL SEMESTER HOURS		15

Fourth Year - First Semester

Course Number/Name		*Hours*
PHYS 4321	ADVANCED LAB I	3
PHYS 4142	STATISTICAL MECHANICS	3
PHYSICS or TECHNICAL ELECTIVE(S)		3
PHYS 4601	SENIOR SEMINAR I	1
FREE ELECTIVE(S)		5
TOTAL SEMESTER HOURS		15

Fourth Year - Second Semester

Course Number/Name		*Hours*
PHYS 4143	QUANTUM MECHANICS II	3
PHYS 4602	SENIOR SEMINAR II	1
PHYSICS or TECHNICAL ELECTIVE(S)		5
FREE ELECTIVE(S)		5
TOTAL SEMESTER HOURS		14

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Bachelor of Science in Applied Physics (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
CHEM 1310	GENERAL CHEMISTRY	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		14

First Year - Second Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II	4
PHYS 2211	INTRODUCTORY PHYSICS I	4
CS 1321	INTRO. TO COMPUTING	3
WELLNESS		2
TOTAL SEMESTER HOURS		16

Second Year - First Semester

Course Number/Name		*Hours*
MATH 2401	CALCULUS III	4
PHYS 2212	INTRODUCTORY PHYSICS II	4
SOCIAL SCIENCE ELECTIVE(S)		6
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		17

Second Year - Second Semester

Course Number/Name		*Hours*
MATH 2403	DIFFERENTIAL EQUATIONS	4
PHYS 2213	INTRO. TO MODERN PHYSICS	3
PHYS 3201	CLASSICAL MECHANICS I	3
SOCIAL SCIENCE ELECTIVE(S)		3
HUMANITIES ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

Third Year - First Semester

Course Number/Name		*Hours*
PHYS 3143	QUANTUM MECHANICS I	3
PHYS 3122	ELECTROSTATICS & MAGNETOSTATICS	3
PHYSICS or TECHNICAL ELECTIVE(S)		3
FREE ELECTIVE(S)		5
TOTAL SEMESTER HOURS		14

Third Year - Second Semester

Course Number/Name		*Hours*
PHYS 3141	THERMODYNAMICS	3
PHYS 3123	ELECTRODYNAMICS	3
PHYSICS or TECHNICAL ELECTIVE(S)		3
PHYS 3266	COMPUTATIONAL PHYSICS	4
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

Fourth Year - First Semester

Course Number/Name		*Hours*
PHYS 4521	ADVANCED LAB I	3
PHYS 3211	ELECTRONICS I	5
PHYS 4601	SENIOR SEMINAR I	1
PHYSICS or TECHNICAL ELECTIVE(S)		3
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		15

Fourth Year - Second Semester

Course Number/Name		*Hours*
PHYS 4206	ELECTRONICS II	5
PHYSICS or TECHNICAL ELECTIVE(S)		5
PHYS 4602	SENIOR SEMINAR II	1
FREE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		14

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Electives

Physics and Technical Electives

These include physics courses and selected courses in other disciplines. At most, six hours may be below the 3000 level. These must include at least one lab-based physics course (other than PHYS 4321) at the 3000 level or above.

Humanities and Social Sciences

Students whose scores are sufficiently high on the College Board SAT Verbal and the English achievement examinations may, in consultation with the School of Literature, Communication, and Culture, replace ENGL 1101 or 1102 with other English courses. All students are required to pass examinations or courses in the history and constitutions of the United States and Georgia. HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200 fulfill this requirement.

See "Information for Undergraduate Students" (pages 35-36) for additional information relative to the twenty-four credit-hour requirement in the humanities and the social sciences.

Physics

Students who have demonstrated competence in mathematics are encouraged to substitute the honors sequence, PHYS 2231-2, for PHYS 2211-2.

Business Option

Students pursuing a B.S. in Physics or Applied Physics as a terminal degree may find the Business Option advantageous. This option uses six hours of social science credits for PSYC 2220 and ECON 2106 and nine hours of free electives for MGT 3000, MGT 3300, and MGT 3150. Or, using another three hours of free electives, MGT 3150 may be replaced by a combination of MGT 3062 and either MGT 3076, MGT 4191, or MGT 4660.

Graduate Programs

Master of Science Program

The Master of Science in Physics degree requires thirty hours of physics course credit. These hours must include six hours of 8000-level Special Problems or Master's Practicum research (with a physics faculty member) and the following six graduate physics courses:

- PHYS 6101 Classical Mechanics I (3)
- PHYS 6103 Electromagnetism I (3)
- PHYS 6104 Electromagnetism II (3)
- PHYS 6105 Quantum Mechanics I (3)
- PHYS 6106 Quantum Mechanics II (3)
- PHYS 6107 Statistical Mechanics (3)

The remaining six credit hours may be earned from either: a) physics lecture courses at the 6000 level or higher; or b) graduate courses at the 6000 level or higher from a school other than physics.

Doctoral Program

The Ph.D. degree in physics requires: 1) admission to candidacy; 2) a program of study in core and advanced physics courses; 3) a minor course of study; and 4) successful defense of the Ph.D. thesis.

Students are admitted to candidacy when they have 1) passed the Comprehensive Exam; 2) selected a Thesis Reading Committee; and 3) submitted a thesis proposal to the graduate coordinator. To ensure adequate preparation for the Comprehensive Exam, the School strongly recommends that the first year of graduate study be devoted to coursework as follows:

First Semester

- PHYS 6101 Classical Mechanics I (3)
- PHYS 6103 Electromagnetism I (3)
- PHYS 6105 Quantum Mechanics I (3)
- PHYS 6124 Mathematical Methods of Physics I (3)

Second Semester

- PHYS 6107 Statistical Mechanics I (3)
- PHYS 6104 Electromagnetism II (3)
- PHYS 6106 Quantum Mechanics II (3)
- PHYS 8901 Special Problems (3)

The School requires every doctoral student to take three lecture-type graduate physics courses not including those previously listed. In some cases, these may be used to satisfy the Institute requirement that every doctoral student earn nine credit hours in a minor course of study in a scientific sub-field different from the sub-field of his or her Ph.D. thesis research. Alternatively, these credit hours are earned in a school other than physics. Finally, each student must prepare a written dissertation that summarizes the Ph.D. research and present a public, oral "defense" of the dissertation to a Thesis Exam Committee.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course. An asterisk (*) denotes prerequisite courses that may be taken concurrently.

PHYSICS

PHYS 1000. Physics Orientation
1-0-1.
Guest lectures will describe career opportunities in physics; the role physicists play in education, government, and industrial laboratories; and programs available to physics majors.

PHYS 2001. Evolution of Physics
2-0-2.
Prerequisite(s): PHYS 2211
The development of physics concepts and doctrines from early times to the the near future, with social and philosophical correlates.

PHYS 2021. The Solar System
3-0-3.
This course covers Ancient and Renaissance astronomy, gravity, sky phenomena, telescopes, and the solar system.

PHYS 2022. Stars, Galaxies, and the Universe
3-0-3.
This course covers optics, telescopes, stellar characteristics and evolution, galaxies, the universe, and the big bang. Physics topics include mechanics, optics, atomic physics, nuclear physics, and relativity.

PHYS 2030. Physics of Music
2-0-2.
An introduction to the physical principles underlying the production, transmission, and detection of musical sounds.

PHYS 2211. Introductory Physics I
3-3-4.
Prerequisite(s): MATH 1502* or MATH 1512*
A calculus-based course with a laboratory covering classical mechanics, applications of classical mechanics, oscillations, and waves.

PHYS 2212. Introductory Physics II
3-3-4.
Prerequisite(s): PHYS 2211 or PHYS 2231
A calculus-based course with laboratory covering electromagnetism, applications of electromagnetism, light, and modern physics.

PHYS 2213. Introduction to Modern Physics
3-0-3.
Prerequisite(s): PHYS 2212 or PHYS 2232
A survey of twentieth century physics. Developments of several branches of physics up to their present frontiers, including historical and philosophical perspectives.

PHYS 2231. Honors Physics I
4-3-5.
Prerequisite(s): MATH 1502* or MATH 1512*
Parallels introductory Physics I (PHYS 2211). Some topics treated in more depth or more extensively. A rigorous physics foundation requiring demonstrated competence in mathematics.

PHYS 2232. Honors Physics II
4-3-5.
Prerequisite(s): PHYS 2211 or PHYS 2231
Parallels introductory Physics II (PHYS 2212). Some topics treated in more depth or more extensively. No modern physics content. A rigorous physics foundation requiring demonstrated competence in mathematics.

PHYS 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

PHYS 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

PHYS 2750. Physics of the Weather
3-0-3.
An introductory treatment applying basic physical laws to understanding weather phenomena. Crosslisted with EAS 2750.

PHYS 2801, -02, -03, -04. Special Topics
Class and credit hours equal last digit of course number.
Courses in special topics of current interest in physics are presented from time to time.

PHYS 2900, -01, -02. Special Problems
Class and credit hours equal last digit of course number.
Course involving special problems in physics are offered from time to time.

PHYS 3021. Stellar Astrophysics
3-0-3.
Prerequisite(s): PHYS 2212 or PHYS 2232
Develops a working knowledge of stellar and extra-stellar galactic astronomy. Includes stellar structure, nucleosynthesis, stellar evolution, and degenerate objects.

PHYS 3043. Wave Mechanics
3-0-3.
Prerequisite(s): PHYS 2212 or PHYS 2232
A first introduction to wave mechanics, with emphasis on practical calculations. The rules of quantum mechanics will be illustrated by many working examples.

PHYS 3122. Electrostatics and Magnetostatics
3-0-3.
Prerequisite(s): (PHYS 2212 or PHYS 2232) and (MATH 2403 or MATH 2413 or MATH 24X3)
First of two courses on the physics of electromagnetism. Topics include Coulomb's Law, Ampere's Law, scalar and vector potentials, Laplace's equation and electric and magnetic fields in matter.

PHYS 3123. Electrodynamics
3-0-3.
Prerequisite(s): PHYS 3122
Second of two courses on the physics of electromagnetism. Topics include time-dependent phenomena including Faraday's Law, the Maxwell equations, electromagnetic radiation, and electromagnetic waves.

PHYS 3141. Thermodynamics
3-0-3.
Prerequisite(s): (PHYS 2212 or PHYS 2232) and (MATH 2403 or MATH 2413 or MATH 24X3)
Introduction to the basic concepts of thermodynamics. Thermodynamic laws will be developed with an emphasis on the macroscopic point of view. Applications of the basic principles will be considered briefly.

PHYS 3143. Quantum Mechanics I
3-0-3.
Prerequisite(s): (PHYS 2212 or PHYS 2232) and (MATH 2403 or MATH 2413)
First of two courses that develop the principles of quantum mechanics. Topics include the state vector concept, Heisenberg and Schrodinger pictures, uncertainty relations, and exact solvable models in one dimension.

PHYS 3151. Mathematical Physics
3-0-3.
Prerequisite(s): (MATH 2403* or MATH 2413* or MATH 24X3) and (PHYS 2212 or PHYS 2232)
A review of the mathematical techniques required for the description of physical systems encountered in mechanics, electromagnetism, thermal physics, and quantum mechanics.

PHYS 3201. Classical Mechanics I
3-0-3.
Prerequisite(s): (PHYS 2212 or PHYS 2232) and (MATH 2403* or MATH 2413*)
Dynamics of particles including oscillations and planetary motion, rotation of rigid bodies, and collisions.

PHYS 3202. Classical Mechanics II
3-0-3.
Prerequisite(s): PHYS 3201
A continuation of PHYS 3201. Topics include Lagrangians and Hamiltonian techniques, and many body mechanics.

PHYS 3211. Electronics I
3-6-5.
Prerequisite(s): PHYS 2212 or PHYS 2232
A first course in both theoretical and applied electronics that is based on a thorough grounding in circuit as well as device physics.

PHYS 3223. Geometrical Optics and Lens Design
3-0-3.
Prerequisite(s): PHYS 2212 or PHYS 2232
Principles of geometrical optics using ray tracing techniques. Stops, pupils, aberrations, and photometry. Design and analysis of lenses using current lens design software.

PHYS 3224. Geometrical Optics Laboratory
1-3-2.
Prerequisite(s): PHYS 3223
Measurement of parameters of optical surfaces, lenses, and systems using a variety of techniques.

PHYS 3225. Modern Optics
3-0-3.
Prerequisite(s): PHYS 2212 or PHYS 2232
Principles of wave propagation, coherence, polarization, diffraction, and Fourier Optics; laser theory including the interaction of light with matter.

PHYS 3226. Modern Optics Laboratory
1-3-2.
Prerequisite(s): PHYS 3225
Measurement of parameters of optical surfaces, lenses, and systems using a variety of modern optics techniques.

PHYS 3265. Acoustics
3-0-3.
Prerequisite(s): PHYS 2212 or PHYS 2232
A course in classical acoustics and applied electroacoustics taught through the palliative of a study of sound reinforcement and reproduction systems.

PHYS 3266. Computational Physics
3-3-4.
Prerequisite(s): PHYS 2212 or PHYS 2232
Computer solutions of realistic physics problems such as projectiles in resistive media, electromagnetic sources and fields, atomic scattering, and band pass filters.

PHYS 3801, -02, -03, -04. Special Topics
Class and credit hours equal last digit of course number.
Courses in special topics of current interest in physics are presented from time to time.

PHYS 3900, -01, -02. Special Problems
Class and credit hours equal last digit of course number.
Courses involving special problems in physics are offered from time to time.

PHYS 4142. Statistical Mechanics
3-0-3.
Prerequisite(s): PHYS 3141 and PHYS 3143
The statistical basis of thermodynamics is developed. Topics include entropy and the second law, partition functions and free energy, systems of variable particle number, and quantum statistics.

PHYS 4143. Quantum Mechanics II
3-0-3.
Prerequisite(s): PHYS 3143
Second of two courses that develop the principles of quantum mechanics. Topics include angular momentum, hydrogen atom, variation methods, perturbation theory, matter-radiation interactions, identical particles.

PHYS 4146. Special Relativity
3-0-3.
Prerequisite(s): PHYS 3123
The unification of space and time emerging from the physics of light, and its experimental and theoretical consequences.

PHYS 4206. Electronics II
3-6-5.
Prerequisite(s): PHYS 3211
A course in electronic instrumentation with an emphasis on signal processing, both analog and digital, and computer interfacing.

PHYS 4220. Optical Design
3-0-3.
Prerequisite(s): PHYS 3223
Principles of optical and optomechanical design including tolerancing, specification, and thermal compensation of systems.

PHYS 4222. Solid State Devices
3-0-3.
Prerequisite(s): PHYS 3141 and PHYS 3143
Course provides an understanding of contemporary research on solid state devices. Topics include band structure, p-n junctions, transistors, superlattices, lasers and detectors, charge coupled devices, and others.

PHYS 4251. Biophysics
3-0-3.
Prerequisite(s): (PHYS 2212 or PHYS 2232) and BIOL 1510
Physical principles applied to molecular and cellular biology. Topics include chemiosmosis, self-assembly, protein biosynthesis, and the mechanisms of muscle and nerve function.

PHYS 4261. Atomic Physics
3-0-3.
Prerequisite(s): PHYS 3143
Course provides an introduction to the fundamentals of atomic physics, the structure of atoms, and their interaction with static and radiation fields.

PHYS 4262. Solid State Physics
3-0-3.
Prerequisite(s): PHYS 3143
A first course in the physics of crystalline solids. Core topics include crystal lattices, diffraction, bonding, elastic properties, band theory, as well as others.

PHYS 4263. Nuclei, Particles, and Fields
3-0-3.
Prerequisite(s): PHYS 3143
An introduction to nuclear and subnuclear systems. Topics include nuclear models, radioactive decay, nuclear reactions, quarks, accelerators, reactors, and stellar nucleosynthesis.

PHYS 4267. Nonlinear Dynamics and Chaos
3-0-3.
Prerequisite(s): PHYS 3201
A modern introduction to nonlinear phenomena. Topics include driven oscillators, entrainment, bifurcation, fractals, and control of chaos. Examples are drawn from physical systems.

PHYS 4321. Advanced Laboratory I
1-6-3.
Prerequisite(s): PHYS 3143
Experiments are conducted that demonstrate basic principles from various fields of physics. An emphasis is placed on contemporary concepts in modern physics.

PHYS 4322. Advanced Laboratory II
1-6-3.
Prerequisite(s): PHYS 4321
A continuation of PHYS 4321. Experiments are conducted that demonstrate basic principles from various fields of physics. An emphasis is placed on contemporary concepts in modern physics.

PHYS 4421. Introduction to Continuum Physics
3-0-3.
Prerequisite(s): PHYS 3201
A modern introduction to continuum physics. Topics include elastic theory, dislocations and waves, fluid mechanics and dynamics, and instabilities in fluids.

PHYS 4601, -02. Senior Seminar I, - II
1-0-1.
Representative research programs in the School are described by advanced graduate students, postdoctoral fellows, and faculty members.

PHYS 4655. Introductory Diffraction Studies
2-6-4.
Introductory theory and practice of X-ray and neutron diffraction techniques, including single crystals and powders. Laboratory work is strongly correlated with principles developed in the lectures.

PHYS 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

PHYS 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

PHYS 4751. Laser Theory and Applications
3-0-3.
Prerequisite(s): PHYS 2212 or PHYS 2232
Provides an introduction to the theory and applications of laser principles and related instrumentation. Emphasis is on the fundamental principles underlying laser action. Crosslisted with ECE 4751.

PHYS 4801, -02, -03, -04. Special Topics
Class and credit hours equal last digit of course number.
Courses in special topics of current interest in physics are presented from time to time.

PHYS 4900, -01, -02. Special Problems
Credit hours to be arranged.
Courses involving special problems in physics are offered from time to time.

PHYS 6011. Nuclear and Particle Physics
3-0-3.
Quantum mechanics of nuclear and subnuclear systems. Topics include shell, collective and pairing models; multi-quark systems; group theoretical and dynamic algebra techniques.

PHYS 6101. Classical Mechanics I
3-0-3.
Newtonian mechanics, Hamilton's variational principle, Lagrangian and Hamiltonian mechanics, central forces, rigid body motion, and small oscillations.

PHYS 6102. Classical Mechanics II
3-0-3.
Prerequisite(s): PHYS 6101
Canonical transformations, Hamilton-Jacobi theory, canonical perturbation theory, and an introduction to the Lagrangian formulations for continuous systems and fields.

PHYS 6103. Electromagnetism I
3-0-3.
Static and quasistatic phenomena in electromagnetism. Boundary value problems in electrostatics and magnetostatics. Maxwell's equations.

PHYS 6104. Electromagnetism II
3-0-3.
Prerequisite(s): PHYS 6103
Theory of generation of electromagnetic waves, their propagation, scattering, and diffraction. Covariant formulation of electrodynamics and application to radiation from charged particles.

PHYS 6105. Quantum Mechanics I
3-0-3.
An axiomatic development of quantum mechanics. Topics include linear vector spaces, linear operators, infinitesimal transformations, function space, representation and transformation groups.

PHYS 6106. Quantum Mechanics II
3-0-3.
Prerequisite(s): PHYS 6105
Applications of quantum mechanics. Topics include systems with spin and angular momentum, atomic structure, time-dependent phenomena, scattering, and various methods of modeling and approximations.

PHYS 6107. Statistical Mechanics I
3-0-3.
Equilibrium statistical mechanics for closed and open systems. Probability distribution for classical and quantum systems. Partition functions and associated thermodynamical potentials.

PHYS 6110. Survey of Physics
5-0-5.
This course provides a review of basic theories in classical and quantum physics through the solution of problems. It provides an excellent preparation for students planning to take the doctoral qualifying exam. This course cannot be used for credit toward a graduate degree in physics.

PHYS 6124. Mathematical Methods of Physics I
3-0-3.
First of two courses on mathematical methods used in classical mechanics, electromagnetism, quantum mechanics, and statistical physics. Topics include complex analysis, vectors and matrices, and Sturm-Liouville theory.

PHYS 6125. Mathematical Methods of Physics II
3-0-3.
Second of two courses on mathematical methods. Topics include partial differential equations, random processes, and group theory.

PHYS 6201. Applied Quantum Mechanics
3-0-3.
Basic postulates of quantum mechanics, one-dimensional energy eigen value problems. Potential wells, tunneling phenomena.

PHYS 6202. Applied Electromagnetism
3-0-3.
A course centered on the solution of practical problems encountered in the transmission and reception of electromagnetic signals via transmission lines, waveguides, and radiation.

PHYS 6203. Solid State Physics
3-0-3.
A first course in the physics of crystalline solids. Core topics include crystal lattices, diffraction, bonding, elastic properties, band theory, as well as others.

PHYS 6204. Electronics I
3-0-4.
A first course in both theoretical and applied electronics that is based on a thorough grounding in circuit as well as device physics.

PHYS 6206. Electronics II
3-0-4.
A course in electronic instrumentation with an emphasis on signal processing, both analog and digital, and computer interfacing.

PHYS 6210. Condensed Matter Physics I
3-0-3.
Introduction to condensed matter physics. Crystal structure, electronic and thermal properties, response to external electric and magnetic fields.

PHYS 6211. Condensed Matter Physics II
3-0-3.
Prerequisite(s): PHYS 6210
Collective and many-electron properties in condensed matter systems. Topics include second quantization, magnetism, phase transitions, and superconductivity.

PHYS 6265. Atomic Physics I
3-0-3.
Prerequisite(s): PHYS 4143
This course provides a detailed description of atomic structures and interactions. It contains applications of advanced quantum mechanics to problems in modern atomic physics.

PHYS 6267. Atomic Physics II
3-0-3.
Prerequisite(s): PHYS 6265
This course will provide detailed descriptions of non-relativistic atomic/molecular scattering/reaction processes.

PHYS 6268. Nonlinear Dynamics and Chaos
3-0-3.
A modern introduction to nonlinear phenomena. Topics include driven oscillators, entrainment, bifurcation, fractals, and control of chaos. Examples are drawn from physical systems.

PHYS 6300. Graduate Laboratory
1-6-3.
Experiments are conducted that demonstrate basic principles from various fields of physics. An emphasis is placed on contemporary concepts in modern physics.

PHYS 6771. Optoelectronics: Materials, Processes, Devices
3-0-3.
Optoelectronic materials, physical processes, and devices. Includes compound semiconductor materials, excitation, recombination, gain, and modulation processes, and devices such as emitters, detectors, and modulators. Crosslisted with ECE 6771.

PHYS 6787. Quantitative Electrophysiology
3-0-3.
A quantitative presentation of electrophysiological systems in biomedical organisms, emphasizing the electrical properties and modeling of neural and cardiac cells and systems. Crosslisted with BMED and ECE 6787.

PHYS 7000. Master's Thesis
Credit hours to be arranged.

PHYS 7123. Statistical Mechanics II
3-0-3.
Prerequisite(s): PHYS 6107
Principles of nonequilibrium statistical mechanics, both classical and quantal. Emphasis is on the dynamics of fluctuations, their measurement, and their relationship to transport properties.

PHYS 7125. Gravity
3-0-3.
Prerequisite(s): PHYS 6101 and PHYS 6103
The theory of gravity, describing how matter curves spacetime and spacetime guides matter, with its experimental and theoretical applications.

PHYS 7141. Many-Particle Quantum Mechanics
3-0-3.
Prerequisite(s): PHYS 6106
Quantum mechanics of interacting Fermi and Bose particles. Topics include second quantization, diagrammatic purturbation theory, variational methods, and path integrals.

PHYS 7143. Group Theory and Quantum Mechanics
3-0-3.
Prerequisite(s): PHYS 6106
Foundations of group representation theory with applications in atomic, molecular, nuclear, and solid state physics.

PHYS 7147. Quantum Field Theory
3-0-3.
Prerequisite(s): PHYS 6106
Introduction to quantum field theory, with an emphasis in quantum electrodynamics. Second quantization, Dirac equation, Feynman diagrams, quantum electrodynamics, electroweak interactions.

PHYS 7150. Quantum Logics
3-0-3.
Prerequisite(s): PHYS 6106
The revision of classical logic and set theory to accommodate the phenomena of quantum interference, with experimental and theoretical consequences.

PHYS 7221. Statistical Optics
3-0-3.
Phenomena in optics where randomness is dominant. Topics include random variables and processes, partial coherence, polarization, photo statistics, and imaging in random media.

PHYS 7222. Quantum Optics I
3-0-3.
Prerequisite(s): PHYS 4143 or PHYS 6106
Basic course on the interaction of light with matter, based on quantum theory. Applications to the laser and to the study of coherence properties of light.

PHYS 7223. Quantum Optics II
3-0-3.
Prerequisite(s): PHYS 7222
Advanced treatment of the interaction of light with matter using modern methods of open quantum systems. Applications to current research.

PHYS 7224. Nonlinear Dynamics
3-0-3.
Prerequisite(s): PHYS 6101
A course on nonlinear dissipative dynamical systems, with an emphasis in aspects relevant to physicists. Topics include bifurcation theory, attractors, renormalization group techniques, and pattern formation.

PHYS 8001. Seminar
1-0-1.
Representative research programs in the School are described by advanced graduate students, postdoctoral fellows, and faculty members. The experimental basis of physics is illustrated through accounts of great experiments of importance to contemporary research.

PHYS 8002. Graduate Student Seminar
1-0-1.
Representative research programs in the School are described by advanced graduate students, postdoctoral fellows, and faculty members. The experimental basis of physics is illustrated through accounts of great experiments of importance to contemporary research.

PHYS 8801, -02, -03, -04. Special Topics
Class and credit hours equal last digit of course number.

PHYS 8901. Special Problems
Credit hours to be arranged.

PHYS 8991, -92, -93. Master's Practicum
Credit hours to be arranged.

PHYS 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding a graduate teaching assistantship.

PHYS 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding a graduate research assistantship.

PHYS 9000. Doctoral Thesis
Credit hours to be arranged.

An asterisk (*) denotes prerequisite courses that may be taken concurrently.

School of Psychology

www.psychology.gatech.edu

Established in 1959
Location: J.S. Coon Building
Telephone: 404.894.2680 or 404.894.2683
Fax: 404.894.8905

Chair and Professor–Randall Engle; *Associate Chair and Associate Professor*–Gregory Corso; *Professor Emeritus*–Edward H. Loveland; *Regents' Professor*–Anderson D. Smith. *Professors*–Phillip L. Ackerman, Fredda Blanchard-Fields, Susan Embretson, Jack M. Feldman, Arthur D. Fisk, Christopher K. Hertzog, Larry James, Ruth Kanfer, Terry L. Maple, M. Jackson Marr, Stanley A. Mulaik (emeritus), M. Carr Payne Jr. (emeritus), Wendy Rogers. *Associate Professors*–Richard Catrambone, Gregory M. Corso, Elizabeth T. Davis, Zenzi Griffin. *Assistant Professors*–Paul Corballis, David Robertson, Eric Schumacher, Daniel Spieler, Bruce Walker. *Instructors*–Dianne Leader, Edward Rickert. *Adjunct Professors*–Dorritt Billman, Mollie Bloomsmith, Kristin Boyle, Theodore J. Doll, Debra L. Forthman, Leonard W. Poon, Tara Stoinski.

General Information

The School of Psychology offers programs of study leading to the Bachelor of Science in Applied Psychology and the Master of Science and Doctor of Philosophy in Psychology. It also offers training in the basic and applied aspects of the science of behavior for the student majoring in architecture, engineering, management, and natural sciences. The undergraduate curriculum provides a broad-based natural science approach to the study of psychology. Courses in mathematics, biology, and chemistry, for instance, complement the psychology courses. The curriculum also stresses methodological issues so that students learn the fundamentals for carrying out solid research.

Undergraduate Program

The curriculum is technically oriented and stresses quantitative and experimental approaches to the study of behavior. The undergraduate curriculum is based on a strong emphasis in the sciences and mathematics and provides an excellent preparation for graduate school in psychology, medical school, law school, and other professional and academic graduate programs. In addition, many students with the B.S. degree in psychology choose to enter a variety of fields including computer software design, human resources, marketing, human factors, system design, personnel selection and training, and management.

Bachelor of Science in Applied Psychology (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
BIOL 1510	BIOLOGICAL PRINCIPLES	4
ENGL 1101	ENGLISH COMPOSITION I	3
WELLNESS		2
MATH 1501	CALCULUS I	4
PSYC 1101	GENERAL PSYCHOLOGY	3
TOTAL SEMESTER HOURS		16

First Year - Second Semester

Course Number/Name		*Hours*
BIOL 1520	INTRO. TO ORGANISMAL BIOLOGY	4
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II	4
PSYC 2103	HUMAN DEVELOPMENT OVER THE LIFE SPAN	3
TOTAL SEMESTER HOURS		14

Second Year - First Semester

Course Number/Name		*Hours*
CHEMISTRY/PHYSICS ELECTIVE(S)		4
HUMANITIES ELECTIVE(S)		3
CS 1321	INTRO. TO COMPUTING	3
PSYC 2010	RESEARCH METHODS	3
PSYC 2210	SOCIAL PSYCHOLOGY	3
TOTAL SEMESTER HOURS		16

Second Year - Second Semester

Course Number/Name		*Hours*
CHEMISTRY/PHYSICS ELECTIVE(S)		4
PSYC 2020	PSYCHOLOGICAL STATISTICS	4
PSYCHOLOGY ELECTIVE(S)		3
FREE ELECTIVE(S)		2
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

Third Year - First Semester

Course Number/Name		*Hours*
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
PSYC 3011	COGNITIVE PSYCHOLOGY	4
PSYC 3020	BIOPSYCHOLOGY	3
FREE ELECTIVE(S)		6
TOTAL SEMESTER HOURS		16

Third Year - Second Semester

Course Number/Name		*Hours*
MATH or COMPUTER SCIENCE REQUIREMENT		3
PSYC 3031	EXPERIMENTAL ANALYSIS OF BEHAVIOR	4
PSYCHOLOGY ELECTIVE(S)		3
FREE ELECTIVE(S)		6
TOTAL SEMESTER HOURS		16

Fourth Year - First Semester

Course Number/Name	*Hours*
PSYCHOLOGY ELECTIVE(S)	6
FREE ELECTIVE(S)	6
HUMANITIES ELECTIVE(S)	3
TOTAL SEMESTER HOURS	15

Fourth Year - Second Semester

Course Number/Name		*Hours*
PSYCHOLOGY CAPSTONE COURSE		4
SOCIAL SCIENCE ELECTIVE(S)		3
FREE ELECTIVE(S)		6
TOTAL SEMESTER HOURS		13

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Bachelor of Science in Applied Psychology - Business Option (Suggested Schedule)

First Year - First Semester

Course Number/Name		*Hours*
BIOL 1510	BIOLOGICAL PRINCIPLES	4
ENGL 1101	ENGLISH COMPOSITION I	3
WELLNESS		2
MATH 1501	CALCULUS I	4
PSYC 1101	GENERAL PSYCHOLOGY	3
TOTAL SEMESTER HOURS		16

First Year - Second Semester

Course Number/Name		*Hours*
BIOL 1520	INTRO. TO ORGANISMAL BIOLOGY	4
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II	4
PSYC 2103	HUMAN DEVELOPMENT OVER THE LIFE SPAN	3
TOTAL SEMESTER HOURS		14

Second Year - First Semester

Course Number/Name		*Hours*
CHEMISTRY/PHYSICS ELECTIVE(S)		4
HUMANITIES ELECTIVE(S)		3
CS 1321	INTRO. TO COMPUTING	3
PSYC 2010	RESEARCH METHODS	3
PSYC 2210	SOCIAL PSYCHOLOGY	3
TOTAL SEMESTER HOURS		16

Second Year - Second Semester

Course Number/Name		*Hours*
CHEMISTRY/PHYSICS ELECTIVE(S)		4
PSYC 2220	INDUSTRIAL/ORGANIZ. PSYCH.	4
PSYCHOLOGY ELECTIVE(S)		3
FREE ELECTIVE(S)		2
SOCIAL SCIENCE ELECTIVE(S)		3
TOTAL SEMESTER HOURS		16

Third Year - First Semester

Course Number/Name		*Hours*
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
PSYC 3011	COGNITIVE PSYCHOLOGY	4
PSYC 3020	BIOPSYCHOLOGY	3
FREE ELECTIVE(S)		3
ECON 2106	PRINCIPLES OF MICROECONOMICS	3
TOTAL SEMESTER HOURS		16

Third Year - Second Semester

Course Number/Name		*Hours*
MATH or COMPUTER SCIENCE REQUIREMENT		3
PSYC 3031	EXPERIMENTAL ANALYSIS OF BEHAVIOR	4
PSYCHOLOGY ELECTIVE(S)		3
FREE ELECTIVE(S)		3
MGT 3000	ACCOUNTING FOR DECISION MAKING	3
TOTAL SEMESTER HOURS		16

Fourth Year - First Semester

Course Number/Name		*Hours*
PSYCHOLOGY ELECTIVE(S)		6
FREE ELECTIVE(S)		3
HUMANITIES ELECTIVE(S)		3
MGT 3300	MARKETING MANAGEMENT I	3
TOTAL SEMESTER HOURS		15

Fourth Year - Second Semester

Course Number/Name		*Hours*
PSYCHOLOGY CAPSTONE COURSE		4
SOCIAL SCIENCE ELECTIVE(S)		3
FREE ELECTIVE(S)		3
MGT 3150 or 3310 or 4191 or 4331		3
TOTAL SEMESTER HOURS		13

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Wellness Requirement

All undergraduate students attending Georgia Tech must satisfactorily complete a wellness requirement (HPS 1040 or equivalent).

Requirements and Electives

General Education

- Humanities/Fine Arts (twelve hours)
- Social Science (twelve hours, including three hours of Const. & History; PSYC 1101 and PSYC 2010 count toward the twelve hours)
- Chemistry/Physics (eight hours): either one year of chemistry (1310, 1311, 1312) or one year of physics (2211, 2212), or one semester of each
- Biology (eight hours): Biol 1510, 1520
- Computer Science (three hours): CS 1321
- Mathematics (eleven hours): one year of calculus (1501, 1502) plus either a third mathematics course (see Psychology Web page for allowable courses) or CS 1322

Preliminary Courses

- PSYC 1101 General Psychology (3-0-3)
- PSYC 2010 Research Methods (w/lab) (3-0-3)
- PSYC 2020 Psychological Statistics (w/lab) (3-3-4)

Required Courses

- PSYC 2103 Human Development (3-0-3)
- PSYC 2210 Social Psychology (3-0-3)
- PSYC 3011 Cognitive Psychology (w/lab) (3-3-4)
- PSYC 3020 Biopsychology (3-0-3)
- PSYC 3031 Exp. Anal. of Behav. (w/lab) (3-3-4)

Required Capstone Course

- PSYC 4031 Applied Experimental Psychology (w/lab) (3-3-4) or
- PSYC 4501 Senior Thesis/Practicum (1-9-4)

Elective Courses (at least four must be taken)

- PSYC 2220 Industrial/Organizational Psychology (3-0-3)
- PSYC 2230 Abnormal Psychology (3-0-3)
- PSYC 2240 Personality Theory (3-0-3)
- PSYC 2270 Engineering Psychology (3-0-3)
- PSYC 3040 Sensation and Perception (3-0-3)
- PSYC 3060 Comparative Psychology (3-0-3)
- PSYC 3790 Introduction to Cognitive Science (3-0-3) (crosslisted w/ CS & ISYE)
- PSYC 4010 Human Abilities (3-0-3)
- PSYC 4050 History and Systems (3-0-3)
- PSYC 4090 Cognitive Neuroscience (3-0-3)
- PSYC 4100 Behavioral Pharmacology (3-0-3)
- PSYC 4200 Advanced Topics in Cognitive Psychology (3-0-3)
- PSYC 4260 Psychology of Aging (3-0-3)
- PSYC 4270 Psychological Testing (3-0-3)
- PSYC 4310 Field Studies in Animal Behavior I (1-6-3)
- PSYC 4320 Field Studies in Animal Behavior II (1-6-3)
- PSYC 4770 Psychology and Environmental Design (2-3-3)
- PSYC 4801-4 Special Topics (3-0-3) [permission of instructor & junior/senior standing] [Only a total of three hours may be applied toward the psychology elective.]
- PSYC 4900-10 Special Problems (credit hours arranged) [permission of instructor junior/senior standing]
  Only a total of three hours may be applied toward the psychology elective.

Other Psychology Classes that May be Offered But Will Not Satisfy the Major Requirements (i.e., they can be free electives only)

- PSYC 2300 Psychology of Advertising (3-0-3)
- PSYC 2901->2903 Special Problems (arranged hours) [permission of instructor]
- PSYC 2400 Psychology and Contemporary Issues in Society (3-0-3)
- PSYC 4750 Human-Computer Interface Design & Evaluation (crosslisted w/CS) (3-0-3)
- PSYC 4790 Seminar in Cognitive Science (w/lab) (crosslisted w/ CS & ISYE) (3-0-3)
- PSYC 4791 Integrative Project in Cognitive Science (3-0-3)
- PSYC 4792 Design Project in Cognitive Science (3-0-3)

Premedical Preparation

Premedical students must take chemistry (CHEM 1310, 1311) ANS physics (PHYS 2211, 2212). In addition, premedical students must take EITHER CHEM 1312 (Inorganic Laboratory) OR 1313 (Introduction to Quantitative Methods) AND CHEM 2311 (Organic I), 2312 (Organic II), AND 2380 (Synthesis Laboratory I).

Business/Management Option

For a psychology major to complete the Business/Management option, he or she must take the following courses:

Required

- ECON 2106 Principles of Microeconomics (3)
- MGT 3000 Accounting for Decision Making (3)
- MGT 3300 Marketing Management I (3)
- PSYC 2220 Industrial/Organizational Psychology (3)

Electives (One course from list below must be taken)

- MGT 3150 Principles of Management (3)
- MGT 3310 Marketing Research: Qualitative Aspects
- MGT 4191 The Entrepreneurship Forum (3)
- MGT 4331 Consumer Behavior

Graduate Programs

Doctoral candidates take a core curriculum in general psychology and quantitative methods. Doctoral candidates will complete all requirements for the master's degree, which includes writing a research thesis.

The master's degree prepares the student for continuation of graduate work toward the Ph.D. Most students require a minimum of two calendar years to complete the master's degree, which includes writing a thesis.

The doctoral program provides the student with an opportunity for advanced study in experimental (focus areas in cognitive science, cognitive aging, and animal behavior), industrial-organizational, or engineering psychology. Each of these curricula consists of additional courses and programs of individual study and research beyond the core curriculum, which contribute to a strong background in general experimental psychology and the student's area of specialization. The doctoral program will ordinarily require at least four years for students who enter immediately after obtaining the bachelor's degree.

Admission to graduate study in psychology with full graduate standing in the School of Psychology requires the equivalent of an undergraduate major in psychology or a related field with courses in general and experimental psychology, as well as psychological statistics. All applicants should submit scores on the Graduate Record Examination.

The psychology faculty will consider admissions applications from competent students who have majored in subjects other than psychology.

Graphics, Visualization, and Usability (GVU)

Center's Suggested Courses for Graduate Minor

To fulfill their graduate minor requirements, psychology graduate students may take an interdisciplinary sequence of courses suggested by the Graphics, Visualization, and Usability Center. Three different tracks of study are designed to provide a systematic overview of a given area: one specializing in graphics, another in visualization, and a third in usability. Courses for these three tracks are specified in the College of Computing section of this catalog.

Master of Science in Human-Computer Interaction

The Master of Science in Human-Computer Interaction (M.S.-H.C.I.) at Georgia Tech is an interdisciplinary, collaborative effort of the College of Computing, the School of Psychology, and the School of Literature, Communication, and Culture, and is coordinated through the GVU Center. The program provides students with the practical, interdisciplinary skills and theoretical understanding they will need to become leaders in the design, implementation, and evaluation of the computer interfaces of the future.

Students may apply to enter the program through any one of the three participating units, the choice of which usually reflects that student's intended area of specialization. All M.S.-H.C.I. students take a common set of core courses, plus a set of additional courses that relate more to that student's area and particular needs.

Full details of the M.S.-H.C.I. program are listed in the College of Computing section and on the GVU Center Web page. Note that all applications for admission to the program are collected by the GVU Center and forwarded to the relevant department for evaluation.

Graduate Certificate in Cognitive Sciences

Cognitive science is an interdisciplinary research area spanning psychology, computer science, linguistics, and philosophy. The certificate in cognitive science provides students with a structured set of courses from related disciplines. Psychology students usually sample artificial intelligence courses (from computer science) and human systems engineering courses (from industrial and systems engineering). Two interactive courses are specifically designed to give students a systematic exposure to cognitive science. Courses for the certificate can also function as the student's graduate minor. An extended description of the program can be found in the College of Computing section of this catalog.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

PSYCHOLOGY

PSYC 1101. General Psychology
3-0-3.
A survey of methods, findings, and theories of the science of mind and behavior.

PSYC 2010. Research Methods
2-3-3.
Prerequisite(s): PSYC 1101
Introduction to methods used in conducting research on human behavior. Experimental research will be emphasized, but the course will cover other methods and some statistics.

PSYC 2020. Psychological Statistics
3-3-4.
Prerequisite(s): PSYC 2010 and (MATH 1502 or MATH 1512) or (MATH 15X2 and MATH 1522)
Introduction to probability and statistics as applied to psychological data. Tests for means, variances, correlation, ANVOA, and regression.

PSYC 2103. Human Development Over the Life Span
3-0-3.
Prerequisite(s): PSYC 1101
Theories and issues in human development including cognitive, social, and emotional development. The course is organized topically rather than chronologically.

PSYC 2210. Social Psychology
3-0-3.
Prerequisite(s): PSYC 1101
Consideration of the behavior of individuals in social contexts, including interpersonal and group settings.

PSYC 2220. Industrial/Organizational Psychology
3-0-3.
Prerequisite(s): PSYC 1101
An introduction to industrial/organizational psychology providing an overview of behavior in the workplace and psychology applied in industrial and organizational settings.

PSYC 2230. Abnormal Psychology
3-0-3.
Prerequisite(s): PSYC 1101
This course surveys the spectrum of psychiatric disorders (symptoms, epidemiology, etiology, and treatment) and provides a perspective on adaptive functioning and psychological resilience.

PSYC 2240. Personality Theory
3-0-3.
Prerequisite(s): PSYC 1101
Introduction to major approaches to personality theory.

PSYC 2270. Introduction to Engineering Psychology
3-0-3.
Prerequisite(s): PSYC 1101
Engineering psychology presented as an integral component in the design and evaluation of human-machine systems. Applied problems and general methodological questions are examined.

PSYC 2300. Psychology of Advertising
3-0-3.
Prerequisite(s): PSYC 1101
An examination of contemporary advertisers' use of basic psychological principles in advertising. Concepts explored include memory, attention, comparative advertising, and attitude change.

PSYC 2400. Psychology and Contemporary Issues in Society
3-0-3.
Prerequisite(s): PSYC 1101
Contributions of psychology to an appreciation of selected contemporary issues.

PSYC 2698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

PSYC 2699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

PSYC 2760. Human Language Processing
3-0-3.
Theories and research in psychlinguistics: how people comprehend and speak human languages. Includes speech perception, word recognition, parsing, sentence interpretation, word production, and sentence generation. Crosslisted with LING 2760.

PSYC 2801, -02, -03. Special Topics
Class and credit hours equal last digit of course number.
Special topics of current interest.

PSYC 2901, -02, -03. Special Problems
Credit hours to be arranged.
Prerequisite(s): PSYC 1101
Special problems of current interest.

PSYC 3011. Cognitive Psychology
3-3-4.
Prerequisite(s): PSYC 2020
Exploration of the central aspects of human cognition including pattern recognition, attention, memory, language, categorization, problem solving, and decision making. Phenomena and methods are stressed.

PSYC 3020. Biopsychology
3-0-3.
Prerequisite(s): PSYC 1101 and BIOL 1520
Neurophysiological, endocrinological, and biochemical bases of sensory and motor functioning, motivation, learning, memory, and behavior dysfunction.

PSYC 3031. Experimental Analysis of Behavior
3-3-4.
Prerequisite(s): BIOL 1510 and PSYC 2020
History, theory, and methods of behavior analysis. Topics include shaping, stimulus-stimulus and response-consequence contingencies, stimulus control, and choice.

PSYC 3040. Sensation and Perception
3-0-3.
Prerequisite(s): BIOL 1510 and PSYC 1101
An examination of how sensations and perceptions are processed by humans. Topics covered will include vision, hearing, the skin senses, taste, smell, and the vestibular senses.

PSYC 3060. Comparative Psychology
2-2-3.
Prerequisite(s): PSYC 1101 and BIOL 1520
Consideration of principles and research methods of animal psychology and ethology. Literature reviews and reports, field trips, and laboratory studies.

PSYC 3790. Introduction to Cognitive Science
3-0-3.
Prerequisite(s): PSYC 1101
Multidisciplinary perspectives on cognitive science. Interdisciplinary approaches to issues in cognition, including memory, language, problem solving, learning, perception, and action. Crosslisted with CS, PST, and ISYE 3790.

PSYC 4010. Human Abilities
3-0-3.
Prerequisite(s): PSYC 2020
Introduction to differential psychology providing an overview of differences in humans. Topics such as abilities, temperament, and group differences (e.g., gender) are addressed.

PSYC 4031. Applied Experimental Psychology
3-3-4.
Prerequisite(s): PSYC 3011
Consideration of the applications of methods and data of experimental psychology. Understanding of human capabilities and limitations is applied to design of technology and environments.

PSYC 4050. History and Systems
3-0-3.
Prerequisite(s): PSYC 1101
A survey of the history, methods, and content of modern psychological theory, research, and application. Schools of psychology (e.g., structuralism, functionalism, behaviorism, gestalt psychology) and central theories of psychology will be reviewed in their historical and philosophical context.

PSYC 4090. Cognitive Neuroscience
3-0-3.
Prerequisite(s): PSYC 3011
Examination of the neural basis of cognitive function. Basic anatomy and methods are covered. Primary focus is on contemporary problems in the neurocognitive study of perception, memory, language, and attention, as well as disorders in these domains.

PSYC 4100. Behavioral Pharmacology
3-0-3.
Prerequisite(s): PSYC 1101 and BIOL 1520 and CHEM 1310 and BIOL 1520
An analysis of drug-behavior interactions with emphasis on basic pharmacology, role of contingencies in drug effects, mechanisms of drug dependency, drugs as stimuli, and basic neuropharmacology.

PSYC 4200. Advanced Topics in Cognitive Psychology
3-0-3.
Prerequisite(s): PSYC 3011
An advanced survey in various topics in cognitive psychology. Topics will vary over time.

PSYC 4260. Psychology of Aging
3-0-3.
Prerequisite(s): PSYC 1101
Survey of research concerned with the nature and causes of adult age differences in behavior.

PSYC 4270. Psychological Testing
3-0-3.
Prerequisite(s): PSYC 2020
Fundamentals of psychological test construction (reliability and validity) and applications of intelligence, personality, and interest assessment. Topics will include theoretical, practical, ethical, and legal issues.

PSYC 4310, -20. Field Studies in Animal Behavior I, -II
1-6-3.
Course takes place in the field (Africa, South America, or Asia) and is limited to fifteen qualified students. Lectures by instructor provide in-class portion. Visits to national parks, game reserves, and in-field observations will introduce students to natural habitats.

PSYC 4501. Senior Thesis/Practicum
1-9-4.
Prerequisite(s): PSYC 2020
For selected students to conduct original work under the direction of a faculty member.

PSYC 4698. Undergraduate Research Assistantship
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

PSYC 4699. Undergraduate Research
Credit hours to be arranged.
Independent research conducted under the guidance of a faculty member.

PSYC 4750. Human-Computer Interface Design and Evaluation
3-0-3.
Prerequisite(s): PSYC 1101 and CS 1321
Human-computer interface is considered in terms of user-system compatibility. Concepts in human factors and interface design are covered in relation to capabilities of both humans and computers. Crosslisted with CS 4750.

PSYC 4770. Psychology and Environmental Design
2-3-3.
Prerequisite(s): PSYC 1101
Introduction of psychological concepts relevant to environmental design. Survey of selected methods for assessing human-made environments and development of design solutions to selected problems. Crosslisted with ARCH 4770.

PSYC 4790. Seminar in Cognitive Science
3-0-3.
Prerequisite(s): PSYC 1101
A seminar-type course in cognitive science focusing on integrating and deepening students' cognitive science knowledge and skills. Topics include memory, language, problem solving, learning, perception, and action. Crosslisted with CS, PST, and ISYE 4790.

PSYC 4791. Integrative Project in Cognitive Science
3-0-3.
An integrative course in cognitive science focusing on the integration and use of concepts and skills from cognitive science. A different integrative project or set of projects will be taken on each semester; students will contribute on the basis of their background and skills. Crosslisted with CS, ISYE, and PST 4791.

PSYC 4792. Design Project in Cognitive Science
3-0-3.
Individual project with a cognitive science faculty member, designed as a supplement to the student's senior design project or thesis in their major area. Crosslisted with CS, ISYE, and PST 4792.

PSYC 4803. Special Topics
3-0-3.
Prerequisite(s): PSYC 2020
Special topics or courses of an experimental nature.

PSYC 4813, -23, -33. Special Topics
3-0-3.
Special topics or courses of an experimental nature.

PSYC 4900, -01. Special Problems
Credit hours to be arranged.
Prerequisite(s): PSYC 2020
Students engage in individual and group projects under the direction of a faculty member.

PSYC 4902, -03, -04, -05, -06, -07, -08, -09, -10. Special Problems
Credit hours to be arranged.
Prerequisite(s): PSYC 1101
Students engage in individual and group projects under the direction of a faculty member.

PSYC 6011. Cognitive Psychology
3-0-3.
Survey course on human cognition including pattern recognition, attention, memory, categorization, problem solving, consciousness, decision making, intention, and the relation between mind and brain.

PSYC 6012. Social Psychology
3-0-3.
Fundamental theory and research in social behavior including social perception/cognition, attitude formation and change, social influences, and group processes.

PSYC 6013. Biopsychology
3-0-3.
Neurophysiological, endocrinological, and biochemical bases of sensory and motor functioning, motivation, learning, memory, and behavior dysfunction.

PSYC 6014. Sensation and Perception
3-0-3.
This course examines how sensations and perceptions of the outside world are processed by humans, including physiological, psychophysical, ecological, and computational perspectives.

PSYC 6015. Developmental Psychology
3-0-3.
Overview of concepts, assumptions, methods, theories, and research in human development across the life span including cognitive, emotional, and social behavior.

PSYC 6016. Experimental Analysis of Behavior
3-0-3.
Conceptual, methodological, and theoretical issues in the experimental analysis of behavior with special emphasis on classical and operant conditioning as foundations for complex behavior.

PSYC 6017. Human Abilities
3-0-3.
Theory, methods, and applications of research on human abilities, including intelligence, aptitude, achievement, learning, aptitude treatment interactions, information processing correlates, and measurement issues.

PSYC 6018. Principles of Research Design
3-0-3.
Co-requisite: PSYC 6019.
Introduction to basic principles and practices of empirical research in psychology. Covers both experimental and correlational methods and designs.

PSYC 6019. Statistical Analysis of Psychological Data I
4-3-5.
Co-requisite: PSYC 6018.
Introductory treatment of descriptive and inferential statistics as applied to psychological research.

PSYC 6020. Statistical Analysis of Psychological Data II
4-3-5.
Prerequisite(s): PSYC 6019
Introductory treatment of inferential statistics, especially the general linear model, as applied to psychological research.

PSYC 6021. Personality Theories
3-0-3.
Survey of personality theories, research, and methods of assessment.

PSYC 6750. Human-Computer Interface
3-0-3.
Describes the characteristics of interaction between humans and computers and demonstrates techniques for the evaluation of user-centered systems. Crosslisted with CS 6750.

PSYC 6795. Introduction to Cognitive Science
3-0-3.
Multidisciplinary perspectives on cognitive science. Interdisciplinary approaches to issues in cognition, including memory, language, problem solving, learning, perception, and action. Crosslisted with CS and ISYE 6795.

PSYC 7000. Master's Thesis
Credit hours to be arranged.

PSYC 7020. Survey of Cognitive Aging
3-0-3.
Introduction to theory and research on adult cognitive development, including intelligence, attention, memory, and problem solving.

PSYC 7101. Engineering Psychology I: Methods
3-0-3.
Basic methods used to study human-machine systems including both system analysis and human performance evaluation techniques. These methods will be applied to specific systems.

PSYC 7102. Engineering Psychology II: Displays, Controls, and Workspace Design
3-0-3.
Basic principles of human factors for the design, evaluation, and use of displays, controls, and workspace layouts including new technologies and associated human factors problems.

PSYC 7103. Engineering Psychology III: Environmental Stressors and Human Performance
3-0-3.
Environmental stressors and their influences on human performance, physiological function, and emotional responses including work/rest cycles, jetlag, noise, vibration, glare, weightlessness, etc.

PSYC 7104. Psychomotor and Cognitive Skill Learning and Performance
3-0-3.
Human capabilities and limitations for learning and performing psychomotor and cognitive skills are studied.

PSYC 7201. Industrial/Organizational Psychology
3-0-3.
This course introduces an overview of issues relevant to behavior in the workplace and psychology applied in industrial and organizational settings.

PSYC 7202. Employee Selection
3-0-3.
The course provides a conceptual framework for personnel selection guided by scientific principles, research, and theory as well as by professional, legal, and technical guidelines.

PSYC 7203. Motivation and Job Attitudes
3-0-3.
Examines theory and pragmatics in description, prediction, and measurement of work-related behavior and associated evaluations. Includes theoretical and methodological problems in field and laboratory contexts.

PSYC 7204. Training and Development
3-0-3.
This course will focus on theory, principles, techniques, and practices relevant to training and developing human resources. Research and professional literature will be examined.

PSYC 7301. Introduction to Multivariate Statistics
3-0-3.
Foundations for multivariate analysis including properties of linear composite variables, multiple regression, multiple and partial correlation, MANOVA, factor analysis, multiple discriminant analysis, canonical correlation, etc.

PSYC 7302. Structural Equation Modeling
3-0-3.
Methods of causal modeling to study causal relations including issues of causality, establishing causality, fundamentals of linear structural equation modeling with latent variables, fitting models.

PSYC 7303. Psychometric Theory
3-0-3.
Preparation of students in statistical theory and techniques relevant to becoming professionally involved in construction, analysis, and evaluation of psychology and personnel tests.

PSYC 7700. Professional Problems
2-0-2.
Discussion of issues faced by professional psychologists in the areas of teaching, research, and professional practice. Ethical issues in all of these areas are emphasized.

PSYC 7701. Teaching Practicum
1-3-2.
Supervised college teaching including techniques, course and curriculum design, evaluation. Students will prepare and present lectures with direct observations and video taping for discussion.

PSYC 7790. Cognitive Modeling
2-6-4.
Prerequisite(s): CS 6795 or ISYE 6795 or PSYC 6795
A hands-on course covering a range of cognitive modeling methodologies. It explores the analysis, development, construction, and evaluation of models of cognitive processing. Crosslisted with CS and ISYE 7790.

PSYC 7999. Preparation for Doctoral Qualifying Exam
Credit hours to be arranged.

PSYC 8000. Seminar in Experimental Psychology
3-0-3.
Critical examination of current problems in a selected area of general experimental psychology. Areas to be discussed may vary each time course is offered.

PSYC 8010. Seminar in Cognitive Psychology
3-0-3.
Critical examination of current problems in a selected area of cognitive psychology. Areas to be discussed may vary each time course is offered.

PSYC 8020. Seminar in Cognitive Aging
3-0-3.
Critical examination of current problems in a selected area of cognitive aging. Areas to be discussed may vary each time course is offered.

PSYC 8030. Seminar in Comparative Psychology
3-0-3.
Critical examination of current problems in a selected area of comparative psychology. Areas to be discussed may vary each time course is offered.

PSYC 8040. Seminar in Engineering Psychology
3-0-3.
Critical examination of current problems in a selected area of engineering psychology. Areas to be discussed may vary each time course is offered.

PSYC 8050. Seminar in Industrial/Organizational Psychology
3-0-3.
Critical examination of current problems in a selected area of industrial/organizational psychology. Areas to be discussed may vary each time course is offered.

PSYC 8060. Seminar in Quantitative Psychology
3-0-3.
Presentation and discussion of quantitative approaches to psychology. Topics will vary, but might include neural networks, measurement theory, behavioral ecology, modeling, system dynamics, etc.

PSYC 8795. Colloquium in Cognitive Science
1-0-1.
Reading of research papers by leading cognitive scientists, attendance at their colloquia, and meeting with them to discuss research. Crosslisted with CS and ISYE 8795.

PSYC 8803. Special Topics in Applied Statistics
3-0-3.
Covers current issues and recent advances in the application of statistical methods to research in psychology. Instructors select the specific focus for a given term.

PSYC 8890. Special Topics in Cognitive Science
3-0-3.

PSYC 8900. Special Problems in Experimental Psychology
Credit hours to be arranged.
Students conduct research under direction of a faculty member on problems in the general area of experimental psychology.

PSYC 8901. Special Problems in Engineering Psychology
Credit hours to be arranged.
Students conduct research under the direction of a faculty member on problems in the general area of engineering psychology.

PSYC 8902. Special Problems in Industrial/Organizational Psychology
Credit hours to be arranged.
Students conduct research under the direction of a faculty member on problems investigating some psychological aspect of industrial/organizational problems.

PSYC 8903. Special Problems in Human-Computer Interaction
Credit hours to be arranged.
Students conduct research under the direction of a faculty member on problems in the general area of human-computer interaction.

PSYC 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding a teaching assistantship.

PSYC 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding a research assistantship.

PSYC 9000. Doctoral Thesis
Credit hours to be arranged.

Rules and Regulations

Student Rules and Regulations

Originally approved by the faculty May 24, 1949. The most recent major revision was approved by the faculty on December 3, 2004.

Index

I. Purpose

These regulations are intended to set forth the requirements of the faculty to the end that a large student body may live and work together harmoniously with a minimum of friction and misunderstanding. Each student is expected to be a law-abiding citizen and to obey the laws of the city of Atlanta, Fulton County, the state of Georgia, and the United States.

II. Academic Calendar

A. Standard Calendar

The standard academic calendar of the Georgia Institute of Technology consists of fall and spring semesters and an accelerated summer session. Each semester normally includes approximately fifteen weeks of instruction plus one week of final examinations; the normal summer session includes approximately eleven weeks of instruction plus one week of final examinations. An "academic year" consists of the fall and spring semesters. "Term" may refer to either a semester or a summer session. The Office of the Registrar publishes the official calendar for each academic term.

B. Other Academic Terms

In addition to the standard academic calendar, certain programs may be offered on other schedules. All such offerings are subject to the approval of the Institute Undergraduate Curriculum Committee, Institute Graduate Committee, and/or the registrar, as appropriate. With approval, such programs may operate under different academic rules, such as credit-hour limits or withdrawal dates, than those specified for standard academic terms.

C. Curriculum Year

1. Requirements for degrees and minors shall be specified for each curriculum year, which is comprised of a summer term plus the immediately following fall and spring semesters. This designation shall be independent of any schedule for publication of such requirements in printed or electronic form.
2. All changes in degree and minor requirements shall become effective at the beginning of the next curriculum year following final approval by the Institute Undergraduate Curriculum Committee, Institute Graduate Committee, Academic Senate, and/or University System, as appropriate.
3. The Registrar's Office shall maintain an archival record of all degree and minor requirements associated with each curriculum year.

III. Responsibility for Notices and Change of Address

A. Notices

All students will have an e-mail account through the Georgia Institute of Technology that will be their official point of contact, and they are expected to check this account each school day. Students are also expected to be aware of notices that appear on the Student Access System as well as general notices that appear in the *Technique*. It is the student's responsibility to check the Student Access System during the drop/add period of registration and during the term to verify the accuracy of his/her schedule and for notices. Schedules should be verified at least once during the first five weeks of the term and once after mid-term.

B. Change of Address

Students are responsible for reporting all changes within one week on the Student Access System.

C. Unclaimed Mail

Students are responsible for returning to the front window of the post office all mail in their post office boxes that is unclaimed after three days.

IV. Attendance

A. General

1. Each term, a course listing is available online showing the time period for each class.
2. If an instructor should be late in meeting the class, the students shall wait twenty minutes after the published starting time. If the instructor has not arrived by that time, the students may leave unless specifically notified to await the instructor's arrival.

B. Class Attendance

1. There are no formal institutional regulations regarding class attendance at the Georgia Institute of Technology. The resources of the Institute are provided for the intellectual growth and development of the students who attend. A schedule of courses is provided for the students and faculty to facilitate an orderly arrangement of the program of instruction. The fact that classes are scheduled is evidence that attendance is important; students should, therefore, maintain regular attendance if they are to attain maximum success in the pursuit of their studies.
2. All students are responsible for obtaining an understanding of each instructor's policy regarding absences; all students are expected to attend announced quizzes, laboratory periods, and final examinations. Although it is recognized that occasionally it may be necessary for students to be absent from scheduled classes or laboratories for personal reasons, including major religious observances, students are responsible for all material covered in their absences, and they are responsible for the academic consequences of their absences. Students should discuss planned absences with their instructors as soon as possible after the beginning of an academic term. Work missed may be made up if the reasons for absences are acceptable to the instructors.
3. Students who are absent because of participation in approved Institute activities (such as field trips and athletic events) will be permitted to make up the work missed during their absences. Approval of such activities will be granted by the Student Academic and Financial Affairs Committee of the Academic Senate, and statements of the approved absence may be obtained from the Office of the Registrar.

V. Grades and Scholastic Average

A. Grades

1. Letter grades for completed courses used in the calculation of scholastic average are the following:
   A - excellent (four quality points)
   B - good (three quality points)
   C - satisfactory (two quality points)
   D - passing (one quality point)
   F - failure, must be repeated if in a required course (no quality points)
2. The following grades will be used in the cases indicated and will not be included in the calculation of scholastic average:
   S - passing of a course taken under pass/fail or completion of a course in which no letter grade may be assigned
   U - unsatisfactory in a course taken under pass/fail or unsatisfactory performance in a course for which no letter grade may be assigned
   V - assigned when the course has been audited; no credit given; and implies no academic achievement on the part of the student
3. The following grades will be used in the cases indicated and will not be included in the calculation of scholastic average:
   I - incomplete. Assigned when a student was doing satisfactory work, but for nonacademic reasons beyond his/her control and deemed acceptable by the instructor, was unable to meet the full requirements of the course. If the student's performance was so poor as to preclude his/her passing, the instructor shall assign the grade of *F*. Refer to section VII.B for regulations regarding removal of the *I* grade.
   W – withdrawal without penalty. Withdrawals from individual courses without penalty will not be permitted after 50 percent of the term has been completed, as specified by the official calendar, except in cases of hardship as determined by the Institute Undergraduate Curriculum Committee or Graduate Committee, as appropriate. Withdrawal from school will not be permitted after 60 percent of the term except in cases of hardship as determined by the Institute Undergraduate Curriculum Committee or Graduate Committee, as appropriate. With the exception of part-time graduate students, students who withdraw from school and

receive all grades of *W* will not ordinarily be permitted to re-enroll the next succeeding term. Refer to section VIII.B for regulations regarding readmission.

NR - not reported. Assigned when an instructor fails to submit grades by the published deadline, through no fault of the student.

4. Final grades are reported to the registrar at the end of each term.
5. Progress report grades will be submitted to the registrar on all classes numbered 1000 and 2000 each term. These grades will be used for the advisement of students, not for the calculation of any GPA at Georgia Tech. Progress report grades will be *S* or *U* (a grade of *U* indicates that based on work completed to that point, the student's standing is in the *D* or lower range). They will be submitted after 40 percent of the term has been completed, as specified by the official calendar, and be available to students no later than the following Monday.
6. If a final course grade is believed to be in error, the student should contact the professor as soon as possible. In general, no change of grade will be made after the end of the student's next term in residence.

B. Academic Average

The academic average is calculated as the ratio of the total number of quality points earned to the total number of credit hours in which a final letter grade has been assigned.

VI. Scholastic Regulations

A. Classification of Students

1. Undergraduate students, with the exception of non-degree-seeking students, shall be classified at the end of each term by the Office of the Registrar on the basis of the total number of semester credit hours for which they have credit in accordance with the following schedule:

   Freshman 0-29 credit hours
   Sophomore 30-59 credit hours
   Junior 60-89 credit hours
   Senior 90+ credit hours

2. Graduate and special students who have completed all requirements for a particular classification as defined by their major department may request reclassification through their major department.
3. Students scheduled for at least twelve credit hours in a semester are classified as full-time students; those scheduled for six-eleven hours are classified as part-time students; and those scheduled for one-five hours are classified as less-than-part-time students.

B. Eligibility for Class Rings

A student may purchase a class ring any time after receiving credit for seventy semester credit hours.

C. Academic Standing

1. The assignment of academic standing is based on both the student's most recent term and overall grade point average.
2. The minimum satisfactory academic average is 1.70 for freshmen and joint-enrolled high school students; 1.80 for sophomores; 1.95 for juniors; 2.00 for seniors and special undergraduates; 2.70 for master's and special graduate students; and 3.00 for doctoral students.
3. Good academic standing: Students not on academic probation are in good academic standing.
4. Academic warning
   a) Academic warning is a subcategory of good academic standing, differing only in the maximum allowable schedule load.
   b) A student who has an overall academic average below the minimum satisfactory scholarship requirement, or whose academic average for work taken during any term is below this requirement, shall be placed on academic warning.
5. Academic probation
   a) A student on academic warning whose academic average is below the minimum satisfactory scholarship requirement for any term shall be placed on academic probation.
   b) An undergraduate student in good academic standing whose academic average for any term is 1.00 or below, based on at least six credit hours, shall be placed on academic probation.
   c) A student also may be placed on academic probation through other actions, as described in the following section.
6. Dismissal for unsatisfactory scholarship
   a) The Institute may drop from the rolls at any time a student whose record in scholarship is unsatisfactory.
   b) A graduate student whose academic average for any term is 2.00 or below may be placed on academic probation or dropped, regardless of the student's previous record.
   c) A student on academic probation whose scholastic average for the term of probation is below the minimum satisfactory scholarship requirement and whose overall academic average is below the minimum satisfactory scholarship requirement shall be dropped from the rolls for unsatisfactory scholarship.
   d) An undergraduate student on academic warning whose academic average for any term is 1.00 or below, based on at least six credit hours, shall be dropped from the rolls for unsatisfactory scholarship.
   e) The record of a student on academic probation whose term average is unsatisfactory, but whose overall academic record is satisfactory, may be reviewed by the Undergraduate Curriculum Committee or the Graduate Committee, as appropriate. The student may be dropped or may be continued on academic probation.
7. *Academic review*: A student who normally would be dropped from the rolls for academic deficiencies but appears from the record not to have completed the term may be placed on academic review. This is a temporary standing that makes the student ineligible for registration. If no acceptable explanation is given within a reasonable time, the standing is changed to drop.
8. The academic standing regulations given previously for graduate students do not preclude a school from having more rigorous requirements.

D. Maximum Schedule Load

1. The maximum number of credit hours for which an undergraduate student may register in fall or spring semester, based on his or her academic standing, is as follows:
   Good 21 semester hours
   Warning 16 semester hours
   Probation 14 semester hours
2. The maximum number of credit hours for which an undergraduate student may register in a normal summer term, based on his or her academic standing, is as follows:
   Good 16 semester hours
   Warning 14 semester hours
   Probation 12 semester hours
3. A graduate student may register for a maximum of twenty-one semester hours in fall or spring semester and a maximum of sixteen semester hours during the normal summer term.
4. Requests for schedule overloads must be recommended by the student's major school and approved by the Institute Undergraduate Curriculum Committee or Graduate Committee, as appropriate.

E. Academic Honors

The Institute encourages excellence in scholarship and gives official recognition to undergraduate students whose work is superior in any given term.

1. *Dean's List* – includes all degree-seeking undergraduates who, during the preceding term, made an academic average of 3.00 or higher, completed a schedule of at least twelve hours of coursework on a letter-grade basis, and are not on academic warning or probation or subject to any disciplinary action. (All grades must be reported.)
2. *Faculty honors* – includes all degree-seeking undergraduates who during the preceding term made an academic average of 4.00, completed a schedule of at least twelve hours of coursework on a letter-grade basis with no *W* grades, and

are not on academic warning or probation or subject to any disciplinary action. (All grades must be reported.)

F. Change of Major

1. *Undergraduate students:* By filing the required form, will be permitted one unrestricted transfer between majors (including undecided) until they have accumulated credit for sixty hours. After sixty hours or upon subsequent request for transfer, the transfer will be permitted at the discretion of the school that the student is seeking to enter. Students who transfer from another institution to pursue a degree at Georgia Tech will be permitted to change their major only at the discretion of the school that the student is seeking to enter. Transfer students are not eligible for the one unrestricted change of major. (Note: Certain majors, because of high enrollment, have been granted a waiver of the one unrestricted transfer regulation. Students should consult with the individual school concerning its current transfer policy.)
2. *Graduate students:* By filing the required form, may transfer with the concurrence of the schools involved and the graduate dean.

G. Exceptions

Exceptions to these scholastic regulations may be made by the Undergraduate Curriculum Committee or the Graduate Committee, as appropriate, whenever a consideration of the student's complete record indicates that the application of a specific regulation will result in injustice.

VII. Deficiencies

A. General

1. A student who has received a grade of *I*, *F*, or *U* in a course has a deficiency in the course.
2. A student whose final grade is *F* or *U* has a failure in that course. The student must repeat and pass the course in class before credit will be allowed. (See section B.4 below.)

B. Removal of Deficiencies

1. If a grade of *I* (incomplete) is assigned in a course, the incomplete must be removed and the grade change reported by the end of the student's next term in residence or, if the student has not been enrolled, by the end of the term one calendar year from the date the incomplete was assigned. Failing to remove the *I* in the allotted time will result in the *I* being changed to the grade of *F*. To remove the incomplete, the student should consult with the instructor as soon as possible after the term is over and complete whatever remaining work is outlined by the instructor. Repeating the course for credit does not remove the grade of *I*.
2. A student who has a failure in a required course must schedule that course the next time it is offered while the student is in residence.
3. A degree candidate who has a single course deficiency from the final term of enrollment will be permitted one re-examination following the commencement and thereafter, one examination per annum following commencement until the deficiency is removed. Upon receipt of the reactivated degree petition for the following term, the Registrar may authorize a re-examination. The examination should be scheduled only following its authorization. A student should schedule the re-examination prior to the last day of Phase II registration to allow time to register for the course during the next semester if the student does not pass the re-examination and chooses to retake the course. The examination will be graded *S* or *U* and the grade so recorded. The previously assigned grade will remain a part of the record and a notation will be made on the student's transcript that the course requirement was satisfied by a re-examination. The student who successfully completes the re-examination will then be eligible to graduate the following term and may obtain a letter of completion from the Registrar.
4. A degree candidate who has otherwise completed all requirements for graduation and who has an incomplete in laboratory work taken during his or her final term in residence may remove the incomplete at the convenience of the department of instruction concerned.

VIII. Withdrawal from School and Readmission

A. Withdrawal

1. Withdrawal from school will not be permitted after 60 percent of the term except in cases of hardship as determined by the Institute Undergraduate Curriculum Committee or Graduate Committee, as appropriate. With the exception of part-time graduate students, students who withdraw from school and receive all grades of *W* will not ordinarily be permitted to re-enroll the next succeeding term. A student may withdraw from school via the Student Access System by the posted deadline in the Official School Calendar published in the OSCAR. All holds on the student's record must be cleared prior to withdrawal.
2. Students who cease attendance without withdrawing via the Student Access System will receive grades of *F*, *U*, or *I* for the courses in which they were registered that term.
3. Permission and/or formal resignation are not required when a student has completed an official school term and does not register for the succeeding term.
4. See section V.A.3 for further information on withdrawal.

B. Readmission

1. Any student who is not enrolled for two or more consecutive terms must apply for readmission. This application, with all the pertinent supporting information (except possibly another college transcript – see 2 below), must be submi ted to the registrar before the deadline for the term for which readmission is requested, as listed below:
   Fall - July 1
   Spring - December 1
   Summer - April 1
   Applications received after these deadlines will not be accepted.
2. Students who have attended other colleges should plan their readmission so as to allow ample time for official transcripts from those colleges to be sent to Georgia Tech. If official transcripts have not been received prior to the last day of registration, the student seeking readmission will not be allowed to complete registration.
3. Any student in good standing who is not enrolled for a single term will be allowed to re-enroll without applying for readmission to the Institute. There will be no distinction between the terms of the regular academic year and the summer term.
4. A student who is on academic warning or academic probation who is not enrolled for a single term will have an automatic hold placed on registration that must be cleared by the student's major school. For example, a student is placed on academic probation at the close of fall term and fails to enroll by the close of registration for the spring term. An automatic registration hold will be set, which must be cleared by the major school before the student can register for any future term.
5. A student who has been dropped once for unsatisfactory scholarship will ordinarily not be readmitted. A student who seeks an exception to this rule must have been out of the Institute for at least one term and have had a conference with the major school concerning the readmission. The readmission application deadline for a student who has been dropped is two months prior to the published readmission deadline for the term.
6. A student who is dropped a second time for unsatisfactory scholarship will not be readmitted to the Institute.
7. Any student, except a part-time graduate student, who withdraws during a term and wishes to return the following term must complete a Petition to the Faculty for consideration. This petition must be submitted to the registrar before the deadline for the term for which readmission is requested.

C. Transfer Credit

1. Course work pursued at another institution after dismissal from Georgia Tech for unsatisfactory scholarship may be considered as evidence for readmission.
2. If readmitted, a student will not necessarily be given transfer credit for work taken at another institution after dismissal from Georgia Tech.
3. With the exception of courses from which a student withdrew and received a grade of *W* or *V*, in no case will transfer credit be allowed for courses completed at another institution that have previously been taken at Georgia Tech.

D. Study Abroad

Any student in good standing choosing to participate in an approved study abroad program for two or more terms must complete a Student Information Update form with the study abroad coordinator prior to departure. This form will enable the student to re-enroll for the term of "planned re-entry" without submitting a formal readmission application. It will be the student's responsibility to inform the study abroad coordinator of any change in the planned re-entry date.

IX. Scheduling

A. General

1. All previously scheduled coursework takes precedence over newly scheduled material. Therefore, all work that is incomplete from a previous term should be completed, or arrangements to complete it should be made prior to placing emphasis on new coursework.
2. Students must follow the approved curriculum of the academic school in which they are registered. Students who do not follow the approved curriculum may be denied registration privileges.
3. Each student is strongly advised each term to schedule all prerequisite courses. Students who do not have the stated prerequisites for a course but believe they have the required knowledge to fulfill prerequisite requirements should contact the department of instruction.
4. The completion of incomplete work from a previous term and the scheduling of out-of-sequence courses are the responsibility of the student, and they will be consequently held accountable. The number of scheduled hours allowed for a term may be adjusted to take into consideration the amount of incomplete work remaining regardless of the student's academic standing.
5. Students may not repeat courses on a letter-grade basis in which the grade of *B* or higher has been earned previously.
6. Subject to approval by a faculty advisor, a course may be taken more than once for academic credit. All grades will count in determining the scholastic average, but the course will be counted only once for credit toward a degree.
7. See section X for Institute rules for courses taken on a pass/fail basis.

B. Academic Load

1. Maximum credit hour loads are given in section VI.D. Any hours above these limits must have prior approval of the Undergraduate Curriculum Committee or the Graduate Committee, as appropriate.
2. Graduate students must maintain a minimum of three credit hours each term of enrollment. Exceptions to this regulation may be made during the student's graduation term.

C. Auditing of Courses

1. Auditing of courses will be permitted to regularly enrolled students who have obtained the approval of their advisor and the departments concerned. Such courses count at full value in computing the student's load.
2. The grade for auditing is *V* (visitor), and this grade will have no effect on the student's grade point average.
3. No academic credit is granted for audit participation in a course.
4. Students are not permitted to change to or from an auditing status except through the regular procedures for schedule change or withdrawal. Any student who does not meet the instructor's requirements for a successful audit will be withdrawn with a grade of *W* assigned at the end of the term.

X. Pass/Fail System

A. General

1. At the option of the student's major school, credit toward a bachelor's degree may be allowed for courses taken under the pass/fail system and completed with a grade of pass.
2. The major school must approve all pass/fail courses included in the final program of study, and students should become aware of school requirements.
3. In graduate programs, thesis research hours will be evaluated on a pass/fail basis.
4. Pass/fail enrollment in any course may be restricted by the school or department offering the course.
5. Students who are permitted to register under the pass/fail system will be so designated on the official class rolls; the grades recorded will be *S* for satisfactory or *U* for unsatisfactory. These grades will not be included in the calculation of the grade point average and cannot be changed to a grade that will count in the average.
6. Withdrawals from courses taken on a pass/fail basis will follow the same rules that govern withdrawals from courses included in the scholastic average.

B. Credit Hours Permitted

1. The maximum number of pass/fail hours permitted in an undergraduate program of study depends upon the number of semester credit hours that will be completed at Georgia Tech, as follows:

Hours included in program of study	Hours allowed on pass/fail basis
45 to 70 credit hours	3 credit hours
71 to 90 credit hours	6 credit hours
91 or more credit hours	9 credit hours

2. For a second undergraduate degree, these limitations apply to the credit hours included in the program of study for that second degree.
3. A master's degree program of study may include up to three semester credit hours on a pass/fail basis.

XI. Cross Enrollment and Concurrent Registration

A. General

1. Students who are enrolled at Georgia Tech may not receive credit for courses completed at another institution during the same academic term, unless prior permission has been obtained for cross enrollment or concurrent registration, as described in this section.
2. With the approval of the student's major school, a student may schedule courses at any one of the colleges or universities comprising the Atlanta Regional Consortium for Higher Education (ARCHE) if such courses are not available in a particular term at Georgia Tech. A list of participating institutions is available from the Office of the Registrar.
3. Cross enrollment also is permitted among institutions participating in the Georgia Tech Regional Engineering Program (GTREP) and selected institutions in the Regents' Engineering Transfer Program (RETP).
4. All cross enrollment registration activities are performed at the student's home institution.
5. For institutions not participating in cross enrollment, a student must apply in advance for permission to be concurrently registered at both Georgia Tech and the other institution.

B. Eligibility

1. Cross enrollment and concurrent registration is available only to degree-seeking juniors, seniors, and graduate students. Ordinarily, students will not be allowed to participate during their first term at Georgia Tech, nor will students be allowed to cross enroll for more than two courses per term. Special rules apply to students participating in the GTREP and RETP programs. Any student seeking an exception to these eligibility requirements should contact the Office of the Registrar.
2. To participate in cross enrollment or concurrent registration, a student must be in good standing during the term when the application is processed.

3. During the term of cross enrollment or concurrent registration, the student must be carrying three or more credit hours at Georgia Tech and be in good standing. The total academic load carried at all institutions combined may not exceed the number of hours for which the student would be allowed to register at Georgia Tech.
4. Cross enrollment and concurrent registration courses must be completed with a grade of *C* or better in order to receive credit for the course. Credits earned under cross enrollment will be handled as transfer credit, but will count as resident credit toward a degree. Credits earned under concurrent registration will be handled as regular transfer credit. Grades received in cross enrollment or concurrent registration courses will not be included in the calculation of the grade point average. No credit will be awarded until an official transcript from the participating institution is received by the Georgia Tech Registrar's Office.

XII. Examinations

A. General

1. All re-examinations, examinations for advanced standing, and special examinations must be authorized by the registrar before being scheduled.
2. If the instructor considers it necessary during an examination, students may be required to present their student identification card to the instructor or an authorized representative.

B. Examinations for Advanced Standing

1. Students who offer satisfactory evidence that they are qualified to do so may receive credit for a course by examination. Such an examination is called an examination for advanced standing.
2. Examinations for advanced standing require the recommendation of the department of instruction in which the course is offered, payment of the appropriate fee, and authorization by the registrar.
3. Examinations for advanced standing will ordinarily be offered during the week of final examinations.
4. A student will not be allowed to take an examination for advanced standing in a given course more than twice.
5. An examination for advanced standing will be reported with an *S* or *U* grade. Neither grade will be included in the calculation of the scholastic average.

C. Regulations Covering Final Examinations

1. The Office of the Registrar will publish the final examination schedule and policies each term.
2. A student reporting to a final examination room more than fifteen minutes after the scheduled starting time shall not be allowed to take the examination unless a satisfactory explanation is presented to the instructor conducting the examination.

XIII. Undergraduate Degrees

A. General

1. To be considered for admission to candidacy for a degree, a student must have passed the Regents' Test and must make a formal petition for the degree during the term preceding the final term in residence. A petition for degree will not be accepted until the Regents' Test has been passed.
2. Students desiring to withdraw their name from the rolls of degree candidates must formally withdraw the petition for degree before the end of the seventh week of the semester (or fourth week of the summer term). This privilege will be extended to a degree candidate only once.
3. A degree program may include a maximum of four hours of basic ROTC and a maximum of six hours of advanced ROTC.
4. The diploma of a candidate for a degree shall bear the date of the commencement at which the degree is awarded.
5. All requirements for the degree must be completed and certified by the registrar no later than forty-eight hours after final grades for the term are due. If a candidate for a degree is not certified by the appropriate deadline, the candidate will be graduated at the next scheduled commencement. The diploma will bear the date of the commencement at which the degree is awarded. It is the responsibility of the student to reactivate the degree petition for the appropriate term.

B. Residency Rule

No student may be considered a candidate for a degree unless the final thirty-six credit hours required for the degree are earned in residence at Georgia Tech and approved by the major school.

C. Ten-Year Rule

Work that was completed more than ten years prior to commencement must be validated by special examinations before it can be counted toward a degree.

D. Requirements for a Degree

1. To be a candidate for a degree, undergraduate students must have passed or be enrolled in all courses required for the degree, must have a scholastic average for their entire academic program of at least 2.00, and must have done creditable work in their departmental courses so as to merit the recommendation for the degree by the chair and faculty of their school.
2. Students, with the approval of their school or specialization, may satisfy the requirements for an undergraduate degree by meeting all of the requirements associated with any one curriculum year in effect during the period of their enrollment in the Institute or during their last two years (prior to their enrollment at Georgia Tech) in the program at one of the RETP schools. A curriculum year is in effect for a student only if the student's date of matriculation is prior to the ending date of the spring term concluding that curriculum year.
3. Constitution and history examinations
   a) The Georgia law as amended March 4, 1953, requires that before graduation all students pass examinations or pass comparable courses in United States and Georgia history as well as the United States and Georgia constitutions.
   b) For courses that may satisfy the constitution and history requirements, refer to the Information for Undergraduate Students/Academic Regulations section of this catalog.
4. *Regents' Testing Program:* All students completing requirements for baccalaureate degrees are required by the University System of Georgia to pass an examination designed to measure proficiency in reading and English composition. This examination is known as the Regents' Test. It must be passed before a petition for graduation will be accepted. Students should obtain further information from the registrar.
5. *Wellness requirement:*
   a) Unless medically exempted, all students are required to satisfy the wellness requirement as specified in the Information for Undergraduate Students/Academic Regulations section of this catalog prior to graduation.
   b) The Health Information Record on file with the director of Health Services will be used to determine any medical exemptions from the wellness courses. All certificates of disability from personal physicians must be endorsed by Student Health Services before they will be accepted by the School of Applied Physiology.

E. Graduation with Academic Distinction

1. For graduation with highest honor, the minimum scholastic average shall be 3.55. For graduation with high honor, the minimum scholastic average shall be 3.35. For graduation with honor, the minimum scholastic average shall be 3.15.
2. A student must have earned at least sixty resident semester credit hours (excluding remedial course work) at Georgia Tech to graduate with highest honor, with high honor, or with honor.
3. In order to qualify for graduation with honors, all grades or grade corrections affecting the honors designation must be received and certified by the registrar no later than noon on Wednesday following the commencement.

F. Second Undergraduate Degree

1. A student enrolled for a second undergraduate degree shall be classified as an undergraduate student, except that a graduate student wishing to pursue a second undergraduate degree will remain classified as a graduate student. A graduate student, with approval of the major school, may work toward a second undergraduate degree while pursuing a graduate program.
2. To be a candidate for a second undergraduate degree, a student must have the recommendation of the chair of the school concerned and the approval of the Undergraduate Curriculum Committee.
3. To obtain a second undergraduate degree, a student must complete all major required courses for the degree and earn credit for a total of at least thirty-six credit hours in excess of the requirement for any previous degrees earned.
4. All regulations in section XIII apply to students completing second undergraduate degrees.

G. Minors

1. A student may complete a minor in another academic field while completing the requirements of his or her major degree program.
2. With the approval of the major school, the student should consult an advisor in the minor field, who can inform the student of the requirements for the minor.
3. When a student petitions for a degree, he or she should complete the petition for a minor and have it approved by the minor advisor. The petition for a minor must accompany the petition for the major degree when reviewed for approval by the major school.
4. The minor will be conferred at the same time the degree is conferred.
5. The minor will not be printed on the diploma, but both the degree and minor will be recorded on the student's transcript.
6. Minors may not be conferred retroactively upon students who have graduated.

XIV. Graduate Degrees

A complete description of Institute requirements for the master's and doctoral degrees is given in this catalog in the section titled "Information for Graduate Students." Students desiring to withdraw their name from the rolls of degree candidates must formally withdraw the petition for degree before the deadline specified in section XIII.A.2.

XV. Student Motor Vehicles

Students desiring to operate motor vehicles on campus are subject to all rules set forth by the Georgia Tech motor vehicle regulations.

XVI. Medical Regulations

A Medical Entrance Form and proof of required immunizations and tuberculosis screening must be on file with the Student Health Center. Failure to provide this information may result in a health hold and delay of registration. All international students (F-1 and J-1 visas) are required to have health insurance coverage. Students may elect to purchase the health insurance made available by the health insurance provider contracted by Georgia Tech or may have their own comparable medical insurance.

XVII. Extracurricular Activities

A. Participation

1. In order to be eligible for participation in extracurricular activities, a student must satisfy the following requirements:
   a) be enrolled in a degree program
   b) maintain a schedule with at least six credit hours on a credit basis or be a student in the Division of Professional Practice on work term
   c) not be on academic probation
   d) all student organization officers must be enrolled in Georgia Tech classes with at least six credit hours on a credit basis or be a student in the Division of Professional Practice on work term in Atlanta.
2. Changes in academic standing that affect eligibility become effective when determined by the Institute at the end of each term (normally the Tuesday following final examination week), except that a student whose academic standing changes from good to probation shall remain eligible through the day preceding the first day of instruction of the following academic term.
3. Any student placed on academic drop/dismissal, review, suspension, or expulsion is immediately ineligible for participation.
4. Changes in disciplinary standing that affect eligibility become effective immediately.
5. Participation also requires satisfaction of any additional requirements established by the Student Activities Committee of the Academic Senate.

B. Scheduling of Events

1. All student organizations must make written application to, and receive permission from, the Division of Student Affairs to hold a social function.
2. In each term, the weekend before final examinations is closed to student-sponsored extracurricular events.

C. Student Organizations

1. All student organizations must adhere to the Conduct Code and Disciplinary Procedures for Student Organizations.
2. Every organization must renew its charter every year or when changing officers by submitting an Officer Update Form and by signing the Alcohol Policy Acknowledgement Form.
3. Requirements and standards for chartering a student organization are established by the Student Activities Committee of the Academic Senate and are available from the Division of Student Affairs.

D. Fraternity and Sorority Regulations

1. To be eligible for initiation, a student must be a full-time student not on academic or disciplinary probation.
2. The initiation of any individual must be registered with and approved by the Division of Student Affairs prior to the initiation.
3. The individual must meet all Georgia Tech Interfraternity Council (IFC) or Panhellenic requirements concerning initiation.
4. All fraternities and sororities are subject to the rules established by the Georgia Tech IFC/Panhellenic/National Pan-Hellenic and all Georgia Tech policies, rules, and regulations.

E. Intercollegiate Athletics Regulations

1. To be eligible for intercollegiate athletic competition, a student must satisfy the following requirements:
   a) be eligible to participate in extracurricular activities, as defined in section XVII.A;
   b) be carrying a full-time workload as defined in section VI.A.3;
   c) be making satisfactory progress toward a degree; and
   d) meet any further requirements of the NCAA or other governing organization; see the athletic director for details.
2. No student may be excused from regularly scheduled classes for athletic practice.
3. No student may participate in more than two sports in intercollegiate competition in any school year, except by permission of the Division of Student Affairs. Being manager or assistant manager is counted as participation within the meaning of this rule.

XVIII. Academic Honor Code

Article I: Honor Agreement

Having read the Georgia Institute of Technology Academic Honor Code, I understand and accept my responsibility as a member of the Georgia Tech community to uphold the Honor Code at all times. In addition, I understand my options for reporting honor violations as detailed in the Code.

Article II: Honor Code

Section 1. Statement of Purpose

The members of the Georgia Tech community believe the fundamental objective of the Institute is to provide the students with a high-quality education while developing in them a sense of ethics and social responsibility. We believe that trust is an integral part of the learning process and that self-discipline is necessary in this pursuit. We also believe that any instance of dishonesty hurts the entire community. It is

with this in mind that we have set forth a Student Honor Code at Georgia Tech.

Section 2. Objectives

An Honor Code at Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. It specifically aims to accomplish the following:

- Ensure that students, faculty, and administrators understand that the responsibility for upholding academic honesty at Georgia Tech lies with them.
- Prevent any students from gaining an unfair advantage over other students through academic misconduct.
- Ensure that students understand that academic dishonesty is a violation of the profound trust of the entire academic community.
- Clarify what constitutes academic misconduct among students at Georgia Tech and what is expected of them by the Institute, the faculty, and their peers.
- Cultivate an environment at Georgia Tech where academic dishonesty is not tolerated among the students.
- Secure a centralized system of education and awareness of the Honor Code.

Section 3. Student Responsibilities

Students are expected to act according to the highest ethical standards. The immediate objective of an Honor Code is to prevent any students from gaining an unfair advantage over other students through academic misconduct. Academic misconduct is any act that does or could improperly distort student grades or other student academic records. Such acts include but need not be limited to the following:

- Possessing, using, or exchanging improperly acquired written or verbal information in the preparation of any essay, laboratory report, examination, or other assignment included in an academic course;
- Substitution for, or unauthorized collaboration with, a student in the commission of academic requirements;
- Submission of material that is wholly or substantially identical to that created or published by another person or persons, without adequate credit notations indicating authorship (plagiarism);
- False claims of performance or work that has been submitted by the claimant;
- Alteration or insertion of any academic grade or rating so as to obtain unearned academic credit;
- Deliberate falsification of a written or verbal statement of fact to a member of the faculty so as to obtain unearned academic credit;
- Forgery, alteration, or misuse of any Institute document relating to the academic status of the student.

While these acts constitute assured instances of academic misconduct, other acts of academic misconduct may be defined by the professor. Students must sign the Honor Agreement affirming their commitment to uphold the Honor Code before becoming a part of the Georgia Tech community. The Honor Agreement may reappear on exams and other assignments to remind students of their responsibilities under the Georgia Institute of Technology Academic Honor Code.

Section 4. Faculty Responsibilities

Faculty members are expected to create an environment where honesty flourishes. In creating this environment, faculty members are expected to do the following:

- Make known to their class as specifically as possible what constitutes appropriate academic conduct as well as what comprises academic misconduct. This includes but is not limited to the use of previously submitted work, collaborative work on homework, etc.
- Provide copies of old exams or lists of sample questions to the Georgia Tech library for students to review.
- Avoid the re-use of exams.
- Include a paragraph containing information about the Georgia Tech Academic Honor Code on the syllabus for each class they teach.
- Report instances of academic dishonesty to the Office of the Dean of Students.

In addition to the expectations listed previously, faculty have the authority to superimpose their own interpretations on some aspects of academic conduct including, but not limited to, the following:

- old exams for use during open-book exams;
- contents of formula sheets allowed on exams;
- use of calculators on exams;
- collaboration on out-of-class assignments; and
- use of previously submitted out-of-class assignments.

Article III: Honor System

Section 1. Governing Bodies

The Georgia Institute of Technology Academic Honor Code recognizes the present bodies given the power to enforce the academic regulations of the Institute. The Honor Code recognizes the Office of the Dean of Students to be the principal administrator to enforce Institute disciplinary measures as presently specified in XIX.B. The Honor Code also recognizes the Student Honor Committee as that body given jurisdiction to hear all cases of alleged academic misconduct as currently specified in XIX.B.

Section 2. Reporting Honor Code Violations

In order for an Honor Code to function, members of the Georgia Tech community must not tolerate violations of it by anyone. Community members are at their discretion to use any of three options to report suspected Honor Code violations:

1. A student may simply desire to confront the fellow student with the perceived infraction. While this option is most likely to enact widespread change in attitude and behavior among students (because violators would understand that they are violating the trust of their peers and not some abstract body of people), it is still expected that an alleged violator be taken before the Student Honor Committee if he or she persists in academic misconduct.
2. A student may choose to approach the professor of the class in which the alleged infraction occurred and seek his or her input on how to proceed. A result of a conference of this type would be the professor's awareness that the alleged violator needs closer monitoring to ascertain reasonable certainty of guilt before being brought before the Student Honor Committee.
3. A student may choose to seek the advice of an honor advisor (see Article III., Section 3). Meetings with honor advisors shall address issues of policy and procedure only. Specifics of an individual case are not to be discussed. After a consultation with an honor advisor, a student may choose to submit a formal accusation of academic misconduct to the Office of the Dean of Students.

Section 3. Student Honor Advisory Council

Students composing the Student Honor Advisory Council are to become well versed in all aspects of the Georgia Institute of Technology Academic Honor Code and the procedures for reporting an honor violation as well as those procedures for the trying of cases of suspected academic misconduct before the Student Honor Committee. The Council is to act as an information resource to all members of the Georgia Tech Community on issues related to the Honor Code.

A. Membership

1. Members are to be selected by the vice president of Student Affairs or a designated person to carry out these duties.
2. Members must be full-time students at Georgia Tech and must be in good academic standing.
3. Once a member of the council, the student shall serve until he or she graduates, unless he or she resigns or is impeached.
4. Impeachment procedures are to be specified in the rules and/or bylaws of the Student Honor Advisory Council.
5. Membership shall be composed of no less than fifteen students at any given time.

B. Duties and Responsibilities

1. To serve in an advisory capacity to any student(s) wishing to report an honor violation or any student(s) being accused of committing an honor violation.
2. To continually educate and maintain awareness among the Georgia Tech community regarding the Honor Code.

3. To limit discussion with students to issues of policy and procedure.

Article IV. Amending the Honor Code

Amendments to the Georgia Tech Academic Honor Code may be proposed by a two-thirds vote of both the Undergraduate Student Council and the Graduate Student Senate, or by a petition of ten percent of the total population (undergraduate and graduate) directed to both the undergraduate student body president and the graduate body president. Amendments become part of this Honor Code upon ratification by two-thirds of the votes cast in a special election open to the undergraduate and graduate students, provided that the proposed amendments have been published in the *Technique* at least one week prior to the vote by the student body and further provided that the amendments are approved by the Academic Senate.

Appendices or amendments of appendices that pertain to either the undergraduate student body or to the graduate student body may be proposed by a two-thirds vote of the respective legislative body or a petition of at least ten percent of the respective student body directed to the respective student body president. These shall become part of this Honor Code upon ratification by two-thirds of the votes in a special election of the respective student body, provided that the proposed appendices or amendments of appendices have been published in the *Technique* at least one week prior to the election, and further provided that the appendices or amendments of appendices are approved by the Academic Senate.

Appendix A: Graduate Addendum to the Academic Honor Code

I. Preamble

The Honor Code recognizes that graduate students are involved in research and scholarly activities that occur outside the classroom. Integrity and academic honesty are as fundamental to research and scholarly activity as they are to classroom activity. Therefore, this Appendix to the Honor Code is adopted to pertain to the academic activities of graduate students that occur outside of the classroom.

II. Scholarly Misconduct

Scholarly misconduct refers to misconduct that occurs in research and scholarly activities outside of the classroom. It can include plagiarism, among other things. The consequences of scholarly misconduct are governed by Institute policy. The following definitions are taken from the Institute Policy on Scholarly Misconduct:

- "Misconduct" or "scholarly misconduct" is the fabrication of data, plagiarism, or other practice that seriously deviates from those that are commonly accepted within the academic or research community for proposing, conducting, or reporting research or scholarly activity. It does not include honest error or honest differences in interpretation or judgments of data.
- "Plagiarism" is the act of appropriating the literary composition of another, or parts of passages of his or her writings, or language or ideas of the same, and passing them off as the product of one's own mind. It involves the deliberate use of any outside source without proper acknowledgement. Plagiarism is scholarly misconduct whether it occurs in any work, published or unpublished, or in any application for funding.

Allegations involving scholarly misconduct fall under the Institute's Policy on Scholarly Misconduct. This document details the procedures involved with reporting allegations and with the handling of cases. All graduate students are encouraged to become familiar with this policy, which is available from the Office of the Provost.

XIX. Student Code of Conduct

This reflects the Student Code of Conduct at the time of the printing of the catalog. The official Code of Conduct reflecting all changes can be found on the Dean of Students Web site at **www.deanofstudents.gatech.edu/integrity/page.php/condcode.htm**. In the event of any conflict, the Code found on the Web site will govern.

A. General

Purpose of the Disciplinary System:

A student enrolling in the Georgia Institute of Technology assumes an obligation to conduct himself or herself in a manner compatible with the Institute's function as an educational institution. Actions considered inimical to the Institute and subject to discipline fall into the categories of academic and nonacademic misconduct. The Student Code of Conduct clearly defines these expectations and outlines the adjudication process. The purpose of the Student Code of Conduct is to educate all members of the Georgia Tech community and to maintain an environment conducive to academic excellence.

Authority for Student Discipline: The Board of Regents' (BOR) policies and bylaws "give institutions responsibility for discipline of students, formulation of rules, and determination of punishment for violations to the Institution." In addition, the Board of Regents and the Georgia Tech Statutes and Bylaws empower the faculty to make rules and regulations for students and their activities per BOR 401.1, 401.4, 406, 302.06 and Georgia Tech Statutes and Bylaws 2.4, 2.4.3.3(F), 2.5.4.

Student Participation: Students, as members of the Institute's community, are asked to assume positions of significant responsibility in the Institute's judicial system in order that they might contribute their skills and insights to the resolution of disciplinary cases. Final authority in disciplinary matters, however, is vested in the BOR in the Institute's administration.

Definitions (when used in this Code):

- "Accused" can be defined as a student, group, or organization.
- "Complainant" is defined as the accuser or the victim of an alleged violation.
- "Dean of Students" means the dean of students or his or her designee.
- "Group" means a number of persons who are associated with each other, but who have not complied with Institute requirements for registration as an organization.
- "Group or Organization Activity" means any activity on or off Institute premises that is directly initiated for or supervised by a group or organization including any individual activity occurring in buildings, facilities, grounds, utilities, or resources (including computer resources) owned, leased, operated, controlled or supervised by an Institute organization.
- "Institution," "Institute," "Georgia Tech," and any other permutations of Georgia Institute of Technology means the Institute and all of its undergraduate, graduate, and professional schools, divisions, and programs.
- "Institute Official" is defined as faculty, administration, or staff personnel including students serving as Institute employees.
- "Institute Premises" means buildings, facilities, grounds, utilities, or resources (including computer resources) owned, leased, operated, controlled, or supervised by the Institute.
- "Organization" means a number of persons who have complied with or are in the process of complying with the requirements for chartering.
- "Student" means any person who is taking or auditing classes of the Institute, is participating in academic programs, is matriculated in any Institute program, has been accepted for enrollment, or is eligible to re-enroll without applying for readmission.
- "Weapon" is defined in accordance with state law and also includes any object used to attempt bodily injury or substance designed to inflict a wound or cause injury.
- "Will" or "shall" are used in the imperative sense.
- "Witness" is defined as a person present before the hearing panel providing evidence.
- "Working Day" is defined as any days when class is in session per the Institute calendar. Final exam periods are not considered working days.

Interpretation of Regulations: The purpose of publishing disciplinary regulations is to give students general notice of prohibited behavior and the judicial process. This Code is not written with the specificity of a criminal statute and should not be confused with criminal proceedings. Judicial proceedings are not restricted by the rules

of evidence governing criminal and civil proceedings. Questions of interpretation regarding the Student Code of Conduct shall be referred to the dean of Students for resolution.

Inherent Authority: The Institute reserves the right to take necessary and appropriate action to protect the safety and well being of the campus community.

Addressing Inappropriate Classroom Behavior: The primary responsibility for managing the classroom environment rests with the instructor. Students who engage in any prohibited or unlawful acts that result in disruption of a class may be directed by the instructor to leave the class for the remainder of the class period. Longer suspensions from a class, or dismissal from the Institute on disciplinary grounds, must be administered by the dean of Students in accordance with this Code.

Jurisdiction: Academic misconduct relevant to any Institute activity will be addressed wherever it may occur. Nonacademic misconduct includes the acts identified in section D of this Code whenever such acts:

- occur on Institute premises;
- occur at Institute-sponsored activities;
- occur at group or organization activities; or
- create a clear and present danger of material interference with the normal or orderly processes of the Institute or its requirements of appropriate discipline.

Disciplinary Action While Criminal Charges Are Pending: Students may be accountable both to civil authorities and the Institute for acts that constitute violations of law and of this Code. Disciplinary action at the Institute will normally proceed during pending criminal proceedings and will not be subject to challenge on the ground that criminal charges involving the same incident have been dismissed or reduced. Students charged with felonies may be interim suspended and given the opportunity to request a review of the decision as provided in Section B (Administration of the Judicial Process, Interim Suspension for Individuals and Student Groups/Organizations) of the Code.

Agreements With Other Schools: Where there is conflict between provisions of this Code and tenets of an agreement with other schools, the agreement takes precedence.

Student Organizational Discipline: Student groups and organizations are accountable to this Code. A student group or organization and its officers may be held collectively and individually responsible when violations of this Code by those associated with the group or organization have received the consent or encouragement of the group or organization, or of the group's or organization's leaders or officers. For more information, see the Conduct Code and Disciplinary Procedures for Student Organizations.

B. Administration of the Judicial Process

Case Referrals: All acts of misconduct (except as specified by the dean of Students in writing) on the part of students shall be reported to the dean of Students, who is designated the principal administrator to formulate and enforce Institute disciplinary measures as they pertain to student academic or nonacademic misconduct. Any person may refer a student or a student group or organization suspected of violating this Code to the dean of Students. Those individuals referring cases are normally expected to provide testimony and to present relevant evidence in hearings and conferences.

Communication: All judicial communication (requests for meetings, notifications, notice of judicial actions, etc.) will be provided via the official Institute e-mail (GT number) address. If the student is not currently enrolled, the notification will be sent via U.S. Postal Service to the last known physical address.

Revocation of Degrees: The Institute reserves the right to revoke an awarded degree for fraud related to the receipt of the degree, or for serious disciplinary violations committed by a student prior to the student's graduation.

Interim Suspension for Individuals and Student Groups/Organizations: Interim suspension is for an interim period pending disciplinary or criminal proceedings or physical or mental evaluation. In certain

circumstances, the dean of Students may impose an interim suspension which shall become immediately effective without advance notice and prior to the actual hearing of the allegations.

1. Interim suspension may be imposed:
   a) to ensure the safety and well-being of members of the Institute community or to preserve Institute property;
   b) to ensure the student's physical or emotional safety and well-being;
   c) if the student or student group/organization poses a definite threat of disruption of or interference with the normal operations of the Institute;
   d) if the student is charged with a felony; or
   e) if the leaders of an organization fail to respond in a timely manner.
2. During the interm suspension, individuals may be denied access to classes, campus facilities, and all other Institute activities or privileges.
3. The Dean of Students' Critical Response Evaluation Team, with appropriate members of the Management Team, (i.e., Department of Housing, Counseling Center, and Greek Affairs representatives) will determine if interim suspension is warranted. Any one member of this team may make the decision with review and ratification, if appropriate, by the remainder of the team within seventy-two hours of this decision.
4. A student or organization that has been suspended on an interim basis may submit a request to the vice president for Student Affairs or his or her designee for a review of the decision within five working days of the implementation of the suspension. A request for review of an interim suspension decision shall be made in writing and shall list all reasons that the student or organization contends that the interim suspension is unwarranted. The reasons for the request for review are limited to:
   a) the reliability of the information concerning the student's or organization's conduct, including the matter of identity;
   b) whether the conduct and surrounding circumstances reasonably indicate that the continued presence of the student or organization on Institute premises poses a substantial and immediate threat to himself, herself, or to others, or the stability and continuance of normal Institute functions.
5. The vice president for Student Affairs or designee will respond to the student or organization in writing within two working days of the receipt of the request.

C. Prohibited Academic Misconduct

Academic misconduct (see XVIII. Academic Honor Code) is any act that does or could improperly distort grades or other student academic records. Such acts include but need not be limited to the following:

1. Possessing, using, or exchanging improperly acquired written or verbal information in the preparation of any essay, laboratory report, examination, or other assignment included in any academic course;
2. Substitution for, or unauthorized collaboration with, a student in the commission of academic requirements;
3. Submission of material that is wholly or substantially identical to that created or published by another person or persons, without adequate credit notations indicating the authorship (plagiarism);
4. False claims of performance for work that has been submitted by the claimant;
5. Alteration or insertion of any academic grade or rating so as to obtain unearned academic credit;
6. Deliberate falsification of a written or verbal statement of fact to a member of the faculty so as to obtain unearned academic credit;
7. Forgery, alteration, or misuse of any Institute document relating to the academic status of the student.

D. Prohibited Nonacademic Misconduct

Nonacademic misconduct by students, organizations, or groups includes but is not limited to the following:

1. Violations of the Georgia Institute of Technology Student Policy on Alcohol and Illegal Drugs and other substance

violations including, but not limited to:
a) underage use or possession of alcohol;
b) possession or consumption of alcohol in unauthorized areas;
c) use or possession of fake identification;
d) distribution of alcohol to minors;
e) behavior, while under the influence of alcohol, that endangers any person;
f) drug abuse, including the use or possession (without valid medical or dental prescription), manufacture, furnishing, sale, or any distribution of any narcotic or dangerous drug controlled by law; this provision is not intended to regulate alcoholic beverages; or
g) disorderly conduct associated with the use of alcoholic beverages including, but not limited to, boisterousness, rowdiness, obscene or indecent conduct or appearance, or vulgar, profane, lewd, or unbecoming language;

2. Intentionally pushing, unjustifiably striking or physically assaulting, or otherwise intentionally causing reasonable apprehension of such harm to any person;
3. Disorderly conduct including but not limited to:
   a) obstruction or disruption of teaching, research, administration, disciplinary procedure or process, or other Institute activities, including its public service functions or other authorized activities, or
   b) breach of the peace;
4. Behavior that endangers any person;
5. Unauthorized use of college facilities or premises including:
   a) unauthorized entry into any Institute premises or remaining in any building after normal closing hours, or
   b) possessing, using, making, or causing to be made any key or any other means of access to any Institute premises without proper authorization;
6. Furnishing false information to any Institute official or offering false statement in any Institute disciplinary hearing;
7. Forgery, alteration, replication, or misuse of any document, record, or identification upon which the Institute relies, regardless of the medium;
8. Any physical or mental hazing action related to membership or connected with rites or ceremonies of induction, initiation, or orientation into Institute life or into the life of any group or organization;
9. Safety violations including but not limited to:
   a) intentionally initiating or causing to be initiated any false reporting, warning, or threat of fire, explosion, or other emergency;
   b) tampering with safety devices or other emergency, safety, or fire fighting equipment;
   c) setting or attempting to set an unauthorized fire;
   d) possession of unauthorized fireworks, firearms, or ammunition;
   e) possession of dangerous weapons, materials, or chemicals; or
   f) unauthorized sale, possession, furnishing, or use of any bomb or explosive or incendiary device;
10. Theft and/or unauthorized possession or use of property or services belonging to the Institute, another person, or any other entity;
11. Malicious or unauthorized damage to or destruction of Institute property or property belonging to another;
12. Violation of rules governing residence in Institute-owned or controlled property, such as residence halls;
13. Illegal gambling, including online;
14. Failure to return or submit property or records of the Institute within the time prescribed by the Institute;
15. Acting with any other person to perform an unlawful act or to violate an Institute regulation or policy;
16. Failure to comply with:
   a) instructions or a direction of any properly identified Institute official while that person is acting in the performance of his or her duties; or
   b) the terms of a disciplinary sanction;
17. Failure to cooperate with investigative, judicial, or disciplinary proceedings;
18. Intentional violations of Georgia Tech regulations or policies, which are found on the Dean of Students' Web page at **www.deanofstudents.gatech.edu/policy/index.html**. Such regulations or policies include the Institute Computer Network Usage Policy, as well as those regulations relating to entry and use of Institute facilities, use of amplifying equipment, campus demonstrations, parking, and student organizations;
19. Violation of the Georgia Tech Student Policy on Sexual Harassment and Sexual Misconduct; or
20. Violation of any Board of Regents policies or the laws of any city, county, state, or the United States.

E. Procedural Rights, Adjudication, and Sanctions

Procedural Rights of the Accused:
Students accused of an act of misconduct and summoned to a hearing before the Honor Committee, Graduate Judiciary Cabinet, Undergraduate Judiciary Cabinet, or Judicial Board have the right to:
a) be informed of the charge(s) and alleged misconduct upon which the charge is based;
b) be informed of the evidence upon which a charge is based and accorded an opportunity to offer a relevant response;
c) be accompanied by an advisor of their choice;
d) remain silent with no inference of guilt drawn therefrom;
e) call and question relevant witnesses; (a witness is permitted to testify via electronic means (telephone, video conferencing, etc.) and permitted to be questioned through the chief justice/chairperson);
f) present evidence in their behalf;
g) be considered innocent of the charges until proven responsible by a preponderance of the evidence;
h) appeal, if requested; and
i) waive any of the above rights.

Investigation: The Institute's judicial process utilizes an investigatory model, not an adversarial model, in resolving allegations of misconduct with the primary goal of uncovering the truth. The dean of Students shall open an initial investigation. During the investigation, a student should continue to attend class and required Institute functions unless otherwise instructed by the dean of Students. The investigation is closed in one of four ways:
1) the student is not charged,
2) the student agrees to an Alternative Dispute Resolution,
3) the student agrees to an administrative conference/resolution, or
4) the dean of Students issues a decision based on the hearing panel's findings and recommendation.

Forums of Adjudication:

Alternative Dispute Resolution: At the sole discretion of the dean of Students, cases may be assigned for Alternative Dispute Resolution (ADR). If ADR is not agreed to by both parties, the remaining forums will adjudicate the case. Results of the ADR proceedings do not require the accused to acquire a formal discipline record; however, ADR cases will be considered "prior violations" if future infractions occur. ADR is available only for an accused's first violation in cases where if adjudicated, the resulting sanction would be less severe than probation. The ADR agreement outlines the exact nature of the appropriate sanction to be administered if the agreement is violated. This agreement will close the case, as a student who chooses ADR is granted no right of appeal.

Administrative Conference/Resolution: After the dean of Students completes a sufficient investigation, charges the accused with a violation of the Student Conduct Code, and outlines appropriate sanctions for the incident, the accused may accept responsibility for the charges and agree to abide by the sanctions. This choice will close the case, as a student, group, or organization that

accepts the terms of an administrative conference/resolution is granted no right of appeal.

The accused may elect to accept an administrative conference/resolution, if offered, at any time before a Hearing Panel convenes. If the accused chooses an administrative conference/resolution, the accused will be provided notice of a final disciplinary action from the administrative hearing officer containing the official charges and terms of the sanctions. If the sanctions are not fulfilled according to the terms, additional charges or sanctions may result, and/or a hold may be placed on the accused's record until terms are met.

Hearing Panel: An accused student, group or organization may choose adjudication. The dean of Students reserves sole discretion to forward cases to the appropriate panel including, but not limited to, the Undergraduate Judiciary Cabinet, the Graduate Judiciary Cabinet, the Student Honor Committee, or the Institute Judicial Board. The hearing panel composed of students will make a recommendation to the dean of Students as to the panel's fact finding and sanctions. A hearing panel composed of faculty members and students will forward a decision to be implemented by the dean of Students. Decisions of a hearing panel and a decision made after a recommendation from a hearing panel can be appealed by the accused.

If a student, group, or organization accused of nonacademic misconduct chooses to have the case adjudicated by a hearing panel, the case will be forwarded to one of three boards: 1) the Undergraduate Judiciary Cabinet; 2) the Judicial Board; or 3) the Graduate Judiciary Cabinet. The Undergraduate Judiciary Cabinet hears cases of undergraduate nonacademic misconduct. The Institute Judicial Board hears cases of undergraduate nonacademic misconduct and has jurisdiction over the case if the event occurred in or around Institute housing and if likely resulting sanction, if found responsible, is less severe than probation with few or noted exceptions. The Graduate Judiciary Cabinet has jurisdiction over all allegations of graduate student nonacademic misconduct. The Undergraduate and Graduate Judiciary Cabinet delegate to the Institute Judicial Board the right to adjudicate nonacademic violations as outlined in the Institute Judicial Board Procedures section. If a student accused of academic misconduct chooses to have the case adjudicated by a hearing panel, the case will be forwarded to the Student Honor Committee.

Notice of Hearing: Cases will be forwarded from the dean of Students to the chairperson of the appropriate hearing panel. The chairperson, upon receipt of this case, will issue official notice to the accused containing the time, date, and location of the hearing, as well as possible sanctions that may result if the accused is found responsible. In addition, the notification should specify the nature of the allegation or suspected misconduct with which the student, group, or organization is accused and the names of all possible witnesses. This notification will be provided at least three calendar days prior to a scheduled hearing. Upon request, the accused may meet with the dean of Students prior to the hearing to review evidence and procedure.

General Hearing Procedures: These procedures shall apply to all hearing panels charged with hearing cases under this Code.

Hearings shall ordinarily be closed except for the accused, the accused's advisor, the complainant, the complainant's advisor, and those directly involved; exceptions may be made at the discretion of the chairperson.

Members of the hearing panel shall disqualify themselves if their personal involvement in the hearing is of such a nature as to prejudice the outcome of the case. Any party may challenge any member of the panel for good cause by notifying the panel's chief justice/chairperson. The panel will hear the challenge and then meet privately to consider whether the request should be granted. The chief justice/chairperson shall not be removed if challenged. (The hearing panel's advisor may remove the chief justice/chairperson if clear conflict of interest or prejudice is determined by the advisor.)

Accused students, groups, or organizations who fail to appear after proper notice will be deemed to have pled "not responsible" to the charges against them and exercised the right to remain silent without prejudice. A hearing may be conducted in their absence at the discretion of the chairperson.

The hearing panel shall make a tape recording and/or summary transcription of the proceeding, which will serve as the official record of the hearing. No other recording devices will be permitted. The accused or the complainant may request a copy of the Institute's tape upon payment of the cost to reproduce the tapes, or may listen to the original tapes in a location designated by the dean of Students at no charge.

The hearing panel's chairperson shall exercise control over the proceedings to avoid needless consumption of time and to achieve orderly completion of the hearing. The chairperson may exclude any person, including the accused, who disrupts a hearing.

The complainant, if any, may be present throughout the hearing and respond to testimony. However, the complainant does not present the allegations against the accused. The complainant may bring a support person. The support person is not permitted to address the panel.

Testimony may be taken in person, in writing, or by other reliable means of communication, including but not limited to electronic, e-mail, telephone, or video conferencing.

The accused may bring as many witnesses as necessary to respond to the allegations. The accused is limited to two character witnesses. Letters of recommendation will be considered during deliberations.

Hearing panel deliberations are closed to all but the hearing panel members.

The hearing panel will consider past violations (but not until responsibility is determined), prior stipulations, the impact or potential impact of the violation on the community and complainant, and the nature of the violation (including whether bias-based) when determining sanctions.

Decisions of the hearing panel shall be by majority vote. The hearing panel shall provide the dean of Students with a brief written summary of each case with a finding of fact. The student hearing panels will include in the written summary recommendations for appropriate disciplinary action to the dean of Students. The Faculty Honor Committee decides sanctions and puts them in writing to be implemented by the dean of Students. The student hearing panels make recommendations in writing to the dean of Students. The dean of Students will review the case and recommendations and implement disciplinary action.

Panel Appointment Criteria: For Board or Committee specification appointment criteria, see the Student Organizations' Web site (**www.deanofstudents.gatech.edu.policy/studentorg.code.html**) for the most recently approved constitutions and bylaws governing each of the student hearing panels, and the Faculty Senate Web site (**www.facultysenate.gatech.edu**) for the most recently approved Statutes and Bylaws governing the Honor Committee.

Student Honor Committee Procedures: The Student Honor Committee (SHC) is a committee of the Faculty Senate that shall hear all cases referred to it by the dean of Students involving alleged dishonesty in academic matters on the part of students. Once a hearing has been scheduled before the SHC, the hearing cannot be cancelled and a student may not accept an administrative resolution without the approval of the chairperson. Refer to the Faculty Statutes and Bylaws

for additional information about this committee.

Undergraduate Judiciary Cabinet Procedures: The Undergraduate Judiciary Cabinet (UJC) is a student hearing panel that primarily shall hear allegations referred to it by the dean of Students of undergraduate student nonacademic misconduct. The typical case heard by the UJC is likely to result in a sanction of disciplinary probation, suspension held in abeyance, suspension, or expulsion if a violation is found to have occurred.

Institute Judicial Board Procedures: The Residence Hall Judicial Board (RHJB) serves as the Institute Judicial Board (IJB) in cases referred to it by the dean of Students involving Code of Conduct violations originating both inside and in the immediate vicinity of housing. The RHJB is not serving as the IJB when adjudicating violations of the Housing Contract, as well as the Housing Community and Services Guide. The IJB is a student hearing panel that shall hear allegations of student nonacademic misconduct that will most likely result in a sanction of reprimand or disciplinary warning, if a violation is found to have occurred. The IJB also may hear allegations of substance abuse violations that could result in probation. It will not consider substance abuse cases involving endangering behavior.

Graduate Judiciary Cabinet Procedures: The Graduate Judiciary Cabinet (GJC), a student hearing panel, shall hear allegations of graduate student nonacademic misconduct referred to it by the dean of Students.

Organizational Judicial Board Procedures: All organizational hearing panels (for example, IFC, NPHC, and Panhellenic, etc.) designated by the dean of Students to hear allegations of organizational violations of Institute policy are recommending bodies to the dean of Students.

Potential Sanctions: Sanctions that may be imposed in accordance with this Code include, but are not limited to:

- Ineligibility to hold an office in any student organization recognized by the Institute or to hold any elected or appointed office of the Institute; ineligibility to represent the Institute outside of the Institute or in a public activity of the Institute. This includes representing the Institute at any official function, intercollegiate athletics, or any forms of intercollegiate competition or representation
- Reprimand: Verbal or written notice that the accused's behavior is inappropriate.
- Disciplinary warning: A warning that continuation or repetition of prohibited conduct may be cause for additional disciplinary action and/or removal from good standing.
- Disciplinary probation: Notice to the accused that any further major disciplinary violation may result in suspension or expulsion. Additional restrictions, conditions, or loss of good standing may also be imposed. Violations of the terms of disciplinary probation, or any violation of this Code during the period of probation, will likely result in suspension or expulsion from the Institute.
- Suspension Held in Abeyance: The sanction of suspension may be held in abeyance. If the accused is found in violation of this Code during the time of suspension held in abeyance, the suspension shall take effect immediately without review or hearing. Additional sanctions appropriate to the new violation also may be given. The accused who has been issued a suspension held in abeyance sanction is deemed "not in good standing" with the Institute. The length of the suspension held in abeyance shall be decided by the hearing panel or as a term of the administrative resolution.
- Suspension: Exclusion for a period of time from the Institute premises and other privileges or activities set forth in the suspension notice. A suspended student or student organization shall immediately leave campus and not enter the campus or its resources during the period of suspension, except when on official school business. Such suspension also may include academic restrictions, including denial of transfer credit for course work completed at another institution during the period of suspension. Violation of this stipulation can adversely affect the accused's chances for readmission. The dean of Students will determine when the accused has met the requirements for readmission.
- Expulsion: Permanent termination of the accused's status and exclusion from Institute premises, privileges, and activities.

Nonstanding related sanctions

- *Restitution:* Repayment to the Institute or to an affected party for damages resulting from a violation of this Code.
- *Fine:* A monetary penalty, paid to the Institute.
- *Grade Change:* Change of grade for the course in which a violation of the Honor Code occurred. This may include the assignment of an *F* grade in a course from which the student had withdrawn and received a grade of *W*.
- *Programmatic Sanctions:* Assignment to educational programs that address issues important to the campus community (i.e., alcohol, community issues, anger management, etc.).
- *Restrictions:* Exclusion from participation in social, privileged, or extracurricular activities for a specified period of time.
- *Other Sanctions:* Other sanctions may be imposed instead of or in addition to those specified such as discipline service hours, counseling assessments, and research projects.

The Institute will develop sanctioning guidelines for some violations of the Code. Guidelines are provided to give an understanding of likely sanctions, but are not a required or guaranteed response to a violation.

F. Appeal Procedures

These procedures apply to individual student allegations. The process for student organization appeals is outlined in the Student Organization Code of Conduct, which can be found on the Office of the Dean of Students Web site and in the appendices of this Code. If accused students are dissatisfied with the action taken by the dean of Students, they may appeal the case in writing to the vice president of Student Affairs of Georgia Tech within seven calendar days after the action about which there is a complaint was delivered. Such an appeal shall cite reason for dissatisfaction with the previous decision. An appeal is not a new hearing and shall be limited to review of the record of the initial hearing, supporting documents, the student's appeal, and the response of the panel and the Institute for one or more of the following purposes:

- to determine whether the original hearing was conducted fairly in light of the charges and evidence presented;
- to determine whether the original hearing was conducted in conformity with prescribed procedures;
- to determine whether the sanctions imposed were appropriate for the violation the student was found to have committed; and/or
- to determine whether new evidence not available at the time of the hearing is relevant to the final decision.

The vice president of Student Affairs and the Student Grievance and Appeal Committee (SGAC) may contact any person or entity needed to adequately review the appeal.

The vice president of Student Affairs, within ten working days, shall refer the appeal to the SGAC. (See the Faculty Senate Web site, **www.facultysenate.gatech.edu**, for the most recently approved Statutes and Bylaws governing the SGAC.) Within ten working days, the SGAC shall review all facts and circumstances connected with the case and shall make its report thereon to the vice president of Student Affairs. Within five working days after receiving the SGAC report and after consideration of the committee's report, the

vice president of Student Affairs shall make a decision. The vice president of Student Affairs may: 1) overturn the SGAC's recommendation; 2) uphold the recommendation; 3) modify the recommendation; or 4) remand the case to the original hearing panel.

The Board of Regents of the University System of Georgia (the Board) is the final appellate authority for all cases involving students who have been suspended or expelled. Should aggrieved persons be dissatisfied with the decision of the vice president of Student Affairs, they may apply to the Board, without prejudice to their position, for a review of the decision. The application for review shall be submitted in writing to the executive secretary of the Board within a period of twenty business days following the delivery of the decision of the vice president of Student Affairs. The controlling Bylaws of the Board governing appeals may be found at **www.usg.edu/admin/humex/bylaws.html#VIII**. This application for review shall state the decision complained of and the redress desired. A review of the Board is not a matter of right but is within the sound discretion of the Board. If the application for review is granted, the Board, or a committee of the Board, shall investigate the matter thoroughly and render its decision thereon within sixty days from the filing date of the application for review or from the date of any hearing that may be held thereon. The decision of the Board shall be final and binding for all purposes.

G. Record Keeping and Release of Information for Individual Student Cases

Maintenance of Discipline Files:

Disciplinary records of students found responsible for any charges against them will normally be retained for five years from the date of the most recent notice of disciplinary action.

Disciplinary records containing records of suspension and expulsion will be permanently retained.

A case referral results in the creation of a disciplinary file in the name of the accused student. This file shall be voided if 1) there are no charges filed, or 2) the case is determined to be an informational file only, or 3) the student is found not responsible for the charges. Voided files will be so marked, shall not be kept with the active disciplinary records, and shall not leave any student with a disciplinary record. If the student is not enrolled when five years have passed and disciplinary action did not result in suspension, suspension held in abeyance, or expulsion, or a student terminates enrollment more than five years after a violation, the record is destroyed.

Release of Information

Open Records Act:

The state of Georgia's Open Records Act, O.C.G.A. § 50-18-70 et seq. makes most records of the state open to public inspection. Such records include, but are not limited to: 1) directory information under FERPA (see below); and 2) records of completed hearings regarding student organizations.

Parental Notification:

Parents of students under the age of twenty-one may be notified when a student is found responsible for violating the Georgia Tech Student Policy on Alcohol and Other Drugs when any of the following occur:

- Students endanger themselves or others while under the influence of alcohol or other substances. Specific instances include DUI, fighting, alcohol poisoning and hospitalization.
- When the dean of Students determines that any future violations of the Institute's policy will most likely result in suspension from Georgia Tech.
- A hearing officer determines that any future violations of the Institute's policy will likely result in removal from housing.

Other Releases:

The Institute complies with the current Family Educational Rights and Privacy Act (FERPA). At the time of printing, FERPA generally provides that personally identifiable information may not be released without the student's consent. However, there are a number of exceptions to this rule.

including, but not limited to, the following:

1. Institute officials, including teachers, who have a legitimate educational interest in the information;
2. Officials of other schools in which the student seeks admission or intends to enroll, on the condition that the student, upon request, receives a copy of the record that has been transferred and has an opportunity to challenge, upon request, the content of the record;
3. Parents of a dependent student defined in the Internal Revenue Code, as evidenced by a notarized affidavit stating that the student is a dependent for income tax purposes;
4. Appropriate parties in a health or safety emergency. Factors to consider in determining whether personally identifiable information should be disclosed shall include:
   a) the seriousness of the threat to the health and safety of the student or other individuals;
   b) the necessity of gaining the information to deal with the emergency;
   c) the ability of the parties to whom the information is disclosed to deal with the emergency; and
   d) the extent to which time is of the essence in dealing with the emergency.
5. In response to a judicial order or lawfully issued subpoena: The university official must make a reasonable effort to notify the student of the order or the subpoena several days in advance of compliance, except when the subpoena was issued for a law enforcement purpose and states that the student is not to be notified.
6. In response to an applicable Open Records request.

Transcript Encumbrances:

In pending cases that could result in suspension or expulsion, the dean of Students will normally place a temporary encumbrance (hold) on a student's records. The dean of Students will also place a hold on a student's records if the student fails to respond to an official request to meet or if the student fails to complete assigned sanctions.

H. Appendices

Policies can be found on **www.deanofstudents.gatech.edu/integrity**:

- Academic Honor Code
- Conduct Code and Disciplinary Procedures for Student Organizations
- Georgia Institute of Technology Student Policy on Alcohol and Illegal Drugs
- Georgia Tech Student Policy on Sexual Harassment and Sexual Misconduct
- Regents' Statement on Disruptive Behavior
- Board of Regents Policy 406.01 Withdrawal of Recognition of Student Organizations
- Policy for Dealing with Students with Psychological Difficulties

Other Relevant Policies

- Computer Use and Network Policy - **www.oit.gatech.edu/security/policy/usage/contents.html**
- GT Parking and Transportation Services Motor Vehicle Registration - **www.parking.gatech.edu/new_rules/index.html**

XX. Student Academic Grievance Procedures

The procedures set forth here are intended to provide students at the Georgia Institute of Technology a means for setting forth grievances relating to academic matters and grade disputes when the student believes that an instructor has acted unfairly or improperly in assignment of grades. It is not the intention of these procedures to provide a forum for questioning the judgment or grading policies of faculty.

A. Applicability of the Grievance Procedures

1. *Subject Matter:* These procedures apply to the review of grievances concerning academic matters and grade disputes. Grade appeals must be initiated by the grievant within their next enrolled term following the term of the course in question, and best efforts should be applied to resolve the appeal within that term.
2. *Grievant:* These procedures shall be the appellate procedures for students at the Georgia Institute of Technology. Students who have pursued a formal grievance procedure or who have

pursued informally the resolution of a grievance in their own school, college, or unit and have had that appeal dismissed, may submit the grievance for review under these procedures.

B. Overview of Grievance Process

1. Informal resolution attempted at the school, department, or unit level.
2. Formal resolution sought at the school, department, or unit level.
3. Formal resolution sought at the Institute level; appeal reviewed and, if so determined, heard by the Student Grievance and Appeal Committee.

C. Steps in the Grievance Process (to be followed in the order presented)

1. The student shall attempt to resolve the grievance with the individual faculty member, the department, or the unit involved.
2. If the grievance is not resolved in step C.1. and the student elects to continue the grievance process, the student may request a formal hearing setting forth in writing the complaint and the remedy sought at the school, college, or unit level. Upon receipt of such appeal, the unit director will acknowledge the appeal in writing within seven calendar days, and will expeditiously proceed to constitute an ad hoc appeal committee. The unit director will serve as a nonvoting member of the committee. In addition, the following four committee members will be selected:
   - One tenured faculty member from within the unit, selected by the unit director.
   - One member of the academic faculty, selected by the student. The student may elect not to select a faculty member; in that case, the committee will consist of three members.
   - One member from outside the unit, selected by the Student Grievance and Appeal Committee in consultation with the unit director.
   - One member of the academic faculty selected by the faculty member whose action is in question.

   This committee will proceed with due haste to examine the merits of the complaint and to render a decision within thirty days. During the proceedings, the student may present any and all evidence that the student deems necessary to support the complaint, except that the committee must agree that the evidence is in some way relevant. Such evidence may consist of documentation and/or testimony, within reason. Both complainant and respondent may be accompanied by advisors; the role of advisor must, however, be restricted to advice. Complainant and respondent must make their own cases before the committee.

   Following a hearing and a written decision at the school, college, or unit level, the grievance is presumed to be resolved unless the grievant appeals.
3. The grievant may appeal the decision that has been rendered by the school, college, or unit to the Student Grievance and Appeal Committee.
   a) If the Committee, or subset thereof appointed by the chairperson, rules that the procedures are not applicable or that based on the facts stated by the grievant viewed in the light most favorable to the grievant, there is no basis for relief, then the appeal is denied.
   b) If the Committee rules that the Institute procedural rules are applicable and that a hearing of the appeal is warranted, the Committee shall initiate a hearing process.
   c) If a student wishes to have a grievance outcome reviewed by the Student Grievance and Appeal Committee with a view to a formal hearing, the student shall observe the following requirements:

      c)1 The appeal must be in writing. It must state the basis for the grievance and the facts that support it, including a summary of the steps that have already been taken to resolve the grievance, reasons why the student finds the resolutions unfair or unsatisfactory, and a statement of the desired remedy.

      c)2 The written appeal must be presented to the chairperson of the Student Grievance and Appeal Committee within thirty days after the student has received notice of a decision from a school, college, or unit.

      c)3 The decision as to whether a formal hearing is warranted shall be made available, in writing, to the parties concerned within thirty days after the Committee has received notice of appeal.

      c)4 The Committee may alter a deadline specified in these procedures on written timely petition of either party showing a meritorious reason for delay; if the Committee itself needs to extend a deadline, it may do so on its own authority for periods up to fourteen calendar days; for longer delays, the Committee must request an extension from the Executive Board of the Institute.

      c)5 The determination of the Committee as to whether a hearing is warranted is final.

      c)6 The Committee shall develop and, with the approval of the Academic Senate, establish and publish its own rules of procedure for the conduct of formal hearings.

      c)7 After receiving testimony and the relevant documents, the Committee shall make a decision within thirty days on the basis of the received material.

      c)8 The Committee's decision shall contain finding of fact, the decision arrived at, reasons for the decision, and the criteria or policy applied in reaching the decision.

D. Remedies

1. *General:* If the Committee finds, after a formal hearing, that a faculty member, a departmental committee, or an administrator of a unit has not acted fairly or properly, it will recommend a remedy. It will seek to find a remedy that can be implemented by those whose cooperation is needed. In the matter of a grade dispute, this must include the faculty member involved in the dispute.
2. *Enforcement:*
   a) If any party does not comply with the decision of the Committee, the Committee shall, upon request of any party, seek full compliance through the administrative offices of the Institute through the chief academic officer (CAO).
   b) The merits of the dispute shall not be subject to review in the process of enforcement. There shall be strong presumption in favor of the remedy selected by the Committee.
3. *Report of a Final Decision:* After a final decision has been made in a case, the Committee shall prepare a report setting forth its findings and recommendations for action and present the report to the CAO. A copy of the report shall be presented to the parties concerned and to those persons involved in implementing the Committee's recommendations. All such communications shall be effected in person or by certified mail with a return receipt requested; such receipt will become part of the Institute records of the case.

   Grade Changes: In decisions that would result in the changing of a posted grade, the CAO will instruct the unit director to ask the involved faculty member to effect the prescribed grade change, or, if cooperation is not forthcoming, to effect the grade change directly by action of the unit director. Such action shall not be construed as restrictive of the recourses of the faculty member through the usual appeal procedure at the Institute.

   Care will be given that no incomplete or inaccurate information pertaining to the grievance is placed in any file; and that all evidence obtained at any stage of the process and all deliberations and proceedings be kept confidential. At the conclusion of each case, the Student Grievance and Appeal Committee shall transmit original or true copies of documents related to the case to the appropriate office of the vice president of student affairs, who shall keep such records securely as Institute records for a period of time specified by Institute statutes.
4. *Final Appeal:* Appeal of the decision of the Committee to the CAO shall be permitted only for the purposes of

procedural review. Such appeal shall be submitted in writing, with copies to the Committee. The CAO will review the findings of the Committee and, upon judgment that the Committee has failed to follow these procedures or has failed to follow the procedures approved by the Academic Senate for the operation of the Student Grievance and Appeal Committee (XXI.C.3.c.c6), return the case to the Committee for reconsideration, along with description of the perceived error in procedure and a recommendation for its correction.

XXI. Exceptions

Where appeals are not otherwise specified, exceptions to these regulations may be made by the appropriate faculty committee upon petition by the student and recommendation of the student's school or department. Blanket exceptions that have the effect of amending these regulations shall be referred to the Academic Senate for approval.

XXII. Student Bill of Academic Rights

1. The right to attend classes at regularly scheduled times without deviation from such time and without penalty if the student cannot attend instructional, lab, or examination hours not institutionally scheduled.
2. The right to consult with an assigned and qualified advisor for a reasonable amount of time each term.
3. The right to consult with faculty outside usual classroom time, such as regularly scheduled office hours, by appointment.
4. The right to have reasonable access to campus facilities of which use is required to complete course assignments and/or objectives.
5. The right to receive a syllabus for each course at the first class meeting. The syllabus should include an outline of the course objectives, criteria used in determining the course grade, and any other requirements. Students should be informed of any changes made to the syllabus with reasonable time to adjust to these changes.
6. The right to have reasonable time to learn course material prior to the administration of an examination.
7. The right of each student to receive access to any of his/her records kept by the institution.
8. The right to have reasonable access to grading instruments and/or evaluation criteria and to have graded material returned in a timely fashion.
9. The right to be informed of the grade appeals process.
10. The right to have reasonable facilities in which to receive instruction and examinations.
11. The right to be informed in each course of the definition of academic misconduct.

Administration, Faculty, and Staff

University System Administration

Board of Regents

The Georgia Institute of Technology is one of the educational institutions constituting the University System of Georgia. The University System is governed by an eighteen-member Board of Regents, the members of which are appointed to seven-year terms by the governor of Georgia. The members of the Board of Regents are listed below.

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William H. Cleveland, Atlanta . . . . . State-at-Large
Donald M. Leebern Jr., McDonough . . . . . State-at-Large
Doreen Stiles Poitevint, Bainbridge . . . . . State-at-Large
Joel O. Wooten Jr., Columbus . . . . . State-at-Large
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Wanda Yancey Rodwell, Stone Mountain . . . . . Fourth District
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Michael J. Coles, Kennesaw . . . . . Sixth District
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Connie Cater, Macon . . . . . Eighth District
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James R. Jolly, Dalton . . . . . Tenth District
Joe Frank Harris, Cartersville . . . Eleventh District
J. Timothy Shelnut, Augusta . . . . . Twelfth District
Vice Chair
Allan Vigil, Morrow . . . . . Thirteenth District

Chancellor of the University System and the Administrative Staff

Chancellor Thomas C. Meredith is the chief administrative officer of the University System and the chief executive officer of the Board of Regents.

Members of the chancellor's administrative staff are the following:

- Gail S. Weber, secretary to the Board
- Ron Stark, associate vice chancellor, internal audit
- Rob Watts, senior policy advicor

Office of Academic and Fiscal Affairs

- Daniel S. Papp, senior vice chancellor, academic and fiscal affairs

Academics, Faculty and Student Affairs

- Frank A. Butler, vice chancellor for academics, faculty and student affairs
- Cathie M. Hudson, associate vice chancellor, strategic research and analysis
- Jan Kettlewell, associate vice chancellor, P-16 initiatives; executive director, University System of Georgia Foundation
- Tonya Lam, associate vice chancellor, student affairs
- John T. Wolfe Jr., associate vice chancellor, faculty affairs
- Kris Biesinger, assistant vice chancellor, advanced learning technologies
- Joseph J. Szutz, assistant vice chancellor, planning
- Dorothy Zinsmeister, assistant vice chancellor, academic affairs; associate director for higher education, PRISM Initiative
- Marci Middleton, director, academic program coordination
- Richard C. Sutton, senior advisor for academic affairs, director of international programs

Fiscal Affairs

- William R. Bowes, vice chancellor for fiscal affairs
- Usha Ramachandran, budget director
- Gerald Vaughan, assistant budget director

- Debra Lasher, executive director, business and

financial affairs
- Michael Cole, assistant director, financial services and systems
- Robert Elmore, assistant director, business services

Information and Instructional Technology
- Randall A. Thursby, vice chancellor/chief information officer
- Jim Flowers, special assistant to the chief information officer
- Tom Maier, assistant vice chancellor, information technology
- John Graham, executive director, enterprise applications systems
- Merryl Penson, executive director, library services
- John Scoville, executive director, enterprise infrastructure services
- David Disney, director, customer services
- Matthew Kuchinski, director, office systems support
- Lisa Striplin, director, administrative services

Office of External Activities and Facilities
- Thomas E. Daniel, senior vice chancellor

External Activities
- Lamar Veatch, assistant vice chancellor, Georgia Public Library Service
- Joy Hymel, executive director, economic development
- Terry Durden, director, ICAPP operations
- Arlethia Perry-Johnson, associate vice chancellor, media and publications
- John Millsaps, director, communications/ marketing
- Diane Payne, director, publications

Facilities
- Linda M. Daniels, vice chancellor, facilities
- Hal Gibson, assistant vice chancellor, design and construction
- Peter J. Hickey, assistant vice chancellor, real properties
- Mark Demyanek, director, environmental safety
- Alan Travis, director, planning

Office of Support Services
- Corlis Cummings, senior vice chancellor

Legal Affairs
- Elizabeth E. Neely, associate vice chancellor, legal affairs
- Robyn A. Crittenden, assistant vice chancellor, legal affairs (contracts)
- J. Burns Newsome, assistant vice chancellor, legal affairs (prevention)

Human Resources
- William H. Wallace Jr., associate vice chancellor, human resources
- Sherea Frazer, director, human resources

The University System of Georgia

Since 1932, all state-operated institutions of higher education in Georgia, including the Georgia Institute of Technology, have sought to accomplish their goals of instruction, public service, and research through their affiliation with the University System of Georgia. Governed by the eighteen-member constitutional Board of Regents under the administration of the chancellor, the four research universities, two regional universities, thirteen state universities, two state colleges, and thirteen two-year colleges that compose the System retain a high degree of autonomy while cooperating with member institutions within the structure of Board policy. In addition to the formulation and administration of policy, the Board of Regents is responsible for requesting appropriations from the Georgia legislature and for allocating these funds to member institutions.

To provide students in Georgia with quality instruction leading to a variety of degrees, the Board of Regents establishes minimum academic standards, granting to each member institution the prerogative of establishing higher standards. Besides providing a foundation for sound instruction, the Board encourages public service and continuing education programs, including lectures, conferences, short courses, advisory services, extension courses, and teacher education consortiums. The Board also encourages research related to the educational objectives of the institutions and originating in societal need. Appointed by the governor and confirmed by the Georgia Senate, the members of the Board of Regents – five from the state at large and one from each of the state's thirteen congressional districts – serve for seven-year terms; the chancellor, who is not a member of the Board, is chief executive and administrative officer for the Board and the University System. Each institution has as its executive head a president, whose selection is recommended by the chancellor and approved by the Board.

Member Institutions

Research Universities
Georgia Institute of Technology
Georgia State University
Medical College of Georgia
University of Georgia

Regional Universities
Georgia Southern University
Valdosta State University

State Universities
Albany State University
Armstrong Atlantic State University
Augusta State University
Clayton College and State University
Columbus State University
Fort Valley State University
Georgia College and State University
Georgia Southwestern State University
Kennesaw State University
North Georgia College and State University
Savannah State University
Southern Polytechnic State University
State University of West Georgia

State Colleges
Dalton State College
Macon State College

Two-year Colleges
Abraham Baldwin Agricultural College
Atlanta Metropolitan College
Bainbridge College
Coastal Georgia Community College
Darton College
East Georgia College
Floyd College
Gainesville College
Georgia Perimeter College
Gordon College
Middle Georgia College
South Georgia College
Waycross College

Board of Regents
University System of Georgia
270 Washington Street S.W.
Atlanta, Georgia 30334
404.656.2202

Georgia Tech Administration

President's Office
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Vacant, Ph.D., executive assistant to the president
Robert T. Harty, M.A., assistant vice president, institute communications and public affairs
Andrea Ashmore, B.A., special assistant to the president; director, institute partnerships
Andrew J. Harris Jr., M.P.A., special assistant to the president; director, government relations

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Charles L. Liotta, Ph.D., vice provost for research and dean of graduate studies
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Jonathan S. Colton, co-director, Center for Polymer Processing (COE)
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Predrag Cvitanovic, director, Center for Nonlinear Sciences (VP Research)
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Charles A. Eckert, director, Specialty Separations Center (COE/VP Research)
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Charles M. Estes Jr., director, Traditional Industries Program (EDI)
Mary Frank Fox, co-director, Center for the Study of Women, Science, and Technology (VP Research)
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Steven P. French, director, Center for Geographic Information Systems (COA/GTRI)
Richard M. Fujimoto, director, Modeling and Simulation Research and Education Center (COC/GTRI)
Thomas F. Fuller, director, Center for Innovative Fuel Cell and Battery Technologies (GTRI)
Aris P. Georgakakos, director, Environmental Fluid Mechanics and Water Resources Institute (COE/VP Research)
Leonid Germanovich, co-director, Center for Applied Geomaterials Research (COE)
Soumen Ghosh, director, Center for the Management of Technology, Extended Value Chain (COM)
Jean-Pierre Goedgebuer, director, Center GTL-CRNS Telecom (COE)
Arun M. Gokhale, director, USCAR on Structural Cast Magnesium Development Project (COE)
Barry Goodno, director, NSF Mid-America Earthquake Center (COE)
Marla J. Gorges, director, Southeastern Trade Adjustment Assistance Center (EDI)
Robert J. Gregor, director, Center for Human Movement Studies (VP Research)

Eugene F. Greneker III, director, Severe Storms Research Center (GTRI)
Sathyanaraya Hanagud, director, MURI: Multifunctional Energetic Structural Materials (COE)
H. Mike Harris, director, Phosphor Technology Center of Excellence (COE/GTRI)
Rigoberto Hernandez, co-director, Center for Computational Molecular Science and Technology (COS)
Nolan E. Hertel, director, Neely Nuclear Research Center (COE)
H. Wayne Hodges, director, Advanced Technology Development Center (EDI)
Timothy D. Israel, manager, Center for International Standards and Quality (EDI)
Nikil S. Jayant, director, Georgia Center for Advanced Telecommunications Technology (VP Research), and director, Georgia Tech Broadband Institute (COE)
Eric N. Johnson, director, MURI: Active-Vision Control Systems for Complex Adversarial 3-D Environment (COE)
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Bernd Kahn, director, Environmental Resources Center (VP Research)
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Gregory H. Nobles, director, Southern Industrialization Center (IAC)
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Zack E. Osborne, director, Georgia Tech Procurement Assistance Center (EDI)
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John W. Peifer, research director, Biomedical Interactive Technology Center (VP Research)
William E. Price, research director, Interactive Media Technology Center (VP Research)
Hans B. Püttgen, director, National Electric Energy Testing, Research, and Application Center (COE)
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Gary S. Tjaden, director, Center for Enterprise Systems (GTRI)
Rao R. Tummala, director, NSF-ERC Packaging Research Center (COE)
Zhong Lin Wang, director, Center for Nanoscience and Nanotechnology (COE/VP Research), director, Center for Nanostructure Characterization (COE), and director, Electron Microscopy Center (COE)
Katja Weber, co-director, European Union Center (IAC)
Ajit Yoganathan, director, Bioengineering Research Center (VP Research), and director, Georgia Tech/Emory Biomedical Technology Research Center (VP Research)
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Karen I. Aardal, Ph.D.
Catholic University of Louvain
Associate Professor, Industrial and Systems Engineering

Gregory B. Abbott, M.F.A
University of Georgia
Instructor, Literature, Communication, and Culture

Said I. Abdel-Khalik, Ph.D.
University of Wisconsin
Southern Nuclear Distinguished Professor and Professor, Nuclear Engineering and Health Physics

Randal T. Abler, Ph.D.
Georgia Institute of Technology
Assistant Professor, Regional Engineering Program

Gregory Abowd, Ph.D.
University of Oxford
Associate Professor, Computing

Gena L. Abraham, Ph.D.
Georgia Institute of Technology
Assistant Professor, Civil and Environmental Engineering

Phillip L. Ackerman, Ph.D.
University of Illinois
Professor, Psychology

Ali Adibi, Ph.D.
California Institute of Technology
Associate Professor, Electrical and Computer Engineering

Pradeep K. Agrawal, Ph.D.
University of Delaware
Associate Professor, Chemical and Biomolecular Engineering

Mustaque Ahamad, Ph.D.
State University of New York - Stony Brook
Professor, Computing

Shabbir Ahmed, Ph.D.
University of Illinois - Urbana-Champaign
Assistant Professor, Industrial and Systems Engineering

Frederick W. Ahrens, Ph.D.
University of Wisconsin - Madison
Professor, Mechanical Engineering

Cyrus K. Aidun, Ph.D.
Clarkson C. Tech
Professor, Mechanical Engineering

Ian F. Akyildiz, Ph.D.
University Erlangen-Nuremberg
Byers Professor in Telecommunications, Electrical and Computer Engineering

Jay L. Alberts, Ph.D.
Arizona State University
Assistant Professor, Applied Physiology

Eleanor Alexander, Ph.D.
Brown University
Associate Professor, History, Technology, and Society

Christos Alexopoulos, Ph.D.
University of North Carolina - Chapel Hill
Associate Professor, Industrial and Systems Engineering

Faiz A. Al-Khayyal, Ph.D.
George Washington University
Associate Professor, Industrial and Systems Engineering

Douglas C. Allen, M.L.A.
R.L.A. (Georgia, Kentucky)
Harvard University
Professor, Architecture Program, College of Architecture

Mark G. Allen, Ph.D.
Massachusetts Institute of Technology
Pettit Professor, Electrical and Computer Engineering

Michael T. Allen, Ph.D.
University of Pennsylvania
Associate Professor, History, Technology, and Society

Phillip E. Allen, Ph.D.
University of Kansas
Schlumberger Professor, Electrical and Computer Engineering

Yucel Altunbasak, Ph.D.
University of Rochester
Associate Professor, Electrical and Computer Engineering

Adjo Amedkudzi, Ph.D.
Carnegie Mellon
Assistant Professor, Civil and Environmental Engineering

Mostafa H. Ammar, Ph.D.
University of Waterloo, Canada
Professor, Computing

Jane C. Ammons, Ph.D.
P.E. (Georgia)
Georgia Institute of Technology
Advance Professor, Industrial and Systems Engineering

David V. Anderson, Ph.D.
Georgia Institute of Technology
Assistant Professor, Electrical and Computer Engineering

Sigrun Andradottir, Ph.D.
Stanford University
Professor, Industrial and Systems Engineering

Libero Andreotti, Ph.D.
Massachusetts Institute of Technology
Associate Professor, Architecture Program, College of Architecture

Alfred D. Andrew, Ph.D.
Stanford University
Professor, Mathematics

Mustafa M. Aral, Ph.D.
Georgia Institute of Technology
Professor, Civil and Environmental Engineering

Ronald C. Arkin, Ph.D.
University of Massachusetts - Amherst
Professor, Computing

Erian A. Armanios, Ph.D.
Georgia Institute of Technology
Director, Georgia Space Grant Consortium and Professor, Aerospace Engineering

Godfried Augenbroe, M.S.
Delft Unviersity of Technology
Associate Professor, Architecture/ Doctoral Program, College of Architecture

Philip Auslander, Ph.D.
Cornell University
Professor, Literature, Communication, and Culture

Farrokh Ayazi, Ph.D.
University of Michigan
Assistant Professor, Electrical and Computer Engineering

Hayriye Ayhan, Ph.D.
Texas A&M University
Associate Professor, Industrial and Systems Engineering

Julia E. Babensee, Ph.D.
University of Toronto
Assistant Professor, Biomedical Engineering

Sonit Bafna, Ph.D.
Georgia Institute of Technology
Assistant Professor, College of Architecture

Matthew Howard Baker, Ph.D.
University of California - Berkeley
Assistant Professor, Mathematics

Nelson C. Baker, Ph.D.
Carnegie Mellon University
Associate Chair, Information Technology and Associate Professor, Civil and Environmental Engineering

Tucker R. Balch, Ph.D.
Georgia Institute of Technology
Assistant Professor, Computing

Daniel F. Baldwin, Ph.D.
Massachusetts Institute of Technology
Associate Professor, Mechanical Engineering

Sujit Banerjee, Ph.D.
Concordia University
Professor, Chemical and Biomolecular Engineering

Gang Bao, Ph.D.
Lehigh University
Professor, Biomedical Engineering

E. Kent Barefield, Ph.D.
Ohio State University
Associate Dean, College of Sciences, Professor, Chemistry and Biochemistry

Richard P. Barke, Ph.D.
University of Rochester
Associate Dean, Ivan Allen College and Associate Professor, Public Policy

Christopher F. Barnes, Ph.D.
Brigham Young University
Associate Professor, Regional Engineering Program

Earl R. Barnes, Ph.D.
University of Maryland
Professor, Industrial and Systems Engineering

Thomas P. Barnwell III, Ph.D.
Massachusetts Institute of Technology
Arbutus Distinguished Chair and Professor, Electrical and Computer Engineering

Bridgette Anne Barry, Ph.D.
University of California - Berkeley
Professor, Chemistry and Biochemistry

Bridgette Anne Barry, Ph.D.
University of California - Berkeley
Professor, Chemistry and Biochemistry

John R. Barry, Ph.D.
University of California - Berkeley
Associate Professor, Electrical and Computer Engineering

John J. Bartholdi, Ph.D.
University of Florida
Manhattan Associate Chair and Professor, Industrial and Systems Engineering

Saugata Basu, Ph.D.
New York University
Associate Professor, Mathematics

Olivier A. Bauchau, Ph.D.
Massachusetts Institute of Technology
Professor, Aerospace Engineering

Ronald H. Bayor, Ph.D.
University of Pennsylvania
Professor, History, Technology, and Society

Haskell W. Beckham, Ph.D.
Massachusetts Institute of Technology
Associate Professor, Polymer, Textile, and Fiber Engineering

Miroslav Begovic, Ph.D.
Virginia Polytechnic Institute and State University
Associate Professor, Electrical and Computer Engineering

Igor Belegradek, Ph.D.
University of Maryland
Assistant Professor, Mathematics

Johan G. Belinfante, Ph.D.
Princeton University
Professor, Mathematics

Ravi Venkat Bellamkonda, Ph.D.
Brown University
Associate Professor, Biomedical Engineering

Jean V. Bellissard, Ph.D.
University of Provence
Professor, Mathematics

Willie J. Belton Jr., Ph.D.
The Pennsylvania State University
Associate Professor, Economics

Paul J. Benkeser, Ph.D.
University of Illinois
Associate Chair for Undergraduate Programs and Associate Professor, Biomedical Engineering

Nathan Bennett, Ph.D.
Georgia Institute of Technology
Associate Professor, Management

Michael Bergin, Ph.D.
Carnegie Mellon University
Associate Professor, Civil and Environmental Engineering

Roberta Berry, J.D.
University of Wisconsin - Madison
Associate Professor, Public Policy

Yves H. Berthelot, Ph.D.
University of Texas - Austin
Professor, Mechanical Engineering

Sue A. Bidstrup Allen, Ph.D.
University of Minnesota
Associate Professor, Chemical and Biomolecular Engineering

Ronald Lester Billings, Ph.D.
University of Texas - Austin
Assistant Professor, Industrial and Systems Engineering

Vicki Birchfield, Ph.D.
University of Georgia
Assistant Professor, International Affairs

H. J. Biritz, Ph.D.
University of Vienna, Austria
Associate Chair and Professor, Physics

Robert X. Black, Ph.D.
Massachusetts Institute of Technology
Associate Professor, Earth and Atmospheric Sciences

Barbara Blackbourn, Ph.D.
University of Wisconsin - Madison
Associate Professor, Modern Languages

Fredda Blanchard-Fields, Ph.D.
Wayne State University
Professor, Psychology

W. J. Blanc Jr., M.S.
Georgia Institute of Technology
Assistant Professor, Building Construction Program, College of Architecture

Douglas M. Blough, Ph.D.
Johns Hopkins University
Professor, Electrical and Computer Engineering

Terry C. Blum, Ph.D.
Columbia University - Munchak
Dean, Ted Munchak Chair in Entrepreneurship, and Professor, Management

Aaron Bobick, Ph.D.
Massachusetts Institute of Technology
Professor, Computing

Ian S. Bogost, Ph.D.
University of California - Los Angeles
Associate Professor, Literature, Communication, and Culture

Alexandra Boldyreva, Ph.D.
University of California - San Diego
Assistant Professor, Computing

Jay D. Bolter, Ph.D.
University of North Carolina - Chapel Hill
James and Mary Wesley Chair in New Media and Professor, Literature, Communication, and Culture

Andreas Bommarius, Ph.D.
Massachusetts Institute of Technology
Professor, Chemical and Biomolecular Engineering

Federico Bonetto, Ph.D.
University of Roma
Assistant Professor, Mathematics

Wayne J. Book, Ph.D.
Massachusetts Institute of Technology
HUSCO/Ramirez Chair and Professor, Mechanical Engineering

Mark Borodovsky, Ph.D.
Moscow Institute of Physics and Technology
Regents' Professor, Biology

Thomas D. Boston, Ph.D.
Cornell University
Professor, Economics

Ann Bostrom, Ph.D.
Carnegie Mellon University
Associate Professor, Public Policy

Lawrence A. Bottomley, Ph.D.
University of Houston
Professor, Chemistry and Biochemistry

Kirk Bowman, Ph.D.
University of North Carolina - Chapel Hill
Associate Professor, International Affairs

Barbara D. Boyan, Ph.D.
Rice University
Price Gilbert Jr. Chair in Tissue Engineering and Professor, Biomedical Engineering

Barry Bozeman, Ph.D.
Ohio State University
Regents' Professor, Public Policy

Oliver Brand, Ph.D.
Swiss Federal Institute of Technology
Associate Professor, Electrical and Computer Engineering

Berdinus A. (Bert) Bras, Ph.D.
University of Houston
Professor, Mechanical Engineering

Robert David Braun, Ph.D.
Stanford University
Associate Professor, Aerospace Engineering

Peter Brecke, Ph.D.
Massachusetts Institute of Technology
Associate Professor, International Affairs

Jean-Luc E Bredas, Ph.D.
Facultes Universitaires Notre Dame de la Paix
Professor, Chemistry and Biochemistry

Laurens Victor Adriaan Breedveld, Ph.D.
University of Twente
Assistant Professor, Chemical and Biomolecular Engineering

Ron Broglio, Ph.D.
University of Florida
Assistant Professor, Literature, Communication, and Culture

Amy S. Bruckman, Ph.D.
Massachusetts Institute of Technology
Associate Professor, Computing

John A. Buck, Ph.D.
University of California - Berkeley
Professor, Electrical and Computer Engineering

David G. Bucknall, Ph.D.
Imperial College - London
Associate Professor, Polymer, Textile, and Fiber Engineering

Alice Bullard, Ph.D.
University of California - Berkeley
Associate Professor, History, Technology, and Society

Leonid Bunimovich, Ph.D.
Moscow University
Regents' Professor, Mathematics

Uwe H. F. Bunz, Ph.D.
Ludwig Max U Munich
Professor, Chemistry and Biochemistry

Thomas J. Burkholder, Ph.D.
University of California - San Diego
Assistant Professor, Applied Physiology

Susan Burns, Ph.D.
Georgia Institute of Technology
Associate Professor, Civil and Environmental Engineering

Robert J. Butera, Ph.D.
Rice University
Associate Professor, Electrical and Computer Engineering

Lloyd L. Byars, Ph.D.
Georgia State University
Professor, Management

John Cairney, Ph.D.
University of Dundee
Associate Professor, Biology

Anthony J. Calise, Ph.D.
University of Pennsylvania
Professor, Aerospace Engineering

William R. Callen Jr., Ph.D.
P.E. (Georgia)
Stanford University
Professor, Electrical and Computer Engineering

Eric A. Carlen, Ph.D.
Princeton University
Professor, Mathematics

Wallace W. Carr, Ph.D.
P.E. (Georgia, Virginia)
Georgia Institute of Technology
Professor, Polymer, Textile, and Fiber Engineering

Timothy N. Carroll, Ph.D.
Duke University
Assistant Professor, Management

W. Brent Carter, Ph.D.
Georgia Institute of Technology
Associate Professor, Materials Science and Engineering

Marco Eduardo Castillo, Ph.D.
University of Wisconsin - Madison
Assistant Professor, Public Policy

Richard Catrambone, Ph.D.
University of Michigan
Associate Professor, Psychology

Rejesh Chakrabarti, Ph.D
University of California - Los Angeles
Assistant Professor, Management

Goutam Challagalla, Ph.D.
University of Texas - Austin
Associate Professor, Management

Jean-Lou Chameau, Ph.D.
Stanford University
Provost, Georgia Research Alliance Eminent Scholar in Water Quality, and Professor, Civil and Environmental Engineering

William L. Chameides, Ph.D.
Yale University
Smithgall Chair in Atmospheric Sciences and Regents' Professor, Earth and Atmospheric Sciences

Gee-Kung Chang, Ph.D.
University of California - Riverside
Kenneth J. Byers Eminent Scholar in Microelectronics and Professor, Electrical and Computer Engineering

Yih-Long Chang, Ph.D.
University of Texas - Austin
Associate Professor, Management

Young-Hui Chang, Ph.D.
University of California - Berkeley
Assistant Professor, Applied Physiology

Michael S. Chapman, Ph.D.
Massachusetts Institute of Technology
Professor, Physics

Abhijit Chatterjee Ph.D.
University of Illinois - Urbana-Champaign
Professor, Electrical and Computer Engineering

Ruizhen Rachel Chen, Ph.D.
California Institute of Technology
Associate Professor, Chemical and Biomolecular Engineering

Xu-Yan Chen, D.Sc.
Hiroshima University
Associate Professor, Mathematics

Ye-Hwa Chen, Ph.D.
University of California - Berkeley
Professor, Mechanical Engineering

Yury Chernoff, Ph.D.
Leningrad State University
Associate Professor, Biology

George Chimonas, Ph.D.
University of Sussex
Professor, Earth and Atmospheric Sciences

Jung H. Choi, Ph.D.
University of California - San Diego
Associate Professor, Biology

Mei-Yin Chou, Ph.D.
University of California - Berkeley
Advance Professor, Physics

Ruchi Choudhary, Ph.D.
University of Michigan - Ann Arbor
Assistant Professor, College of Architecture

Shui-Nee Chow, Ph.D.
University of Maryland
Professor, Mathematics

Chul Chung, Ph.D.
University of Michigan - Ann Arbor
Assistant Professor, Economics

Wayne Chung, M.I.D.
Philadelphia College of Art
Associate Professor, College of Architecture

Bryan K. Church, Ph.D.
University of Florida
Professor, Management

Alka Varma Citrin, Ph.D.
Washington State University
Assistant Professor, Management

David S. Citrin, Ph.D.
University of Illinois - Urbana-Champaign
Associate Professor, Electrical and Computer Engineering

Mihai Ciucu, Ph.D.
University of Michigan
Associate Professor, Mathematics

Frank Leo Clark, Ph.D.
University of Arizona
Director and Professor, Music Program, College of Architecture

Jonathan E. Clarke, Ph.D.
University of Pittsburgh
Assistant Professor, Management

Mark A. Clements, Sc.D.
Massachusetts Institute of Technology
Director, Interactive Media Technology Center, and Professor, Electrical and Computer Engineering

Brian E Cliff, Ph.D.
Emory University
Instructor, Literature, Communication, and Culture

Alan Ramon Clinton, Ph.D.
University of Florida
Instructor, Literature, Communication, and Culture

G. Wayne Clough, Ph.D.
University of California - Berkeley
President of the Institute and Professor, Civil and Environmental Engineering

Kim M. Cobb, Ph.D.
Scripps College
Assistant Professor, Earth and Atmospheric Sciences

Molly Cochran, Ph.D.
London School of Economics and Political Science
Associate Professor, International Affairs

Carol A. Colatrella, Ph.D.
Rutgers University
Professor, Literature, Communication, and Culture

Daniel W. Colestock, M.S.
Georgia Institute of Technology
Lecturer, Computing

David M. Collard, Ph.D.
University of Massachusetts
Associate Professor, Chemistry and Biochemistry

Jonathan S. Colton, Ph.D.
Massachusetts Institute of Technology
Professor, Mechanical Engineering

Eugene E. Comiskey, Ph.D.
C.M.A., C.P.A.
Michigan State University
Fuller E. Callaway Professor, Management

Edward H. Conrad, Ph.D.
University of Wisconsin
Associate Professor, Physics

Cheryl K. Contant, Ph.D.
Stanford University
Professor, City Planning Program, College of Architecture

Fred L. Cook, Ph.D.
Georgia Institute of Technology
Professor, Polymer, Textile, and Fiber Engineering

William J. Cook, Ph.D.
University of Waterloo, Canada
Russell and Sammie Chandler Chair and Professor, Industrial and Systems Engineering

Brian Frank Cooper, Ph.D.
Stanford University
Assistant Professor, Computing

John A. Copeland, Ph.D.
Georgia Institute of Technology
Director, Communications Systems Center, John H. Weitnauer Technology Transfer Chair, and Professor, Electrical and Computer Engineering

Paul M. Corballis, Ph.D.
Columbia University
Assistant Professor, Psychology

Gregory M. Corso, Ph.D.
New Mexico State University
Associate Professor, Psychology

Bettina F. Cothran, Ph.D.
Wuppertal University
Associate Professor, Modern Languages

Nora Cottille-Foley, Ph.D.
Northwestern University
Associate Professor, Modern Languages

Mark H. Cottle, M.S.
Harvard University
Assistant Professor, Architecture Program, College of Architecture

Susan E. Cozzens, Ph.D.
Columbia University
Professor, Public Policy

James I. Craig, Ph.D.
Stanford University
Professor, Aerospace Engineering

Robert M. Craig, Ph.D.
Cornell University
Professor, Architecture Program, College of Architecture

T. Hugh Crawford, Ph.D.
Duke University
Associate Professor, Literature, Communication, and Culture

John D. Cressler, Ph.D.
Columbia University
Professor, Electrical and Computer Engineering

Ernest Samuel Croot III, Ph.D.
University of Georgia
Assistant Professor, Mathematics

Kenneth A. Cunefare, Ph.D.
Pennsylvania State University
Associate Professor, Mechanical Engineering

Derek M. Cunnold, Ph.D.
Cornell University
Professor, Earth and Atmospheric Sciences

Judith A. Curry, Ph.D.
University of Chicago
School Chair and Professor, Earth and Atmospheric Sciences

Predrag Cvitanovic, Ph.D.
Cornell University
Glen Robinson Chair in Nonlinear Sciences and Professor, Physics

Richard Dagenhart, M.Arch., M.C.P.
R.A. (Georgia, Texas)
University of Pennsylvania
Associate Professor, Architecture Program, College of Architecture

Jiangang Dai, Ph.D.
Stanford University
Professor, Mathematics and Industrial and Systems Engineering

Rui Dai, Ph.D.
University of Texas - Austin
Assistant Professor, Management

Angela Dalle Vacche, Ph.D.
University of Iowa
Associate Professor, Literature, Communication, and Culture

Amanda Damarin, M.A.
Columbia University
Associate Professor, History, Technology, and Society

D. Stefan Dancila, Ph.D.
Georgia Institute of Technology
Assistant Professor, Aerospace Engineering

Steven Danyluk, Ph.D.
Cornell University
Morris M. Bryan Jr. Chair in Mechanical Engineering for Advanced Manufacturing and Professor, Mechanical Engineering

Dragomir Davidovic, Ph.D.
Johns Hopkins University
Assistant Professor, Physics

J. Nari Davidson, Ph.D.
P.E. (Georgia)
University of Michigan
Associate Dean, College of Engineering and Professor, Mechanical Engineering

Elizabeth T. Davis, Ph.D.
Columbia University
Associate Professor, Psychology

Jeffrey A. Davis, Ph.D.
Georgia Institute of Technology
Assistant Professor, Electrical and Computer Engineering

E. Levent Degertekin, Ph.D.
Stanford University
Assistant Professor, Mechanical Engineering

Walter A. DeHeer, Ph.D.
University of California - Berkeley
Professor, Physics

Frank Dellaert, Ph.D.
Case Western Reserve University
Assistant Professor, Computing

Richard A. DeMillo, Ph.D.
Georgia Institute of Technology
Imlay Dean and Professor, Computing

Shijie Deng, Ph.D.
University of California - Berkeley
Assistant Professor, Industrial and Systems Engineering

Yulin Deng, Ph.D.
University of Manchester
Associate Professor, Chemical and Biomolecular Engineering

Reginald DesRoches, Ph.D.
University of California - Berkeley
Associate Chair and Associate Professor, Civil and Environmental Engineering

Stephen Paul DeWeerth, Ph.D.
California Institute of Technology
Professor, Electrical and Computer Engineering

Emanuele Di Lorenzo, Ph.D.
Scripps College
Assistant Professor, Earth and Atmospheric Sciences

Thomas J. DiChristina, Ph.D.
California Institute of Technology
Associate Professor, Biology

Robert E. Dickinson, Ph.D.
Massachusetts Institute of Technology
Georgia Power/Georgia Research Alliance Eminent Scholar in Atmospheric Sciences and Professor, Earth and Atmospheric Sciences

Pat Dickson, Ph.D.
University of Alabama
Assistant Professor, Management

Robert Dickson, Ph.D.
University of Chicago
Associate Professor, Chemistry and Biochemistry

Luca Dieci, Ph.D.
University of New Mexico
Professor, Mathematics

Harris H. Dimitropoulos, Ph.D.
Aristotelion University - Greece
Associate Professor, Architecture Program, College of Architecture

Yan Z. Ding, Ph.D.
Harvard University
Assistant Professor, Computing

Michelle Lynn Dion, Ph.D.
University of North Carolina - Chapel Hill
Assistant Professor, International Affairs

Deepakraj M. Divan, Ph.D.
University of Calgary
Professor, Electrical and Computer Engineering

William Alan Doolittle, Ph.D.
Georgia Institute of Technology
Assistant Professor, Electrical and Computer Engineering

John E. Dorsey, Ph.D.
Michigan State University
Professor, Electrical and Computer Engineering

Andre L. Dos Santos, Ph.D.
University of California - Santa Barbara
Assistant Professor, Computing

Konstantinos Dovrolis, Ph.D.
University of Wisconsin - Madison
Assistant Professor, Computing

Elizabeth M. Dowling, Ph.D.
R.A. (Georgia)
University of Pennsylvania
Associate Professor, Architecture Program, College of Architecture

Donald E. Doyle, Ph.D.
University of North Carolina - Chapel Hill
Assistant Professor, Chemistry and Biochemistry

Mulalo Doyoyo, Ph.D.
Brown University
Assistant Professor, Civil and Environmental Engineering

William J. Drummond, Ph.D.
University of North Carolina - Chapel Hill
Associate Professor, City Planning Program, College of Architecture

Richard A. Duke, Ph.D.
University of Virginia
Professor, Mathematics

Ellen Dunham-Jones, M.S.
Princeton University
Associate Professor, College of Architecture

Russell Dean Dupuis, Ph.D.
University of Illinois - Urbana-Champaign
Professor, Electrical and Computer Engineering

Gregory David Durgin, Ph.D.
Virginia Polytechnic Institute
Assistant Professor, Electrical and Computer Engineering

Charles M. Eastman, M.Arch.
University of California - Berkeley
Professor, College of Architecture and College of Computing

Imme Ebert-Uphoff, Ph.D.
Johns Hopkins University
Associate Professor, Mechanical Engineering

Charles A. Eckert, Ph.D.
University of California - Berkeley
J. Erskine Love, Jr. Institute Chair, Director of Specialty Separations Center and Institute Professor, Chemical and Biomolecular Engineering

Athanassios Economou, M.ARCH.
University of Southern California
Associate Professor, Architecture Program, College of Architecture

Paul Edmonds, Ph.D.
University of Cincinnati
Associate Professor, Biology

Warren Keith Edwards, Ph.D.
Georgia Institute of Technology
Associate Professor, Computing

Magnus Egerstedt, Ph.D.
Royal Veteran College of Sweden
Assistant Professor, Electrical and Computer Engineering

Jeremy C. Eisenberg, M.A.
University of Alabama
Instructor, Literature, Communication, and Culture

Bruce Ellingwood, Ph.D.
University of Illinois - Urbana-Champaign
Professor, Civil and Environmental Engineering

Michael L. Poirier Elliott, Ph.D.
Massachusetts Institute of Technology
Associate Professor, City Planning Program, College of Architecture

Wedad Elmaghraby, Ph.D.
University of California - Berkeley
Assistant Professor, Industrial and Systems Engineering

Mostafa A. El-Sayed, Ph.D.
Florida State University
Julius Brown Chair and Regents' Professor, Chemistry and Biochemistry

Kirstn Ely, Ph.D.
University of Chicago
Associate Professor, Management

Susan E. Embretson, Ph.D.
University of Minnesota
Professor, Psychology

Leroy Z. Emkin, Ph.D.
Massachusetts Institute of Technology
Professor, Civil and Environmental Engineering

Howard L. Emple, Ph.D.
University of Minnesota
Professor, Chemical and Biomolecular Engineering

John E. Endicott, Ph.D.
Tufts University
Professor, International Affairs

Cassiano Ricardo Endres de Oliveira, Ph.D.
University of London
Professor, Mechanical Engineering

Randall W. Engle, Ph.D.
Ohio State University
Associate Dean, College of Sciences, School Chair and Professor, Psychology

Ahmet Erbil, Ph.D.
Massachusetts Institute of Technology
Professor, Physics

Laszlo Erdos, Ph.D.
Princeton University
Professor, Mathematics

Alan Erera, Ph.D.
University of California - Berkeley
Assistant Professor, Industrial and Systems Engineering

Ozlem Ergun, Ph.D.
Massachusetts Institute of Technology
Assistant Professor, Industrial and Systems Engineering

Augustine O. Esogbue, Ph.D.
University of Southern California
Professor, Industrial and Systems Engineering

Irfan Essa, Ph.D.
Massachusetts Institute of Technology
Associate Professor, Computing

Cheol S. Eun, Ph.D.
New York University
Thomas R. Williams Chair and Professor, Management

Chrsitopher J. Fahrni, Ph.D.
University of Basel, Switzerland
Assistant Professor, Chemistry and Biochemistry

Ko-Hui Michael Fan, Ph.D.
University of Maryland
Associate Professor, Electrical and Computer Engineering

Donald B. Fedor, Ph.D.
University of Illinois - Urbana-Champaign
Professor, Management

Andrei G. Fedorov, Ph.D.
Purdue University
Assistant Professor, Mechanical Engineering

Faramarz Fekri, Ph.D.
Georgia Institute of Technology
Assistant Professor, Electrical and Computer Engineering

Jack M. Feldman, Ph.D.
University of Illinois
Professor, Psychology

Ian T. Ferguson, Ph.D.
University of Saint Andrews
Professor, Electrical and Computer Engineering

Mark Ferguson, Ph.D.
Duke University
Assistant Professor, Management

Ronald W. Ferguson, Ph.D.
Northwestern University
Assistant Professor, Computing

Facundo M Fernandez, Ph.D.
University of Buenos Aires
Assistant Professor, Chemistry and Biochemistry

Aldo A. Ferri, Ph.D.
Princeton University
Associate Professor, Mechanical Engineering

Bonnie Heck Ferri, Ph.D.
Georgia Institute of Technology
Professor, Electrical and Computer Engineering

Phillip N. First, Ph.D.
University of Illinois
Associate Professor, Physics

Arthur Dan Fisk, Ph.D.
University of Illinois
Professor, Psychology

Douglas Flamming, Ph.D.
Vanderbilt University
Associate Professor, History, Technology, and Society

M. Raymond Flannery, Ph.D.
University of Belfast
Regents' Professor, Physics

Angela Flury, Ph.D.
University of California - Davis
Instructor, Literature, Communication, and Culture

James Foley, Ph.D.
University of Michigan
Stephen Fleming Associate Dean and Professor, Computing

Robert D. Foley, Ph.D.
University of Michigan
Professor, Industrial and Systems Engineering

Larry J. Forney, Ph.D.
Harvard University
Associate Professor, Chemical and Biomolecular Engineering

Lawrence Foster, Ph.D.
University of Chicago
Professor, History, Technology, and Society

Paul Foster, Ph.D.
Ohio State University
Assistant Professor, Modern Languages

Mary Frank Fox, Ph.D.
University of Michigan
Advance Professor, History, Technology, and Society

Ronald F. Fox, Ph.D.
Rockefeller University
School Chair and Regents' Professor, Physics

A. Bruno Frazier, Ph.D.
Georgia Institute of Technology
Associate Professor, Electrical and Computer Engineering

William James Frederick, Ph.D.
University of Maine
Director of Institute of Paper Science and Technology and Professor, Chemical and Biomolecular Engineering

Peter A. Freeman, Ph.D.
Carnegie Mellon University
Professor, Computing

Steven P. French, Ph.D.
University of North Carolina - Chapel Hill
Professor, City Planning Program, College of Architecture

Hermann Marc Fritz, Ph.D.
Swiss Federal Institute of Technology
Assistant Professor, Regional Engineering Program

J. David Frost, Ph.D.
Purdue University
Director, Regional Engineering Program, and Professor, Civil and Environmental Engineering

Rong Fu, Ph.D.
Columbia University
Associate Professor, Earth and Atmospheric Sciences

Richard M. Fujimoto, Ph.D.
University of California - Berkeley
Professor, Computing

Merrick L. Furst, Ph.D.
Cornell University
Associate Dean and Professor, Computing

Cheryl Gaimon, Ph.D.
Carnegie Mellon University
Professor, Management

Martha Gallivan, Ph.D.
California Institute of Technology
Assistant Professor, Chemical and Biomolecular Engineering

Thomas D. Galloway, Ph.D.
University of Washington
Dean and Professor, College of Architecture

Vicki B. Galloway, Ph.D.
University of South Carolina
Professor, Modern Languages

Michael Gamble, M.Arch.
Georgia Institute of Technology
Assistant Professor, Architecture Program, College of Architecture

Wilfrid Gangbo, Ph.D.
Swiss Federal Institute of Technology
Professor, Mathematics

Andres J. Garcia, Ph.D.
University of Pennsylvania
Associate Professor, Mechanical Engineering

Srinivas Garimella, Ph.D.
Ohio State University
Associate Professor, Mechanical Engineering

Hamid Garmestani, Ph.D.
Cornell University
Professor, Materials Science and Engineering

Stavros Garoufalidis, Ph.D.
University of Chicago
Professor, Mathematics

Laurie Anne Garrow, Ph.D.
Northwestern University
Assistant Professor, Computing

John W. Garver, Ph.D.
University of Colorado
Professor, International Affairs

Monica M. Gaughan, Ph.D.
University of North Carolina - Chapel Hill
Assistant Professor, Public Policy

Thomas K. Gaylord, Ph.D.
P.E. (Texas)
Rice University
Julius Brown Chair and Regents' Professor, Electrical and Computer Engineering

Russell T. Gentry, Ph.D.
P.E. (Michigan, Maryland)
University of Michigan
Associate Professor, Architecture Program, College of Architecture

Aristidis P. Georgakakos, Ph.D.
Massachusetts Institute of Technology
Associate Chair Research Programs and Professor, Civil and Environmental Engineering

Rosario A. Gerhardt, Sc.D.
Columbia University
Professor, Materials Science and Engineering

Leonid Germanovich, Ph.D.
Moscow State University
Professor, Civil and Environmental Engineering

Jeffrey Geronimo, Ph.D.
Rockefeller University
Professor, Mathematics

S. Mostafa Ghiaasiaan, Ph.D.
P.E. (California)
University of California - Los Angeles
Professor, Nuclear Engineering and Health Physics

Mohammad Ghomi, Ph.D.
Johns Hopkins University
Associate Professor, Mathematics

Vivek Ghosal, Ph.D.
University of Florida
Associate Professor, Economics

Soumen Ghosh, Ph.D.
Ohio State University
Professor, Management

Robert W. Ghrist, Ph.D.
Cornell University
Associate Professor, Mathematics

Don P. Giddens, Ph.D.
Georgia Institute of Technology
Dean, College of Engineering, Lawrence L. Gellerstedt Jr. Chair in Bioengineering and Professor, Biomedical Engineering

August W. Giebelhaus Jr., Ph.D.
University of Delaware
Professor, History, Technology, and Society

Jerry H. Ginsberg, E.Sc.D.
Columbia University
George W. Woodruff Chair in Mechanical Systems and Professor, Mechanical Engineering

Ari Glezer, Ph.D.
California Institute of Technology
George W. Woodruff Chair in Thermal Systems and Professor, Mechanical Engineering

Elias N. Glytsis, Ph.D.
Georgia Institute of Technology
Professor, Electrical and Computer Engineering

Ashok K. Goel, Ph.D.
Ohio State University
Associate Professor, Computing

Marc Goetschalckx, Ph.D.
Georgia Institute of Technology
Associate Professor, Industrial and Systems Engineering

Arun M. Gokhale, Ph.D.
University of Florida
Professor, Materials Science and Engineering

Arun M. Gokhale, Ph.D.
University of Florida
Professor, Materials Science and Engineering

Stuart H Goldberg, Ph.D.
University of Wisconsin - Madison
Assistant Professor, Modern Languages

David Goldsman, Ph.D.
Cornell University
Professor, Industrial and Systems Engineering

Guillermo H. Goldsztein, Ph.D.
Massachusetts Institute of Technology
Assistant Professor, Mathematics

James L. Gole, Ph.D.
Rice University
Professor, Physics

Michael David Goodisman, Ph.D.
University of Georgia
Assistant Professor, Biology

Seymour Goodman, Ph.D.
California Institute of Technology
Professor, International Affairs

Barry Goodno, Ph.D.
P.E. (Georgia)
Stanford University
Professor, Civil and Environmental Engineering

T. Govindaraj, Ph.D.
University of Illinois - Urbana-Champaign
Associate Professor, Industrial and Systems Engineering

Stuart Graham, Ph.D.
University of California - Berkeley
Assistant Professor, Management

Samuel Graham Jr., Ph.D.
Georgia Institute of Technology
Assistant Professor, Mechanical Engineering

Deborah R. Grayson, Ph.D.
Michigan State University
Assistant Professor, Literature, Communication, and Culture

Itzhak Green, Sc.D.
Technion-Israel Institute of Technology
Professor, Mechanical Engineering

William L. Green, Ph.D.
University of Pennsylvania
Professor, Mathematics

Robert J. Gregor, Ph.D.
Pennsylvania State University
School Chair and Professor, Applied Physiology

Paul M. Griffin, Ph.D.
Texas A&M University
Associate Chair for Undergraduate Studies and Associate Professor, Industrial and Systems Engineering

Zenzi M. Griffin, Ph.D.
University of Illinois - Urbana-Champaign
Assistant Professor, Psychology

Anselm C. Griffin III, Ph.D.
University of Texas - Austin
School Chair and Professor, Polymer, Textile, and Fiber Engineering

Roman Grigoriev, Ph.D.
California Institute of Technology
Assistant Professor, Physics

Rebecca Elizabeth Grinter, Ph.D.
University of California - Los Angeles
Associate Professor, Computing

Diane Gromala, M.F.A
Yale University
Associate Professor, Literature, Communication, and Culture

Randall Guensler, Ph.D.
University of California - Davis
Associate Professor, Civil and Environmental Engineering

Serge E Guillas, Ph.D.
University of Paris
Assistant Professor, Mathematics

Robert E. Guldberg, Ph.D.
University of Michigan
Associate Professor, Mechanical Engineering

Mark Guzdial, Ph.D.
University of Michigan
Associate Professor, Computing

Kevin A. Haas, Ph.D.
University of Delaware
Assistant Professor, Regional Engineering Program

Thomas G. Habetler, Ph.D.
University of Wisconsin
Professor, Electrical and Computer Engineering

Steven Hackman, Ph.D.
University of California - Berkeley
Associate Professor, Industrial and Systems Engineering

Wassim M. Haddad, Ph.D.
Florida Institute of Technology
Professor, Aerospace Engineering

Rami Haj-Ali, Ph.D.
University of Illinois
Associate Professor, Civil and Environmental Engineering

James O. Hamblen, Ph.D.
Georgia Institute of Technology
Professor, Electrical and Computer Engineering

Sathyanaraya V. Hanagud, Ph.D.
Stanford University
Professor, Aerospace Engineering

Ronald G. Harley, Ph.D.
University of London
Duke Power Distinguished Professor, Electrical and Computer Engineering

Evans M. Harrell III, Ph.D.
Princeton University
Professor, Mathematics

Mary Jean Harrold, Ph.D.
University of Pittsburgh
Advance Professor, Computing

James G. Hartley, Ph.D.
Georgia Institute of Technology
Professor, Mechanical Engineering

Stephen Harvey, Ph.D.
Dartmouth College
Georgia Research Alliance Eminent Scholar in Structural Biology and Professor, Biology

Paul E. Hasler, Ph.D.
California Institute of Technology
Associate Professor, Electrical and Computer Engineering

Narin Hassan, Ph.D.
University of Rochester
Assistant Professor, Literature, Communication, and Culture

John J. Havick, Ph.D.
University of Iowa
Associate Professor, Public Policy

Mark E. Hay, Ph.D.
University of California - Irvine
Harry and Linda Teasley Chair in Environmental Biology and Professor, Biology

Monson H. Hayes III, Ph.D.
Massachusetts Institute of Technology
Professor, Electrical and Computer Engineering

Anthony John Hayter, Ph.D.
Cornell University
Associate Professor, Industrial and Systems Engineering

Christopher E. Heil, Ph.D.
University of Maryland
Professor, Mathematics

Clifford L. Henderson, Ph.D.
University of Texas - Austin
Associate Professor, Chemical and Biomolecular Engineering

Rigoberto Hernandez, Ph.D.
University of California - Berkeley
Goizueta Associate Professor, Chemistry and Biochemistry

David M. Herold, Ph.D.
Yale University
Gary T. and Elizabeth R. Jones Chair and Professor, Management

TyAnna K. Herrington, Ph.D.
Texas Technical University
Associate Professor, Literature, Communication, and Culture

Nolan E. Hertel, Ph.D.
P.E. (Georgia)
University of Illinois - Urbana-Champaign
Professor, Nuclear Engineering and Health Physics

Christopher K. Hertzog, Ph.D.
University of Southern California
Professor, Psychology

Peter J. Hesketh, Ph.D.
University of Pennsylvania
Professor, Mechanical Engineering

Dennis W. Hess, Ph.D.
Lehigh University
William W. LaRoche Jr. Chair and Professor, Chemical and Biomolecular Engineering

Diana M. Hicks, Ph.D.
University of Sussex
School Chair and Professor, Public Policy

Dewey H. Hodges, Ph.D.
Stanford University
Professor, Aerospace Engineering

Michael H. G. Hoffmann, Ph.D.
Ludwig Max U Munich
Associate Professor, Public Policy

John Wendell Holmes, Ph.D.
Massachusetts Institute of Technology
Professor, Aerospace Engineering

Christian Houdre, Ph.D.
McGill University
Professor, Mathematics

Jeffery S. Hsieh, Ph.D.
Syracuse University
Director, Pulp and Paper Research Center, and Associate Professor, Chemical and Biomolecular Engineering

Frances Hsu, M.S.
Harvard University
Assistant Professor, College of Architecture

Ching-Hua Huang, Ph.D.
Carnegie Mellon
Assistant Professor, Civil and Environmental Engineering

Nicholas V. Hud, Ph.D.
University of California - Davis
Associate Professor, Chemistry and Biochemistry

L. Gregory Huey, Ph.D.
University of Wisconsin - Madison
Associate Professor, Earth and Atmospheric Sciences

Joseph Blake Hughes, Ph.D.
University of Iowa
School Chair and Professor, Civil and Environmental Engineering

Joseph L. A. Hughes, Ph.D.
Stanford University
Associate Chair and Professor, Electrical and Computer Engineering

Piper Huguley-Riggins, M.A.
Georgia State University
Instructor, Literature, Communication, and Culture

William D. Hunt, Ph.D.
University of Illinois - Urbana-Champaign
Professor, Electrical and Computer Engineering

Michael Hunter, Ph.D.
University of Texas - Austin
Assistant Professor, Civil and Environmental Engineering

Xiaoming Huo, Ph.D.
Stanford University
Assistant Professor, Industrial and Systems Engineering

Maurizio Iacopetta, Ph.D.
New York University
Assistant Professor, Economics

Plamen Ignatov Iliev, Ph.D.
Catholic University
Assistant Professor, Mathematics

Ellery D. Ingall, Ph.D.
Yale University
Associate Professor, Earth and Atmospheric Sciences

Mary Ann Ingram, Ph.D.
Georgia Institute of Technology
Associate Professor, Electrical and Computer Engineering

Charles Lee Isbell Jr., Ph.D.
Massachusetts Institute of Technology
Assistant Professor, Computing

Julie Jacko, Ph.D.
Purdue University
Associate Professor, Industrial and Systems Engineering

Joel Jackson, Ph.D.
Georgia Institute of Technology
Assistant Professor, Regional Engineering Program

Karl I. Jacob, Ph.D.
Ohio State University
Associate Professor, Polymer, Textile, and Fiber Engineering

Laurence J. Jacobs, Ph.D.
Columbia University
Associate Chair Undergraduate Programs and Professor, Civil and Environmental Engineering

Jechiel I. Jagoda, Ph.D.
Imperial College, University of London
Associate Chair and Professor, Aerospace Engineering

Ramesh C. Jain, Ph.D.
Indian Institute of Technology
Rhesa Farmer Chair in Embedded Systems and Professor, Electrical and Computer Engineering

Lawrence Robert James, Ph.D.
University of Utah
Professor, Psychology

Jiri Janata, Ph.D.
Charles University
Georgia Research Alliance Eminent Scholar in Sensors and Instrumentation and Professor, Chemistry and Biochemistry

Christopher Jarrett, M.Arch.
Columbia University
Associate Professor, Architecture Program, College of Architecture

Nikil Jayant, Ph.D.
Stanford University
John E. Pippin Chair in Wireless Systems, Director of the Georgia Tech Broadband Institute, Executive Director of the Georgia Centers for Advanced Telecommunications Technology and Professor, Electrical and Computer Engineering

Nayrayan Jayaraman, Ph.D.
University of Pittsburgh
Professor, Management

Sundaresan Jayaraman, Ph.D.
North Carolina State University
Associate Chair for Graduate Studies and Research and Professor, Polymer, Textile, and Fiber Engineering

Michael W.M. Jenkins, B.S.
Chartered Engineer (Great Britain)
Gloucester Institute of Technology - England
Lecturer, Aerospace Engineering

Sheldon M. Jeter, Ph.D.
P.E. (Georgia)
Georgia Institute of Technology
Associate Professor, Mechanical Engineering

Chuanyi Ji, Ph.D.
California Institute of Technology
Associate Professor, Electrical and Computer Engineering

Ellis L. Johnson, Ph.D.
University of California - Berkeley
Coca-Cola Chair and Professor, Industrial and Systems Engineering

Eric N. Johnson, Ph.D.
Georgia Institute of Technology
Lockheed Martin Assistant Professor, Aerospace Engineering

W. Steven Johnson, Ph.D.
Duke University
Professor, Materials Science and Engineering

William W. Johnson, Ph.D.
University of Kentucky
Associate Professor, Modern Languages

George Barnett Johnston, M.Arch.
R.A. (Georgia, Mississippi)
Rice University
Associate Director and Associate Professor, Architecture Program, College of Architecture

Jon J. Johnston, M.S.
University of London
Assistant Professor, Public Policy

Christopher Jones, Ph.D.
California Institute of Technology
Assistant Prossor, Chemical and Biomolecular Engineering

Yogendra K. Joshi, Ph.D.
University of Pennsylvania
Professor, Mechanical Engineering

Igor B. Jouline, Ph.D.
St. Petersburg (Leningrad) State University
Assistant Professor, Biology

Biing Hwang Juang, Ph.D.
University of California - Santa Barbara
Professor, Electrical and Computer Engineering

Lorraine Justice, M.ARCH.
Ohio State University
Director and Associate Professor, Industrial Design Program, College of Architecture

Lawrence F. Kahn, Ph.D.
P.E. (California, Michigan, Georgia)
University of Michigan
Professor, Civil and Environmental Engineering

Britta Kallin, Ph.D.
Cincinnati University
Assistant Professor, Modern Languages

Ruth Kanfer, Ph.D.
Arizona State University
Professor, Psychology

Roozbeh Kangari, Ph.D.
University of Illinois
Director and Professor, Building Construction Program, College of Architecture

George A. Kardomateas, Ph.D.
Massachusetts Institute of Technology
Professor, Aerospace Engineering

Jens O. M. Karlsson, Ph.D.
Massachusetts Institute of Technology
Associate Professor, Mechanical Engineering

Stylianos Kavadias, Ph.D.
INSEAD, France
Assistant Professor, Management

E. Larry Keating, Ph.D.
University of Wisconsin
Professor, City Planning Program, College of Architecture

Edward Keene, Ph.D.
London School of Economics and Political Science
Assistant Professor, International Affairs

David C. Keezer, Ph.D.
Carnegie Mellon University
Associate Professor, Electrical and Computer Engineering

Derek K. Kellenberg, Ph.D.
University of Colorado - Boulder
Assistant Professor, Economics

Robert Kennedy, Ph.D.
Georgetown University
Professor, International Affairs

Thomas Albert Brian Kennedy, Ph.D.
Queen's University of Belfast
Professor, Physics

J. Stevenson Kenney, Ph.D.
Georgia Institute of Technology
ON Semiconductor Associate Professor, Electrical and Computer Engineering

Robert P. Kertz, Ph.D.
Northwestern University
Professor, Mathematics

Pinar Keskinocak, Ph.D.
Carnegie Mellon University
Assistant Professor, Industrial and Systems Engineering

Sabir Khan, M.Arch.
Rice University
Associate Dean and Associate Professor, Architecture Program, College of Architecture

Ajay Khorana, Ph.D.
C.F.A.
University of North Carolina – Chapel Hill
Associate Professor, Management

Subhash A. Khot, Ph.D.
Princeton University
Assistant Professor, Computing

Masato Kikuchi, Ph.D.
University of Pittsburgh
Associate Professor, Modern Languages

Rehim Kilic, Ph.D.
Michigan State University
Assistant Professor, Economics

Jaehong Kim, Ph.D.
University of Illinois - Urbana-Champaign
Assistant Professor, Civil and Environmental Engineering

Seong-Hee Kim, Ph.D.
Northwestern University
Assistant Professor, Industrial and Systems Engineering

William Paul King, Ph.D.
Stanford University
Assistant Professor, Mechanical Engineering

Gordon Kingsley, Ph.D.
Syracuse University
Associate Professor, Public Policy

Bernard Kippelen, Ph.D.
University of Louis Pasteur
Professor, Electrical and Computer Engineering

John Richard Kirby, Ph.D.
University of Illinois - Urbana-Champaign
Assistant Professor, Biology

Bradley L. Kirkman, Ph.D.
University of North Carolina - Chapel Hill
Associate Professor, Management

Robert J. Kirkman, Ph.D.
State University of New York - Stony Brook
Assistant Professor, Public Policy

Christopher Klausmeier, Ph.D.
University of Minnesota
Assistant Professor, Biology

Maren Klawiter, Ph.D.
University of California - Berkeley
Assistant Professor, History, Technology, and Society

Benjamin D.B. Klein, Ph.D.
University of Illinois - Urbana-Champaign
Assistant Professor, Regional Engineering Program

Hans Klein, Ph.D.
Massachusetts Institute of Technology
Associate Professor, Public Policy

Jackie Kleiner, J.D.
New York Law School
Associate Professor, Management

Cynthia J. Klestinec, Ph.D.
University of Chicago
Assistant Professor, Literature, Communication, and Culture

Anton Kleywegt, Ph.D.
Purdue University
Associate Professor, Industrial and Systems Engineering

Mikhail M. Klimenko, Ph.D.
Stanford University
Associate Professor, Physics

Kenneth J. Knoespel, Ph.D.
University of Chicago
School Chair and Professor, Literature, Communication, and Culture

Arthur J. Koblasz, Ph.D.
California Institute of Technology
Associate Professor, Electrical and Computer Engineering

Paul A. Kohl, Ph.D.
University of Texas - Austin
Regents' Professor and Institute Fellow, Chemical and Biomolecular Engineering

Janet L. Kolodner, Ph.D.
Yale University
Professor, Computing

Narayanan M. Komerath, Ph.D.
Georgia Institute of Technology
Professor, Aerospace Engineering

William J. Koros, Ph.D.
University of Texas - Austin
Roberto C. Goizueta Chair and Professor, Chemical and Biomolecular Engineering

Gerhard Jean Marie Krige, Ph.D.
University of Sussex
Kranzberg Professor, History, Technology, and Society

David N. Ku, Ph.D., M.D.
Georgia Institute of Technology
Lawrence P. Huang Chair in Engineering and Entrepreneurship and Regents' Professor, Mechanical Engineering

Julia Kubanek, Ph.D.
University of British Columbia
Assistant Professor, Biology

Satish Kumar, Ph.D.
Indian Institute of Technology
Professor, Polymer, Textile, and Fiber Engineering

Thomas R. Kurfess, Ph.D.
P.E. (Pennsylvania)
Massachusetts Institute of Technology
Professor, Mechanical Engineering

Kimberly Kurtis, Ph.D.
University of California - Berkeley
Assistant Professor, Civil and Environmental Engineering

Alexander Kuzmich, Ph.D.
University of Rochester
Assistant Professor, Physics

Paul Kvam, Ph.D.
University of California - Davis
Associate Professor, Industrial and Systems Engineering

Angela Labarca, Ph.D.
Ohio State University
Professor, Modern Languages

Michael T. Lacey, Ph.D.
University of Illinois
Professor, Mathematics

W. Jack Lackey, Ph.D.
North Carolina State University
Professor, Mechanical Engineering

Uzi Landman, D.Sc.
Technion-Israel Institute of Technology
Fuller E. Callaway Chair and Regents' Professor, Physics

Aaron D. Lanterman, Ph.D.
University of Washington
Assistant Professor, Electrical and Computer Engineering

Michelle C. LaPlaca, Ph.D.
University of Pennsylvania
Assistant Professor, Biomedical Engineering

Joy Laskar, Ph.D.
University of Illinois
Petit Professor, Electrical and Computer Engineering

Michael J. Laughter, M.F.A.
University of New Orleans
Instructor, Literature, Communication, and Culture

Thang Tu Quoc Le, Ph.D.
Moscow State University
Professor, Mathematics

W. Marshall Leach, Jr. Ph.D.
Georgia Institute of Technology
Professor, Electrical and Computer Engineering

Dianne Leader, Ph.D.
University of Tennessee
Instructor, Psychology

William Leahy, M.S.
Virginia Polytechnic Institute and State University
Lecturer, Computing

W. Jude LeBlanc, M.ARCH.
Harvard University
Associate Professor, Architecture Program, College of Architecture

Richard J. Leblanc Jr., Ph.D.
University of Wisconsin - Madison
Professor, Computing

Joseph M. LeDoux, Ph.D.
Rutgers University
Assistant Professor, Biomedical Engineering

Chin-Hui Lee, Ph.D.
University of Washington
Professor, Electrical and Computer Engineering

Eva Lee, Ph.D.
Rice University
Assistant Professor, Industrial and Systems Engineering

Hsien-Hsin Lee, Ph.D.
University of Michigan - Ann Arbor
Assistant Professor, Electrical and Computer Engineering

Jay Lee, Ph.D.
California Institute of Technology
Professor, Chemical and Biomolecular Engineering

Kok-Meng Lee, Ph.D.
Massachusetts Institute of Technology
Professor, Mechanical Engineering

Wenke Lee, Ph.D.
Columbia University
Assistant Professor, Computing

Cheryl Leggon, Ph.D.
University of Chicago
Associate Professor, Public Policy

Nancey Green Leigh, Ph.D.
University of California - Berkeley
Professor, City Planning Program, College of Architecture

Blake Leland, Ph.D.
Cornell University
Associate Professor, Literature, Communication, and Culture

Lionel J. Lemarchand, Ph.D.
University of Georgia
Assistant Professor, Modern Languages

Jan Lenstra, Ph.D.
University of van Amsterdam
John P. Hunter Chair and Professor, Industrial and Systems Engineering

Roberto Leon, Ph.D.
P.E. (Minnesota)
University of Texas - Austin
Professor, Civil and Environmental Engineering

John D. Leonard, Ph.D.
University of California - Irvine
Associate Professor, Civil and Environmental Engineering

Marc E. Levenston, Ph.D.
Stanford University
Associate Professor, Mechanical Engineering

Ronald B. Lewcock, Ph.D.
Cape Town University
Professor, Architecture/Doctoral Program, College of Architecture

Geoffrey Li, Ph.D.
Auburn University
Associate Professor, Electrical and Computer Engineering

Haizheng Li, Ph.D.
University of Colorado - Boulder
Associate Professor, Economics

Mo Li, Ph.D.
California Institute of Technology
Associate Professor, Materials Science and Engineering

Wing-Suet Li, Ph.D.
University of Michigan
Professor, Mathematics

Xiaoliang Li, Ph.D.
University of Virginia
Associate Professor, Modern Languages

Steven Y. Liang, Ph.D.
University of California - Berkeley
Professor, Mechanical Engineering

Timothy C. Lieuwen, Ph.D.
Georgia Institute of Technology
Assistant Professor, Aerospace Engineering

Sung-Kyu Lim, Ph.D.
University of California - Los Angeles
Assistant Professor, Electrical and Computer Engineering

Stanley Lindsey, Ph.D.
Vanderbilt University
Professor, Regional Engineering Program

Charles L. Liotta, Ph.D.
University of Maryland
Vice Provost for Research and Dean, Graduate Studies, and Regents' Professor, Chemistry and Biochemistry

Harvey Lipkin, Ph.D.
University of Florida
Associate Professor, Mechanical Engineering

Richard Lipton, Ph.D.
Carnegie Mellon University
Frederick G. Storey Chair and Professor, Computing

Ling Liu, Ph.D.
Tilburg University – Netherlands
Associate Professor, Computing

Meilin Liu, Ph.D.
University of California - Berkeley
Professor, Materials Science and Engineering

Yingjie Liu, Ph.D.
University of Chicago
Assistant Professor, Mathematics

Daniel Lizarralde, Ph.D.
Massachusetts Institute of Technology
Assistant Professor, Earth and Atmospheric Sciences

Kirill S. Lobachev, Ph.D.
St. Petersberg State University
Assistant Professor, Biology

Frank Loeffler, Ph.D.
University Hohenheim
Associate Professor, Civil and Environmental Engineering

Robert G. Loewy, Ph.D.
University of Pennsylvania
William R.T. Oakes Chair and Professor, Aerospace Engineering

Gabriel Hsiuwei Loh, Ph.D.
Yale University
Assistant Professor, Computing

Jack R. Lohmann, Ph.D.
P.E. (Michigan)
Stanford University
Associate Dean, College of Engineering and Professor, Industrial and Systems Engineering

Leland T. Long, Ph.D.
P.G. (Georgia)
Oregon State University
Professor, Earth and Atmospheric Sciences

William J. Long, Ph.D.
Columbia University
Professor, International Affairs

Michael Loss, Ph.D.
Eidgenossische Technische Hochschule
Professor, Mathematics

Robert P. Lowell, Ph.D.
Oregon State University
Professor, Earth and Atmospheric Sciences

Hanchao Lu, Ph.D.
University of California – Los Angeles
Professor, History, Technology, and Society

Jye-Chi Lu, Ph.D.
P.E. (Michigan)
University of Wisconsin - Madison
Professor, Industrial and Systems Engineering

Doron S. Lubinsky, Ph.D.
University of Witwatersrand
Professor, Mathematics

Peter J. Ludovice, Ph.D.
Massachusetts Institute of Technology
Associate Professor, Chemical and Biomolecular Engineering

Thomas N. Lux, B.A.
Emerson College
Margaret and Henry Bourne Chair in Poetry and Professor, Literature, Communication, and Culture

Christopher S. Lynch, Ph.D.
University of California - Santa Barbara
Associate Chair for Administration and Associate Professor, Mechanical Engineering

Jean Lynch-Stieglitz, Ph.D.
Columbia University
Associate Professor, Earth and Atmospheric Sciences

Louis Lyon, Ph.D.
Northwestern University
Associate Professor, Chemistry and Biochemistry

Russell D. Lyons, Ph.D.
University of Michigan
Professor, Mathematics

Blair MacIntyre, Ph.D
Columbia University
Assistant Professor, Computing

Vijay Madisetti, Ph.D.
University of California - Berkeley
Professor, Electrical and Computer Engineering

Sylvia G. Maier, Ph.D.
University of Southern California
Assistant Professor, International Affairs

Naresh K. Malhotra, Ph.D.
State University of New York - Buffalo
Regents' Professor, Management

Panagiotis Manolios, Ph.D.
University of Texas - Austin
Assistant Professor, Computing

Terry L. Maple, Ph.D.
University of California - Davis
Elizabeth Smithgall Watts Chair in Behavioral and Animal Conservation and Professor, Psychology

Alexei N. Marchenkov, Ph.D.
Leiden University
Assistant Professor, Physics

Seth Richard Marder, Ph.D.
University of Wisconsin – Madison
Professor, Chemistry and Biochemistry

Catherine Marin, Ph.D.
University of Wisconsin - Madison
Associate Professor, Modern Languages

Leo Mark, Ph.D.
Aarhus University
Associate Professor, Computing

Luis D. L. Martins, Ph.D.
New York University
Associate Professor, Management

Marianne Mason, Ph.D.
University of Georgia
Assistant Professor, Modern Languages

Kyoko Masuda, Ph.D.
University of Arizona
Assistant Professor, Modern Languages

Michael J. Mateas, Ph.D.
Carnegie Mellon University
Assistant Professor, Literature, Communication, and Culture

Heinrich Felix Matzinger, Ph.D.
Cornell University
Assistant Professor, Mathematics

Dimitri N. Mavris, Ph.D.
Georgia Institute of Technology
Associate Professor, Aerospace Engineering

Gary Stephen May, Ph.D.
University of California - Berkeley
Executive Assistant to the President and Motorola Professor, Electrical and Computer Engineering

Sheldon W. May, Ph.D.
University of Chicago
Regents' Professor, Chemistry and Biochemistry

Paul W. Mayne, Ph.D.
Cornell University
Professor, Civil and Environmental Engineering

Mark J. McCabe, Ph.D.
Massachusetts Institute of Technology
Assistant Professor, Economics

Patrick S. McCarthy, Ph.D.
Claremont Graduate School
School Chair and Professor, Economics

Nael A. McCarty, Ph.D.
University of Texas Health Science Center - Houston
Associate Professor, Biology

James W. McClellan, Ph.D.
Rice University
Byers Professor in Digital Signal Processing, Electrical and Computer Engineering

John McCuan, Ph.D.
Stanford University
Assistant Professor, Mathematics

Todd C. McDevitt, Ph.D.
University of Washington
Assistant Professor, Biomedical Engineering

John F. McDonald, Ph.D.
University of California - Davis
School Chair and Professor, Biology

David L. McDowell, Ph.D.
University of Illinois - Urbana-Champaign
Carter N. Paden Distinguished Chair in Metal Processing and Regents' Professor, Mechanical Engineering

Carter N. Paden Distinguished Chair in Metal Processing and Regents' Professor, Mechanical Engineering

Leon E. McGinnis, Ph.D.
North Carolina State University
Eugene C. Gwaltney Chair and Professor, Industrial and Systems Engineering

Peter J. McGuire, Ph.D.
Brown University
Associate Chair and Professor, Literature, Communication, and Culture

Larry Vern McIntire, Ph.D.
Princeton University
Wallace H. Coulter School Chair and Professor, Biomedical Engineering

John R. McIntyre, Ph.D.
University of Georgia
Director, C.I.B.E.R., and Professor, Management

Phillip McKnight, Ph.D.
Brown University
School Chair and Professor, Modern Languages

Stephen W. McLaughlin, Ph.D.
University of Michigan
Professor, Electrical and Computer Engineering

Robert C. McMath Jr., Ph.D.
University of North Carolina - Chapel Hill
Vice Provost for Undergraduate Studies and Academic Affairs and Professor, History, Technology, and Society

James D. Meindl, Ph.D.
Carnegie Mellon University
Joseph M. Pettit Chair in Microelectronics, Director of Microelectronics Research Center, and Professor, Electrical and Computer Engineering

Athanasios P. Meliopoulos, Ph.D.
Georgia Institute of Technology
Professor, Electrical and Computer Engineering

Shreyes N. Melkote, Ph.D.
Michigan Technological University
Associate Professor, Mechanical Engineering

Ronald Mendola, M.S.
State University of New York - Buffalo
Assistant Professor, College of Architecture

Suresh Menon, Ph.D.
University of Maryland
Professor, Aerospace Engineering

Carson Meredith, Ph.D.
University of Texas - Austin
Assistant Professor, Chemical and Biomolecular Engineering

Ralph Charles Merkle, Ph.D.
Stanford University
Professor, Computing

Alfred H. Merrill, Ph.D.
Cornell University
Smithgall Institute Chair and Professor, Biology

Russell M. Mersereau, Sc.D.
Massachusetts Institute of Technology
Regents' Professor, Electrical and Computer Engineering

Michael D. Meyer, Ph.D.
Massachusetts Institute of Technology
Professor, Civil and Environmental Engineering

Jennifer E. Michaels, Ph.D.
Cornell University
Associate Professor, Electrical and Computer Engineering

Thomas E. Michaels, Ph.D.
Washington State University
Associate Professor, Electrical and Computer Engineering

Melina Mihail, Ph.D.
Harvard University
Associate Professor, Computing

Valeria Tolver Milam, Ph.D.
University of Illinois - Urbana-Champaign
Assistant Professor, Materials Science and Engineering

Melinda L. Millard-Stafford, Ph.D.
University of Georgia
Professor, Applied Physiology

Linda S. Milor, Ph.D.
University of California - Berkeley
Associate Professor, Electrical and Computer Engineering

Vedat H. Milor, Ph.D.
University of California - Berkeley
Assistant Professor, Public Policy

Konstantin Mischaikow, Ph.D.
University of Wisconsin - Madison
Professor, Mathematics

Farrokh Mistree, Ph.D.
University of California - Berkeley
Professor, Mechanical Engineering

Christine M. Mitchell, Ph.D.
Ohio State University
Professor, Industrial and Systems Engineering

Sabyasachi Mitra, Ph.D.
University of Iowa
Associate Professor, Management

Tracy L. Mitzner, Ph.D.
University of Kansas
Instructor, Psychology

Boris Mizaikoff, Ph.D.
Vienna University of Technology, Austria
Associate Professor, Chemistry and Biochemistry

Gerd Mockenhaupt, Ph.D.
University of Siegen (Germany)
Assistant Professor, Mathematics

Renato Monteiro, Ph.D.
University of California - Berkeley
Professor, Industrial and Systems Engineering

Cecilia Montes-Alcala, Ph.D.
University of California - Berkeley
Assistant Professor, Modern Languages

Joseph P. Montoya, Ph.D.
Harvard University
Associate Professor, Biology

Vincent J. Mooney, Ph.D.
Stanford University
Associate Professor, Electrical and Computer Engineering

Carole Moore, Ph.D.
University of California - Santa Barbara
Director, Office of Academic Affairs and Professor, History, Technology, and Society

Christopher Moore, M.F.A.
East Carolina University
Assistant Professor, College of Architecture

Elliot Moore II, Ph.D.
Georgia Institute of Technology
Assistant Professor, Regional Engineering Program

Thomas D. Morley, Ph.D.
Carnegie Mellon University
Professor, Mathematics

Peter J. Mucha, Ph.D.
Princeton University
Assistant Professor, Mathematics

Rafi L. Muhanna, Ph.D.
University of Sofia
Associate Professor, Regional Engineering Program

Charles W. Mulford Jr., D.B.A. C.P.A.
Florida State University
INVESCO Chair and Professor, Management

James A. Mulholland, Ph.D.
Massachusetts Institute of Technology
Associate Professor, Civil and Environmental Engineering

Janet Murray, Ph.D.
Harvard University
Graduate Director and Professor, Literature, Communication, and Culture

Niren Murthy, Ph.D.
University of Washington
Assistant Professor, Biomedical Engineering

John D. Muzzy, Ph.D.
Rensselaer Polytechnic Institute
Professor, Chemical and Biomolecular Engineering

Beth Mynatt, Ph.D.
Georgia Institute of Technology
Associate Professor, Computing

Dennis H. Nagao, Ph.D.
University of Illinois
Associate Professor, Management

Sankar Nair, Ph.D.
University of Massachussets
Assistant Professor, Chemical and Biomolecular Engineering

Usha Nair-Reichert, Ph.D.
Purdue University
Associate Professor, Economics

Sridhar Narasimhan, Ph.D.
Ohio State University
Professor, Management

Roger J. Narayan, Ph.D.
North Carolina State University
Assistant Professor, Materials Science and Engineering

Shamkant B. Navathe, Ph.D.
University of Michigan - Ann Arbor
Professor, Computing

Subhankar Nayak, Ph.D.
Yale University
Assistant Professor, Management

G. Paul Neitzel, Ph.D.
Johns Hopkins University
Professor, Mechanical Engineering

George L. Nemhauser, Ph.D.
Northwestern University
A. Russell Chandler III Chair and Institute Professor, Industrial and Systems Engineering

Athanasios Nenes, Ph.D.
California Institute of Technology
Assistant Professor, Earth and Atmospheric Sciences

Robert M. Nerem, Ph.D.
The Ohio State University
Parker H. Petit Distinguished Chair for Engineering in Medicine and Professor, Mechanical Engineering

Nancy Nersessian, Ph.D.
Case Western Reserve
Professor, Public Policy and College of Computing

Richard W. Neu, Ph.D.
University of Illinois - Urbana-Champaign
Associate Professor, Mechanical Engineering

Michael Niemier, Ph.D.
University of Notre Dame
Assistant Professor, Computing

Michael Nitsche, M.A.
Cambridge University
Associate Professor, Literature, Communication, and Culture

Gregory Nobles, Ph.D.
University of Michigan
Professor, History, Technology, and Society

Douglas Simpson Noonan, Ph.D.
University of Chicago
Assistant Professor, Public Policy

Bryan G. Norton, Ph.D.
University of Michigan
Professor, Public Policy

Rita Oberle, Ph.D.
P.E. (Georgia)
University of Florida
Associate Professor, Building Construction Program, College of Architecture

John R. Olds, Ph.D.
P.E. (Georgia)
North Carolina State University
Associate Professor, Aerospace Engineering

Edward R. Omiecinski, Ph.D.
Northwestern University
Associate Professor, Computing

Thomas M. Orlando, Ph.D.
State University of New York - Stony Brook
School Chair and Professor, Chemistry and Biochemistry

David I. Orloff, Ph.D.
Drexel University
Professor, Mechanical Engineering

Alessandro Orso, Ph.D.
Politechno De Milano
Assistant Professor, Computing

Allen M. Orville, Ph.D.
University of Minnesota
Assistant Professor, Chemistry and Biochemistry

Henry Owen III, Ph.D.
P.E. (Georgia)
Georgia Institute of Technology
Professor, Electrical and Computer Engineering

Krishna Palem, Ph.D.
University of Texas - Austin
Professor, Electrical and Computer Engineering

Ronghua Pan, Ph.D.
Chinese Academy of Sciences
Assistant Professor, Mathematics

Santosh Pande, Ph.D.
North Carolina State University
Associate Professor, Computing

Ioannis Papapolymerou, Ph.D.
University of Michigan - Ann Arbor
Assistant Professor, Electrical and Computer Engineering

John G. Papastavridis, Ph.D.
Purdue University
Associate Professor, Mechanical Engineering

Daniel S. Papp, Ph.D.
University of Miami
Senior Vice Chancellor for Academic Affairs, University System of Georgia, and Professor, International Affairs

Christiaan Jos Jan Paredis, Ph.D.
Carnegie Mellon University
Assistant Professor, Mechanical Engineering

R. Gary Parker, Ph.D.
Kansas State University
Associate Chair for Graduate Studies and Professor, Industrial and Systems Engineering

Charles K. Parsons, Ph.D.
University of Illinois
Professor, Management

Leonard J. Parsons, Ph.D.
Purdue University
Professor, Management

Tim Patterson, Ph.D.
Georgia Institute of Technology
Assistant Professor, Mechanical Engineering

Spyros G. Pavlostathis, Ph.D.
Cornell University
Professor, Civil and Environmental Engineering

Willie Pearson Jr., Ph.D.
Southern Illinois University
School Chair and Professor, History, Technology, and Society

John B. Peatman, Ph.D.
Case Western Reserve University
Professor, Electrical and Computer Engineering

Liang Peng, Ph.D.
Erasmus University
Assistant Professor, Mathematics

Kurt Pennell, Ph.D.
University of Florida
Associate Professor, Civil and Environmental Engineering

John Peponis, Ph.D.
R.A. (Greece)
London University
Professor, Architecture/Doctoral Program, College of Architecture

Edward M. Perdue, Ph.D.
Georgia Institute of Technology
Professor, Earth and Atmospheric Sciences

Joseph W. Perry, Ph.D.
California Institute of Technology
Professor, Chemistry and Biochemistry

Georgia A. Persons, Ph.D.
Massachusetts Institute of Technology
Professor, Public Policy

Andrew F. Peterson, Ph.D.
University of Illinois - Urbana-Champaign
Professor, Electrical and Computer Engineering

Dorcen M. Piano, Ph.D.
Bowling Green University
Instructor, Literature, Communication, and Culture

Jeffrey S. Pierce, Ph.D.
Carnegie Mellon University
Assistant Professor, Computing

Frank Pilipp, Ph.D.
University of North Carolina - Chapel Hill
Professor, Modern Languages

Steven M. Pomer, Ph.D.
University of California - Irvine
Assistant Professor, Biomedical Engineering

Colin Potts, Ph.D.
Sheffield University
Associate Professor, Computing

James C. Powers, Ph.D.
Massachusetts Institute of Technology
Regents' Professor, Chemistry and Biochemistry

J. V. R. Prasad, Ph.D.
Georgia Institute of Technology
Professor, Aerospace Engineering

Mark Prausnitz, Ph.D.
Massachusetts Institute of Technology
Associate Professor, Chemical and Biomolecular Engineering

Amy Pritchett, Ph.D.
Massachusetts Institute of Technology
Associate Professor, Industrial and Systems Engineering

Milos Pryulovic, Ph.D.
University of Illinois - Urbana-Champaign
Assistant Professor, Computing

Calton Pu, Ph.D.
University of Washington
John P. Imlay Jr. Chair and Professor, Computing

Gerald S. Pullman, Ph.D.
University of California - Davis
Professor, Biology

Michael Pustilnik, Ph.D.
Bar Ilan University
Assistant Professor, Physics

Hans B. Püttgen, Ph.D.
University of Florida
Associate Chair, Director of the National Electric Energy Research, Applications and Testing Center, and Georgia Power Professor, Electrical and Computer Engineering

Sara M. Putzell, Ph.D.
Emory University
Associate Professor, Literature, Communication, and Culture

Jianmin Qu, Ph.D.
Northwestern University
Professor, Mechanical Engineering

Harish Radhakrishna, Ph.D.
University of Maryland Baltimore County
Assistant Professor, Biology

Arthur J. Ragauskas, Ph.D.
University of Western Ontario
Associate Professor, Chemistry and Biochemistry

Farzad Rahnema, Ph.D.
University of California - Los Angeles
Associate Chair and Professor, Nuclear Engineering and Health Physics

Stephen E. Ralph, Ph.D.
Cornell University
Associate Professor, Electrical and Computer Engineering

Ashwin Ram, Ph.D.
Yale University
Associate Professor, Computing

Umakishore Ramachandran, Ph.D.
University of Wisconsin – Madison
Professor, Computing

Chandra S. Raman, Ph.D.
University of Michigan - Ann Arbor
Assistant Professor, Physics

Dana Randall, Ph.D.
University of California - Berkeley
Associate Professor, Mathematics and College of Computing

Mary Lynn Realff, Ph.D.
Massachusetts Institute of Technology
Director of Undergraduate Affairs and Associate Professor, Polymer, Textile, and Fiber Engineering

Matthew J. Realff, Ph.D.
Massachusetts Institute of Technology
Associate Professor, Chemical and Biomolecular Engineering

Kevin Reeder, M.A.
Stanford University
Assistant Professor, Industrial Design Program, College of Architecture

William S. Rees, Ph.D.
University of California - Los Angeles
Professor, Materials Science and Engineering

James Matthew Rehg, Ph.D.
Carnegie Mellon University
Associate Professor, Computing

Spyros Reveliotis, Ph.D.
University of Illinois - Urbana-Champaign
Associate Professor, Industrial and Systems Engineering

William T. Rhodes, Ph.D.
Stanford University
Professor, Electrical and Computer Engineering

Elisa Riedo, Ph.D.
University of Milan
Assistant Professor, Physics

Christine P. Ries, Ph.D.
University of Chicago
Professor, Economics

George E. Riley, Ph.D.
Georgia Institute of Technology
Assistant Professor, Electrical and Computer Engineering

Gabriel A. Rincon-Mora, Ph.D.
Georgia Institute of Technology
Assistant Professor, Electrical and Computer Engineering

David A. Ringholz, M.A.
North Carolina State University
Assistant Professor, Industrial Design Program, College of Architecture

Glenn J. Rix, Ph.D.
University of Texas - Austin
Associate Professor, Civil and Environmental Engineering

Greg Robbins, Ph.D.
Columbia University
Assistant Professor, Management

Philip J. W. Roberts, Ph.D.
California Institute of Technology
Professor, Civil and Environmental Engineering

David Robertson, Ph.D.
University of Wisconsin
Assistant Professor, Psychology

Juan Rogers, Ph.D.
Virginia Polytechnic Institute and State University
Associate Professor, Public Policy

Peter H. Rogers, Ph.D.
Brown University
Rae and Frank H. Neely Professorship and Professor, Mechanical Engineering

Wendy A. Rogers, Ph.D.
Georgia Institute of Technology
Associate Chair and Professor, Psychology

Ajeet Rohatgi, Ph.D.
Lehigh University
Georgia Power Distinguished Professor, Director of the University Center of Excellence for Photo Voltaics Research and Education and Regents' Professor, Electrical and Computer Engineering

Howard A. Rollins Jr., Ph.D.
University of California - Los Angeles
Director of International Education and Professor, Psychology

Kathy O. Roper, M.S.
Georgia State University
Assistant Professor, Building Construction Program, College of Architecture

David W. Rosen, Ph.D.
University of Massachusetts - Amherst
Professor, Mechanical Engineering

Catherine B. Ross, Ph.D.
Cornell University
Professor, City Planning Program, College of Architecture

Sue V. Rosser, Ph.D.
University of Wisconsin - Madison
Dean, Ivan Allen College, and Professor, History, Technology, and Society

Jarek Rossignac, Ph.D.
University of Rochester
Professor, Computing

Frank T. Rothaermel, Ph.D.
University of Washington
Assistant Professor, Management

William Rouse, Ph.D.
Massachusetts Institute of Technology
H. Milton and Carolyn J. Stewart School Chair and Professor, Industrial and Systems Engineering

Ronald W. Rousseau, Ph.D.
P.E. (North Carolina)
Louisiana State University
Cecil J. "Pete" Silas Chair, School Chair and Professor, Chemical and Biomolecular Engineering

Charles Rudolph, M.B.D.
Columbia University
Associate Professor, Architecture Program, College of Architecture

Stephen M. Ruffin, Ph.D.
Stanford University
Associate Professor, Aerospace Engineering

Carolyn D. Ruppel, Ph.D.
Massachusetts Institute of Technology
Associate Professor, Earth and Atmospheric Sciences

Armistead (Ted) Russell, Ph.D.
California Institute of Technology
Georgia Power Chaired Professor and Professor, Civil and Environmental Engineering

William Russell, M.S.
University of Illinois - Urbana-Champaign
Assistant Professor, College of Architecture

Massimo Ruzzene, Ph.D.
Politecnico di Torino
Assistant Professor, Aerospace Engineering

Carlos Sa de Melo, Ph.D.
Stanford University
Associate Professor, Physics

Ashraf S. Saad, Ph.D.
Vanderbilt University
Associate Professor, Regional Engineering Program

Michael D. Sacks, Ph.D.
University of California - Berkeley
Professor, Materials Science and Engineering

Nader Sadegh, Ph.D.
University of California - Berkeley
Associate Professor, Mechanical Engineering

Saeid Sadri, Ph.D.
Georgia Institute of Technology
Assistant Professor, Building Construction Program, College of Architecture

Francois Sainfort, Ph.D.
Ecole Centrale Paris
Professor, Industrial and Systems Engineering

Richard F. Salant, Sc.D.
Massachusetts Institute of Technology
Georgia Power Professor, Mechanical Engineering

Michael D. Salomone, Ph.D.
University of Pittsburgh
Professor, International Affairs

Athanassios Sambanis, Ph.D.
University of Minnesota
Professor, Chemical and Biomolecular Engineering

Bhaven N. Sampat, Ph.D.
Columbia University
Assistant Professor, Public Policy

Thomas H. B. Sanders Jr., Ph.D.
Georgia Institute of Technology
Regents' Professor, Materials Science and Engineering

Kenneth H. Sandhage, Ph.D.
Massachusetts Institute of Technology
Professor, Materials Science and Engineering

N. L. Sankar, Ph.D.
Georgia Institute of Technology
Regents' Professor, Aerospace Engineering

Carlos Santamarina, Ph.D.
Purdue University
Roberto C. Goizueta Professor, Civil and Environmental Engineering

E Michael Saunders, Ph.D.
P.E. (Georgia)
University of Illinois
Professor, Civil and Environmental Engineering

Mathieu W. Savelsbergh, Ph.D.
Erasmus University
Professor, Industrial and Systems Engineering

David S. Sawicki, Ph.D.
Cornell University
Professor, City Planning Program, College of Architecture and Public Policy

Michael F. Schatz, Ph.D.
University of Texas
Associate Professor, Physics

David E. Schimmel, Ph.D.
Cornell University
Associate Professor, Electrical and Computer Engineering

Jonathan Schneer, Ph.D.
Columbia University
Professor, History, Technology, and Society

Arnold Schneider, Ph.D.
C.P.A.
The Ohio State University
Associate Professor, Management

F. Joseph Schork, Ph.D.
P.E. (Georgia)
University of Wisconsin
Associate Chair and Professor, Chemical and Biomolecular Engineering

Daniel Schrage, D.Sc.
Washington University - St. Louis
Director, Center of Excellence in Rotorcraft Technology and Professor, Aerospace Engineering

Gary B. Schuster, Ph.D.
University of Rochester
Dean, College of Sciences, Vasser Woolley Chair, and Professor, Chemistry and Biochemistry

Karsten Schwans, Ph.D.
Carnegie Mellon University
Professor, Computing

David W. Scott, Ph.D.
Georgia Institute of Technology
Assistant Professor, Regional Engineering Program

Waymond R. Scott Jr., Ph.D.
P.E. (Georgia)
Georgia Institute of Technology
Professor, Electrical and Computer Engineering

Jerry M. Seitzman, Ph.D.
Stanford University
Associate Professor, Aerospace Engineering

Carol A. Senf, Ph.D.
State University of New York - Buffalo
Associate Professor, Literature, Communication, and Culture

Richard F. Serfozo, Ph.D.
Northwestern University
Professor, Industrial and Systems Engineering

Marion B. Sewer, Ph.D.
Emory University
Assistant Professor, Biology

Xin Wei Sha, Ph.D.
Stanford University
Assistant Professor, Literature, Communication, and Culture

Christina Shalley, Ph.D.
University of Illinois
Professor, Management

Philip Shapira, Ph.D.
University of California - Berkeley
Professor, Public Policy

Alexander Shapiro, Ph.D.
Ben-Gurion University of the Negev
Professor, Industrial and Systems Engineering

Gunter P. Sharp, Ph.D.
P.E. (Georgia)
Georgia Institute of Technology
Associate Professor, Industrial and Systems Engineering

Samuel V. Shelton, Ph.D.
Georgia Institute of Technology
Associate Professor, Mechanical Engineering

C. David Sherrill, Ph.D.
University of Georgia
Assistant Professor, Chemistry and Biochemistry

Rumiko Shinzato-Simonds, Ph.D.
University of Hawaii
Professor, Modern Languages

Olin Shivers, Ph.D.
Carnegie Mellon University
Associate Professor, Computing

David J. Shook, Ph.D.
University of Illinois
Associate Professor, Modern Languages

Tina M. Simonton, M.F.A
Massachusetts College of Art
Assistant Professor, Architecture Program, College of Architecture

Anurag Singh, Ph.D.
University of Michigan - Ann Arbor
Assistant Professor, Mathematics

Preet M. Singh, Ph.D.
University of Newcastle
Associate Professor, Materials Science and Engineering

Vinod R. Singhal, Ph.D.
University of Rochester
Professor, Management

William E. Singhose, Ph.D.
Massachusetts Institute of Technology
Assistant Professor, Mechanical Engineering

Suresh K. Sitaraman, Ph.D.
The Ohio State University
Professor, Mechanical Engineering

Raghuprthy Sivakumar, Ph.D.
University of Illinois - Urbana-Champaign
Assistant Professor, Electrical and Computer Engineering

Oskar Skrinjar, Ph.D.
Yale University
Assistant Professor, Biomedical Engineering

Ioannis Smaragdakis, Ph.D.
University of Texas - Austin
Assistant Professor, Computing

Anderson D. Smith, Ph.D.
University of Virginia
Associate Dean, College of Sciences and Regents' Professor, Psychology

David M. Smith, M.S.
Imperial College - London
Lecturer, Computing

Glenn S. Smith, Ph.D.
Harvard University
Pippin Chair in Electromagnetics and Regents' Professor, Electrical and Computer Engineering

Marc K. Smith, Ph.D.
Northwestern University
Professor, Mechanical Engineering

Marilyn J. Smith, Ph.D.
Georgia Institute of Technology
Associate Professor, Aerospace Engineering

Thomas P. Smith, M.A.
University of South Florida
Instructor, Literature, Communication, and Culture

Terry W. Snell, Ph.D.
University of South Florida
Professor, Biology

Robert L. Snyder, Ph.D.
Fordham University
School Chair and Professor, Materials Science and Engineering

Patricia A. Sobecky, Ph.D.
University of Georgia
Associate Professor, Biology

Joel Sokol, Ph.D.
Massachusetts Institute of Technology
Assistant Professor, Industrial and Systems Engineering

Irina N. Sokolik, Ph.D.
Academy Science USSR
Professor, Earth and Atmospheric Sciences

Minjae Song, Ph.D.
Harvard University
Assistant Professor, Economics

Yun Song, Ph.D.
Stanford University
Assistant Professor, Biology

Samit Soni, Ph.D.
Universty of Texas- Dallas
Assistant Professor, Management

Fotis Sotiropoulos, Ph.D.
University of Cincinnati
Associate Professor, Civil and Environmental Engineering

Phillip B. Sparling, Ed.D.
University of Georgia
Professor, Applied Physiology

Robert Speyer, Ph.D.
University of Illinois - Urbana-Champaign
Andrew T. Hunt School Chair and Professor, Materials Science and Engineering

Daniel H. Spieler, Ph.D.
Washington State University
Assistant Professor, Psychology

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Rice University
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University of Texas - Austin
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University of Massachusetts
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California Institute of Technology
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University of Illinois - Urbana-Champaign
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