The Georgia Institute of Technology

A UNIT OF THE UNIVERSITY SYSTEM OF GEORGIA

GENERAL CATALOG

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AND ANNOUNCEMENTS

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DEGREES

The Georgia Institute of Technology at present offers curricula leading to the following degrees which are shown in the order of the establishment of the school in which the work is given:

Undergraduate Degrees

Bachelor of Mechanical Engineering
Bachelor of Electrical Engineering
Bachelor of Civil Engineering
Bachelor of Textile Engineering
*Bachelor of Science in Textile Chemistry
Bachelor of Science in Textiles
Bachelor of Chemical Engineering
Bachelor of Science in Chemistry
*Bachelor of Architecture
Bachelor of Ceramic Engineering
Bachelor of Aerospace Engineering
Bachelor of Science in Industrial Management
Bachelor of Science in Physics
Bachelor of Industrial Engineering
Bachelor of Science in Applied Mathematics
*Bachelor of Science in Building Construction
*Bachelor of Science in Industrial Design
Bachelor of Engineering Science
Bachelor of Science in Applied Psychology
Bachelor of Science in Applied Biology
Bachelor of Science in General Management
Bachelor of Science in Behavioral Management
Bachelor of Science in Management Sciences
Bachelor of Science in Economics

To graduates who have completed their courses under the Cooperative Plan, the degree is awarded with the designation "Cooperative Plan."

Graduate Degrees

The degree of Master of Science (with or without designation) is offered in all fields shown above (with the exception of those marked*) and also in:

Engineering Mechanics
Geophysical Sciences
Information Science
Metallurgy
Nuclear Engineering
Nuclear Science
Sanitary Engineering

Also Offered are the degrees:

- Master of Architecture
- Master of City Planning

The degree of Doctor of Philosophy is offered in:

- Aerospace Engineering
- Chemical Engineering
- Chemistry
- Civil Engineering
- Economics
- Electrical Engineering
- Engineering Mechanics
- Industrial Engineering
- Industrial Management
- Information Science
- Mathematics
- Mechanical Engineering
- Nuclear Engineering
- Physics
- Psychology
- Sanitary Engineering

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1971

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TENTATIVE CALENDAR 1971-72*

Summer Quarter 1971

June	24	Registration.
July	5	Holiday.
Sept.	7	End of term.

*An official school calendar is published prior to the beginning of each quarter. Students should refer to this official calendar for changes.

Fall Quarter 1971

Sept.	16	Registration.
Nov.	25	Begin Thanksgiving recess.
Nov.	28	Last Day of Thanksgiving recess.
Dec.	8	End of term.
Dec.	9	Begin Christmas recess.
Jan.	2	Last day of Christmas recess.

Winter Quarter 1972

Jan.	3	Registration.
Mar.	16	End of term.
Mar.	17	Begin Spring recess.
Mar.	22	Last day of Spring recess.

Spring Quarter 1972

Mar.	23	Registration.
June	6	End of term.

Summer Quarter 1972

June	19	Registration.
Sept.	1	End of term.

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Nathan T. Pierce, M.S., *Counselor*

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Raymond S. Gent, *Housing Business Manager*
Izear Feagins, Jr., B.S., *Housing Operations & Activities Coordinator*
Rudy F. Xavier, II, M.A., *Housing Staff Coordinator*
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Irma J. Morris, *Senior Clerk, Married Student Housing*

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Rex W. Allen, A.B., *House Coordinator*
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Pete S. Matrangos, B.F.A., *Arts-Crafts Coordinator*
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David O. Savini, B.Arch., *Campus Architect*
C. William King, M.L.A., *Campus Landscape Architect*
John B. Hayes, *Institutional Planner*
Carol A. Wood, *Principal Secretary*
Ann F. Edwards, *Senior Secretary*

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Marjorie H. Martin, *Administrative Assistant*

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M. M. Coppenger, *Captain*
Marcelle Simpson, *Senior Clerk*

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Robert L. Dodd, Athletic Director

WGST RADIO STATION

Jack Collins, *General Manager*

GENERAL INFORMATION

The Georgia Institute of Technology, founded in 1885, is a four-year, co-educational institution of higher learning located in the heart of Atlanta, Georgia. Master's and doctorate programs are also offered in many fields. Nationally prominent for education and research in engineering, science, architecture and management, Georgia Tech is also famous for its colorful traditions–the Ramblin' Wreck parade and the school song by the same name, football, and hard-working students who also approach play with zest and ingenuity. Georgia Tech alumni support is consistently among the strongest in the nation for public institutions.

The Institute operates on the quarter plan with the fall, winter, and spring quarters normally constituting the academic year. A summer quarter is also offered, and many students accelerate their program by attending four quarters per year. The requirements for a degree may be completed at the end of any quarter.

Because of the heavier workload associated with technological education in this country, the average student takes fourteen (14) quarters to complete the four-academic-year or twelve (12)-quarter curricula at Georgia Tech. Many students prefer to attend one or more summer sessions in order to obtain the greatest benefit from their educational program while fulfilling the requirements for graduation in the four-year period. Georgia Tech recommends that students plan to attend a summer session and reduce their academic load.

Courses are offered in Aerospace, Ceramic, Chemical, Civil, Electrical, Industrial & Systems, Mechanical, and Textile Engineering; Engineering Science and Mechanics; Applied Biology; Applied Mathematics; Applied Psychology; Architecture; Building Construction; Industrial Design; Chemistry; Physics; Industrial Management; Textile Chemistry; and Textiles. The curricula in these various fields are listed on the following pages and work submitted for credit must be checked against these basic requirements.

The Georgia Institute of Technology is a member of the Southern Association of Colleges and Schools. As such, it is accredited by this Association.

All of the four-year engineering curricula leading to bachelor's degrees in engineering and the five-year program leading to a master's degree in Sanitary Engineering are accredited by the Engineers' Council for Professional Development, which is the national engineering accrediting agency.

The curriculum leading to the degree Bachelor of Architecture is accredited by the National Architectural Accrediting Board.

The curriculum leading to the B.S. in Chemistry degree is accredited by the American Chemical Society.

ADMISSION REQUIREMENTS

For any information regarding admission to Georgia Tech, write to the Director of Admissions, Georgia Tech, Atlanta, Georgia 30332. Both freshmen and transfer students are accepted for all four academic quarters which begin in September, January, March, and June.

It is advisable for candidates to the freshman class to make application not earlier than one year or later than six months prior to the date of the beginning of the quarter for which applying. Transfer students must have all required credentials on file in the Office of Admissions within twenty days of the date of the beginning of the quarter for which applying.

Georgia Tech reserves the right to refuse to accept an application at any time when it appears that students already accepted will fill the Institute to its maximum capacity. The Institute also reserves the right to reject an applicant who is not a resident of the State of Georgia.

The single most important criterion of any decision of acceptance is the probability of the applicant's completing the requirements for the desired degree. The Institute reserves the right, in every case, to reject any applicant whose over-all credentials do not indicate a probability of success, notwithstanding the satisfaction of other requirements. Applicants must comply with such other procedures, including personal interviews and psychological or other tests, as may be necessary to determine the applicant's general fitness for admission. If an interview is required, the Director of Admissions will notify the applicant of the time and place at which the interview will be conducted.

The decision as to whether an applicant shall be accepted or rejected will be made by the Director of Admissions, subject to the applicant's right of appeal as provided by the bylaws of the Institute of the Board of Regents of the University System.

FRESHMEN

Course Requirements

Students who are considering Georgia Tech should be sure to plan their high school schedules to include the following required courses:

ENGINEERING-SCIENCE		ARCHITECTURE		INDUSTRIAL MANAGEMENT	
English	4	English	4	English	4
Algebra	2	Algebra	2	Algebra	2
Plane Geometry	1	Geometry	1	Geometry	1
Advanced Algebra	½*	Advanced Algebra	½*	Science	2
Trigonometry	½	Trigonometry	½	History	1
Chemistry	1	Science	2		
Physics	1	History	1		
History	1				

*Elementary functions, mathematical analysis, or analytical geometry are acceptable substitutes. Solid Geometry is NOT an acceptable substitute. An outline of topics is available upon request.

Language is not required for entry to Georgia Tech, but at least two years of a modern language is recommended. Extra courses in mathematics and science are recommended. A course in mechanical drawing and one in typing also prove beneficial if they can conveniently be scheduled. The total number of high school units completed should be sufficient to insure graduation under local requirements. Students unable to schedule required courses should write to the Director of Admissions for information regarding ways of making up missing high school credits.

The Institute reserves the right to reject the credits from any high school or other institution notwithstanding its accredited status, where the Institute determines from investigation that the quality of instruction available at such high school or institution is for any reason deficient or unsatisfactory.

College Board Test Requirements

All applicants for admission in Engineering, Science, and Mathematics are required to take the Scholastic Aptitude Tests and three Achievement Tests, English, mathematics (Level I or II), and chemistry or physics. Majors in Architecture and Industrial Management may omit the Achievement Test in chemistry or physics.

Dates the tests are offered during the 1971-72 school year are as follows:

November 6, 1971 (SAT only)
December 4, 1971
January 8, 1972
March 4, 1972
April 15, 1972 (SAT only)
May 6, 1972 (Achievement Tests only)
July 8, 1972

It is recommended that the Scholastic Aptitude Tests be scheduled in November or December and the Achievement Tests in December or January. It is *not* recommended that both tests be taken on the same testing date. No applicant should schedule the SAT later than the March test date nor the Achievement Tests later than the May test date.

High school counselors can provide application blanks for the tests, or they can be obtained by writing the College Examination Board, P. O. Box 592, Princeton, New Jersey 08540.

Criteria for Selection of Students

Admission is selective, and the following criteria are used in the selection process:

A. *Major*

(1) Graduation from an accredited high school (2) Overall high school grades (3) Results of College Board SAT tests (4) Recommendations of principals, counselors, teachers.

B. *Minor*

(1) Results of interview if required to establish qualifications of applicant (2) Results of College Board Achievement Tests (3) Results of additional tests (4) Honors and advanced course work (5) Trend in academic performance (6) Type of high school attending (7) Percent of college-bound students in school attending (8) Residency (9) Relationship to Georgia Tech alumni (10) Activities and leadership in school and community (11) Any other factor that applies to an individual situation.

Admission Decision

In order for an admission decision to be made, the following items must be submitted to complete the application file:

1. *Application for Admission*—It is recommended that the complete application be given to the high school and mailed to the Admissions Office with the transcript. Co-operative student applicants must file an additional "Application for Co-operative Courses." *No application fee is required.*
2. *High School Transcript*—It must cover the first three years of high school with student's senior year schedule indicated by semesters. A school may use its own standard transcript form rather than the form provided. This is acceptable to Georgia Tech, if the substituted form shows the applicant's rank in class, grading system, accredited status of the school, and any honors or advanced courses completed.
3. *Scholastic Aptitude Test Results*—Applicants should make certain that a copy of the scores be sent to Georgia Tech from Princeton, New Jersey. Reproductions of scores received by the high school are also acceptable.

Admission Notification

After the Office of Admissions has received the application for admission, school transcript, and SAT scores, evaluation and action on an application will be possible. Approximately one month to five weeks should be allowed for the College Board to score and report test results to the college. Applications are not reviewed in any special order, such as alphabetically or by major requested, so it is most likely that friends or classmates will receive their admission action letter at different times.

Applicants who indicate a preference for the Co-operative Plan on the application for admission will be mailed an "Application for Co-operative Courses." This must be received before consideration for admission can be given. Co-operative Plan applicants will not be processed as rapidly as standard applications.

Applications for financial assistance awarded by Georgia Tech can be obtained by writing to the Office of Student Financial Aid, and the required

College Scholarship Service forms can be obtained from the high school. Financial Aid awards are made between March and May.

NROTC Scholarship notifications will be sent as soon as Georgia Tech receives the certified list of candidates from the Department of the Navy. This usually occurs in April.

Failure to file any of the above material, or failure to respond promptly to requests for further information will invariably delay the processing of an application.

Advanced Placement and Honors Programs

Superior students entering Georgia Tech may receive college credit for courses completed in high school if their grades and scores on the advanced placement tests or the achievement tests of the College Board indicate a satisfactory knowledge of college course work. Advanced placement and credit are offered by the School of Mathematics and Departments of English and Social Sciences on the basis of Advanced Placement Test results of the College Board Advanced Placement Program. Advanced sectioning is possible in the School of Chemistry. An honors program is offered in the School of Mathematics. Participation in the advanced placement and honors programs is voluntary.

Pre-Med—Pre-Dental—Pre-Law Programs

Pre-med, pre-dental, and pre-law programs are all offered at Georgia Tech. None of these are specified as degree programs as such but if a student takes the proper courses from the various Tech curriculums, these objectives can certainly be met.

A major may be declared in almost any engineering or science area for pre-medical or pre-dental, and in almost any engineering or management area for pre-law.

Commonly, if one wants to obtain a pre-med or pre-dental background, a major in Biology is declared. The courses taken routinely in the first three years in Biology include all of the courses listed in *Medical School Admissions Requirements, USA and Canada,* published by the Association of American Medical Colleges. Other quite logical majors for pre-med and pre-dental are Chemistry, Chemical Engineering, Physics, and Psychology.

To obtain a pre-law background, a bachelor's degree in Industrial Engineering or Industrial Management would be most acceptable.

One should check with the graduate school in medicine, dentistry, or law that he hopes to enter for any specific course requirements that might be peculiar to that particular institution.

Early Admission of High School Juniors

Under exceptional circumstances, students may be admitted to the Institute at the end of their junior year. These students must have outstanding records in college preparatory subjects and must have completed all course requirements under a regular admission with the single exception of a fourth year of English. The student must present all College Board Tests results as regularly required. In addition, the Office of Admissions must receive a letter of recommendation from the high school principal or guidance counselor.

Acceptance Deposit

It is mandatory for all admitted applicants to make such deposits (acceptance and/or dormitory) as required on the letter of admission.

Health Information Record

Each admitted student will be required to submit a Health Information Record form which will be sent with the notice of acceptance.

Health Information Record forms are mailed to students with the notice of their acceptance for enrollment. These forms are to be completed by the prospective student and his parents or guardians and mailed to the Director of Health in sufficient time to be received prior to the date of initial registration. After review of the Health Information Record, the school physicians shall determine the qualifications for Physical Training. Any student who desires special consideration because of mental or physical disability should have his physician write an explanatory letter to the Director of Health giving full details of the disability and any desired limitations on physical activity. This letter is to be attached to the Health Information Record. Any special examination or reports needed to determine eligibility for enrollment or assignment are at the expense of the student, not the school.

Readmissions

Georgia Tech students who find it necessary to discontinue enrollment for one or more quarters, with the exception of a summer quarter, must apply for readmission when planning to return to the Institute. An application for readmission may be obtained from the Office of the Registrar and must be completed and returned at least 20 calendar days prior to the beginning of the quarter to which readmission is sought.

TRANSFER STUDENTS

General Regulations

Applicants who have made satisfactory records in scholarship and in conduct at other colleges may be considered for admission with advanced standing. Courses completed in other colleges must have an over-all average of "C" or better, and grades must be satisfactory for the last term prior to transferring.

The basic policy regarding the acceptance of courses by transfer is to usually allow credit for courses completed with satisfactory grades in other accredited colleges providing the courses correspond in time and content to courses offered at the Georgia Institute of Technology. It is ordinarily impossible to give an official statement regarding transfer credit unless the student has an interview with the departments or schools concerned at Georgia Tech where credit is anticipated. The student should bring a catalog from all previous colleges plus information on texts used, authors, and chapters covered. Transfer credit from a non-accredited institution is not normally allowed, and an application from a student attending such a college is discouraged and usually disapproved by the Committee on Admissions. Courses used as credits for a degree must have been completed in a period of ten years, counting from the time the first credits were acquired until the time all requirements for a degree have been met. Courses not falling within this time limit may be validated by examination. Transfer students should realize that credits six or more years old at the time of transferring are in danger of being voided by this regulation.

Transfer students who desire to enter the School of Architecture are generally confronted with a difficult problem due to the highly specialized nature of the curriculum in this school, which starts with the first quarter of the freshman year. The specialized sequence of courses involved usually results in five additional years from the point of transfer to obtain a bachelor's degree in Architecture. These courses are not ordinarily obtainable in another college unless it also has an Architecture School.

Transfer students should be prepared to meet their own expenses, since financial assistance for such students is extremely limited.

Veterans should submit a copy of the form DD214 for their period of service in order to receive credit in physical training and military.

Application Procedures

A student transferring from another college must request the Registrar of all colleges previously attended to send official transcripts to the Director of Admissions for evaluation. A transcript of high school work is ordinarily required to establish the academic background of the applicant.

Transfer students must submit scores from the Scholastic Aptitude Test of the College Entrance Examination Board. Information and applications to schedule the required tests may be obtained from the Educational Testing Service, Box 592, Princeton, New Jersey 08540.

An admission decision is determined and forwarded to the applicant as soon as possible after his file is complete.

TRANSIENT STUDENTS

A student who has taken work in another college or university may apply for the privilege of temporary registration in Georgia Tech. Such registration is generally for the summer quarter and the student will ordinarily be one who expects to return to the institution in which previously enrolled.

A transient student may be admitted on the receipt of a statement of permission and good standing from the Dean or Registrar of the institution last attended and where the applicant expects to return for further studies.

SPECIAL STUDENTS

Students in special situations, such as one who holds a bachelor's degree but needs to complete certain undergraduate prerequisite courses in order to be granted full graduate status, may be admitted on receipt of a transcript sent from the institution from which the bachelor's degree was obtained.

Students in this category are not considered as degree candidates but may be required to meet all requirements prescribed for admission to regular student status and meet any additional requirements that may be prescribed by the Institute.

GRADUATE STUDENTS

All correspondence relative to admission to graduate study should be directed to the Dean, Division of Graduate Studies and Research. Necessary application forms may be obtained from his office. These forms, together with letters of recommendation and official transcripts of previous academic work, should be on file in the Office of the Dean at least four weeks before the beginning of the quarter for which the applicant plans to register if he is to be assured consideration for acceptance. The Graduate Bulletin may be obtained on request.

AUDITORS

Any officially enrolled student who has obtained the approval of his adviser and the departments of instruction concerned may audit courses. However, no credit is granted for courses scheduled on an auditing basis, and students are not permitted to change to or from an auditing status except through the regular procedures for schedule changes and during the period for changes as published in the college calendar for each given quarter.

All students registered as auditors are required to pay tuition at the regular rate.

Members of the faculty or staff of the Georgia Institute of Technology may sit in on a course providing permission is obtained from the Department concerned and the Registrar.

ADMISSION OF WOMEN

By action of the Board of Regents, December 13, 1967, qualified women students were ruled eligible for admission in all programs of study offered at Georgia Tech. The requirements for admission and the regulations governing students apply alike to men and women except that women students will not be required to schedule physical training and will not have to make up the credit hours.

VETERANS' PROGRAM

Any veteran desiring to further his education under veterans' benefits at the Georgia Institute of Technology should first be accepted as a student of Georgia Tech by the Director of Admissions. This acceptance has no direct connection whatsoever with the Veterans' Administration. After being accepted by Georgia Tech, the new veteran student must secure from the Registrar instructions on how to register on registration day. The veteran who is a resident of Georgia will pay resident fee costs, and the veteran who is a resident of another state will pay non-resident fee costs.

At least one month before entering Georgia Tech, any student who plans to enroll under Public Law 634 (War Orphans Educational Assistance for Sons and Daughters of Deceased Veterans); Public Law 894 (Disabled Veterans' Bill); or Public Law 89-358 (Post-Korean Bill), should go in person to the nearest Veterans' Administration to make application. After the Veterans' Administration has issued a certificate of eligibility, any questions regarding procedure for enrolling under one of these bills should be directed to the Director of Financial Aid located in the Administration Building on the Georgia Tech campus.

THE 3-2 PLAN OF ENGINEERING EDUCATION

With more and more engineers occupying positions of leadership in the business, manufacturing, and governmental fields, there has developed a need for a plan of engineering education that will provide a broader base on which to build more courses in liberal arts than is possible under the regular engineering curriculum. Recognizing this need, the Georgia Institute of Technology has arranged a combined plan with a limited number of outstanding liberal arts colleges in the South to offer to qualified prospective engineers a more complete and well-rounded form of training for the world of today and tomorrow.

Under this plan the student may attend one of these liberal arts colleges for three years and then one of the nine engineering schools of the Georgia Institute of Technology for two years. Upon satisfactory completion of his two years at the school of engineering, he is eligible for the appropriate bachelor's degree from his original college and the bachelor of engineering in his particular field from the Georgia Institute of Technology.

Colleges and universities associated with the Georgia Institute of Technology in offering the 3-2 Plan of Engineering Education include *The Atlanta University Center* (Morehouse, Clark and Morris Brown Colleges), Atlanta, Georgia; *Davidson College,* Davidson, North Carolina; *Southwestern at Memphis,* Memphis, Tennessee; *The University of Tennessee at Chattanooga,* Chattanooga, Tennessee; *The University of Georgia,* Athens, Georgia; *The University of The South,* Sewanee, Tennessee; and *West Georgia College,* Carrollton, Georgia. For further information, write to the Director of Admissions of the particular institution in which interested.

INTERNATIONAL STUDENTS

The number of international students enrolled at Georgia Tech is one of the largest of any engineering and scientific college in the United States.

The applicant must be eligible for admission to a first-rank university in his home country. Average performance is not enough. To be accepted the applicant must be among the best in his class, with high grades made in school subjects and on the examinations given by the Ministry of Education or similar agency where national examinations are available.

In addition to meeting the regular admissions requirements, prospective foreign students must demonstrate proficiency in the English language by taking the Test of English as a Foreign Language (TOEFL).

A special information pamphlet for foreign students is available upon request which indicates the application procedures for both undergraduate freshmen and transfers and other basic information helpful to applicants from other countries.

DEFINITION OF LEGAL RESIDENCE

To be considered a legal resident of Georgia for the purpose of registering at an institution of the University System of Georgia, a student must establish the following facts to the satisfaction of the Residence Committee of that institution:

1. A student who is under 21 years of age at the time he seeks to register or re-register at the beginning of any quarter will be accepted as a resident student only upon a showing by him that his supporting parent or guardian has been legally domiciled in Georgia for a period of at least twelve months immediately preceding the date of registration or re-registration.
2. In the event that a legal resident of Georgia is appointed as guardian of a non-resident minor, such minor will not be permitted to register as a resident student until the expiration of one year from the date of appointment, and then only upon proper showing that such appointment was not made to avoid payment of the non-resident fee.
3. If a student is over 21 years of age, he may register as a resident student only upon a showing that he has been domiciled in Georgia for at least twelve months prior to the registration date.

   Any period of time during which a person is enrolled as a student in any educational institution in Georgia may not be counted as a part of the twelve months' domicile and residence herein required when it appears that the student came into the State and remained in the State for the primary purpose of attending a school.
4. A full-time faculty member of the University System, his or her spouse, and minor children may register on the payment of resident fees, even

though such faculty member has not been a resident in Georgia for twelve months.

5. If the parents or legal guardian of a minor changes residence to another state following a period of residence in Georgia, the minor may continue to take courses for a period of twelve consecutive months on the payment of resident fees. After the expiration of the twelve months' period the student may continue his registration only upon the payment of fees at the non-resident rate.
6. Military personnel and their dependents may become eligible to enroll in institutions of the University System as resident students provided they file with the institution in which they wish to enroll the following:
   (a) A statement from the appropriate military official showing that the applicant's "home of record" is the State of Georgia; and
   (b) Evidence that applicant is registered to vote in Georgia; or
   (c) Evidence that applicant, if under 18 years of age, is the child of parents who are registered to vote in Georgia; and
   (d) Evidence that applicant, or his supporting parent or guardian, filed a Georgia State income tax return during the preceding year.
7. Foreign students who attend institutions of the University System under sponsorship of civic or religious groups located in this state, may be enrolled upon the payment of resident fees, provided the number of such foreign students in any one institution does not exceed the quota approved by the Board of Regents for that institution.
8. All aliens shall be classified as non-resident students; provided, however, that an alien who is living in this country under a visa permitting permanent residence or who has filed with the proper federal immigration authorities a Declaration of Intention to become a citizen of the United States shall have the same privilege of qualifying for resident status for fee purposes as has a citizen of the United States.
9. Teachers in the public schools of Georgia and their dependents may enroll as students in University System institutions on the payment of resident fees, when it appears that such teachers have resided in Georgia for nine months, that they were engaged in teaching during such nine months' period, and that they have been employed to teach in Georgia during the ensuing school year.
10. If a woman who is a resident of Georgia and who is a student in an institution of the University System marries a non-resident of the State, she may continue to attend the institution on payment of resident fees, provided that her enrollment is continuous.

11. If a woman who is a non-resident of Georgia marries a man who is a resident of Georgia, she will not be eligible to register as a resident student in a University System institution until she has been domiciled in the State of Georgia for a period of twelve months immediately preceding the date of registration.
12. Non-resident graduate students who hold assistantships that require at least one-third time service may register as students in the institution in which they are employed on payment of resident fees.

PLEASE NOTE: In order to avoid delay and inconvenience upon arrival for registration, if there is any question in your mind concerning your residence status, application for clarification should be made immediately or not later than one month prior to the registration date. Applications should be addressed to Residence Committee, Georgia Institute of Technology, Atlanta, Georgia 30332.

TUITION AND FEES

	Resident of Georgia	**Non-Resident of Georgia**
FEES:		
Matriculation	$135	$135
Non Resident	0	235
Student Activity Fee	18	18
Health Service Fee	15	15
	$168	$403
BOOKS AND SUPPLIES:	$50	$50
ROOM RENT:	$87-97-117**	$87-97-117**
BOARD:	$190-220	$190-220
PERSONAL EXPENSES: (clothing, laundry, recreation, etc.)	$150	$150
TOTAL PER QUARTER	$645-705	$880-940
TOTAL PER YEAR (3 quarters)	$1935-2115	$2640-2820
TOTAL PER YEAR (2 quarters)– For Co-op Students in school 2 quarters instead of 3	$1290-1410	$1760-1880
ADDITIONAL FRESHMEN EXPENSES:		
(First quarter) ROTC Uniform Deposit	$25	$25
Slide Rule, Drawing Supplies, etc. (In addition to quarterly costs)	$100	$100

TOTAL PER YEAR– FRESHMAN ONLY	$2060-2240	$2765-2945

**Dormitory Room Rent is normally: $ 87 for Freshmen
$ 97 for Sophomores
$117 for Seniors, Graduate Students, and Coeds.

The actual amount depends upon dormitory assignment.

NOTE: (a) The above expenses do not include fraternity, club dues or transportation expenses.

(b) Since changes may occur without notice, the student must refer to information provided on registration day by the Office of the Vice President for Business and Finance for official amounts on fees and other institutional charges for each individual quarter.

(c) An extra fee may be charged in special courses.

(d) A deposit of $25.00 (in addition to the $25.00 dormitory room deposit mentioned on page 34) is required of each accepted applicant for admission to the Fall Quarter as required in the letter of admission. Approximately two weeks following registration, this deposit will be refunded to the student by check mailed to his campus post office box.

(e) Any student who withdraws during the first quarter of his attendance shall have his admission deposit deducted before any computation is made of the refund to which he may be entitled.

Other Fees

Each person receiving a diploma must pay a diploma fee of $8.00 before graduating. A candidate for the doctor's degree must pay a charge of $25.00 for microfilming his dissertation and depositing it with the University Microfilms Service.

Examinations at other than regular examination times will be granted in exceptional cases only and by Faculty action. A fee of $2.00 will be charged in all such cases.

A LATE REGISTRATION FEE OF NOT MORE THAN SIXTEEN DOLLARS ($16.00) IS CHARGED AT THE RATE OF TEN DOLLARS ($10.00) FOR THE FIRST DAY AFTER REGULAR REGISTRATION, AND AN ADDITIONAL TWO DOLLARS ($2.00) FOR EACH OF THE NEXT THREE DAYS.

Refund of Fees

Refunds of matriculation, tuition, or dormitory rents for reasons of withdrawal from the Institute or dropping of subjects may be considered only upon written application for refund of fees. The application must be dated and signed by the individual requesting the refund. It should be addressed to Mr. E. I. Barnes, Vice President for Business and Finance.

A form is available from the Dean of the Graduate Division, Dean of the Undergraduate Division or the Cashier's Office to request the refund. A copy of the withdrawal application or drop slip must accompany the refund application. STUDENT ACTIVITY AND MEDICAL FEES ARE NOT REFUNDABLE.

Students who formally withdraw during one week following the scheduled registration date are entitled to a refund of 80% of the fees paid for that quarter.

Students who formally withdraw during the period between one and two weeks after the scheduled registration date are entitled to a refund of 60% of the fees paid for that quarter.

Students who formally withdraw during the period between two and three weeks after the scheduled registration date are entitled to a refund of 40% of the fees paid for that quarter.

Students who formally withdraw during the period between three and four weeks after the scheduled registration date are entitled to a refund of 20% of the fees paid for that quarter.

Students who withdraw or drop a subject after a period of four weeks has elapsed from the scheduled registration date will not be entitled to a refund of any part of fees paid for that quarter. All requests for refunds must be received in the office of the Vice President for Business and Finance with one month following the registration date.

STUDENT MOTOR VEHICLES

Students who are classified as freshmen or certain level sophomores and are living within the defined campus boundaries are not allowed to own or operate a motor vehicle on the campus. Any exception to this regulation will be granted only by special permission by the Dean of Students.

Any student (day, evening, graduate, or co-operative) who operates a vehicle on the campus must register it for ON CAMPUS parking. ON CAMPUS registration will allow student parking in designated institutionally-owned or controlled areas.

An annual registration fee of $10.00 must be paid to register each vehicle for ON CAMPUS parking. This fee is applicable regardless of which quarter the vehicle is registered and will cover an entire academic year from September until registration the follow September.

Freshmen and upperclassmen granted student parking permits are required to observe all parking regulations on the campus. The Georgia Institute of Technology reserves the right to limit in any way whatsoever the issuance of student parking privileges at the beginning of any quarter.

ROTC

The Georgia Tech Reserve Officers Training Program is on a voluntary basis.

Both the four-year and the two-year programs are offered as provided for in the 1964 ROTC Vitalization Act.

Each applicant for formal enrollment in the basic course of the Air Force, Army or Navy ROTC shall be required to execute a Certificate of Loyalty Oath in such form as shall be prescribed by the Secretary of Defense. If a freshman elects to enroll in ROTC, the first course should be scheduled during his first quarter in attendance.

Students who have successfully completed the basic course on a college level (senior division) and who are selected, may pursue the advanced course in the junior and senior years. However, not more than six hours of basic and nine hours of advanced ROTC may be used as elective credit towards a degree.

A student who is qualified for and enrolled in the ROTC senior division while at Georgia Tech may be deferred from induction until after his graduation provided he possesses certain qualifications and meets the prescribed requirements. Such an individual, if required to report for active duty, would report as an officer after having received his reserve commission through the ROTC.

For further details regarding the Army ROTC, see page 213, the Naval ROTC, see page 234, and for Air ROTC, see page 49.

Selective Service Student Deferments

Any full-time undergraduate requesting a student deferment, II-S classification, should file a Selective Service Authorization card with the Office of the Registrar, so that enrollment status can be reported to the local board. The Military Selective Service Act of 1967 specifies that a registrant requesting student deferment for the first time must make this request in writing to his local board, preferably on the SSS Form 104 which is available in the Office of the Registrar.

Section 1622.25 (a) of the Selective Service Regulation states:

> "In Class II-S shall be placed any registrant who has requested such a deferment and who is satisfactorily pursuing a full-time course of instruction at a college, university, or similar institution of learning, such a deferment to continue until such registrant completes the requirement for his baccalaureate degree, fails to pursue satisfactorily a full-time course of instruction, or attains the twenty-fourth anniversary of the date of his birth, whichever comes first."

Co-operative students are recognized as being enrolled on a full-time five-year course of instruction and are eligible to be considered for II-S deferment during their entire five-year program.

Any questions concerning student deferments should be directed to the Office of the Registrar, Room 104, Administration Building.

HEALTH SERVICES

The Health Service is located in the Joseph Brown Whitehead Memorial

Infirmary, located on Fifth Street adjoining Rose Bowl Field. The Infirmary contains the offices of the medical staff, examination and treatment rooms, clinical laboratory, X-ray and physiotherapy departments, plus wards and rooms for seventy patients.

The staff consists of several full time physicians, visiting consultants in Internal Medicine, Psychiatry and Radiology, with the necessary supplement of registered nurses, medical technicians, etc. There are many physicians and dentists on the consulting staff, representing all medical and dental specialities, whose services are available upon request.

Infirmary policy is determined by a committee composed of the Dean of Students, the Assistant Athletic Director, the Vice President for Academic Affairs, the Athletic Association physician, the Director of Health, and a student appointed by the Student Council.

The facilities of the Health Service are available to all students. The Health Service is financed by student fees and only those who have paid a health fee for the current quarter are eligible for free treatment. Co-op students on their work quarter and students registered for less than 6 credit hours are not charged a health fee and are not entitled to free treatment at the Infirmary, but may be treated on a "fee-for-service" basis.

For those eligible, the Health Service provides unlimited free Infirmary office treatment by the Infirmary Staff for any illness or injury that occurs after enrollment at Georgia Tech. This includes such medical care, minor surgery, X-rays and Staff conducted laboratory examinations, and physical therapy as deemed necessary and provided by the full-time school physicians. Hospitalization in the school Infirmary with Staff nursing care, drugs, laboratory, X-rays, and physical therapy is provided free, except for a charge of one dollar for each meal served, and one dollar per day to cover laundry expenses. If the illness or injury is of such complexity or severity that consultation with a specialist or treatment with another hospital is deemed advisable, arrangements can be made by the school physicians for such care. (See later paragraphs for financial aspects.)

All students who are sick or injured are expected to report to the Infirmary for treatment. If the student does not desire treatment by one of the school employed physicians, he may arrange for another physician to care for him at the Infirmary. The Health Service will assume no responsibility, financial or otherwise, for treatment rendered by non-staff physicians.

Medical care is available at the Infirmary 24 hours a day when school is in session, but not between quarters. Clinic hours are 7 A.M. to 6 P.M.–Monday thru Friday, 8 A.M. to Noon–Saturday, and 3 P.M. to 6 P.M.–Sunday.

Emergency visits are possible at any hours of the day or night. Students are expected to make their clinic visits during their free periods or before classes begin in the morning.

School regulations prohibit any student staying in his room, in a dormitory or fraternity house, with a contagious disease. If the school physicians feel that the illness of the student is contagious or is severe enough to justify absence from classes, the student will be admitted to the Infirmary and remain until such time as he is able to return to classes with safety. The Health Service does not provide any care for students in the home, nor do the physicians make house calls.

Free service is limited to Staff care in the Infirmary, and, with certain limitations, for those injuries specified in the following paragraph. Unless otherwise indicated herein, free service does not include surgery, specialist treatment, orthopedic appliances, special nurses, or off campus hospitalization. The Health Service will assume no financial responsibility for the treatment of diseases or injury existing at the time of or prior to enrollment. The Health Service provides no dental care except for repair of teeth injured in P.T. class, provided such injury is reported within one hour of the injury and is verified by the instructor. It does not pay for eye refraction or for glasses. Only if glasses are broken in P.T. class while wearing protective goggles, will the glasses be replaced by the Health Service. It is recommended that all students who must wear glasses keep an extra pair on hand with a copy of their prescription. The Health Service will not pay for broken or lost contact lens under any circumstances.

The Health Service will provide financial assistance for medical care rendered by physicians outside the Infirmary only for:

(1) On-campus injuries sustained in the classroom, laboratory and physical training, or

(2) Injuries sustained while participating in regularly scheduled intramural activities.

The Health Service will provide full financial coverage for medical care for those injuries sustained in the classroom, laboratory, and physical training classes. For intra-mural injuries, the financial responsibility of the Health Service for any one injury will be limited to $200 for the physician's fees, and if treatment in a hospital outside the Infirmary is required, $10 per day for room and board up to 14 days, plus $100 toward other hospital charges. In all cases, the Health Service will assume this financial responsibility only if such service is deemed necessary and authorized in writing by one of the school physicians.

Health and Accident Insurance written especially for Georgia Tech to supplement the service provided by the School Infirmary is offered to all students at the beginning of each quarter. Excellent coverage for physical and mental illness, on a twelve month basis, is provided at a most reasonable premium. Full details will be mailed to all prospective students in late August so that coverage will be provided at registration at the beginning of each quarter.

All students are required to have immunization against tetanus (toxoid), small-pox, and polio, prior to enrollment. Boosters for tetanus, smallpox, and polio will be given as needed. Tech does not require typhoid vaccine, but advises it for those who intend to do water skiing, skin diving, or other fresh water sports.

Health Information Record and Consent-for-Treatment forms are mailed to students with the notice of their acceptance for enrollment. These forms are to be completed by the prospective student and his parents or guardians and mailed to the Director of Health in sufficient time to be received prior to the date of initial registration. After review of the Health Information Record, the school physicians shall determine the qualifications for Physical Training. Any student who desires special consideration because of mental or physical disability should have his physician write an explanatory letter to the Director of Health giving full details of the disability and any desired limitations on physical activity. This letter is to be attached to the Health Information Record. Any special examinations or reports needed to determine eligibility for enrollment or assignment are at the expense of the student, not the school.

The Director of Health, as representative of the Institute, reserves the right to exclude students with certain infirmities or disabilities which he feels may be detrimental either to the individual or the other students. He also reserves the right to require certain treatment of students in order to qualify for enrollment or to remain in school.

DORMITORY HOUSING

It is the policy of the Institute to require all single freshmen, men and women, who do not reside with their parents, near relatives, or bona fide guardians, to live in the dormitories. Freshmen (except those from the Atlanta area) are given *first priority* in making dormitory assignments. The Atlanta area includes that area with post office addresses of a 20-mile radius of Georgia Tech.

Atlanta area freshmen are not assigned dormitory housing until all other students are housed. During the fall quarter, very few Atlanta area freshmen can be given dormitory housing. Some Atlanta area freshmen are given assignments after the fall quarter begins when cancellations occur. These assignments can be obtained after the quarter begins by personally coming by the Housing Office. The majority of Atlanta area freshmen who desire dormitory housing during the winter and spring quarters can be accommodated. All students that request dormitory housing for the summer quarter can be given accommodations.

The priority for making dormitory assignments is as follows:

Area I	Area II	Area III
1st Priority–Freshmen	1st Priority–Senior	1st Priority–Graduate
2nd Priority–Sophomore	2nd Priority–Junior	2nd Priority–Senior
3rd Priority–Junior	3rd Priority–Sophomore	3rd Priority–Junior
4th Priority–Senior		4th Priority–Sophomore

Transfer Students will be placed according to class status, as above. (Class status should not be taken for granted, as this is determined after credits have been evaluated by the Registrar's Office.) Sophomore classification requires 51 acceptable credit hours.

Area I dormitories consist of Brown, Cloudman, Glenn, Harris, Harrison, Howell, Smith, Techwood and Towers. While students in the Co-operative Plan are housed primarily in Techwood, regular students are also given assignments there. Harris is an experimental dormitory consisting of suites. Assignments to this dormitory are made by a special student and staff selection process.

Area II dormitories consist of Field, Hanson, Hopkins, Matheson and Perry. Field is reserved for seniors and juniors.

Area III dormitories include Hefner for graduate students; Caldwell and Folk for juniors and seniors; and Armstrong and Fulmer for women (see Co-ed Dormitory Accommodations described on page 36).

Each Georgia Tech dormitory is staffed with a faculty or staff member, a mature Graduate Student or an advanced upperclassman as Resident Advisor, who is assisted by a Senior Counselor and a staff of upperclass Student Counselors, who advise and counsel student residents.

In each dormitory or dormitory area there is a Dormitory Council, which is a student government of elected representatives. The Dormitory Councils provide programs of social, recreational and leadership activities.

The dormitories provide housing for 3,400 students. In the Area I dormitories most of the rooms accommodate two students. There are a few three-man rooms and some four-man rooms which consist of two connecting rooms, which are used for an overflow of students. These rooms are reduced to two students per three-man and four-man rooms when space permits.

In the Area II dormitories all of the rooms are double occupancy with telephone capabilities in each room.

In the Area III dormitories all rooms are double occupancy. In addition to being air conditioned, telephone capabilities are provided in all dormitory rooms in Area III.

All rooms are equipped with beds, study desks, dressers, clothes lockers, book cases, chairs, mirrors and waste baskets. The student should provide himself with a mattress pad or cover (a plastic mattress cover is provided in Areas II and III), blankets, bedspreads, sheets (36" x 76" fitted for Area I, and 39" x 82" for Area II, and 36" x 80" for Area III—top and bottom fitted sheets as per these sizes are available in the College Inn), pillow and pillow cases, towels and a good study lamp.

Linen service is available on an optional basis. Two sheets, one pillow case and two bath towels are provided each week. Detailed information concerning this service will be mailed along with the room assignment.

Dormitory regulations prohibit the installation and use of such electrical appliances as hot-plates, toasters, irons, coffee makers, heaters and radio transmitters. The only electrical appliances permitted are electric razors, radios, clocks and a fan not to exceed 2.5 amp. power rating. Refrigerators that do not exceed an overall dimension of 36" x 24" x 32" are allowed in all dormitories except Brown and Techwood. Televisions are permitted in Areas II and III only.

Dormitory Applications from beginning freshmen and transfer students for fall quarter should be sent to the Office of Vice President for Business and Finance by May 1 after receiving the Notification of Acceptance and Dormitory Application from the Registrar. When Notification of Acceptance to fall quarter is received after May 1, the Dormitory Application must be mailed to the Office of the Vice President for Business and Finance within two (2) weeks. New students entering for quarters other than fall quarter must submit the Dormitory Application with the $25.00 room deposit to the Office of the Vice President for Business and Finance within two (2) weeks after receiving the Notification of Acceptance and Dormitory Application from the Registrar.

Applicants are encouraged to indicate their roommate requests, if they have a preference, and it is usually possible to grant such requests provided the applicants request each other. However, one's application is for an accommodation in the dormitories and *not* for a specific room or roommate. With roommate requests, the applicant having the lower priority establishes the priority for both applicants.

A $25.00 Room Deposit (in addition to the admission deposit mentioned on page 27) must be submitted with the dormitory application. No application for dormitory housing will be honored without the required deposit, except from students from countries with restrictive monetary policies. (In such cases, the international student should send his application to the Housing Office with a request for delay of payment.) Upon payment of the deposit, the Housing Office will promptly return to the applicant a receipt along with helpful preliminary instructions. The deposit is not applicable to dormitory rent. It may be refunded at such time as the student leaves the dormitories, provided he checks out properly, returns his room key, has no room damage for which he is responsible and has observed policies concerning room cancellations and withdrawals from the dormitories. The refund *must* be applied for; it is not refunded automatically.

ASSIGNMENTS: Dormitory Room Assignments are not mailed until approximately forty (40) days prior to the first day of classes, for the quarter applied for. Those applying after the beginning of this 40-day period will receive a room assignment as available and be held responsible for acceptance. If it is too late to mail the assignment, it may be secured at the Dormitory Housing Office upon arrival at Tech.

Requests for assignment changes between dormitories are not made beyond the second day (Saturday) before registration. However, room changes may be made within the dormitory, to which assigned, *provided* the change has been *approved* by the Resident Advisor of that dormitory and then officially arranged in the Housing Office *before* the change is made. Room change is scheduled on the first Monday and Tuesday after registration.

The Dormitory Housing Office will send instructions as to shipment of baggage, arrival dates and other information with the *room assignment.*

CANCELLATIONS: If, for any reason, the Dormitory Application, or an assignment to a room, is to be cancelled, the cancellation must be recorded in the *Dormitory Housing Office* at least thirty (30) days *prior* to registration day, or the deposit is *forfeited.* Exceptions to this policy are as follows:

(a) Beginning freshmen and transfer students for fall quarter have until *May 1* to submit the Dormitory Application with the $25.00 room deposit. After the room deposit is made, no refund is applicable except for an Act of Providence.

(b) Beginning freshmen and transfer students admitted for fall quarter after *May 1* are to send Dormitory Application to the Office of the Vice President for Business and Finance within two (2) weeks after receiving the Notification of Acceptance. No refund is applicable after the deposit is made.

(c) New students entering for quarters other than fall quarter must cancel their application or assignment 30 days prior to the first day of registration or the deposit is forfeited.

DORMITORY RENT is as follows: (A $2.00 Dormitory Activity Fee is included in the rent) *Room rent is subject to change at the end of any quarter*

Area I – $ 87.00 per quarter
Area II – $ 97.00 per quarter
Area III – $117.00 per quarter

DORMITORY RENT is payable as follows:

(a) On or before the last day of scheduled registration, for assignments made before the beginning of a quarter, unless otherwise indicated on assignment notice.

(b) Within two (2) days from date the room is assigned (when assignment is made after the beginning of a quarter).

A penalty fee will be charged for failure to pay rent on or before the last date due. The penalty fee will be five dollars ($5.00) for the first day following the date due, and one dollar ($1.00) for each of the next three days, the total not to exceed eight dollars ($8.00).

Students who fail to pay their room rent, including penalty fees, according to the conditions in above paragraphs (a) and (b), will be reported to the Dean of Students for appropriate action, four days after the deadline stated in the notice of assignment.

WITHDRAWALS: Residents once having paid rent, will receive no refund of room rent should they decide to move from the dormitories during any given quarter, UNLESS disenrolling from school in good standing.

Any student who withdraws from school and is in good academic and disciplinary standing should receive a dormitory rent refund in accordance with the Institution tuition refund policy.

Any student who moves from a dormitory to an apartment, fraternity house, private home, or is removed from the dormitory for disciplinary reasons, or leaves the Institute without proper notification should not receive a room rent refund and should forfeit his room deposit.

COED DORMITORY ACCOMMODATIONS: Armstrong and Fulmer dormitories, located in Area III, the new dormitory complex between Sixth and Eighth Streets, house a total of 186 women. All rooms are double occupancy with individual room controls to the central air conditioning and heating. Telephone capabilities are provided in each room and upon application at the Housing Office telephones will be installed. Each floor has a study room. The Women's Dormitory Director resides in the dormitory complex. Freshmen women (except Atlanta area) are given first priority in dormitory housing.

APARTMENTS

The school has 300 apartments for married students. The apartments range in size from efficiency to three-bedroom units. Detailed information and an apartment application blank will be supplied upon request to the Housing Office, Georgia Tech, Atlanta, Georgia 30332. It is necessary to be accepted as a student before application may be made. As apartments are vacated they are reassigned according to the date of application and priority.

FOOD SERVICE

Georgia Tech has three food service facilities conveniently located on the Campus. The newest of these facilities is found in the recently completed Student Center Building. The Student Center houses a cafeteria, a table service dining room and a Snack Bar.

For those students living on the East side of the campus, Brittain Dining Hall provides full meal service. Bradley Dining Hall, located in the Administration Building, provides a cafeteria serving breakfast and lunch as well as a Snack Bar.

GEORGIA TECH PLACEMENT CENTER

The Georgia Institute of Technology operates a centralized placement operation serving all degree candidates for career employment. The four principal services available to students and employers are (1) campus interviews (2) a weekly bulletin published to students listing position vacancies (3) an open resume file for employer selection of candidates and (4) communication information for more than 3,000 prospective employers. In addition, the Placement Center staff conducts orientation and employment seminars to aid students in their employment search. Summer and part-time position openings are also made known to the students through the Placement Center. Formal campus interview periods are October and November, and January through April but can be arranged at anytime with at least two weeks notice. Employers wishing to establish interview dates, list position vacancies or review resumes may call (404) 873-4211 Ext. 688 or visit the Placement Center at 891 Hemphill Avenue, N.W.

OTHER INFORMATION

Class Attendance: There are no formal 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 and students should, therefore, maintain regular attendance if they are to attain maximum success in the pursuit of their studies.

Examinations and Grade Reports: Final examinations are scheduled during the last week in each quarter and reports of the student's academic progress are issued after the close of the quarter.

Constitution and History Examinations: A Georgia law, amended March 4, 1953, requires all students to pass examinations on United States and Georgia history and the United States and Georgia constitutions or pass comparable courses before graduation. Courses which may be substituted for the United States and Georgia constitutions examination are Pol. 151 or Pol. 351; courses which may be substituted for the United States and Georgia history examination are: Hist. 101, Hist. 102, Hist. 301, or Hist. 302.

Limitations on credit for ROTC courses: Six (6) quarter hours in Basic ROTC courses and nine (9) quarter hours in Advanced ROTC courses are the maximum credits allowed toward meeting the requirements for any degree.

Grading System:

A–excellent (4 quality points)
B–good (3 quality points)
C–satisfactory (2 quality points)
D–passing (1 quality point)
F–failure, must be repeated if in a required course (no quality points)
S–Credit by transfer, examination for advanced standing, or satisfactory completion of a course in which no other letter grade has been assigned (not included in calculation of scholastic average)
V–audited, no credit (no academic achievement implied)

A grade of D is passing in a single subject but a general average of C is required for graduation.

More detailed information regarding the academic regulations of the Institute is contained in the handbook of student rules and regulations which is available to all students in the Office of the Dean of Students.

CURRICULA

In the following pages there will be found in alphabetical order a tabulation of the work required for degrees in the curricula offered by the Georgia Institute of Technology.

At least 33 credit hours of humanities and social science must be included in all curricula leading to an undergraduate degree.

Engineering College—all students enrolled in curricula of the Engineering College must take at least 36 hours of humanities and social sciences distributed as follows:

At least 18 hours of humanities (including at least 3 hours of literature) selected from the following subjects:

English: 107-8-9, 201-2-3, 206, 207, 221, 222, 223, 241, 242, 243, 301, 302, 304, 306, 331, 332, 333, 341, 342, 343, 344, 360, 381, 382, 383, 441, 442, 443, 444, 451, 452, 453.

Modern Language:*

German: 301, 302, 303, 401, 402, 403, 421, 422, 423, 491, 492, 493.

Russian: 301, 302, 303.

Spanish: 301, 302, 303, 306, 401, 402, 403, 404, 405, 406, 494, 495, 496.

French: 301, 302, 303, 401, 402, 403, 497, 498, 499.

Linguistics: 201, 202, 203, 401, 402, 403.

*Up to 9 hours of beginning modern language may be included, *provided that* 9 additional hours of literature studies in the same language are also completed.

Music: 201, 203.

Architecture: 335, 336, 337, 338, 339, 361, 362, 363, 435, 436, 461, 462, 463, 465, 466, 530.

At least 18 hours of social sciences (including at least 3 hours of history) selected from the following subjects:

History: 101, 102, 301, 302, 303, 304, 306, 310, 312, 314, 316, 317, 318, 320, 321, 323, 420, 421, 424.

PHS: 126, 127, 128, 326, 328, 329, 330, 331, 333, 334, 341, 342, 343, 344, 345, 346, 347, 348, 428, 430, 435, 436, 448, 449.

Pol: 151, 152, 351, 353, 354, 356, 361, 362, 365, 366, 367, 370, 371, 450, 451, 452, 453, 465, 470, 471, 474, 475.

Soc: 176, 177, 376, 377, 379, 380, 381, 382, 383, 384, 385, 386, 476, 477, 480, 490.

Modern Lanugage:

German: 201, 202, 203.

French: 201, 202, 203.

Russian: 201, 202, 203.

Spanish: 201, 202, 203, 304, 305.

Linguistics: 201, 202, 203, 401, 402, 403.

Psychology: 300, 303, 304, 400, 402, 410, 480.

Econ: 201, 202, 203, 204, 486, 487, 489, 495.

Socio-technology:

C.E.: 470

N.E.: 420

PHS: 127, 128, 341, 342, 343, 344, 345, 428, 436.

Pol: 474, 475
Soc: 476.
Econ: 489, 495

General College and Industrial Management College—all students enrolled in curricula of either the General College or the Industrial Management College must take at least 36 hours of humanities and social sciences distributed as follows:

At least 18 hours of humanities selected from the following subjects:

English: 107, 108, 109, 201, 202, 203, 204, 206, 207, 221, 222, 223, 241, 242, 243, 301, 302, 304, 306, 331, 332, 333, 341, 342, 343, 344, 360, 381, 382, 383, 441, 442, 443, 444, 451, 452, 453.

Modern Language:
- German: 101, 102, 103, 105, 106, 301, 302, 303, 401, 402, 403, 421, 422, 423, 491, 492, 493.
- Russian: 101, 102, 103, 301, 302, 303.
- Spanish: 101, 102, 103, 301, 302, 303, 306, 401, 402, 403, 404, 405, 406, 494, 495, 496.
- French: 101, 102, 103, 301, 302, 303, 401, 402, 403, 497, 498, 499.
- Linguistics: 201, 202, 203, 301, 302, 303, 401, 402, 403.

Music: 201, 203.

Architecture: 335, 336, 337, 338, 339, 361, 362, 363, 435, 436, 461, 462, 463, 465, 466, 530.

At least 18 hours of social sciences selected from the following subjects:

Social Science:
- History: 101, 102, 301, 302, 303, 304, 306, 310, 312, 314, 316, 317, 318, 320, 321, 323, 420, 421, 424.
- PHS: 126, 127, 128, 326, 328, 329, 330, 331, 333, 334, 341, 342, 343, 344, 345, 346, 347, 348, 428, 430, 435, 436, 448, 449.
- Pol: 151, 152, 351, 353, 354, 356, 361, 362, 365, 366, 367, 370, 371, 450, 451, 452, 453, 465, 470, 471, 474, 475.
- Soc: 176, 177, 376, 377, 379, 380, 381, 382, 383, 384, 385, 386, 476, 477, 480, 490.

Modern Language:
- German: 201, 202, 203.
- French: 201, 202, 203.
- Russian: 201, 202, 203.
- Spanish: 201, 202, 203, 304, 305.
- Linguistics: 201, 202, 203, 301, 302, 303, 401, 402, 403.

Psychology: 300, 303, 304, 400, 402, 410, 480.

Economics: 201, 202, 203, 204, 486, 487.

SCHOOL OF AEROSPACE ENGINEERING
(Daniel Guggenheim School of Aeronautics)
(Established in 1930)

Director–Arnold L. Ducoffe; *Associate Director*–Robin B. Gray; *Professors*–Robert L. Carlson, Donnell W. Dutton, Howard D. Edwards, John J. Harper, Wilfred H. Horton, A. Ben Huang, James E. Hubbartt, James C. Wu; *Associate Professors*–Stanley C. Bailey, Louis H. Bangert, Don P. Giddens, Sathyanarayana V. Hanagud, C. Gerald Justus, Howard M. McMahon, G. Alvin Pierce, Lawrence W. Rehfield, Robert G. Roper, C. Virgil Smith, Jr., Warren C. Strahle, Ben T. Zinn; *Assistant Professor*–James I. Craig; *Instructor*–Eugene A. Powell; *Lecturer*– Robert E. Singleton; *Visiting Professor*–Sathyanarayana V. Hanagud; *Administrative Assistants*–Paul E. Blumensaadt, Miss Sarah Quinn Slaughter; *Research Engineers*–George T. Bird, Robert A. Cassanova, Brady R. Daniel, John C. Handley, Hendrik R. Hudson, Charlie R. Lord, John G. Palfery, Allan J. Smith, Jr.; *Senior Secretaries*–Mrs. Sophia C. Alexandrides, Miss Mary Ann Booth, Mrs. Ruth Shaw; *Secretaries*–Miss Ann Asher, Mrs. Nelly E. Burch, Mrs. Anne E. Fisher, Miss Teresa D. Harris, Mrs. Suyin Liang, Mrs. Mattie Jo Sims; *Accounting Clerk*–Francis M. Mobley; *Office Manager*–Theodore H. Edwards; *Academic Machine Shop Foreman*–Dewey L. Ransom; *Principal Lab Mechanic*–Lloyd F. Willard; *Instrument Lab Foreman*–John Caudell; *Senior Machinists*–Harold W. Meyer, Calvin F. Wiser.

General Information

The mission of the School of Aerospace Engineering is the preparation of graduates for a career in flight vehicle engineering and related applied research. The curriculum is specifically designed to develop proficiency for research, analysis and design in the three disciplines of fluid flow, structures and vehicle performance. The background developed in these disciplines is applicable to vehicles within the complete flight spectrum–underwater, atmospheric and space flight.

Chemistry, mathematics, physics and the humanities are emphasized in the first two years of the curriculum. The disciplines in Aerospace Engineering and the related engineering sciences are covered in the third and fourth years. Basic principles and theories are stressed in recognition of the sophistication and rapid changes associated with modern engineering technology. The curriculum prepares the graduate for either an engineering position, usually in the aerospace industry, or for additional education at the graduate level, usually with specialization in one of the disciplines in Aerospace Engineering. Electives are offered during the last two years of the curriculum so that a student's program of study can be tailored for his objectives and abilities.

The School offers graduate work leading to both the Master of Science and the Doctor of Philosophy degrees.

Freshman Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
Chem.	104-5	Inorganic Chemistry	4-3-5	4-3-5	....
E.Gr.	170-1	Visual Comm. and Engineering Design I, II	2-3-3	2-3-3	....
Hum/S.S./M.L.*		Humanities, Social Sciences, or Modern Language..	3-0-3	3-0-3	3-0-3
E.S.M.	205	Statics..........................	....	....	3-0-3
Math.	107-8-9	Calculus I, II, III...........	5-0-5	5-0-5	5-0-5
Phys.	227	Physics.........................	....	....	4-3-5
Electives **		....	2-0-2	2-0-2	2-0-2
P.T.	101-2-3	Physical Training	0-4-1	0-4-1	0-4-1
Gen.	101	Orientation..................	1-0-0	....	....
		Totals	17-10-19	16-10-19	17-7-19

Sophomore Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
A.E.	290	Structures I..................	....	....	4-3-5
E.S.M.	309-10	Dynamics I, II..............	3-0-3	3-0-3	....
Hum./S.S./M.L.*		Humanities, Social Sciences, or Modern Language..	3-0-3	3-0-3	3-0-3
Math.	207	Calculus IV..................	5-0-5	....	....
Math.	208	Calculus and Linear Algebra	....	5-0-5	....
Math.	209	Ordinary Differential Equations	....	....	5-0-5
M.E.	322	Thermodynamics..........	....	....	3-0-3
Phys.	228-9	Physics.........................	4-3-5	4-3-5	....
P.T.	201-2-3	Physical Training	0-4-1	0-4-1	0-4-1
		Totals	15-7-17	15-7-17	15-7-17

*Eighteen credit hours in Humanities and 18 credit hours in Social Sciences are required for graduation. To satisfy these requirements, Humanities and Social Sciences courses must be selected from the Engineering College listings shown on page 38 of the General Catalog. The School of Aerospace Engineering strongly recommends that English 107-8-9 be scheduled in the Freshman Year.

**These free elective courses may be taken at any time during a student's course of study. However, these six credit hours may be satisfied by selecting basic ROTC. If basic ROTC is elected by the student, then it must be scheduled beginning the first quarter the student is enrolled. For further details, see page 28 of the catalog.

Junior Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
A.E.	361-2-3	Fluid Mechanics I, II, III	4-3-5	4-3-5	4-3-5
A.E.	391-2-3	Structures II, III, IV	4-3-5	4-3-5	4-3-5
E.E.	325	Electric Circuits and Fields	2-3-3	....	....
E.E.	326	Elementary Electronics.	....	2-3-3	....
E.S.M.	421	Mechanical Vibrations	....	....	3-0-3
Hum./S.S./M.L.*		Hunanities, Social Sciences, or Modern Language	3-0-3	3-0-3	3-0-3
		Totals	13-9-16	13-9-16	14-6-16

Senior Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
A.E.	443	Aerospace Engineering Design Project	....	....	3-9-6
A.E.	456	Vibration and Flutter	3-0-3	....	....
A.E.	458	Stability and Control	....	5-0-5	....
A.E.	460	Fluid Mechanics IV	4-3-5	....	....
A.E.	480	Jet Propulsion	....	5-0-5	....
Hum./S.S./M.L.*		Humanities, Social Sciences or Modern Language	3-0-3	3-0-3	3-0-3
Math.	412	Advanced Engineering Math	3-0-3	....	....
Electives**		....	3-0-3	3-0-3	3-0-3
		Totals	16-3-17	16-0-16	12-0-15

Total credit hours required for B.A.E.–204

*Eighteen credit hours in Humanities and 18 credit hours in Social Sciences are required for graduation. To satisfy these requirements, Humanities and Social Sciences courses must be selected from the Engineering College listings shown on page 38 of the General Catalog.

**Free electives. Not more than 9 credit hours of advanced ROTC may be applied toward the requirements for a degree.

Courses of Instruction

NOTE: 4-3-5 *means* 4 *hours class,* 3 *hours laboratory,* 5 *hours credit.*

A.E. 290. Structures I

4-3-5. Prerequisites: Math 208 and ESM 205.

Introduction to the elements of structural mechanics which are basic in the design of aircraft and missile structures. Emphasis on the use of the concepts of strain and stress in problems involving trusses and beams with application to wing type structures. Relation of design decisions to phenomenological failure theories.

Text: To be selected.

A.E. 323. Aerodynamics of the Airplane II.

3-0-3. Prerequisites: A.E. 421 and A.E. 424, parallel 440.

Drag; horsepower; basic performance; special performance problems; load factors and maneuvers; compressibility effects.

Texts: Sherby, Dommasch, and Connoly, *Airplane Aerodynamics;* Perkins and Hage, *Airplane Performance, Stability and Control.*

A.E. 325. Aero and Hydro Mechanics

3-0-3. Prerequisites: Math. 412 or concurrently; 2.0 overall average and a 2.0 average in Freshman and Sophomore Math. and in Sophomore Physics.

Fluid mechanics, hydrodynamics, including continuity, circulation and curl, irrotational flow, velocity potential, vortex theorems, Euler equations, momentum theory, Bernoulli equation.

Text: Kuethe and Schetzer, *Foundations of Aerodynamics.*

A.E. 331. Theory of Structures I.

3-0-3. Prerequisites: Math. 304, and ESM 334.

Basic theory of aircraft and missile structural design including: a review of plane stress and strain theory; loads, shears, and moments in wings and fuselages; inertia loads and load factors; section properties of aircraft components, space structures; bending of beams; materials properties and testing.

Text: Peery, *Aircraft Structures; Mil HNBK -5.*

A.E. 361. Fluid Mechanics I.

4-3-5. Prerequisites: Math. 209 and M.E. 322.

The atmosphere, properties of fluids, classifications of flows, flow parameters, and one-dimensional flows including Bernoulli equation, stagnation conditions, sonic speed, isentropic flows, normal shocks, and duct flows with friction and heat addition.

Text: To be selected.

A.E. 362. Fluid Mechanics II

4-3-5 Prerequisites: A.E. 361.

The development of the physical equations for continuum flows followed by applications to laminar and turbulent boundary layers for incompressible and compressible flow.

Text: Kuethe and Schetzer, *Foundations of Aerodynamics.*

A.E. 363. Fluid Mechanics III

4-3-5 Prerequisites: A.E. 362.

Two-dimensional incompressible flow theory, superpositioning of flows, and conformal transformations, with applications to flow around bodies and to airfoil theory.

Text: Kuethe and Schetzer, *Foundations of Aerodynamics.*

A.E. 391. Structures II

4-3-5. Prerequisites: Math. 209 and A.E. 290.

Discussion of inertia loads and load

factors. Analysis of three-dimensional trusses, thin-walled beams, beams with taper and unsymmetrical bending. Introduction to theory of elasticity and application to selected two-dimensional problems.

Text: To be selected.

A.E. 392. Structures III

4-3-5. Prerequisites: A.E. 391.

Principle of virtual work and introduction to energy principles. Applications to truss, beam and frame problems with linear and nonlinear elasticity and including shear deformation and temperature effects. Principle of superposition, flexibility and influence coefficients, reciprocal theorem, Betti's Law. Introduction to stability analysis with application to simple models and to columns. Plastic bending of beams and effects of impact loading.

Text: To be selected.

A.E. 393. Structures IV

4-3-5. Prerequisites: A.E. 392.

Concept of redundancy and deflection calculations for statically indeterminant structures. Torsion and bending of multicell box beams. Tension field beam. Shear lag concept. Warping restraint in torsion. Application of matrix methods to structural analysis.

Text: To be selected.

A.E. 401-2-3. Aeronautical Research I,II,III.

0-9-3. Prerequisites: Third Quarter Junior or Senior Standing and approval of A.E. School Director.

A clearly stated program prepared by the student describing in detail the nature, purpose and scope of the proposed problem, carrying the endorsement of the sponsoring A.E. staff member, must be submitted to the A.E. School Director for approval. Library, experimental, or theoretical work will be considered.

A.E. 410. Thermal Stresses

3-0-3. Prerequisites: A.E. 435, or consent of instructor.

Origin of thermal stress; external constraints; determination of temperatures —the heat transfer problem; fundamental equations of uncoupled isotropic thermoelasticity; some solutions of typical thermoelastic problems; properties of materials at high temperatures; problems in creep analysis.

Text: Gatewood, B.E., *Thermal Stresses.*

A.E. 421. Aerodynamics—Elementary Supersonics

3-0-3. Prerequisites: A.E. 325, M.E. 322.

The equations of motion, energy and continuity, thermodynamic principles, one-dimensional flow. Mach waves, shock waves, Prandtl-Meyer flow.

Text: Shapiro, *The Dynamics and Thermodynamics of Compressible Fluid Flow, Volume I.*

A.E. 424. Aerodynamics—Perfect Fluids

5-0-5. Prerequisites: A.E. 325, Math. 412.

Flow about a body; finite thickness airfoils and three-dimensional wing theory; complex variable theory; conformal mapping and transformations.

Text: Rauscher, *Introduction to Aeronautical Dynamics.*

A.E. 426. Viscous Flow

3-0-3. Prerequisites: A.E. 421, A.E. 430.

A study of the momentum and energy equations as applied to viscous flows with applications. Boundary layer equations with applications.

Text: Kuethe and Schetzer, *Foundations of Aerodynamics.*

A.E. 428. Experimental Methods

1-6-3. Prerequisites: A.E. 323, A.E. 426 or concurrently, A.E. 437, A.E. 457.

The methods, equipment, and instrumentation used in experimental aerospace engineering. The technique of recording and interpreting experimental data from selected laboratory tests is emphasized.

A.E. 430. Theory of Structures II.

3-3-4. Prerequisites: A.E. 331, Math. 412.

Development of the basic concepts of stress and strain suitable for both solids and fluids; statement of generalized Hooke's Law and simplification to isotropic materials; introduction to plane stress, with applications to beam bending; torsion of cylindrical rods; laboratory experiments.

Text: Shames, *Mechanics of Deformable Bodies.*

A.E. 435. Theory of Structures III

3-3-4. Prerequisite: A.E. 430.

General discussion of strain energy in elastic structures; application to rods, webs, beams, and shafts; virtual work and generalized virtual work; structural deflections by virtual work, Rayleigh-Ritz, and double integration; introduction to stability analysis; use of energy methods; long and short columns; elastic and plastic buckling of plates; the pure tension field beam; the semi-tension field beam.

Text: Peery, *Aircraft Structures; Mil HNBK-5.*

A.E. 437. Theory of Structures IV

3-3-4. Prerequisite: A.E. 435.

Statically indeterminant structures by energy methods and special methods; torsion of multicell sections; elastic axis of multicell sections; elastic axis of wing sections, warping of box beams; correlation of theory and practice by experiments in laboratory.

Text: Perry, *Aircraft Structures.*

A.E. 439. Advanced Structures

3-0-3. Prerequisites: A.E. 435.

Detailed study of beam columns, shear webs with cut-outs; shear lag, bending in the plastic range; miscellaneous thin metal structural problems.

Text: Peery, *Aircraft Structures;* Niles and Newell, *Airplane Structures,* Vol. II.

A.E. 440. Aerospace Vehicle Design I

0-9-3. Prerequisites: Parallels A.E. 323 and A.E. 435.

Preliminary design of an advanced contemporary flight vehicle in accordance with appropriate F.A.A. or Air Force requirements, including weight and balance, performance, loading report, and general arrangement. A team effort with emphasis on the systems engineering approach.

A.E. 441. Aerospace Vehicle Design II

0-9-3. Prerequisites: A.E. 440, Parallels A.E. 437.

Continuation of A.E. 440 including a stability, propulsion system and wing and fuselage or landing gear structural analysis.

A.E. 442. Aerospace Vehicle Design III

0-9-3. Prerequisites: A.E. 441 and A.E. 437.

Preliminary design of a space vehicle or satellite. A team effort with emphasis on the systems engineering approach.

A.E. 443. Aerospace Engineering Design Project

3-9-6. Prerequisite: Last quarter senior standing or consent of instructor.

Preliminary design or case study of a contemporary aerospace system such as a complete flight vehicle, a jet propulsion system or a flight vehicle structural system. The laboratory periods will be used for the design and/or design analyses while the lecture periods will be used to introduce the related engineering analysis, experimental results, empiricism, and technical literature and to maintain organization, interchange ideas, and report progress.

A.E. 456. Vibration and Flutter

3-0-3. Prerequisites: A.E. 424, ESM 421.

Structural dynamics of one-dimensional systems utilizing normal coordinates. Fundamental analyses of static aeroelastic phenomena and various types of flutter. Formulation of the generalized equations of motion for complete aeroelastic systems and a description of the techniques used for this solution.

Text: Scanlon and Rosenbaum, *Aircraft Vibration and Flutter.*

A.E. 457. Static and Dynamic Stability

5-0-5. Prerequisites: A.E. 323, ESM 421 or concurrently.

Airplane and missile static lateral and longitudinal stability and a study of the equations and methods used in the analysis of dynamic stability of airplanes and missiles.

Text: Perkins and Hage, *Airplane Performance, Stability and Control.*

A.E. 458. Stability and Control

5-0-5. Prerequisites: A.E. 460 and ESM 421.

Principles of static lateral and longitudinal stability and studies of the equations and methods used in the analysis of dynamic stability and controls. Applications to airplane and missile systems are emphasized.

A.E. 460. Fluid Mechanics IV

4-3-5. Prerequisites: A.E. 363.

Finite wing theory in incompressible flow, two-dimensional subsonic and supersonic compressible flows, airfoils and finite wings in compressible flow, supersonic flow around bodies of revolution, and an introduction to transonics and hypersonics.

Text: Kuethe and Schetzer, *Foundations of Aerodynamics.*

A.E. 467-468. Seminar

1-0-1. Prerequisites: A.E. 323, A.E. 440, Engl. 320 concurrently.

Scheduled meetings at which individual students present technical papers on important current aeronautical developments, the reading of each paper being followed by group discussion.

A.E. 471. Internal Aerodynamics

3-0-3. Prerequisite: A.E. 421.

One dimensional, internal aerodynamics. Flow characteristics of wind tunnels, diffusers and exhaust nozzles. Flow in ducts with friction, energy change and mass addition.

Text: Shapiro, *The Dynamics and Thermodynamics of Compressible Fluid Flow.* Volume I.

A.E. 473. Introduction to Propeller and Rotor Theory

3-0-3. Prerequisites: A.E. 323 or consent of instructor.

A study of the theory and equations used in the design of propellers and helicopter rotors.

A.E. 480. Jet Propulsion

5-0-5. Prerequisite: A.E. 460.

The theory and principles of jet propulsion including the mechanics and thermodynamics of combustion and reacting one-dimensional flows, theory of engine diffusers and exhaust nozzles, fundamental principles of jet propulsion, and cycle analysis and performance characteristics of gas turbine, turbo-prop, turbo-fan, turbojet, ram-jet, and rocket engines.

Text: Hill and Peterson, *Mechanics and Thermodynamics of Propulsion.*

A.E. 481. Jet Propulsion

3-0-3. Prerequisite: A.E. 471.

Theory of jet propulsion. Cycle analysis and performance characteristics of gas turbine, turbo-prop, turbo-fan, turbo-jet, and rocket engines.

Text: Hill and Peterson, *Mechanics and Thermodynamics of Propulsion.*

Graduate Courses Offered

A.E.	604,5,6	Special Problems in Aerospace Engineering	(credit to be arranged)
A.E.	607*	Thermodynamics	4-0-4
A.E.	608*	Combustion I	3-0-3
A.E.	609*	Combustion II	3-0-3
A.E.	621	Elements of Viscous Fluid Theory	3-0-3
A.E.	622	Elements of Compressible Flow Theory	3-0-3
A.E.	625	Laminar Flow Theory I	4-0-4
A.E.	626	Laminar Flow Theory II	3-0-3
A.E.	630	Theoretical Elasticity	3-0-3
A.E.	631	Advanced Structural Analysis I	3-0-3
A.E.	632	Advanced Structural Analysis II	3-0-3
A.E.	633	Advanced Structural Analysis III	3-0-3
A.E.	634	Advanced Structural Analysis IV	3-0-3
A.E.	635	Advanced Structural Analysis V	3-0-3
A.E.	636	Aerospace Structures Laboratory	1-6-3
A.E.	640	Molecular Gasdynamics	3-0-3
A.E.	641	Rarefied Gasdynamics I	3-0-3
A.E.	645	High Temperature Gas Dynamics I	3-0-3
A.E.	646	High Temperature Gas Dynamics II	3-0-3
A.E.	650	Advanced Potential Flow I	3-0-3
A.E.	651	Structural Dynamics I	3-0-3
A.E.	654**	Systems Design Methodology	2-3-3
A.E.	655,6**	Complex Systems Design	2-4-3
A.E.	660	Thermal Effects in Structures I	3-0-3
A.E.	661	Thermal Effects in Structures II	3-0-3
A.E.	662	Thermal Effects in Structures III	3-0-3
A.E.	670	Meteorology and Atmospheric Dynamics	3-0-3
A.E.	671	Turbulence and Atmospheric Dynamics	3-0-3
A.E.	676	Aerodynamics of the Helicopter I	3-0-3
A.E.	677	Aerodynamics of the Helicopter II	3-0-3
A.E.	683	Rocket Propulsion Principles II	3-0-3
A.E.	684	Rocket Propulsion Principles III	3-0-3
A.E.	694***	Engineering Acoustics I	3-0-3
A.E.	695***	Engineering Acoustics II	3-0-3
A.E.	696	Combustion Instability in Propulsion Systems	3-0-3
A.E.	699	Preparation for Ph.D. Qualifying Exams	no credit

*Also taught as M.E. 607, 608, and 609, respectively.
**Also taught as E.E. 654, 655, 656 and M.E. 654, 655, 656.
***Also taught as E.S.M. 694 and 695, respectively.

A.E. 700	Master's Thesis	
A.E. 701	Aerospace Seminar	no credit
A.E. 704, 5, 6	Special Problems in Aerospace Engineering	(credit to be arranged)
A.E. 710	Aerodynamic Heating	3-0-3
A.E. 711****	Magnetogasdynamics I	3-0-3
A.E. 712****	Magnetogasdynamics II	3-0-3
A.E. 713****	Magnetogasdynamics III	3-0-3
A.E. 714****	Methods of Experimental Magnetogasdynamics	2-3-3
A.E. 717	Three-Dimensional Vortex Theory	3-0-3
A.E. 718	Turbulent Flow	3-0-3
A.E. 719	Hypersonic Flow Theory	3-0-3
A.E. 721	Advanced Viscous Flow Theory	3-0-3
A.E. 725	Introduction to Theory of Turbulence	3-0-3
A.E. 726	Advanced Compressible Flow Theory I	3-0-3
A.E. 729	Advanced Compressible Flow Theory II	3-0-3
A.E. 741	Rarefied Gasdynamics II	3-0-3
A.E. 742	Reacting Boundary Layer Theory I	3-0-3
A.E. 743	Reacting Boundary Layer Theory II	3-0-3
A.E. 750	Advanced Potential Flow II	3-0-3
A.E. 751	Structural Dynamics II	3-0-3
A.E. 752	Applied Aeroelasticity I	3-0-3
A.E. 753	Applied Aeroelasticity II	3-0-3
A.E. 754	Experimental Aeroelasticity	3-0-3
A.E. 756	Special Topics in Aeroelasticity I	3-0-3
A.E. 757	Special Topics in Aeroelasticity II	3-0-3
A.E. 780,1*****	Space Power and Energy Conversion	3-0-3
A.E. 782*****	Spece Nuclear Propulsion	3-0-3
A.E. 799	Preparation for Ph.D. Dissertation	no credit
A.E. 800	Doctor's Thesis.	

****Also taught as M.E. 711, 712, 713, and 714, respectively.
*****Also taught as N.E. 780, 781, and 782, respectively.

DEPARTMENT OF AIR FORCE AEROSPACE STUDIES

(Established in 1950)

Professor of Air Force Aerospace Studies–Colonel William T. Preston; *Assistant Professors*–Lt. Col. Robert V. Dean, Major John C. Cardosi, Major Dee G. Sullins, Jr.; *Staff*–Master Sergeant Cecil C. Culbreth, Staff Sergeant Kenneth R. Clinkingbeard, Staff Sergeant Albert F. Cron, Jr., Staff Sergeant Lindel R. Thompson; *Secretary*–Mrs. Elizabeth W. Cerulli.

Air Force Reserve Officer Training Corps

The Department of Air Force Aerospace Studies was established in 1950 to select and prepare students to serve as officers in the Regular and Reserve components of the United States Air Force. AFROTC training is divided into two phases. The first two years constitute the General Military Course (GMC); the last two years the Professional Officer Course (POC). Students with prior active military service or previous officer training in high school or college may receive a waiver and credit for portions of the GMC. Co-operative students can be accommodated in both the GMC and POC.

Four-Year Program

A formal application is not required from students entering the 4-year program. Students enroll in Air Force ROTC courses in the same manner in which they register for other undergraduate college courses. Enrollment in the GMC is normally for freshmen and sophomores. Students enrolled in the GMC incur no military obligation whatsoever. Students must compete for entry into the POC which is usually taken during the last two years of college. Selection is based upon the results of an Air Force medical examination, the scores achieved on the Air Force Officer Qualifying Test, and an interview by a board of Air Force officers. Selectees must be free from academic probation, or any institutional status denoting academic deficiency. Students accepted for the POC become members of the Air Force Reserve and receive a $50 per month tax-free subsistence allowance.

Two-Year Program

The 2-year program and the last two years of the 4-year program are identical in academic content. To be eligible for the 2-year program, students must have two academic years remaining at either the undergraduate or graduate level at the time of enrollment. Entry into the 2-year program is also on a competitive basis. Students still must qualify on the Air Force Officer Qualifying Test, the Air Force medical exam, and be selected by a board of Air Force officers. In addition, candidates must successfully complete a 6-week Field Training Course at an Air Force base during the summer preceding their enrollment. They are then ready to enter the POC upon their return to campus.

Air Force ROTC College Scholarship Program

AFROTC College Scholarships are available to qualified cadets in the four year program. These scholarships cover tuition, matriculation, health service, student activities fee, and an allowance for books. Scholarship cadets also receive a $50 per month tax-free subsistence allowance. Initial selection for scholarships to sophomores, juniors and seniors is made on campus by a board composed of institutional officials and Air Force officers. Final selection is made by a central selection board at the Air Force ROTC Headquarters. Cadets are selected on the basis of:

1. Scores achieved on the Air Force Officers Qualifying Test.
2. Grade point average of at least 2.0 on a 4.0 (A) scale.
3. The rating from an interview board composed of institutional officials and Air Force officers.

Additionally, the academic major and potential active duty career field of each cadet is considered relative to the needs of the Air Force. Receiving an AFROTC Scholarship does not result in any additional active duty service commitment. High school seniors may also compete for a four year scholarship by applying directly to Headquarters, Air Force ROTC (ARTO-O/TA), Maxwell AFB, AL 36112.

Flight Instruction Program

The Flight Instruction Program provides up to 35 hours of flight training and the necessary ground school required by the Federal Aviation Administration for primary flying schools. The main purpose of this program is to determine aptitude and interest in training as an Air Force pilot after commissioning. This program may lead to a private pilot's certificate. Flight instruction is provided by a civilian flying school which is approved and certified by the Federal Aviation Administration. This program is only open to male POC category I-P cadets who are physically and mentally qualified and who desire to be pilots.

Leadership Laboratory

Leadership Laboratory, or Corps Training, is that portion of the AFROTC on-campus curriculum that centers on the cadet corps. This activity is largely cadet planned and directed. The function of Corps Training is to provide leadership training experiences which will improve a cadet's ability to perform later as an USAF officer. These experiences range from participating in basic military drill and ceremonies to instructing, correcting and evaluating other cadets. It culminates in organizing, directing and managing the entire cadet corps.

Field Training

Cadets in the four-year program normally attend a four-week Field Training session between their sophomore and junior years; except co-ops who normally attend Field Training after graduation. Special cases are handled on an individual basis. Candidates for the 2-year program must attend a special six-week Field Training prior to beginning the POC. Cadets will receive pay, compensation for travel expenses, and are furnished food, housing, uniforms and medical care while attending Field Training, which is conducted at regularly established Air Force bases.

Summary of Qualifications and Requirements

I. General Qualifications
  1. Be a citizen of the United States
  2. Be of sound physical condition
  3. Be of sound moral character
  4. Be at least 14 years of age

II. Additional Qualifications for Admission to the Professional Officer Course (POC):
  1. For the 4-year cadet, complete the General Military Course
  2. For the 2-year applicant, complete the 6-week Field Training Course
  3. Qualify on the Air Force Officer Qualifying Test (AFOQT)
  4. Qualify on the Air Force medical evaluation
  5. Be interviewed and selected by a board of Air Force officers
  6. Enlist in the Air Force Reserve prior to entry into the POC

III. Commission Requirements:
  1. If applying for the 2-year program, attend the 6-week Field Training Course and, upon satisfactory completion, participate in 3 hours of classroom instruction and an average of 1 hour of Corps Training each week for 2 years (i.e. completion of the Professional Officer Course)
  2. If in the 4-year program, participate in 1 hour of classroom and 1 hour of Corps Training each week for 2 years, prior to entry and completion of the Professional Officer Course
  3. Earn at least a baccalaureate degree
  4. Agree to accept, if offered, a commission in the United States Air Force
  5. Remain medically, morally, and otherwise qualified for a commission

IV. How to Apply:
  1. Students applying for the 4-year program register for the Air Force ROTC in the same manner and at the same time as they register for other undergraduate college courses.
  2. Students interested in applying for the 2-year program must be enrolled at Georgia Tech and apply to the Professor of Air Force Aerospace

Studies. Application must be made early in the academic year and not later than registration week of Winter Quarter which precedes Field Training. The student must have two academic years of study remaining after completion of the six-week Field Training.

V. Complete physical requirements are too lengthy and technical to be listed here. The following are simply some of the more important:

Requirements for Air Force Commission:

1. At least 20/400 bilateral vision without glasses, correctable to 20/30 in one eye and 20/40 in the other
2. Normal hearing
3. Blood pressure: Systolic, between 100 and 139
   Diastolic between 60 and 89
4. Normal heartbeat, free of murmurs
5. Height between 64 and 80 inches for men and 60 and 72 inches for women.
6. Weight normal for height and age
7. No history of asthma since 12th birthday
8. No limiting physical infirmity
9. Good dental health

Additional Requirements for pilot or navigator (male only):

1. Pilots: 20/20 bilateral near and far vision without glasses
   Navigators: 20/70 bilateral far vision correctable with glasses to 20/20 and 20/20 bilateral near vision uncorrected
2. Normal color vision
3. Normal hearing
4. Not over 76 inches in height; at least 64 inches
5. No history of hay fever or sinusitis since twelfth birthday
6. At least eight serviceable, opposed teeth in both upper and lower jaws

Uniforms & Texts

The Air Force ROTC uniform is identical to the regulation Air Force uniform except for insignia. Air Force ROTC cadets are required to wear the uniform during Corps Training periods. Newly entering students in the Air Force ROTC are issued required uniforms and most of their textbooks from AFROTC supply. A deposit of $25.00 is required. The uniform remains the property of the Air Force and is returned to supply during quarters of non-attendance, transfer to another institution, or upon completion of the General Military Course. The full $25.00 deposit, less cost of lost or damaged items of uniform, will be refunded to the student when he returns the uniform.

A cadet entering the Professional Officer Course is required to purchase a new uniform through Georgia Institute of Technology. The cost of the Professional

Officer Course uniform is approximately $108.00. A Professional Officer Course cadet will receive a partial reimbursement for the uniform upon completion of the Course or upon disenrollment without prejudice. In addition he will be allowed to retain the uniform.

Academic Credit

Academic credit is granted for the completion of Air Force ROTC courses as indicated in the sections that follow, however, not more than 6 hours in General Military Courses and not more than 9 hours in Professional Officer Courses may be applied toward a degree.

General Military Course:	1st Q.	2nd Q.	3rd Q.	Credit Hrs.
1st year	1	1	1	3
2nd year	1	1	1	3
Professional Officer Course:				
1st year	3	3	3	9
2nd year	3	3	3	9
Total				24

Courses of Instruction

NOTE: 3-1-3 *means* 3 *hours class,* 1 *hour laboratory,* 3 *hours credit.*

GENERAL MILITARY COURSE

AEROSPACE STUDIES I –

United States Military Forces in the Contemporary World

A.S. 151 The United States Aerospace Organization and Strategic Offensive Forces

1-1-1.

A study of the United States Air Force doctrine, mission and organization, and the strategic offensive forces are covered with emphasis on mission and employment.

A.S. 152. The United States Aerospace Strategic Defensive and General Purpose Forces

1-1-1

A study of the United States strategic defensive and general purpose forces; emphasis on their mission and employment and the control over employment of nuclear weapons.

A.S. 153. The United States Aerospace Support and General Purpose Forces

1-1-1

A study of the mission, resources and operation of tactical air forces with special attention to limited war; review of Army, Navy and Marine general purpose forces and aerospace support forces.

AEROSPACE STUDIES II –

United States Military Forces in the Contemporary World

A.S. 251. Modern Warfare and the United States Department of Defense

1-1-1.

This course is designed to familiarize the student with the nature and principles of modern warfare. Emphasis will be placed on analysis of the instruments of national power, with special attention being given to the military instrument. Also included is a look at the organization of the United States Department of Defense, to include the roles and missions of the several military departments.

A.S. 252. Comparative Military Policies and Capabilities

1-1-1.

The objective of this course is to provide the student a comparative look at both the military capabilities and policies of the United States, the Soviet Union and Red China. Current examples of general and limited war strategies of all three nations will be considered. In addition, the security alliances to which the above nations are aligned will be surveyed.

A.S. 253. United States Defense Policymaking Process

1-1-1.

This course will provide the student with a detailed study of the various aspects of how United States defense policy is determined. Included will be a study of the roles in defense policymaking of the President and the Executive Branch agencies, the National Security Council, the Joint Chiefs of Staff, and the Legislative Branch. Particular attention will be given to the relationship between foreign policy and defense policy.

PROFESSIONAL OFFICER COURSE

AEROSPACE STUDIES III – The Growth and Development of Aerospace Power

A.S. 311. Development of Air Power

3-1-3.

A survey of the development of air power in the United States. Major emphasis is placed on the development of doctrine, technology, organization and employment of this nation's air arm between 1903 and 1961. Within this study, attention is devoted to developing the communicative skills needed by junior officers.

A.S. 312. Contemporary Aerospace Power

3-1-3.

A survey of contemporary air power including: strategies and military programs in the contemporary nuclear age, employment of aerospace forces, and the future of manned aircraft. Within this study, attention is devoted to developing the communicative skills needed by the junior officer.

A.S. 313. Astronautics and Space Opérations

3-1-3.

An examination of the national space effort and its evolution; characterisitics of the spatial environment; types of orbits and trajectories; space vehicle systems, and concepts of space operations and their application to future aerospace power. Within this study, attention is devoted to developing the communicative skills needed by the junior officer.

AEROSPACE STUDIES IV – THE PROFESSIONAL OFFICER

A.S. 411. Air Force Leadership

3-1-3.

A study of the need for Air Force leadership, human relations, discipline in the military services, and the military justice system. Command positions in leadership laboratory.

A.S. 412. Command-Staff Relationships

3-1-3.

A study of the variables affecting leadership, problem solving, and the principles and concepts of the commander and his staff. Introduction to Air Force management.

A.S. 413. Air Force Management and the Junior Officer

3-1-3.

A study of the functions of management, Air Force personnel policies, and the information sciences. Briefing for commissioned service.

SCHOOL OF ARCHITECTURE

(Established in 1908)

Director–Paul M. Heffernan; *Assistant Director and Associate Professor*–Joseph N. Smith; *Professors Emeritus*–Harold Bush-Brown, Howard K. Menhinick; *Professors*–Arthur F. Beckum, Jr., Hin Bredendieck, H. Griffith Edwards (part-time), Geoffrey G. Eichholz (part-time), John C. Gould (part-time), James H. Grady, Julian H. Harris (part-time), Malcolm G. Little, Jr., Demetrios A. Polychrone (part-time), Richard Wilson; *Visiting Professor*–Sergio Lenci; *Associate Professors*–Richard A. Anderson, Anthony J. Catanese, Arnall T. Connell, Edward L. Daugherty (part-time), C. Malcolm Gailey, *Peter J. R. Norris, Elliott A. Pavlos (part-time), George H. Ramsey, Roger F. Rupnow, Isaac E. Saporta (part-time), William J. Seay, R. Michael Schneider; *Assistant Professors*–*William W. Allison (part-time), Sidney R. Barrett (part-time), Neill W. Connah, Dale A. Durfee, Rufus R. Greene, William W. Howell, Michael A. Jones, John C. Hardy, John A. Kelly, Robert J. Young; *Instructors*–James P. Chapman (part-time), Robin David (part-time), Rufus R. Hughes, II (part-time); *Lecturer*–Joseph de Casseres Reshower (part-time); *Principal Secretaries*–Eleanor R. Shearouse, Dorothy Beaver; *Senior Secretary*–Carolyn Carter; *Secretary*–Nelly Burch (part-time); *Head Architecture Librarian and Assistant Professor*–Helen B. Martini; *Library Assistant*–Barbara Waters; *Laboratory Mechanic*–Carl Finch.

General Information

The School of Architecture was established as a degree granting department of the Institute in 1908 and now offers the following courses of study–(1) the five-year curricula in Architecture with options in Architectural Design or Structural Design both leading to the degree Bachelor of Architecture, (2) a four-year curriculum in Building Construction leading to the degree Bachelor of Science in Building Construction and (3) a four-year curriculum in Industrial Design leading to the degree Bachelor of Science in Industrial Design. In addition, the graduate program in Architecture** prepares for the degree Master of Architecture, and the graduate program in City Planning** leads to the degree Master of City Planning.

In addition, the following graduate studies are offered: a one-year program leading to the degree Master of Architecture; a joint two-year program with emphasis on Urban Design leading to the simultaneous award of the degrees Master of Architecture and Master of City Planning; a one-year program in City Planning studies leading to the degree Master of Science without designation; the regular two-year program leading to the degree Master of City Planning; and the joint two-year programs leading to the simultaneous award of the degrees Master

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*On leave.

**For the graduate program in Architecture and City Planning, see Graduate Bulletin.

of City Planning and Master of Civil Engineering (Transportation Engineering), or Master of Landscape Architecture at the University of Georgia.

Except for those courses listed as electives on page 38 of this catalog. instruction is available only to majors in the School of Architecture.

Architecture

The original objective and first aim of the School is to prepare students for the profession of Architecture. The scope of the field is of such breadth in current practice that need is felt not only for men who are strong in design but for others whose interests will be closely integrated with design in structural and mechanical techniques. The training in Architecture is uniform for the first four years with two areas of specialization, Architectural Design and Structural Design, strongly emphasized in the final year. The central core of the curriculum in Architecture is the study of design, with related exercises and drawing, graphics, visual composition and model building. The student is given an opportunity in these courses to develop his creative as well as his analytical powers by finding solutions to programs employing the requirements of contemporary buildings and paralleling the conditions to be encountered in later practice. Instruction is generally in the form of guidance and suggestion on the part of the instructor to each student individually, accompanied by group discussions, lectures, and demonstrations. Solutions are submitted as drawings or models for review and judgment by a jury of teachers, practicing architects, and such designers or specialists as the occasion may require.

Closely allied to design and, insofar as possible, integrated with it are the courses in construction which, in turn, are dependent on the basic requirements of mathematics, physics, and mechanics. Courses in the history and theory of architecture supply a fuller understanding of our architectural heritage, its meaning and impact on contemporary problems. Work of technical importance is offered in building materials, mechanical plant (plumbing, heating, air-conditioning and electrical installations), office and field practice.

The National Architectural Accrediting Board has officially accredited the five-year course leading to the degree Bachelor of Architecture at the Georgia Institue of Technology.

The National Council of Architectural Registration Boards and the Georgia State Board for the Examination, Qualification and Registration of Architects, recognize the Bachelor of Architecture degree at the Georgia Institute of Technology as adequate preparation for practice, with the exception of experience requirements. After three years internship in the office of a registered architect, Bachelor of Architecture graduates may apply for examination and registration as licensed architects.

All work executed in classes administered by the School becomes the property of the School and will be retained, or returned at the discretion of the faculty.

The faculty reserves the right to refuse for credit any project executed outside the precincts of the School of Architecture, or otherwise executed without proper coordination with the instructor.

Standards for Advancement

All students entering the School of Architecture are required during the first term of residence to take interest and aptitude tests with the Office of Guidance and Testing.

Curriculum in Architecture

In order for students to obtain the greatest benefit from courses offered concurrently in the curriculum, progress will be noted at several intervals as follows:

a) Averages in drawing and design will be checked at the end of each year-group of three courses (151-52-53; 251-52-53, etc.). A student will not be permitted to enter a more advanced group until his record in the previous group equals 2.0 or better.

b) Admission to the third year of Architecture will be based on faculty approval plus the completion of all required and prerequisite courses, both academic and departmental, in the first two years of the curriculum. A point average in design of 2.0 and an overall average not less than 1.9 are required. The student on entering the third year must be prepared to schedule his primary subjects concurrently (Arch. 322, 351, 361, ESM 346).

c) Admission to the 5th year of Architecture will be based on faculty approval plus the completion of all required and prerequisite courses, both academic and departmental, in the first four years of the curriculum. A point average of 2.0, both overall and in design courses is required. The student must be prepared to schedule his primary subjects concurrently (Arch. 551 or 554, 561 and C.E. 400);

d) Admission to the thesis in Architecture requires faculty approval and a minimum average of 2.0 in Arch. 551-52 (Option I) or 554-55 (Option II).

e) To qualify for graduation each student must present an affidavit confirming at least three months practical experience in the office of a registered architect or approved construction company.

Curriculum in Building Construction

a) Requirements for the first two years are identical with those for architectural students, except for the substitutions noted.

b) Admission to the third year of Building Construction will be based on faculty approval plus the completion of all required and prerequisite courses, both academic and departmental, in the first two years of the curriculum. An overall average not less than 1.9 is required. The student must be prepared to schedule his primary subjects concurrently (Arch. 322, 337, ESM 346).

c) To become a candidate for a degree, the student must present an affidavit confirming at least three months practical experience with an approved construction or materials concern.

Curriculum in Industrial Design

a) Requirements for the first four quarters are identical with those for architectural students, except for the substitutions noted.

b) Averages in Industrial Design will be checked at the end of each year-group of courses (I.D. 202-3, I.D. 301-2-3, etc.). A student will not be permitted to enter a more advanced group until his record in the previous group equals 2.0 or better.

ARCHITECTURE

Freshman Year *(Uniform for Architecture, Building Construction and Industrial Design)*

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Arch.	151-52-53	Arch. Drawing	0-9-3	0-9-3	0-9-3
Arch.	162-63	Arch. Orientation	....	1-0-0	1-0-0
Arch.	171-72-73	Graphics	1-3-2	1-3-2	1-3-2
Engl.	107-8-9	Introduction to Literature	3-0-3	3-0-3	3-0-3
Math.	107-8-9	Calculus I, II, III	5-0-5	5-0-5	5-0-5
*M.L.		Modern Language	3-0-3	3-0-3	3-0-3
P.T.	101-2-3	Physical Training	0-4-1	0-4-1	0-4-1
**Electives		....	2-0-2	2-0-2	2-0-2
Gen.	101	Orientation	1-0-0	....	....
		Totals	15-16-19	15-16-19	15-16-19

NOTE: Under Quarters, 3-3-4 means 3 hours class, 3 hours lab., 4 hours credit.

*Chemistry is required in place of M.L. for the curricula in Building Construction and Industrial Design.

**These free elective courses may be taken at any time during a student's course of study. However, these six credit hours may be satisfied by selecting basic ROTC. If basic ROTC is elected by the student, then it must be scheduled beginning the first quarter the student is enrolled. For further details, see page 28 of the catalog.

Sophomore Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
**Arch.	251-52-53	Arch. Design	0-15-5	0-15-5	0-15-5
Arch.	271	Structures	3-0-3	....	....
Engl.	201-2-3	Survey of the Humanities	3-0-3	3-0-3	3-0-3
ESM	344-45	Statics and Mechanics of Materials	....	3-3-4	3-0-3
Phys.	211-12-13	Mech; Elec; Heat, Light and Sound	4-0-4	4-0-4	4-0-4
PT	201-2-3	Physical Training	0-4-1	0-4-1	0-4-1
Electives			....	....	3-0-3
		Totals	10-19-16	10-22-17	13-19-19

Junior Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Arch.	322-23-24	Building Materials	2-0-2	2-0-2	2-0-2
Arch.	351-52-53	Arch. Design	0-15-5	0-15-5	0-15-5
Arch.	361-62-63	History and Theory	3-0-3	3-0-3	3-0-3
Arch.	372-73	Structures	....	3-0-3	3-0-3
ESM	346	Mechanics of Materials	3-0-3	....	....
SS		Social Sciences	3-0-3	3-0-3	3-0-3
Electives			3-0-3	3-0-3	3-0-3
		Totals	14-15-19	14-15-19	14-15-19

Senior Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Arch.	451-52-53	Arch. Design	0-18-6	0-18-6	0-18-6
Arch.	461-62-63	History and Theory	3-0-3	3-0-3	3-0-3
Arch.	471	Structures	3-0-3	....	....
C.E.	306, 406	Structural Analysis, Reinforced Concrete	....	3-3-4	2-3-3
M.E.	334-35	Mech. Equip. Bldgs.	3-0-3	2-3-3	....
E.E.	315	Mech. Equip. (Elec.)	....	....	3-0-3
[1] Electives			3-0-3	3-0-3	3-0-3
		Totals	12-18-18	11-24-19	11-21-18

Fifth Year *(Option I–Architectural Design)*

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Arch.	551-52-53	Arch. Design	0-27-9	0-27-9	0-27-9
Arch.	561-62-63	Seminar	2-0-2	2-0-2	2-0-2
Arch.	581-82-83	Professional Practice	3-0-3	3-0-3	3-0-3
C.E.	400	Reinforced Concrete	3-0-3	....	....
[1] Electives		Group I Electives	....	4-0-4	4-0-4
		Totals	8-27-17	9-27-18	9-27-18

Fifth Year *(Option II–Structural Design)*

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Arch.	554-55-56	Structural Design	0-27-9	0-27-9	0-27-9
Arch.	561	Seminar	2-0-2	....	....
Arch.	581-82-83	Professional Practice	3-0-3	3-0-3	3-0-3
Arch.	522	Structural Design: Integration	....	3-3-4	....
C.E.	400	Reinforced Concrete	3-0-3	....	....
[1] Electives		Group II Electives	....	2-0-2	6-0-6
		Totals	8-27-17	8-30-18	9-27-18

[1] Electives: 8 hours must be chosen from the restricted list of the School of Architecture, Group I or Group II corresponding to option.
12 hours must be chosen from the list of general electives approved by the School of Architecture.
9 hours may be used as free electives. If advanced military is elected, 9 hours only will be credited toward a degree.

Building Construction

As one of the major industries in the country, Construction has need of many men who are trained in the field of materials, products, manufacture, sales and general contracting. The Building Construction curriculum at Georgia Tech is designed to supply graduates for those varied building activities which, with the architect and engineer, help to coordinate all building projects. The course parallels the curriculum in Architecture for the first two years, then specializes in technical studies in construction, materials, personnel and management problems. The degree, Bachelor of Science in Building Construction, is awarded on the completion of four years of study.

Freshman and Sophomore years—see Architecture.

Junior Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Arch.	322-23-24	Building Materials.........	2-0-2	2-0-2	2-0-2
Arch.	337-38-39	History.........................	2-0-2	2-0-2	2-0-2
Arch.	372-73	Structures.....................	....	3-0-3	3-0-3
ESM	346	Mechanics of Materials..	3-0-3	....	....
C.E.	206	Elem. Surveying............	....	....	2-3-3
C.E.	306	Structural Analysis.......	....	3-3-4	....
Engl.	320	Tech. Writing...............	3-0-3	....	....
Econ.	204	Economics...................	3-0-3	....	....
Mgt.	340	Accounting Survey.......	....	....	3-3-4
M.E.	353	Materials Laboratory....	....	0-3-1	....
M.L. or		Modern Language			
S.S.		Social Science..............	3-0-3	3-0-3	3-0-3
Electives		....	3-0-3	3-0-3	3-0-3
		Totals........................	19-0-19	16-6-18	18-6-20

Senior Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Arch.	471	Structures.....................	3-0-3	....	....
Arch.	581-82-83	Professional Practice.....	3-0-3	3-0-3	3-0-3
Arch.	584	Cost Analysis................	....	2-3-3	....
C.E.	406, 400	Reinforced Concrete.....	....	2-3-3	3-0-3
M.E.	334-35	Mech. Plant..................	3-0-3	2-3-3	....
E.E.	315	Mech. Plant (Elec.).......	....	....	3-0-3
Mgt.	310	Industrial Marketing.....	....	3-0-3	....
Mgt.	316	Fin. Survey...................	3-0-3	....	....
Mgt.	325	Survey of Bus. Law.......	3-0-3	....	....
Mgt.	443	Principles of Investment.................	....	....	3-0-3
[1] Electives		....	3-0-3	3-0-3	6-0-6
		Totals........................	18-0-18	15-9-18	18-0-18

[1] Electives: 15 hours must be chosen from the approved list of the School of Architecture. 9 hours may be used as free electives. If advanced military is elected, 9 hours only will be credited toward a degree.

Industrial Design

Industrial Design deals with the development of those products of industry with which man, in utilizing them, has direct visual physical relationship, such as utensils, appliances, equipment, and furnishings for the home, industry, commercial and public places.

The specialized curriculum in Industrial Design begins with the second term of the Sophomore Year. It is comprised of two design series which are taken concurrently.

The Industrial Design Series deals with the nature of objects, the design processes, the different fields of design, and the types and groups of objects. In this series the student deals with the actual design and execution of text models as well as with the theoretical aspect of design for mass-production.

The Material and Technique Series covers the relationship of design to various industrial materials and processes. In this series the student designs and executes objects, but is limited in each assignment to specific materials and/or processes.

The degree, Bachelor of Science in Industrial Design, is awarded on the completion of four years of study.

Freshman year—see Architecture.

Sophomore Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Arch.	251	Arch. Design	0-15-5	....	....
Arch.	254-55	Color Theory	....	1-3-2	1-3-2
I.D.	202-3	Design	....	1-12-5	1-12-5
I.D.	215-16	Material and Technique	....	1-3-2	1-3-2
Engl.	201-2-3	Survey of the Humanities	3-0-3	3-0-3	3-0-3
Phys.	211-12-13	Physics	4-0-4	4-0-4	4-0-4
P.T.	201-2-3	Physical Training	0-4-1	0-4-1	0-4-1
[1]Electives		....	3-0-3	....	....
		Totals	10-19-16	10-22-17	10-22-17

[1]Electives: 17 hours must be chosen from the approved list of the School of Architecture. 9 hours may be used as free electives. If advanced military is elected, 9 hours only will be credited toward a degree.

Junior Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Arch.	354-55	Arch. Rendering	0-3-1	0-3-1	....
Arch.	337-38-39	Arch. History	2-0-2	2-0-2	2-0-2
I.D.	301-2-3	Design	1-12-5	1-12-5	1-15-6
I.D.	314-15-16	Material and Technique	1-3-2	1-3-2	1-3-2
Met.	325	General Metallurgy	....	3-0-3	....
I.E.	311	Manufacturing Processes	....	....	3-0-3
M.L. or S.S.		Modern Language Social Science	3-0-3	3-0-3	3-0-3
[1] Electives			6-0-6	3-0-3	3-0-3
		Totals	13-18-19	13-18-19	13-18-19

[1] Electives: 17 hours must be chosen from the approved list of the School of Architecture. 9 hours may be used as free electives. If advanced military is elected, 9 hours only will be credited toward a degree.

Senior Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Arch.	530	Art History	....	2-0-2	....
I.D.	401-2-3	Design	1-15-6	1-18-7	1-21-8
I.D.	414	Material and Technique	1-3-2	....	....
Engl.	320	Tech. Writing	3-0-3	....	....
I.E.	490	Legal and Ethical Phases of Engr.	....	....	3-0-3
Mgt.	310	Industrial Marketing	....	3-0-3	....
Psy.	303-4	General Psychology A and B	3-0-3	3-0-3	....
Pol.	370	Problems of Public Opinion	....	....	3-0-3
[1] Electives			4-0-4	3-0-3	4-0-4
		Totals	12-18-18	12-18-18	11-21-18

[1] Electives: 17 hours must be chosen from the approved list of the School of Architecture. 9 hours may be used as free electives. If advanced military is elected, 9 hours only will be credited toward a degree.

ELECTIVES

General Electives: See humanities list on page 38 plus the following: Engl. 315, 320; ICS 151, I.D. 215, 216; Mgt. 316, 325, 340, 443; Math. 207, 208, 209, 236.

Restricted Electives: Group I: Arch. 254, 255, 335, 336, 354, 355, 384, 416, 435, 436, 444, 465, 466, 484, 485, 486, 510, 511, 512, 513, 514, 522, 530, 540, 541, 584. Group II: Arch. 540, 541, 584; C.E. 201 or 206, 211, 460; ICS 151; I.E. 460; M.E. 353.

Courses of Instruction: Architecture

NOTE: 4-3-5 *means* 4 *hours class,* 3 *hours laboratory,* 5 *hours credit.*

Arch. 151, 152, 153. Architectural Drawing

0-9-3

Introductory studies in drawing and the principles of visual expression; includes one laboratory period per week in creative drawing.

Texts: Martin, *Architectural Graphics;* Mendelwitz, *Drawing–A Study Guide;* Bevlin, *Design Through Discovery;* French and Turnbull, *Lessons in Lettering.*

Arch. 162, 163. Orientation

1-0-0.

An introduction to the field of architecture and design; a requirement for all students in the School of Architecture.

Texts: Danby, *Grammar of Architectural Design;* Rasmussen, *Experiencing Architecture.*

Arch. 171, 172, 173. Graphics

1-3-2.

Lectures and laboratory exercises in descriptive geometry; shades and shadows; perspective.

Texts: Warner and McNeary, *Applied Descriptive Geometry.* Martin, *Architectural Graphics.*

Arch. 251, 252, 253. Design

0-15-5. Prerequisites: Arch. 153, 163, 173.

Basic composition, architectural problems and presentation methods; includes one laboratory period per week in creative drawing.

Arch. 254, 255. Color Theory

1-3-2. Prerequisite: Arch. 251 or Soph. standing.

Lecture and laboratory experiments on the properties of color and its use in design.

Arch. 271. Introduction to Building Structures

3-0-3. Prerequisite: Math. 109

A discussion of building frames and components and their relation to architecture.

Arch. 310, 311, 312. Freehand Drawing

0-3-1.

For non-architects and architects who lack credit when transferring from other schools or institutions. Creative drawing from compositions by students.

Arch. 322, 323, 324. Building Materials

2-0-2. Prerequisite: Arch. 253 or consent.

A study of materials of construction, their properties and use in modern construction, with special attention to their effect upon architectural design.

Text: Hornbostel, *Materials for Architecture.*

Arch. 335, 336. Art History

2-0-2. Prerequisite: Arch. 253 or consent.

A history of the development from primitive to modern times of the useful objects, artifacts, and inventions of man (tools, utensils, furniture, weapons, etc.) as distinguished from the usual categories of painting, sculpture, and architecture; with an analysis of present-day principles and processes.

Arch. 337, 338, 339. Architectural History

2-0-2. Prerequisite: Arch. 252 or consent.

A survey course in architectural history for non-architectural students. In non-technical language, it covers architectural development from ancient times to the present. Lectures, supplemented by slide projection, notes and reading assignments.

Text: Hamlin, *Architecture Through the Ages.*

Arch. 351, 352, 353. Design

0-15-5. Prerequisites: Arch. 253 and admission to the third year curriculum.

Elementary problems in architectural design and presentation methods; includes one laboratory period per week in creative drawing.

Text for 351: Burbank and Shaftel, *House Construction Details.*

Arch. 354, 355. Architectural Rendering

0-3-1. Prerequisite: Arch. 251.

Rendering of architectural subjects in various media.

Arch. 361, 362, 363. History and Theory

3-0-3. Prerequisite: Admission to the third year curriculum or consent.

History of architecture in ancient Egypt and Mesopotamia, Greece and Rome; Medieval Europe; the Renaissance in continental Europe.

Texts: Millon, *Key Monuments of Architecture;* Fletcher, *A History of Architecture.*

Arch. 371, 372, 373. Structures

3-0-3. Prerequisites: ESM 343 and admission to the third year curriculum.

Introduction to methods of construction, proportioning and qualitative explanation of behavior; theory and design of ordinary timber structures; theory and design of metal structures (Part I).

Texts: Salvadori, *Structure in Architecture;* Scofield and O'Brien, *Modern Timber Engineering;* Lehigh Univ., *Structural Steel Design; A.I.S.C. Steel Construction Handbook.*

Arch. 381, 382. Design and Graphic Presentation

1-12-4. Prerequisite: Senior standing.

A basic course in drawing and design for students preparing for the Master's program in City Planning. Not open to architectural students.

Arch. 384 Acoustics of the Built Environment

2-0-2. Prerequisite: Physics 213

The basic principles of and the design approach to the acoustics of buildings and their surroundings.

Arch. 410. Freehand Drawing

0-6-2.

For non-architects, and architects electing additional work in creative drawing.

Arch. 411. Freehand Drawing

0-3-1.

For non-architects, and architects electing additional work in creative drawing.

Arch. 412. Freehand Drawing

0-6-2.

For non-architects, and architects electing additional work in creative drawing.

Arch. 416. Introduction to Landscape Architecture

2-0-2. Prerequisites: Arch. 451 and Arch. 461.

A brief history of landscape architecture followed by a study of the principles of landscape design as applied to contemporary problems.

Arch. 435, 436. Art History

2-0-2. Prerequisite: Junior standing.

A survey course in the history of artistic manifestations from primitive times to our own day.

Text: Janson, *History of Art.*

Arch. 444. Housing Seminar

2-0-2. Prerequisite: Junior standing.

Lecture and discussion broadly covering the housing field and the home building industry, housing needs, housing markets and financing, standards of design and construction, the Government and housing.

Arch. 451, 452, 453. Design

0-18-6. Prerequisites: Arch. 353 and advancement standard.

Intermediate problems in architectural design and presentation methods; includes one laboratory period per week in freehand drawing from live models.

Arch. 461, 462, 463. History and Theory

3-0-3. Prerequisites: Arch. 363 and advancement standard.

Renaissance architecture in England and America; the 19th and 20th centuries; history of town and city planning in Europe and America.

Texts: Fletcher, *A History of Architecture;* Richards, *Modern Architecture;* Gallion, *The Urban Pattern.*

Arch. 465, 466. Art History

2-0-2. Prerequisite: Junior standing.

A history of Pre-Columbian and Oriental art and architecture.

Arch. 471. Structures

3-0-3. Prerequisite: Arch. 373.

Theory and design of metal structures (Part II).

Texts: Lehigh Univ., *Structural Steel Design; A.I.S.C. Steel Construction Handbook.*

Arch. 484 (Psy. 484) Psychology and Environmental Design I.

3-3-4. Prerequisite: Permission of instructor.

Arch. 485 (Psy. 485) Psychology and Environmental Design II.

3-3-4. Prerequisite: Arch. 484 and permission of instructor.

Arch. 486 (Psy. 486) Special Problems in Psychological Aspects of Environmental Design.

Prerequisites: Arch. 484, 485 and permission of instructor. Credit to be arranged.

Arch. 510, 511, 512. Freehand Drawing: Advanced

0-3-1. Prerequisite: Arch. 453.

Freehand drawing of varied subjects and in various media.

Arch. 513, 514. Freehand Drawing: Advanced

0-3-1, 0-6-2. Prerequisite: Arch. 453.

Freehand drawing from live models.

Arch. 522. Structural Design: Integration

3-3-4. Prerequisites: Arch. 373 and C.E. 400 or consent.

This course brings together the information obtained in previous courses in Structural Design and presents the subject matter as an integrated whole.

Arch. 530. Art History

2-0-2. Prerequisites: Arch. 339, 462 or consent.

A survey of 19th and 20th century art in Europe and the United States.

Text: Hunter, *Modern French Painting.*

Arch. 540, 541. Research

0-6-2, 0-9-3 or 1-9-4.

A clearly stated program by the student describing in detail the nature, purpose and extent of the proposed problem must be submitted for approval. The major portion of the work will be conducted in library, drafting room, or shop.

Arch. 551, 552, 553. Design

0-27-9. Prerequisites: Arch. 453 and advancement standard.

Group I. Advanced problems in architectural design with emphasis on the solution of complex building programs and site planning, terminating in an independent major problem submitted as a thesis for the degree Bachelor of Architecture (Option I).

Arch. 554, 555, 556. Design

0-27-9. Prerequisites: Arch. 453 and advancement standard.

Group II. Advanced Problems in architectural design with emphasis on structural solutions, computations and details, terminating in an independent problem submitted as a thesis for the degree Bachelor of Architecture (Option II).

Arch. 561, 562, 563. Seminar

2-0-2. Prerequisites: Arch. 453, 463.

Preparation of thesis programs and research; lectures and discussions of current problems in architectural design and architectural education.

Arch. 581, 582, 583. Professional Practice

3-0-3. Prerequisites: Arch. 453, 463, or Senior Standing.

Conduct of architectural practice, office organization, competitions, contracts, legal and ethical problems; specification writing; estimating and supervision of construction.

Texts: *A.I.A. Handbook of Architectural Practice;* H. G. Edwards, *Specifications.* Second Edition; Peurifoy, *Estimating Construction Costs.*

Arch. 584. Cost Analysis

2-3-3. Prerequisite: Senior standing.

Principles and methods of cost analysis in the construction industry. Methods of compiling and analyzing material, labor and equipment production costs. Exercises in office and field management procedures.

Text: Peurifoy, *Estimating Construction Costs.*

Courses of Instruction: Industrial Design

NOTE: 4-3-5 *means* 4 *hours class,* 3 *hours laboratory,* 5 *hours credit.*

I.D. 202. Design

1-12-5. Prerequisite: Arch. 251. Concurrent with I.D. 215.

Introduction to Industrial Design.

Theory and practical exercises in ideation and design procedure.

I.D. 203. Design

1-12-5. Prerequisite: I.D. 202. Concurrent with I.D. 216.

The basic attributes of objects. Study of factors which determine the characteristics of an object.

I.D. 215. Material and Technique

1-3-2. Prerequisite: Arch. 153 or consent.

The standard joints and hand operated machines. Exercises, execution and development of joints.

I.D. 216. Material and Technique

1-3-2. Prerequisite: I.D. 215 or consent.

Continuation of I.D. 215. Design for low-production processes.

I.D. 301. Design

1-12-5. Prerequisite I.D. 203. Concurrent with I.D. 314.

Design of structural objects.

I.D. 302. Design

1-12-5. Prerequisite: I.D. 301. Concurrent with I.D. 315.

Design analysis of a mass produced object.

I.D. 303. Design

1-15-6. Prerequisite: I.D. 301. Concurrent with I.D. 316.

Design and execution of an object, based on studies in the previous course.

I.D. 314. Material and Technique

1-3-2. Prerequisite: I.D. 216.

Casting and fabricating techniques—plaster, plastic-casting, blowing, sand casting, ceramics, paper, rubber, etc.

Design of objects for the various techniques.

Texts: Bolz, *Manufacturing Processes and Their Influence on Design;* DuMond, *Fabricated Materials and Parts.*

I.D. 315. Material and Technique

1-3-2. Prerequisite: I.D. 314.

The industrial pre-formed materials–extrusion, rolled and drawn profiles, mouldings, etc.

Design of objects for the various techniques.

Texts: Bolz, *Manufacturing Processes and Their Influence on Design;* DuMond, *Fabricated Materials and Parts.*

I.D. 316. Material and Technique

1-3-2. Prerequisite: I.D. 315.

Semi-automatic and mass-production techniques–forging, stamping, heading, screw machining, wire forming.

Design of objects for various techniques.

Texts: Bolz, *Manufacturing Processes and Their Influence on Design;* DuMond, *Fabricated Materials and Parts.*

I.D. 401. Design

1-15-6. Prerequisite: I.D. 303. Concurrent with I.D. 414.

Design of products enclosing engineering components.

I.D. 402. Design

1-18-7. Prerequisite: I.D. 401.

Ecology of products. Complex interrelationship of products to space and time.

I.D. 403. Design

1-21-8. Prerequisite: I.D. 402.

Design and execution of a product based on studies in the preceding course.

I.D. 414. Material and Technique

1-3-2. Prerequisite: I.D. 316.

The mass-production techniques–die casting, impact extrusion, compression–transfer–injection–molding, etc.

Design of objects for various techniques.

Sophomore Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
Bio.	210-11-12	Introductory Biology....	5-3-6	5-3-6	5-3-6
Engl.	201-2-3	Survey of Humanities ...	3-0-3	3-0-3	3-0-3
M.L.	*	Modern Language OR			
S.S.		Social Science..............	3-0-3	3-0-3	3-0-3
Chem.	340-41-42	Organic Chemistry........	3-0-3	3-0-3	3-0-3
Chem.	343, 348	Organic Chem. Lab.......	0-6-2	....	0-6-2
P.T.	201-2-3	Physical Training..........	0-4-1	0-4-1	0-4-1
		Totals........................	14-13-18	14-7-16	14-13-18

*Three quarters of either M.L. or S.S. are required.

Junior Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
Bio.	310	Microbiology	....	....	3-6-5
Bio.	333	Biostatistics	3-3-4	....	....
Bio.	334	Genetics.......................	....	3-3-4	....
Phys.	227-8-9	Introductory Physics	4-3-5	4-3-5	4-3-5
Electives*		....	0-0-6	0-0-6	0-0-5
		Totals........................	7-6-15	7-6-15	7-9-15

*Not more than 9 hours of Electives in the Junior and Senior Years may be advanced ROTC. The remaining electives must be chosen in conference with a staff advisor to provide a sequence or group of courses which is interrelated to a specific field of interest.

Senior Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
Bio.	431	Cytology......................	3-6-5	....	....
Bio.	478	Physical Biology	....	4-0-4	....
Bio.	443-44-45	Physiology...................	3-6-5	3-6-5	3-6-5
Electives*		....	0-0-6	0-0-6	0-0-10
		Totals........................	6-12-16	7-6-15	3-6-15

*Not more than 9 hours of Electives in the Junior and Senior Years may be advanced ROTC. The remaining electives must be chosen in conference with a staff advisor to provide a sequence or group of courses which is interrelated to a specific field of interest. NOTE: Of the 45 hours of electives, 25 hours must be departmentally approved courses in biology, mathematics, physics, chemistry, or engineering.

Courses of Instruction

NOTE: 4-3-5 *means* 4 *hours class,* 3 *hours laboratory,* 5 *hours credit.*

Bio. 101. Orientation to Biology

1-0-1. Prerequisite: None.

An orientation to the broad spectrum of subdisciplines encompassed by the term "biology" and to the biology program at Georgia Tech. The objective will be to give to students ideas of the nature of biology, contemporary research in biology, and the types of career opportunities available to graduates.

Bio. 110-11-12. Introduction to Biology I, II, III.

3-3-4, 3-3-4, 3-3-4. Prerequisite: None.

A three quarter lecture and laboratory study of the principles of biology for students interested in one year of laboratory science. The chemical basis of life is defined and life processes studied at the cellular and organism levels. Basic principles of genetics, physiology, metabolism, taxonomy, and evolution in plants and animals are discussed. Non-credit for biology majors.

Text: Keeton, *Biological Science.*

Bio. 210-11-12. Principles of Biology

5-3-6, 5-3-6, 5-3-6. Prerequisites: Chem. 112; the biology courses to be taken in sequence.

These three courses constitute an intensive, three quarter introduction to the principles of biology and are intended for biology majors and students who have a strong interest in the subject of biology. Chemical as well as descriptive considerations are emphasized in the study of the physiology, anatomy, and genetics of individual cells. The cellular aspects of biology are then integrated into a study of the physiology, development, anatomy, and behavior of intact organisms, both plant and animal. Finally, a study is made of the ecology of populations of organisms, including the principles of biological evolution.

Text: Curtis, *Biology;* supplemented by selected specialized texts.

Bio. 310. General Microbiology

3-6-5. Prerequisites: Bio. 212; Chem. 341.

Study of bacteria and other microorganisms.

Text: Pelczar and Reid, *Microbiology.*

Bio. 316. Industrial Hygiene

3-0-3. Prerequisite: None.

Problems of health in industry; industrial poisons, occupational hazards and diseases, industrial fatigue, ventilation, and accident prevention.

Text: References.

Bio. 333. Biostatistics

3-3-4. Prerequisites: Math. 109; Bio. 212.

An introduction to statistical methods and their use in the preparation and interpretation of biological experiments.

Texts: Croxton, *Elementary Statistics with Emphasis in Medical and Biological Sciences;* Goldstein, *Biostatistics.*

Bio. 334. Genetics

3-3-4. Prerequisites: Bio. 212 or consent of instructor.

An introduction to the principles of heredity.

Text: To be selected.

Bio. 341. Comparative Anatomy

3-6-5. Prerequisite: Bio. 211.

Study of the comparative anatomy of the vertebrates with laboratory dissection of several vertebrate forms.

Text: To be selected.

Bio. 407. Advanced Microbiology

3-4-4. Prerequisites: Bio. 310, Chem. 341.

Advanced discussion and laboratory procedures in bacteriology and general microbiology.

Text: To be selected.

Bio. 413. Air and Water Pollution

3-0-3. Prerequisite: None.

An introduction to the technical and legal problems of air and water pollution by industry and its control, for those engineers working in industry.

Text: References.

Bio. 415. Introductory Radiation Biology

3-3-4. Prerequisite: Consent of instructor.

A general survey of biological systems and their responses to various kinds of radiations.

Text: Bacq and Alexander, *Fundamentals of Radiobiology.*

Bio. 429. Biological Principles of Radiobiology

3-3-4. Prerequisite: None.

A survey of the biological principles necessary as a prerequisite for the study of radiobiology. Non-credit for Biology majors.

Text: Selected references.

Bio. 431. Cytology

3-6-5. Prerequisite: Bio. 212.

Modern aspects of the morphologic, functional and cytochemical organization of the cell. Preparative techniques and principles for observations in light, phase and electron microscopy.

Text: DeRobertis, Nowinski, and Saez, *Cell Biology.*

Bio. 435, 436. Applied Biology

3-0-3. Prerequisite: Consent of Instructor.

Selected topics in modern biology.

Text: References.

Bio. 443, 444, 445. General Physiology

3-6-5, 3-6-5, 3-6-5. Prerequisites: Bio. 310, Chem. 342.

The chemical, physical and biological responses and functions of living systems. The study of cellular biochemistry and metabolism, tissue and organ function, interrelationship of organ systems and the response of the whole organism to its environment.

Texts: Giesè, *Cell Physiology;* Other texts to be selected.

Bio. 450. Seminar

2-0-2. Prerequisite: Senior status.

Student and staff presentations of reports on laboratory or literature searches.

Text: References.

Bio. 460, 461, 462. Special Problems

Hours to be arranged. Prerequisite: Bio. 212.

A course for the study of special laboratory problems in biology, to be given any quarter with credits (not to exceed 6) to be arranged.

Text: References.

Bio. 478. Physical Biology.

4-0-4. Prerequisites: Phys. 227, Chem. 342; or consent of instructor.

This course emphasizes the use of modern physics and biochemistry in explaining the structure and function of biological systems at the atomic and molecular levels. The approach is mainly mathematical; quantum mechanics will be introduced as needed.

Texts: Setlow and Pollard, *Molecular Biophysics;* Hanna, *Quantum Mechanics in Chemistry.*

Graduate Courses Offered

Bio.	630	Biological Effects of Radiation	3-3-4
Bio.	632	Design of Experiments in Quantitative Biology	3-3-4
Bio.	633	Selected Topics in Radiobiology	3-3-4
Bio.	634	Selected Topics in Experimental Cell Biology	3-3-4
Bio.	635	Air Pollution Biology	3-0-3
Bio.	640	Instrumental Methods in Biology	3-6-5
Bio.	641	Electron Microscopy Laboratory	0-6-2
Bio.	704,5,6	Special Problems	

(Complete details about these courses are contained in the *Graduate Bulletin,* a copy of which is available upon request.)

SCHOOL OF CERAMIC ENGINEERING

(Established 1924)

Director—Lane Mitchell; *Professor*—Willis E. Moody; *Associate Professors*—James F. Benzel, A. T. Chapman, William C. Hansard; *Special Lecturers*—R. J. Gerdes, Jerry Johnson, Jas. Neiheisel, Thos. H. Sanders, *Principal Secretary*—Thelma Saggus; *Secretary*—Paula Carpenter; *Senior Laboratory Mechanic*—Thomas Mackrovitch.

General Information

A four-year curriculum leads to the degree of Bachelor of Ceramic Engineering. Graduate work leading to the Master of Science in Ceramic Engineering is also offered. A broad basic training is given the Bachelor degree candidate in the fundamental and engineering courses, thus preparing the student to enter successfully any division of ceramic engineering. However, the necessary cultural courses are included. The classroom, laboratory and library work are co-ordinated to combine theoretical and practical knowledge. Periodic contracts with the non-metallic mineral and clayworking industries of the State enlarge the practical viewpoint of the student.

The School is vitally concerned with future development of the ceramic and mineral industries in the South. Through research, the use of Georgia minerals has been extended so that almost every ceramic industry may find the greater proportion of its raw materials within the state boundaries. Demonstration of a stable market and the many industrial advantages of Georgia are encouraging the establishment of new industries. In this program the School is using its facilities to aid proper development.

The School also offers to non-majors survey courses in Ceramics. These courses broaden the viewpoint of other students concerning a vital field contributing to contemporary civilization. Many contributions to ceramic science and industry of implication nationally and world wide have emanated from this School. Much fundamental research is presently in progress and will continue.

Freshman Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
Chem.	104-5	General Chemistry	4-3-5	4-3-5	....
E.Gr.	170-1	Engineering Graphics	2-3-3	2-3-3	....
Math.	107-8-9	Calculus I, II, III	5-0-5	5-0-5	5-0-5
Phys.	227	Physics	....	....	4-3-5
P.T.	101-2-3	Physical Training	0-4-1	0-4-1	0-4-1
Hum./S.S./M.L.		Humanities, Social Sciences, Modern Languages	3-0-3	3-0-3	3-0-3
***Elec.		....	2-0-2	2-0-2	2-0-2
Gen.	101	Orientation	1-0-0	....	....
		Totals	17-10-19	16-10-19	14-7-16

NOTE: Under quarter, 3-3-4 means 3 hours class, 3 hours lab, 4 hours credit.

Sophomore Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
Cer.E.	204	Ceramic Data Handling	....	....	2-3-3
Cer.E.	208	Ceramic Survey	....	....	2-0-2
ESM	205	Statics	3-0-3	....	....
ESM	309	Applied Mechanics	....	3-0-3	....
Math.	207	Calculus IV	5-0-5	....	....
Math.	208	Calculus and Linear Algebra	....	5-0-5	....
Math.	209	Ordinary Differential Equations	....	....	5-0-5
Phys.	228-9	Physics	4-3-5	4-3-5	....
P.T.	201-2-3	Physical Training	0-4-1	0-4-1	0-4-1
Hum./S.S./M.L.		....	3-0-3	3-0-3	3-0-3
Hum./S.S./M.L.		....	....	....	3-0-3
		Totals	15-7-15	15-7-17	15-7-17

***These free elective courses may be taken at any time during a student's course of study. However, these six credit hours may be satisfied by selecting basic ROTC. If basic ROTC is elected by the student, then it must be scheduled beginning the first quarter the student is enrolled. For further details, see page 28 of the catalog.

Junior Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Cer.E.	305	Phase Equilibria for Ceramists..................	....	3-0-3	....
Cer.E.	310	Principal Materials of Ceramics...................	2-3-3	....	....
Cer.E.	311	Processing and Forming	3-3-4	....	....
Cer.E.	315	Solid State Ceramics.....	....	....	3-0-3
Cer.E.	318	Pyrometry and Instruments..............	....	1-3-2	....
Cer.E.	320	Glass............................	....	2-3-3	....
Chem.	209	Chemical Principles.......	3-3-4	....	....
Chem.	331-332	Physical Chemistry.......	....	3-0-3	3-0-3
Chem.	339	Physical Chemistry Laboratory...............	....	....	0-6-2
ESM	334	Mechanics of Deformable Bodies.......................	....	....	5-0-5
Geol.	203	General Geology..........	....	3-3-4	....
Geol.	325	Mineralogy...................	....	....	3-3-4
Hum./S.S./M.L.		....	3-0-3	3-0-3	....
Hum./S.S./M.L.		....	3-0-3	....	....
Elec.		....	3-0-3	....	....
		Totals.......................	17-9-20	15-9-18	14-9-17

Senior Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Cer.E.	420	Microscopy..................	....	2-6-4	....
Cer.E.	418	Drying and Psychrometry	2-0-2	....	....
Cer.E.	419	Firing and Combustion.	....	2-3-3	....
Cer.E.	422-28-29	Thesis..........................	1-0-1	0-3-1	1-6-3
Cer.E.	425-26	Physical Ceramics.........	....	3-3-4	2-0-2
Cer.E.	431-32-34	Design and Construction	1-3-2	0-6-2	0-3-1
Cer.E.	441	Glaze and Enamel Coating.....................	2-3-3	....	....
Chem.	333	Physical Chemistry.......	3-0-3	....	....
E.E.	325	Electrical Circuits and Fields.................	....	....	2-3-3
Met.	401	Engineering Materials....	3-0-3	....	....
Hum./S.S./M.L.		....	....	3-0-3	3-0-3
Elec.		....	3-0-3	....	3-0-3
mm		Totals.......................	15-6-17	10-21-17	11-12-15

Recommended Electives*

Course	*No.*	*Subject*	*Hours*
Cer.E.	406-7-8	Seminar	2-0-2
Cer.E.	421	Cements	2-3-3
Cer.E.	450	Engineering Materials in Nuclear Engineering	2-3-3
C.E.	206	Elementary Surveying	2-3-3

Any course for which student has prerequisites in geology, chemistry, physics, industrial engineering, industrial management, mathematics, psychology, or English.

*Check quarterly schedule of course offerings to determine if offered. Ordinarily a request for a course by eight or more students will be honored. Also, check prerequisites required.

Courses of Instruction

NOTE: 3-4-5 *means* 4 *hours class,* 3 *hours laboratory,* 5 *hours credit.*

Cer.E. 202. Products and Materials

2-3-3. Prerequisites: Chem. 103. Cer.E. 208.

An engineering survey of ceramics; relationship between industrial service requirements and the properties of ceramic products. The common ceramic materials are classified according to mineralogical character; their influence on each other, the effects of size, and the physical properties of particles are stressed.

Text: Norton, *Elements of Ceramics.*

Cer.E. 203. Equipment and Tests

2-3-3. Prerequisites: Chem. 103, Cer.E. 208.

Testing of ceramic raw materials and products; requirements of proper test methods and practical applications to industry.

Interpretation of results and writing of formal reports. Uses, operation, and calibration of machinery, apparatus, and equipment for ceramic manufacture of testing. Mathematical analysis of data; inherent errors.

Texts: Wilson, *An Introduction to Scientific Research;* and Cloxton, *Elementary Statistics with Applications in Medicine and the Biological Sciences.*

Cer.E. 204. Ceramic Data Handling (Replaces Cer.E. 203)

2-3-3. No prerequisites.

Study of reasons for testing and details and nature of tests selected; interpretation of results, consolidation of data, analysis of effectiveness, statistical and computer methods, presentation of results and formal reports. Laboratory experiments to gain and handle data.

Cer.E. 208. Ceramic Survey

2-0-2. Prerequisite: None. General Elective for non-ceramic majors.

A survey is made of the classification and physical properties of ceramic products. The physical properties of raw materials are studied briefly with emphasis on qualities and limitations which relate to design and manufacturing processes.

Text: Mitchell, *Ceramics – Stone Age to Space Age.*

Cer.E. 209. Ceramic Survey Laboratory

0-3-1. Prerequisite or Corequisite: Cer.E. 208.

Plant trips to local ceramic plants. Production of molds and pottery.

Cer.E. 305. Phase Equilibria for Ceramists

3-0-3. Prerequisite or Corequisite: Chem. 331.

Heterogeneous equilibria of inorganic systems. One, two, and three component systems. Solid solutions isomorphous replacement. Alkemade lines. Metastable equilibrium. Paths of crystallization.

Text: Levin and McMurdie, *Phase Diagrams for Ceramists*, (A monograph of the American Ceramic Society).

Cer.E. 310 Principal Materials of Ceramics (Replaces Cer.E. 202)

2-3-3. Prerequisite: Cer.E. 208.

Study of nature, properties, occurrence, uses, functions, and modification of silica, clays, feldspars, carbonates, talc, carbons, and related minerals used widely in ceramic compositions. Substitutes possible: atomic and structural nature as related to properties. Laboratory introduces these minerals in various experiments.

Cer.E. 311. Processing and Forming

3-3-4. Prerequisite: Cer.E. 203.

Winning, refining and preparation of ceramic raw materials, methods and mechanism of processing and forming ceramic products; their effect on the control of the properties of the products and adaptation to service requirements.

The relation of laboratory technique to plant practice including properties of materials, machines, processing and products. Commercial raw materials and products are provided and analyzed and, where practical, the corresponding plants are visited.

Text: Kingery, *Ceramic Fabrication Processes.*

Cer.E. 315. Solid State Ceramics

3-0-3. Prerequisite: Cer.E. 311.

The physical and chemical properties of materials throughout common processes used in the production of ceramic products. Control of phases of manufacture to introduce in the product those properties service conditions require. Sintering, melting, and crystallization processes and their effects on structure and density are discussed. Whitewares, terra cotta, heavy clay products, glass, and body, mold, and sagger composition and processing are studied.

Text: Kingery, *Introduction to Ceramics; Course Notes.*

Cer.E. 318. Pyrometry and Instruments

1-3-2. Prerequisite: Physics 208.

The principles of heat measurement by shrinkage rings, melting points, color, pyrometric cones, expanding metals, thermocouples and resistance bridges. The factors governing choice of thermocouples. The principles behind construction of couples, CO_2 meters, temperature controls, and other control instruments.

Texts: Foote, Fairchild and Harrison, *Pyrometric Practice;* Dike, *Thermoelectric Thermometry.*

Cer.E. 320. Glass

2-3-3. Prerequisite or Corequisite: Cer.E. 305.

The fundamentals of glass structure, composition, manufacture, properties and applications. Phase relations of the important oxides. Reasons for glass formation instead of crystallization. Melting, quenching, annealing, tempering, fracturing, devitrification and modification are phenomena studies. Techniques of forming and basis of selection of ingredients for glass forming, fluxing, color, refractive index, and other properties are carefully considered.

Text: Scholes, *Modern Glass Practice.*

Cer.E. 406-7-8. Seminar

2-0-2. Prerequisite: Senior standing in Cer.E.

Discussion of current ceramic and scientific literature and reports of investigation. Course may be repeated with different numbers.

Text: *Journal of American Ceramic Society.*

Cer.E. 409. Microscopy

3-6-5. Prerequisites: Physics 209, Geology 414.

Involves the use of the microscope in the study and control of composition and structure of ceramic bodies and raw materials. Nature of light and crystallography are briefly studied.

Text: Bloss, *An Introduction to the Methods of Optical Crystallography.*

Cer.E. 420. Microscopy (Replaces Cer.E. 409)

2-6-4. Prerequisites: Phys. 229, Geology 325.

Involves the use of the microscope in the study and control of composition and structure of ceramic bodies and raw materials. Nature of light and crystallography are briefly studied.

Cer.E. 422-23-12. Thesis

1-0-1, 0-6-2, 0-6-2. Prerequisite: Senior standing in Ceramic Engineering.

Each senior conducts an original investigation on an approved ceramic subject under the supervision of the instructor in charge. The object of this course is to place the student upon his own initiative and to coordinate the knowledge that he has previously received.

Cer.E. 418. Drying and Psychrometry

2-0-2. Prerequisites: Cer.E. 315, Physics 209.

Fundamental consideration of water removal from unfired ceramic products by heat and air. Control of humidity, temperatures, air velocity and volume; economy and efficiency of drying and driers; problems to be met in safe drying.

Texts: Madison, *Fan Engineering;* North American, *Combustion Handbook;* Moody and Wysong, *Drying.*

Cer.E. 419. Firing and Combustion

2-3-3. Prerequisites: Physics 209, M.E. 320 or equivalent.

Objectives of firing; combustion behavior of gaseous, liquid and solid fuels; the mechanics of heat transfer; physical and chemical properties of clay and other raw materials under heat treatment; design, operation and heat accounts of periodic and continuous kilns. The utilization of refractories in industry; the control of properties of refractories through raw materials and all phases of manufacture to best meet industrial requirements; fundamentals of aggregate packing and photoelastic study of expansion and contraction.

Texts: *ASTM Refractories Specifications;* Norton, *Refractories.*

Cer.E. 421. Cements

2-3-3. Prerequisites: Chem. 332; Cer.E. 305.

Includes the required properties of raw materials, processing and the hydraulic properties of cements. Portland, magnesia, high alumnia, dental, and gypsiferous cements are included. This is an elective course for seniors and graduates. This course is offered periodically upon demand of six or more students.

Text: Bogue, *The Chemistry of Portland Cement.*

Cer.E. 425-426. Physical Ceramics

3-3-4, 2-0-2. Prerequisites: Cer.E. 315, Chem. 331, and Phys. 209.

Application of Physical Chemistry, Crystal Chemistry, Colloid Chemistry, and Solid State Physics to Ceramics. Dispersion, viscosity, plasticity, grain size, crystal structure as related to properties, densification with additives to fill holes in structure, and theory of clay as a colloidal electrolyte are studied. Differential thermal analysis, thermal shock, thermal expansion, electrodialysis, viscosity measurement, X-ray analysis, and other techniques of analysis are studied in the laboratory. Sintering, melting, and recrystallization.

Text: Kingery, *Introduction to Ceramics; Course notes.*

Cer.E. 428. Thesis (Replaces Cer.E. 423)

0-3-1. Prerequisite: Cer.E. 422.

Second quarter of undergraduate thesis. The senior student is conducting his original investigation under supervision of an instructor. Material and library search preparation for the thesis should be accomplished in this part of the thesis sequence and actual laboratory experimentation begun.

Cer.E. 429. Thesis (Replaces Cer.E. 412)

1-6-3. Prerequisite: Cer.E. 420.

Completion of all laboratory work on investigation, submission of preliminary write-up one month before quarter end and final submission of approved write-up in acceptable format one week before examination week.

Cer.E. 431-32-34. Design and Construction

1-3-2, 0-6-2, 0-3-1. Corequisite: Cer.E. 418. Prerequisite: Drawing 109 (or 103).

Design and working drawings of ceramic manufacturing equipment and plant layouts for specified products. The student makes his own selection under the supervision and with the approval of the instructor.

Cer.E. 440. Glaze and Enamel Coatings

3-3-4. Prerequisite: Cer.E. 320.

The fundamental methods for calculating, compounding, manufacturing and using vitreous and crystalline protective coatings as well as the methods commonly employed to correct faults. The prior preparations of frits, and ceramic bodies for glazing, or metals or glass for enameling are also considered. Compositions of low, moderate, and high temperature coatings are studied to learn basis of glass properties, adherence, color, opacification, and texture.

Texts: Parmelee, *Ceramic Glazes;* Andrews, *Porcelain Enamels.*

Cer.E. 441. Vitreous and Crystalline Coatings (Replaces Cer.E. 440)

2-3-3. Prerequisite: Cer.E. 320.

The fundamental methods for calculating, compounding, manufacturing, and using vitreous and crystalline protective coatings as well as the methods commonly employed to correct faults. The prior preparations of frits, and ceramic bodies for glazing, or metals or glass for enameling are also considered. Compositions of low, moderate, and high temperature coatings are studied to learn basis of glass properties, adherance, color, opacification, and texture.

Cer.E. 450. Engineering Materials in Nuclear Engineering

2-3-3. Prerequisites: Senior or graduate standing and consent of instructor.

The basic principles of ceramics and metallurgy with particular emphasis on problems inherent in reactor technology. Engineering aspects of the structure and constitution of materials used in reactors including ceramic materials, cermets, metals and alloys. The behavior of these materials under conditions involving elevated temperatures, corrosion, and irradiation.

Text: Hausner, *Materials of Nuclear Reactors; Notes.*

GRADUATE COURSES

(Complete details about graduate courses in Ceramic Engineering are contained in the *Graduate Bulletin,* a copy of which is available upon request.)

SCHOOL OF CHEMICAL ENGINEERING

(Established in 1901)

Director–G. L. Bridger; *Associate Director and Regents' Professor*–Clyde Orr, Jr.; *Associate Director for Metallurgy and Professor*–R. F. Hochman; *Regents' Professors*–J. W. Mason, W. T. Ziegler; *Professor Emeritus*–Paul Weber; *Professors*–N. N. Engel, C. W. Gorton, H. V. Grubb, H. C. Lewis, H. C. Ward; *Associate Professors*–John H. Burson, III, B. G. LeFevre, Jude T. Sommerfeld, S. Spooner, E. A. Starke, Jr.; *Assistant Professors*–H. Grenga, M. J. Matteson, J. D. Muzzy; *Graduate Assistants*–Ta-Yen J. Fang, Roger D. Hester, J. W. Ivey, Michael S. Knight, I. K. Mozawalla, Charles B. Sedman, Jufu Shiau, Nan Wei, Yo-Kil Yoon; *Administrative Assistants*–H. O. Connor, Frances Norton; *Principal Secretary*–Joyce M. Williams; *Senior Secretary*–E. K. Browning; *Secretary*–M. L. Thornton; *Senior Laboratory Mechanic*–C. A. Mayes; *Laboratory Mechanic*–C. R. Blackwood.

General Information

Chemical engineers perform many essential functions in those industries which convert raw materials by means of chemical and physical processes into useful finished products. Almost every major manufacturing industry employs chemical engineers, who work in research, development, design, production, sales, consulting, and management positions. Some of the industries which use substantial numbers of chemical engineers are the petroleum, petrochemical, pulp and paper, plastics, metallurgical, fiber, fertilizer, nuclear energy, space, rubber, food, photographic, heavy and fine chemical, mineral, pharmaceutical and dye industries. Environmental and pollution control activities require an increasing number of chemical engineers.

The following curriculum leads to the degree of Bachelor of Chemical Engineering, and is designed to train students both for positions immediately or for graduate work leading to master's and doctor's degrees.

Freshman Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Gen.	101	Orientation	1-0-0	....	....
Ch.E.	101	Introduction to Chem. Eng.	1-0-1	....	....
Chem.	111-2*	General Chemistry	4-3-5	4-3-5	....
Chem.	209	Chemical Principles	....	....	3-3-4
Engl.	107-8-9	Introduction to Literature	3-0-3	3-0-3	3-0-3
Math.	107-8-9	Calculus I, II, III	5-0-5	5-0-5	5-0-5
E.Gr.	170-1	Engineering Graphics	....	2-3-3	2-3-3
P.T.	101-2-3	Physical Training	0-4-1	0-4-1	0-4-1
**Electives			2-0-2	2-0-2	2-0-2
		Totals	16-7-17	16-10-19	15-10-18

*General Chemistry for Chemical Engineering and Chemistry Majors; however, Chem. 104-5 will be accepted for students transferring into Chemical Engineering from other curricula.

**These free elective courses may be taken at any time during a student's course of study. However, these six credit hours may be satisfied by selecting basic ROTC. If basic ROTC is elected by the student, then it must be scheduled beginning the first quarter the student is enrolled. For further details, see page 28 of the catalog.

Sophomore Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Ch.E.	207-8	Chemical Process Principles	3-0-3	3-0-3	....
Ch.E.	209	Computers in Ch.E	....	....	2-3-3
Math.	207	Calculus IV	5-0-5	....	....
Math.	208	Calculus and Linear Algebra	....	5-0-5	....
Math.	209	Differential Equations	....	....	5-0-5
Phys.	227-8-9	Physics	4-3-5	4-3-5	4-3-5
Hum./S.S./M.L.		Humanities/Social Sciences/ Modern Language*	3-0-3	3-0-3	3-0-3
P.T.	201-2-3	Physical Training	0-4-1	0-4-1	0-4-1
		Totals	15-7-17	15-7-17	14-10-17

*A language is recommended for students considering graduate work.

Junior Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
Ch.E.	304-5	Transport Phenomena I, II	3-3-4	3-3-4	....
Ch.E.	306	Unit Operations I..........	....	....	3-0-3
Ch.E.	315	Unit Operations II	....	....	3-3-4
Chem.	340-1	Organic Chemistry........	3-0-3	3-0-3	....
Chem.	343	Organic Chemistry Lab.	....	....	0-6-2
Chem.	331-2-3	Physical Chemistry	3-0-3	3-0-3	3-0-3
Chem.	339	Physical Chemistry Lab	....	0-6-2	....
Hum./S.S./M.L.		Humanities/Social Sciences/ Modern Language	3-0-3	3-0-3	3-0-3
ESM	205	Statics..........................	3-0-3	....	....
ESM	309 or 331	Dynamics or Mechanics of Materials......................	....	3-0-3	....
Electives		....	3-0-3	....	3-0-3
		Totals	18-3-19	15-9-18	15-9-18

Senior Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
Ch.E.	435-6	Chem. Eng. Thermodynamics	3-0-3	3-0-3	....
Ch.E.	446	Comprehensive Problems	....	....	3-0-3
Ch.E.	407-8	Chemical Process Analysis	3-0-3	3-0-3	....
Ch.E.	413	Unit Operations III.......	3-3-4	....	....
Met.	401	Engineering Materials....	....	3-0-3	....
Ch.E.	339	Chemical Engineering Literature	1-0-1	....	....
Ch.E.	431	Chemical Engineering Economics................	....	3-0-3	....
Ch.E.	434	Chemical Plant Design ..	....	....	1-6-3
Ch.E.	341	Process Instrumentation	....	....	2-3-3
E.E.	325	Electrical Circuits and Fields.......................	2-3-3	....	....
E.E.	326	Elementary Electronics.	....	2-3-3	....
Hum./S.S./M.L.		Humanities/Social Sciences/ Modern Language	3-0-3	3-0-3	3-0-3
Electives		....	....	....	3-0-3
		Totals	15-6-17	17-3-18	12-9-15

Courses of Instruction

NOTE: *Under Quarters,* 3-3-4 *means* 3 *hours class,* 3 *hours laboratory,* 4 *hours credit.*

Ch.E. 101. Introduction to Chemical Engineering

1-0-1. Prerequisites: None

An orientation to chemical engineering at Georgia Tech and in industry. The goal will be to give some idea of the nature of chemical engineering, the types of opportunities available, and the requirements for graduation and for a successful career.

Ch.E. 207, 208. Chemical Process Principles I, II

3-0-3. Prerequisites: Chem. 209 or concurrently with Chem. 209 and Math. 109.

A study of stoichiometric principles, physical and chemical properties, thermophysics and thermochemistry leading to rather detailed material and energy balances on chemical, metallurgical and petroleum processes.

Text: Hougen, Watson and Ragatz, *Chemical Process Principles,* Part I.

Ch.E. 209. Computers in Chemical Engineering

2-3-3. Prerequisites: Math. 208 and Ch.E. 208 or concurrently with Ch.E. 208.

A study of the application of digital and analog computers to the solution of chemical engineering problems.

Texts: Peterson, *Analog Computation;* McCracken, *A Guide to FORTRAN IV Programming*

Ch.E. 304. Transport Phenomena I

3-3-4. Prerequisites: Ch.E. 209 and Math. 209.

Fundamental principles of momentum and energy transfers are developed. Applications of these principles are stressed.

Text: Bird, Stewart and Lightfoot, *Transport Phenomena.*

Ch.E. 305. Transport Phenomena II

3-3-4. Prerequisite: Ch.E. 304.

The development of Ch.E. 304 is extended to include mass transfer. Major emphasis is placed on applications involving heat and mass transfer.

Text: Bird, Stewart and Lightfoot, *Transport Phenomena.*

Ch.E. 306. Unit Operations I

3-0-3. Prerequisites: Ch.E. 304 and concurrently with Ch.E. 305.

The analyses of chemical engineering processes and operations involving fluid and heat transfer.

Texts: McCabe and Smith, *Unit Operations of Chemical Engineering;* Perry, *Chemical Engineer's Handbook.*

Ch.E. 315. Unit Operations II

3-3-4. Prerequisite: Ch.E. 304.

Stagewise operations.

Texts: McCabe and Smith, *Unit Operations of Chemical Engineering;* Perry, *Chemical Engineer's Handbook;* Notes.

Ch.E. 329. Survey of Chemical Engineering

3-0-3. Prerequisites: Chemistry 103, Mathematics 107 and Physics 209 or 213.

A general survey of chemical engineering including processes, equipment and calculations. Not open to students in the School of Chemical Engineering.

Text: Shreve, *Chemical Process Industries.*

Ch.E. 339. Chemical Engineering Literature

1-0-1. Prerequisites: Ch.E. 304, Chem. 340, 331.

This course has as its objective the training of students in the use of the sources of information and an introduction to the finding of information in the library.

Text: Mellon, *Chemical Publications.*

Ch.E. 341. Process Instrumentation

2-3-3. Prerequisite: Ch.E. 305; E.E. 326 recommended.

A study of the methods and technology associated with chemical process systems analysis and the application of measurement and control devices and techniques to these systems.

Text: Murrill, *Automatic Control of Processes.*

Ch.E. 350. Elementary Heat and Mass Transfer

3-0-3 Prerequisites: Math. 208.

Physics 209, M.E. 320, and Senior standing or consent of instructor.

Elementary heat and mass transfer primarily designed for Textile students. Not open to students in the School of Chemical Engineering. Offered in the fall quarter only.

Text: McCabe and Smith, *Unit Operations of Chemical Engineering.*

Ch.E. 407. Chemical Process Analysis

3-0-3. Prerequisites: Ch.E. 315, Chem. 342 and Chem. 333.

Introduction to the engineering of chemical reactions involving colloidal and amorphous materials.

Texts: Golding, *Polymers and Resins;* Jergensons and Straumanis, *A Short Textbook of Colloid and Surface Chemistry.*

Ch.E. 408. Chemical Process Analysis

3-0-3. Prerequisites: Ch.E. 315, Chem. 342 and Chem. 333.

Introduction to applied chemical kinetics.

Text: Levenspiel, *Chemical Reaction Engineering.*

Ch.E. 413. Unit Operations III

3-3-4. Prerequisite: Ch.E. 305.

Diffusional processes, including combined mass and heat transfer.

Text: Perry, *Chemical Engineer's Handbook;* McCabe and Smith, *Unit Operations of Chemical Engineering.*

Ch.E. 431. Chemical Engineering Economics

3-0-3. Prerequisite: Ch.E. 315.

A study of techniques required in project analysis in areas of systems cost analysis and the use of the economic balance for design and optimization.

Text: Peters and Timmerhaus, *Plant Design and Economics for Chemical Engineers.*

Ch.E. 434. Chemical Plant Design

1-6-3. Prerequisites: Ch.E. 341 or concurrently with 341, 408, 413, 431, 436, ESM 331.

A comprehensive problem in plant design.

Ch.E. 435-436-437. Chemical Engineering Thermodynamics

3-0-3. Prerequisites: Chem. 333 and Ch.E. 315.

A study of the principles of thermodynamics with applications to the problems of industry. The areas covered include flow of compressible fluids, estimation and use of thermodynamic properties, charts and tables, power and refrigeration cycles, phase equilibria, chemical equilibria and properties of solutions.

Text: Smith and Van Ness, *Introduction to Chemical Engineering Thermodynamics.*

Ch.E. 443-444-445. Special Problems

0-3-1. Prerequisite: Ch.E. 305.

The student is given an opportunity to develop initiative and to apply fundamental principles by doing semi-original laboratory investigation of a chemical engineering research nature.

Ch.E. 446-447-448. Comprehensive Problems

3-0-3. Prerequisites: Ch.E. 408, 431, 436.

The integration of the professional work of the previous courses by means of a series of comprehensive problems.

Text: To be selected.

Ch.E. 450. Introduction to Polymer Science

3-0-3. Prerequisite: Phys. 208.

An introduction to the chemistry and physics of polymers, including polymerization, structure, and properties.

Text: Billmeyer, *Textbook of Polymer Science.*

Ch.E. 451. Polymer Engineering

3-0-3. Prerequisites: Ch.E. 450, Ch.E. 305 or consent of instructor.

A description and analysis of polymer processing techniques including calendering, extrusion, mixing, molding, casting and bonding operations. Fundamental equations characterizing specific processes are developed where possible.

Text: McKelvy, *Polymer Processing.*

Courses of Instruction in Metallurgy

NOTE: *Under Quarters,* 3-3-4 *means* 3 *hours class,* 3 *hours lab.,* 4 *hours credit.*

***Met. 325. General Metallurgy**

3-0-3. Prerequisites: Chem. 103 and Physics 207.

An introductory survey of basic physical metallurgical concepts followed by a study of the characteristics and engineering applications of carbon steels, gray and malleable cast irons. Consideration is given to the engineering significance of static and dynamic properties of metals and alloys.

Text: Guy, *Engineering Metallurgy.*

Met. 401. Engineering Materials

3-0-3. Prerequisite: Chem. 333.

Principles of physical metallurgy including binary phase diagrams and mechanical testing methods as applied to metallic materials. Production of iron, steel, and nonferrous metals is surveyed.

Text: Guy, *Elements of Physical Metallurgy.*

Met. 402. Engineering Materials

3-3-4. Prerequisite: Met. 401.

A study of the properties and application of carbon and alloy steels, cast irons, and nonferrous alloys. Some time is devoted to corrosion as an engineering problem and methods utilized in minimizing its effects. Laboratory work consists of metallographic observation of common ferrous and nonferrous alloys in various conditions.

Text: Guy, *Elements of Physical Metallurgy and Notes.*

Met. 403. Introductory Nuclear Metallurgy

3-3-4. Prerequisites: Chem. 103 and Phys. 209.

The fundamentals of physical metallurgy, metal crystals, phase diagrams, properties, fabrication, and testing with emphasis on refractory metals and fuel materials. The laboratory will essentially be demonstrations and plant trips.

Text: Brick, Gordon, and Phillips, *Structure and Properties of Alloys.*

Met. 411. Basic Extractive Metallurgy

3-0-3. Prerequisite: Chem. 333 or equivalent.

Theory and practice of extraction and refining of ferrous and nonferrous metals. Calculations and reactions related to pyrometallurgical and hydrometallurgical extractive processes will be emphasized.

Text: Newton, *Extractive Metallurgy.*

Met. 421. Nonferrous Metallography

2-3-3. Prerequisite: Met. 441 or 402, or equivalent.

The use of the microscope to study the influence of processing variables on the structure and properties of metals and alloys. Pyrometric instrumentation as applied to heat treating operations and thermal analysis of metals and alloys is also covered.

*This course is not to be scheduled by Chemical Engineering students, since they are required to schedule Met. 401.

Text: Kehl, *Metallographic Laboratory Practice.*

Met. 422. Ferrous Metallography

3-3-4. Prerequisites: Met. 401 and 402.

The influence of processing variables on the microstructure and properties of steels and ferrous alloys. Heat treat operations and thermal analysis of ferrous materials.

Text: Brick and Phillips, *Structure and Properties of Alloys. Notes.*

Met. 423. Metallurgical Fabrication

3-0-3. Prerequisite: Met. 401.

Primary forming techniques and secondary fabrication and joining processes will be discussed. Some of the processes to be considered are casting, rolling, forging, welding, etc.

Text: Semans, *Engineering Materials, the ASM Handbook and Notes.*

Met. 441. Theoretical Physical Metallurgy

3-0-3. Prerequisites: Met. 402 and Chem. 333 or equivalent.

A study of the physical and mechanical properties of metals and alloys in the light of their structure.

Text: Cottrell, *Theoretical Structural Metallurgy.*

Met. 445. Electron Microscopy

2-3-3. Prerequisites: Phys. 319, Math. 209 and Met. 402.

The theory and principles of electron optics and electron microscopy will be covered. Techniques of preparation and observation of materials by electron microscopy will be presented in lecture and applied in the laboratory.

Text: Thomas, *Transmission Electron Microscopy of Metals.*

Met. 446. X-ray Metallography

3-3-4. Prerequisites: Met. 401.

The theory and application of x-ray diffraction to metallurgy. Crystal studies, texture studies, phase diagram determination and chemical analysis will be discussed.

Text: Azaroff and Donahue, *Laboratory Experiments in X-ray Crystallography.*

Met. 463. Metallurgical Testing

2-3-3. Prerequisites: Met. 402, Phys. 319 or equivalent.

Destructive and nondestructive test methods are outlined. The emphasis will be on the significance of results and the choice of materials based on test data.

Text: *Notes.*

Met. 464. Nondestructive Testing

2-3-3.

The principles and theory of current industrial nondestructive testing methods will be covered. The emphasis will be on testing the soundness and reliability of primary and secondary fabricated metal structures.

Text: *Nondestructive Testing Handbook* and *Notes.*

Met. 491. Corrosion and Protective Measures

3-0-3. Prerequisites: Chem. 333 and Met. 325 or 401.

The electrochemical theory of corrosion; recommended materials and protective measures for chemical processing equipment and for atmospheric, underground, underwater, and elevated temperature exposures.

Text: *Notes.*

Graduate Courses in Chemical Engineering

Ch.E.	601, 2, 3	Chemical Engineering Thermodynamics I, II, III	3-0-3
Ch.E.	604, 5, 6	Organic Chemical Technology	3-0-3
Ch.E.	610	Aerosol Technology	3-0-3
Ch.E.	611	Industrial Emission Control	3-0-3
Ch.E.	612	Atmospheric Reactions	3-0-3
Ch.E.	613	Technology of Fine Particles	3-0-3
Ch.E.	615, 6, 7	Transport Phenomena I, II, III	3-0-3
Ch.E.	619, 20	Chemical Engineering Calculations I, II	3-0-3
Ch.E.	622	Applied Chemical Kinetics	3-0-3
Ch.E.	624	Introduction to Cryogenics	3-0-3
Ch.E.	628, 9	Advanced Unit Operations	3-0-3
Ch.E.	633	Inorganic Chemical Technology	3-0-3
Ch.E.	635	Advanced Unit Operations	3-0-3
Ch.E.	637	Advanced Unit Operations	3-0-3
Ch.E.	646	Economic Analysis of Chemical Engineering Processes	3-0-3
Ch.E.	648, 9	Chemical Plant Design	1-6-3
Ch.E.	650, 1	Polymer Structure and Bulk Properties I, II	3-0-3
Ch.E.	699	Preparation for Ph.D. Qualifying Examinations	None
Ch.E.	701, 2, 3	Seminar	1-0-0
Ch.E.	704, 5, 6	Special Problems in Chemical Engineering	Variable
Ch.E.	710, 1, 2	Special Topics in Chemical Engineering	Variable
Ch.E.	716	Advanced Unit Operations	3-0-3
Ch.E.	722	Foundations of Gaseous Kinetics	3-0-3
Ch.E.	736, 7	Chemically Reacting Flow Processes I, II	3-0-3
Ch.E.	738	Advances in Transport Phenomena	3-0-3
Ch.E.	740	High Pressure Technology	3-0-3

Graduate Courses in Metallurgy

Met.	601, 2, 3	Seminar	2-0-1
Met.	604	Special Topics in Metallurgy	Variable
Met.	605	Dental-Medical Materials	2-0-2
Met.	614	Electrometallurgy	2-3-3
Met.	621	Metallurgical Design Problems	1-6-3
Met.	625	Powder Metallurgy	1-3-2
Met.	633	High Temperature Metallurgy	2-0-2
Met.	635	Advanced Nuclear Materials	3-0-3
Met.	691	Advanced Theory of Metallic Corrosion	3-3-4
Met.	700	Master's Thesis	Variable
Met.	701	Special Topics in Advanced Physical Metallurgy	3-0-3
Met.	741	Advanced Physical Metallurgy	3-0-3
Met.	745-6	Advanced Electron Microscopy I, II	3-0-3
Met.	751	Advanced Mechanical Metallurgy	3-0-3

Met.	752, 3	Dislocations and Strengthening Mechanisms I, II	3-0-3
Met.	762	Magnetism in Metals	3-0-3
Met.	763	Neutron Diffraction	3-0-3
Met.	781	Metallurgical Thermodynamics	3-0-3
Met.	785	Metallurgical Kinetics	3-0-3

(Complete details about these courses are contained in the *Graduate Bulletin,* a copy of which is available upon request.)

SCHOOL OF CHEMISTRY

(Established in 1906)

Director–William M. Spicer; *Assistant Director*–James A. Stanfield; *Seydel-Woolley Professor*–Herbert O. House; *Julius Brown Professor*–Erling Grovenstein, Jr.; *Regents' Professor*–William H. Eberhardt, Hermann A. Flaschka; *Professor Emeritus*–Henry L. Edwards; *Professors*–Eugene C. Ashby, J. Aaron Bertrand, John R. Dyer, Richard W. Fink, George A. Miller, Henry M. Neumann, Robert A. Pierotti, Leon H. Zalkow; *Associate Professors*–Edward M. Burgess, Drury S. Caine, III, Harold R. Hunt, Sidney L. Gordon, Charles L. Liotta, Thomas F. Moran, Donald J. Royer, Peter B. Sherry, Peter E. Sturrock, Allan C. Topp; *Assistant Professors*–Raymond F. Borkman, Bruce W. Davis, Ronald H. Felton, William F. Fisher, James C. Powers, Nai-Teng Yu; *Instructors*–Frank R. Dobbs, David C. Fullerton, Don B. Weser. *Graduate Assistants*–Alvaro Abidaud, Jesse Baskerville, James T. Baxter, Ralph L. Buice, Jr., Malton J. Bullock, John L. Carden, Jr., Chia Y. Chu, Marion G. Clower, Arthur M. Dula, Thomas P. Fletcher, John L. Hardwick, Henry P. Harris, Gerald L. Hasenhuettl, Alan C. Hayman, Fred T. Helm, Thomas R. Henson, Paul F. Ingwalson, Gilbert F. Kuipers, Donald T. Liles, Christopher S. Liu, Nadim Moucharafieh, Patricia W. Mueller, David S. Newsome, Daniel C. Paschal, John P. Peters, Richard D. Schwartz, Walter M. Sackelford, Tomoo Shibata, Steven J. Steindel, John J. Tice, James T. Tippett, Samuel W. Twiggs, III, John J. Walker, Larry W. Wheeler, Larry K. Whisenant, Ronald J. Whitley, Ronald W. Woodard, Joseph E. Wreen, Jr., Ping P. Yang; *Principal Secretaries*–Martha W. Craig, Mildred E. Moore; *Secretaries*–Elizabeth Byrd, Linda Flowers, Sandy Hayles, Rhonda McGinley; *Stores Supervisor*–Billy J. Jones; *Administrative Assistant*–Royce L. Brandon; *Glass Blowers*–James Kinloch, Donald E. Lillie; *Electronic Technicians*–Gerald O'Brien, Charles Taaffe; *Machinist*–Malcolm E. Rucker; *Instrument Operator*–George E. Turner; *Supply Attendant*–Robert Dean.

General Information

Included in the School are:

1. The courses in chemistry required in the various engineering curricula.

2. A curriculum leading to the degree of Bachelor of Science in Chemistry.

3. Graduate courses and research leading to the degree of Master of Science in Chemistry, and Master of Science in Nuclear Science.

4. Graduate courses and research leading to the degree of Doctor of Philosophy in Chemistry.

The degree of Bachelor of Science in Chemistry will be awarded upon the completion of the following prescribed courses and 59 quarter hours of elective work. No elective course will be given for less than six applicants. A student must have had the prerequisites for any course he elects.

A prerequisite for senior courses is a minimum grade-point average of 2.0 in the following courses: Chem. 331, 332, 333, 338, 339, 340, 341, 342, 343, 344 and 345.

Freshman Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Chem.	211-12	General Chemistry........	4-3-5	4-3-5	....
Chem.	209	Chemical Principles.......	....	....	3-3-4
Math.	107-8-9	Calculus........................	5-0-5	5-0-5	5-0-5
Engl.	107-8-9	Introduction to Literature	3-0-3	3-0-3	3-0-3
M.L.	101-2-3*	Elementary German OR			
S.S.	*	Social Science...............	3-0-3	3-0-3	3-0-3
P.T.	101-2-3	Physical Training..........	0-4-1	0-4-1	0-4-1
**Electives		....	2-0-2.	2-0-2	2-0-2
Gen.	101	Orientation..................	....	....	....
		Totals	18-7-19	17-7-19	16-7-18

NOTE: Under Quarters, 3-3-4 means 3 hours class, 3 hours lab, 4 hours credit.
*The School of Chemistry recommends that German be taken in the Freshman year. However, Social Science may be taken in the freshman year and German taken later.
**These free elective courses may be taken at any time during a student's course of study. However, these six credit hours may be satisfied by selecting basic ROTC. If basic ROTC is elected by the student, then it must be scheduled beginning the first quarter the student in enrolled. For further details, see page 28 of the catalog.

Sophomore Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Chem.	340-1-2	Organic Chemistry........	3-0-3	3-0-3	3-0-3
Chem.	343-4-5	Organic Chemistry Lab............................	0-6-2	0-6-2	0-6-2
Math.	207	Calculus........................	5-0-5	....	....
Math.	208	Calculus and Linear Algebra......................	....	5-0-5	....
Phys.	227-8-9	Physics..........................	4-3-5	4-3-5	4-3-5
P.T.	201-2-3	Physical Training..........	0-4-1	0-4-1	0-4-1
Electives, free*		....	....	....	6-0-6
		Totals	12-13-16	12-13-16	13-13-17

*Electives, free: Not more than 9 hours of electives may be in advanced ROTC. At least 15 hours of electives must be selected from the humanities on page 39, of which at least 9 hours must be in the social sciences. Among these electives the second year of German and the first year of French or Russian are recommended.

Junior Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
Chem.	331-2-3	Physical Chemistry	3-0-3	3-0-3	3-0-3
Chem.	339	Physical Chemistry Lab.	....	0-6-2	....
Chem.	403	Physical Chemistry	3-0-3	....	....
Chem.	434-5	Inorganic Chemistry	....	3-0-3	3-0-3
Chem.	421	Instrumental Analysis I.	3-6-5	....	....
Engl.	201-2-3	Survey of Humanities ...	3-0-3	3-0-3	3-0-3
Electives, free***		....	3-0-3	6-0-6	6-0-6
		Totals	15-6-17	15-6-17	15-0-15

***Electives, free: Not more than 9 hours of electives may be in advanced ROTC. At least 15 hours of electives must be selected from the humanities on page 39, of which at least 9 hours must be in the social sciences. Among these electives the second year of German and the first year of French or Russian are recommended.

Senior Year

Course	No	Subject	1st Q.	2nd Q.	3rd Q.
Chem.	400	Physical Chemistry	3-0-3	....	....
Chem.	338	Physical Chemistry Lab.	0-6-2	....	....
Chem.	411	Applied Spectroscopy...	3-0-3	....	....
Chem.	422*	Instrumental Analysis II	....	3-6-5	....
Electives, free**		....	6-0-6	6-0-6	10-0-10
Electives, Chemistry***		....	....	5-0-5	5-0-5
		Totals	12-6-14	14-6-16	15-0-15

*May be taken in the junior year.

**Electives, free: Not more than 9 hours of electives may be in advanced ROTC. At least 15 hours of electives must be selected from the humanities on page 39, of which at least 9 hours must be in the social sciences. Among these electives the second year of German and the first year of French or Russian are recommended.

***A total of 10 quarter hours in elective chemistry courses are required of which a minimum of 4 hours and a maximum of 6 hours must be from laboratory electives. These laboratory electives may consist of:

a. Two laboratory courses, 0-6-2 each.
b. One laboratory course, 0-6-2, and Chem. 437, 438 OR
c. Chem. 437-8-9.

Options b and c must have the approval of the department.

Chemistry electives may consist of those chemistry courses numbered 4xx, 6xx, or 7xx with the exception of Chem. 461 and Chem. 475. Registration for courses 600 and above must have Departmental and Graduate Division approval.

Courses of Instruction

NOTE: 4-3-5 *means* 4 *hours class,* 3 *hours laboratory,* 5 *hours credit.*

ADDITIONAL NOTE: All students are required to wear safety glasses while working in the laboratories. The glasses will be provided at the students' expense.

Chem. 104-5. General Chemistry

4-3-5. Prerequisite: Entrance requirements.

A lecture and laboratory study of the fundamental laws and theories of chemistry designed for those students who do not plan to take more advanced chemistry courses. The courses include topics related to the thermodynamics of chemical change, the structure of atoms and molecules, the nature of chemical change and reactivity and the chemistry of carbon compounds.

Text: To be selected.

These two courses (10 hours total) will replace the present Chem. 101-2-3 (12 hours total) and will satisfy the Engineering College Core Curriculum.

Chem. 111-12. General Chemistry

4-3-5. Prerequisite: Entrance requirements.

A lecture and laboratory study of the fundamental laws and theories of chemistry designed for those students who plan to pursue advanced courses in chemistry. The topics covered are more limited than those in Chem. 104-105 but are treated in a manner in which they can be built upon more readily in the advanced courses. The laboratory emphasizes the techniques of quantitative analysis necessary for advanced courses in chemistry.

Text: To be selected.

Chem. 209. Chemical Principles

3-3-4. Prerequisite: Chem. 108 or Chem. 103.

A continuation of Chem. 108 stressing thermodynamics and kinetics and their applications to chemistry. The laboratory portion of the course will be devoted to quantitative experimentation. Completion of this course along with Chem. 107, and Chem. 108 fulfills first-year chemistry requirements in all curricula.

Text: Mahan, *University Chemistry, 2nd ed.*

Chem. 305, 306. Survey of Organic Chemistry

3-3-4. Prerequisite: Chem. 103 or Chem. 209.

A study of the various classes of organic compounds at an elementary level with emphasis on applications to the textile field.

Text: Cason, *Principles of Modern Organic Chemistry.*

Chem. 331, 332, 333. Physical Chemistry

3-0-3. Prerequisites: Chem. 209, Phys. 208, and Math. 208.

Physico-chemical properties of matter in the gaseous, liquid, and solid states; solutions; equilibrium, kinetics and thermodynamics of chemical reactions, electrochemistry.

Text: Daniels and Alberty, *Physical Chemistry.*

Chem. 338. Physical Chemistry Laboratory

0-6-2. Prerequisite: Chem. 339. To be taken concurrently with or following Chem. 333.

Applications of vibration, rotation, and electronic spectroscopy, electric and magnetic susceptibility, and resonance techniques to the study of molecular structure.

Text. *Notes.*

Chem. 339. Physical Chemistry Laboratory

0-6-2. Prerequisite: Concurrent with or following Chem. 332.

Applications of physical chemistry principles.

Text: *Notes.*

Chem. 340, 341, 342. Organic Chemistry

3-0-3. Prerequisite: Chem. 209.

The principal classes of organic compounds, aliphatic and aromatic, are studied.

Text: Morrison & Boyd, *Organic Chemistry,* 2nd ed.

Chem. 343, 344, 345. Organic Chemistry Laboratory

0-6-2. Prerequisite: To be taken concurrently with or following Chem. 340, 341, 342, respectively. But Chem. 343 is prerequiste to Chem. 344, 345.

Text: Brewster, VanderWerf & McEwen, *Unitized Experiments in Organic Chemistry.*

Chem. 346, 347. Organic Chemistry Laboratory

0-3-1. Prerequisite: Chem. 343. To be taken concurrently with or following Chem. 341 and 342, respectively.

Organic preparations and reactions-similar to, but less extensive than, Chem. 344, 345.

Text: Brewster, VanderWerf & McEwen, *Unitized Experiments in Organic Chemistry.*

Chem. 348. Organic Chemistry Laboratory

0-6-2. Prerequisite: Chem. 342, 343, or concurrent with 342.

Contents identical to Chem. 346 and 347.

Text: Brewster, VanderWerf and McEwen, *Unitized Experiments in Organic Chemistry.*

Chem. 400. Physical Chemistry

3-0-3. Prerequisites: Chem. 209, Physics 209, and Math. 208 or consent of instructor.

Application of molecular spectroscopy, electron diffraction, X-ray diffraction, neutron diffraction, and magnetic methods to the determination of molecular structure.

Text: To be selected.

Chem. 403. Physical Chemistry

3-0-3. Prerequisite: Chem. 209, Phys. 209 and Math. 208 or consent of instructor.

A study of the relation of atomic and molecular structure to the physical properties of matter and the nature of chemical bonding.

Text: Royer, *Bonding Theory.*

Chem. 411. Applied Spectroscopy

3-0-3. Prerequisite: Chem. 342.

Application of various spectroscopic techniques in organic analysis.

Text: Dyer, *Applications of Absorption Spectroscopy of Organic Compounds;* and Notes.

Chem. 412. Identification of Organic Compounds

0-9-3. Prerequisites: Chem. 345 and concurrent with or following Chem. 411.

Text: Shriner, Fuson, and Curtin, *Systematic Identifications of Organic Compounds.*

Chem. 421. Instrumental Analysis I

3-6-5. Prerequisite: Concurrent with or following Chem. 331.

An introductory course in both the theory and practice of modern instrumental methods: polarography, spectroscopy, colorimetry, microscopy, polarimetry, electroanalytical methods.

Text: Flaschka, Barnard, and Sturrock, *Quantitative Analytical Chemistry, Vol. I.*

Chem. 422. Instrumental Analysis II

3-6-5. Prerequisite: Chem. 421 or consent of instructor.

A continuation of Instrumental Analysis I.

Text: Willard, Merrit, and Dean, *Instrumental Methods of Analysis.*

Chem. 423. Analytical Laboratory

0-6-2. Prerequisite: Concurrent with or following Chem. 422.

Advanced techniques and investigations of newer analytical methods in the practices of analysis.

Text: *Notes.*

Chem. 432. Synthetic Inorganic Chemistry

0-6-2. Prerequisite: To be taken concurrently with or following Chem. 434.

The preparation and characterization of inorganic compounds, with special emphasis on the apparatus and techniques employed in modern synthetic inorganic chemistry.

Text: Jolly, *Synthetic Inorganic Chemistry.*

Chem. 434, 435. Advanced Inorganic Chemistry

3-0-3. Prerequisites: Chem. 331 and Chem. 403.

A classroom study of selected topics with emphasis on laws, principles, and generalizations; the periodic classifications, atomic structure, natural and artificial radioactivity, valence, complex compounds, and other topics.

Texts: Jolly, *The Chemistry of the Non-Metals;* Douglas and McDaniel, *Concepts and Models of Inorganic Chemistry.*

Chem. 437, 438, 439. Special Problems

0-6-2. Prerequisite: Departmental approval.

The instruction will be individual and will include library, conference, and laboratory work.

Chem. 443, 444. Organic Reactions

3-0-3. Prerequisite: Chem. 342.

A study of the scope and usefulness of some important reactions and theories in organic chemistry from the standpoint of physical organic chemistry.

Text: Liberles, *Introduction to Theoretical Organic Chemistry.*

Chem. 445, 446, 447. Biochemistry

3-0-3. Prerequisite: Chem. 306, 342 or consent of instructor.

Lectures, independent reading, and discussion of topics relating to the chemistry and metabolism of plant and animal products.

Text: Karlson, *Introduction to Modern Biochemistry.*

Chem. 448. Biochemistry Laboratory

0-6-2. Prerequisite: Concurrent with or following Chem. 445.

Laboratory techniques and practices in biochemistry.

Text: To be selected.

Chem. 461. Chemistry of Nuclear Technology

3-3-4. For students in Nuclear Engineering only.

A course for non-chemists, covering principles of inorganic chemistry, radiation chemistry, radio chemistry, separation methods for actinide elements and fission products, and other topics related to the production and utilization of nuclear energy.

Text: *Notes.*

Chem. 475. Physical Chemistry for Engineers

3-0-3. Prerequisite: M.E. 320 or equivalent.

This course is designed to familiarize students who have had some thermodynamics in other areas with the applications of thermodynamics to chemical systems and with a foundation of the modern theory of chemical bonding.

Text: Barrow, *Physical Chemistry.*

Chem. 476. Chemistry of the Solid State

3-0-3. Prerequisite: Chem. 333 or consent of instructor.

Applications of the concepts developed in Chemistry 475 to the structure of solids and their chemical and physical properties.

Text: Barrow, *Physical Chemistry.*

Graduate Courses Offered

Chem.	612	Instrumental Methods of Organic Analysis	3-0-3
Chem.	623, 4	Nuclear Chemistry	3-0-3
Chem.	626	Fast-neutron Interactions	3-0-3
Chem.	630, 1, 2	Organic Chemistry	3-0-3
Chem.	633, 4, 5	Reactivity, Mechanism, and Structure in Organic Chemistry	3-0-3
Chem.	639	Organic Chemistry	3-0-3
Chem.	644, 5	Molecular Structure and Chemical Principles	3-0-3
Chem.	657	Radiochemistry	3-0-3
Chem.	658	Experimental Radiochemistry	1-3-2
Chem.	661, 2, 3	Chemical Thermodynamics	3-0-3
Chem.	664, 5, 6	Advanced Inorganic Chemistry	3-0-3
Chem.	667, 8	Special Topics in Inorganic Chemistry	3-0-3
Chem.	670	Chemical Crystallography	3-0-3
Chem.	674	Organic Reagents in Analytical Chemistry	3-0-3
Chem.	675	Electroanalytical Chemistry	3-0-3
Chem.	677	Advanced Analytical Chemistry	3-0-3
Chem.	679	Special Topics in Analytical Chemistry	2-3-3
Chem.	700	Master's Thesis	
Chem.	701, 2, 3	Seminar	1-0-0
Chem.	710-1	Polymer Chemistry	3-0-3
Chem.	733, 4	Organic Chemistry	3-0-3
Chem.	735, 6	Special Topics in Organic Chemistry	3-0-3
Chem.	747, 8, 9	Organic Chemistry	3-0-3
Chem.	750	Nuclear Spectroscopy	2-0-2
Chem.	757	Chemical Kinetics	3-0-3
Chem.	760, 1	Special Topics in Physical Chemistry	3-0-3
Chem.	764	Statistical Thermodynamics	3-0-3
Chem.	767, 8	Principles of Quantum Mechanics	3-0-3
Chem.	780, 1, 2	Molecular Spectra	3-0-3
Chem.	800	Doctor's Thesis	

(Complete details about these courses are contained in the *Graduate Bulletin,* a copy of which is available upon request.)

SCHOOL OF CIVIL ENGINEERING

(Established in 1896)

Director–William M. Sangster; *Assistant Director*–Paul H. Sanders; *Professor Emeritus*–Radnor J. Paquette; *Regents' Professor*–George F. Sowers; *Professors*–Marion R. Carstens, Austin B. Caseman, Donald O. Covault, John O. Eichler, Richard King, Paul G. Mayer, Frederick W. Schutz, Jr., Thomas E. Stelson, Robert E. Stiemke, Ernest C. Tsivoglou; *Associate Professors*–Richard D. Barksdale, Alfred W. Hoadley, Charles S. Martin, Billy B. Mazanti, Peter S. Parsonson, Dale C. Perry, Frederick G. Pohland, George M. Slaughter, Calvin W. Tooles, James R. Wallace, Paul H. Wright; *Assistant Professors*–Richard R. Avent, Russell H. Brown, William F. Brumund, Leroy Z. Emkin, Russell G. Hicks, Billy H. Kornegay, Alan M. Lumb, Mark A. McClanahan; *Lecturer*–Thomas A. Kirk; *Post-Doctoral Fellow*–George E. Mouchahoir; *Research Engineer*–King Kuen Mak; *Assistant Research Chemist*–Cynthia C. Bright, Ernest E. Ozburn, Linda F. Porter; *Secretaries*–Julia M. Brown, Eleanor C. Clark, Brenda A. Duckworth, Marlene Frankum, Betty Jordan, June Nethery, Kyle Shiver, Jody Williams; *Laboratory Technicians*–Gloria Ajello, Homer J. Bates, Rolland L. Brown, Charles M. Pavey, William L. Westbrooks.

General Information

The civil engineer conceives, designs, constructs, and maintains projects coordinating and utilizing natural and human resources for urban and regional development. He works in the following broad fields of specialization within the profession: structural and construction engineering, hydraulic engineering, sanitary engineering, transportation, soils engineering, municipal and regional engineering and management, surveying and mapping. The functional phases of civil engineering are research and development, planning and design, construction, and operation and maintenance.

It is not the purpose of the four-year curriculum described herein to cover in detail all that is known or considered in the profession or in any one of its branches. Rather, emphasis is placed on fundamental laws and concepts to enable the students to attack problems in a logical manner and to draw conclusions from principles and facts. In addition to specific civil engineering courses, the curriculum provides training in the physical and social sciences and selected subjects from the other engineering professions.

Satisfactory completion of the four-year curriculum leads to the degree of Bachelor of Civil Engineering.

Laboratories

The School of Civil Engineering occupies the Civil Engineering Building, part of the old Civil Engineering Building, and most of the Joint Highway Research

Laboratory. Modern laboratories provide for practical experience and research in air pollution, building materials, fluid mechanics, foundation models, highway materials, hydraulics, hydrology, photogrammetry, sanitary engineering, soil mechanics, stress analysis, structural models, and surveying. The course requirements for the Bachelor of Civil Engineering degree are tabulated here. Many of the courses need not be taken during the quarter indicated, but prerequisites must be satisfied.

Freshman Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Chem.	104-5	Inorganic Chemistry ..	4-3-5	4-3-5	....
C.E.	302	Civil Engineering Seminar	....	....	0-3-1
E.Gr.	170-1	Visual Comm. & Engrg. Design........................	2-3-3	2-3-3	....
*Hum./S.S./M.L.		Humanities/Social Sciences/ Modern Language	3-0-3	3-0-3	3-0-3
Math.	107-8-9	Calculus I, II, III...........	5-0-5	5-0-5	5-0-5
Physics	227	Physics..........................	....	....	4-3-5
**Electives		....	2-0-2	2-0-2	2-0-2
P.T.	101-2-3	Physical Training..........	0-4-1	0-4-1	0-4-1
Gen.	101	Orientation...................	1-0-0	....	....
		Totals	17-10-19	16-10-19	14-10-17

*See page 38.
**These free elective courses may be taken at any time during a student's course of study. However, these six credit hours may be satisfied by selecting basic ROTC. If basic ROTC is elected by the student, then it must be scheduled beginning the first quarter the student is enrolled. For further details see page 28 of the catalog.

Sophomore Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
ESM	205	Statics............................	3-0-3	....	....
ESM	309	Dynamics.......................	....	3-0-3	....
*Hum./S.S./M.L.		Humanities/Social Sciences Modern Language	3-0-3	3-0-3	3-0-3
Math.	207	Calculus IV...................	5-0-5	....	....
Math.	208	Calculus & Linear Algebra	....	5-0-5	....
Math.	209	Ordinary Differential Eg'ns..........................	....	....	5-0-5
Physics	228-29	Physics..........................	4-3-5	4-3-5	....
ESM	334	Mech. of Deformable Bodies........................	....	....	5-0-5

*See page 38.

Sophomore Year (cont.)

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
C.E.	201	Plane Surveying	....	....	3-3-4
P.T.	201-2-3	Physical Training	0-4-1	0-4-1	0-4-1
		Totals	15-7-17	15-7-17	16-7-18

Junior Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
C.E.	312	Surveying.....................	....	3-3-4	....
C.E.	211	Digital Computers.........	1-3-2	....	....
C.E.	309	Materials of Construction	3-3-4	....	....
C.E.	311	Structural Analysis I.....	5-3-6	....	....
C.E.	313-14	Fluid Mechanics I, II.....	....	3-0-3	3-3-4
*Hum./S.S./M.L.		Humanities/Social Sciences/ Modern Language	3-0-3	....	3-0-3
Geol.	203	Physical Geology	....	3-3-4	....
Econ.	204	Economics....................	....	3-0-3	....
I.E.	425	Engineering Economy...	....	....	3-0-3
M.E.	320	Thermodynamics..........	....	....	4-0-4
C.E.	451	Metal Structural Components	....	3-3-4	....
**Electives		....	3-0-3	....	3-0-3
		Totals	15-9-18	15-9-18	16-3-17

*See page 38.

**Nine hours of electives must be taken if Advanced ROTC is not taken. These electives are to be 300, 400, and 600 level courses from any engineering curriculum, Industiral Management, Mathematics, Physics, Chemistry, Social Sciences, Psychology, Applied Biology, Architecture, Information and Computer Science and English.

Senior Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
C.E.	320	Fluid Mechanics Laboratory	0-3-1	....	....
C.E.	452	Concrete Structural Components	3-3-4	....	....
C.E.	455	Transportation Engineering I	....	3-3-4	....
C.E.	457-8	Sanitary Engineering I, II	3-0-3	3-0-3	....
C.E.	431	Hydrology	3-0-3	....	....
C.E.	460	Behavior of Soil and Rock	....	3-3-4	....
E.E.	325	Electrical Circuits and Fields	....	....	3-0-3
Mgt.	325 or	Law I			
I.E.	490	Legal and Ethical Phases of Engineering	....	....	3-0-3
*Hum./S.S./M.L.		Humanities/Social Sciences/ Modern Language	3-0-3	3-0-3	3-0-3
**C.E.	Electives		3-0-3	3-0-3	6-0-6
***Elect.			....	....	3-0-3
		Totals	15-6-17	15-7-17	18-0-18

*See page 38.

**C.E. Electives. Each C.E. senior must choose 4 of the following courses: C.E. 403, 413, 433, 438, 442, 443, 447, 448, 449, 450, 453, 454, 456, 459, 461, 470. Students having earned a minimum grade point average of 2.6 on all course taken as a junior may substitute other elective courses (not ROTC) for these courses.

***Nine hours of electives must be taken if Advanced ROTC is not taken. These electives are to be 300, 400, and 600 level courses from any engineering curriculum, Industrial Management, Mathematics, Physics, Chemistry, Social Sciences, Psychology, Applied Biology, Architecture, Information Science, and English.

Courses of Instruction

NOTE: 4-3-5 *means* 4 *hours class,* 3 *hours laboratory,* 5 *hours credit.*

C.E. 201. Plane Surveying

3-3-4. Prerequisite: E. Gr. 170.

Methods of obtaining and analyzing field data to be used in engineering planning, design, and construction. Introduction to the use of modern instruments and office procedures, and the design of engineering surveys of various required precisions.

C.E. 202. Route Surveying

3-3-4. Prerequisite: C.E. 201.

Theory, computation and field techniques, of the curves required in the planning, design and layout of highways, power lines, pipe lines, and other route locations. Computation of earthwork including the effects of grade and curvature.

C.E. 206. Elementary Surveying

2-3-3. For non-C.E. students. Not offered winter quarter.

Use of tape, transit and level with applications to planimetric and topographic mapping; traverse and area computations; stadia; construction surveys; optical tooling.

C.E. 211. Civil Engineering Applications of Digital Computers

1-3-2. Prerequisite: Math. 108.

A study of the application of digital computers to the solution of Civil Engineering problems. Exercises will use an algebraic compiler language and selected numerical methods. This course is a prerequisite to all junior and senior C.E. courses.

C.E. 302. Civil Engineering Seminar

0-3-1. Prerequisite: None.

Lectures, discussions and reports on current Civil Engineering projects and problems, including engineering ethics, professionalism, introductions to the specialties in civil engineering, and introductions to civil engineering contemporary literature.

C.E. 306. Structural Analysis II

3-3-4. Prerequisite: ESM 343. No credit for C.E. students.

Analysis of structures to find reactions, deflections, and internal forces with emphasis on methods of analysis for statically indeterminate structures.

C.E. 309. Materials of Construction

3-3-4. Prerequisites: ESM 334, Geol. 203.

Basic principles of the properties of materials. Physical, chemical and mechanical properties of metals, concrete, timber, masonry, and asphalt. The laboratory period is for tests, demonstrations, and writing reports.

C.E. 311. Structural Analysis I

5-3-6. Prerequisite: ESM 334.

Determination of internal forces in statically determinate and indeterminate structures including influence lines with applications to beams, frames and trusses.

C.E. 312. Advanced Surveying I

3-3-4. Fall and Spring Quarters. Prerequisite: C.E. 201.

Field astronomy. Precise taping, leveling, triangulation, sub-tense bar, adjustments of level nets and triangulation figures; special problems in land division; photogrammetry: history and fundamental principles.

C.E. 313. Fluid Mechanics I

3-0-3. Prerequisite: ESM 309.

Elementary mechanics of fluids with emphasis on analysis; fluid statics; fluid kinematics; equations of motion; momentum and energy principles; surface and form resistance.

C.E. 314. Fluid Mechanics II

3-3-4; Prerequisite: C.E. 313.

Elementary mechanics of fluids with emphasis on engineering applications. Enclosed conduit flow; open-channel flow; hydraulic machinery; fluid measurements; dynamic similitude.

C.E. 320. Fluid Mechanics Laboratory

0-3-1. Prerequisite: C.E. 314.

Experiment, demonstration and analysis of basic fluid phenomena and exercise in laboratory techniques.

C.E. 324. Elements of Fluid Mechanics

3-3-4. Prerequisite: ESM 306. For non-C.E. students.

Elementary mechanics of fluids in a single comprehensive course. Hydrostatics; fluid kinematics; equations of motion; momentum and energy principles; flow in pipes, fluid measurements, pump selection.

C.E. 400. Reinforced Concrete Design II

2-3-3. Prerequisites: C.E. 306, C.E. 406. No credit for C.E. students.

Analysis and design of reinforced concrete foundations, slabs, and building frames.

C.E. 403. Construction

2-3-3. Prerequisites: C.E. 460, I.E. 425.

The relations of construction to design and ultimate use; the construction contract; basic machinery and construction operations; job planning, estimating; cost accounting; preparation of bids. The laboratory is for supervised problems and inspection trips.

C.E. 406. Reinforced Concrete Design I

3-0-3. Prerequisites: ESM 343, and Arch. 324. No credit for C.E. students.

Principles of behavior of reinforced concrete beams and columns with application to the design of elementary structures.

C.E. 413. Structural Analysis III

2-3-3. Prerequisite: C.E. 311.

General elastic solution of indeterminate framed structures using digital computer. Stiffness and flexibility matrices; frames and trusses in plane and space; grids; nonprismatic members.

C.E. 431. Hydrology

3-0-3. Prerequisite: C.E. 314.

Occurrence and movement of water on the earth as expressed in the hydrologic cycle; elementary meteorology; precipitation, evapotranspiration and runoff; infiltration and groundwater; hydrograph analysis.

C.E. 433. Applied Hydraulics

3-0-3. Prerequisites: C.E. 314, C.E. 431.

Analysis and design of hydraulics works and structures. Typical exercises: stability of dams, spillway design, stilling basins, culverts, pipe systems, sediment transport, erosion, and erosion control.

C.E. 438. Elementary Aerial Photogrammetry

2-3-3. Prerequisite: C.E. 312 or consent of instructor.

Principles of stereoscopy and stereoscopic instruments. Analytical solutions of altitude, base line, line of flight and parallax. Radial line plotting for planimetric and topographic maps.

C.E. 442. Applied Hydrology

3-0-3. Prerequisites: C.E. 314, 431. Winter Quarter.

Applications of hydrology in the design of hydraulic structures for water supply, irrigation, power, drainage and flood control facilities.

C.E. 443. Water Resources Development

2-2-3. Prerequisite: C.E. 431. Spring Quarter.

Identification and evaluation of problems related to comprehensive water resources development; flood management, power, navigation, water quality, irrigation, conservation, and other objectives. Socio-economic and policy implications.

C.E. 444. Special Problems

1 Credit.

C.E. 445, 446. Special Problems

2 Credits. Prerequisite: Senior standing.

Minor research or special problems involving analytical or experimental investigations to develop student initiative and technique under supervision.

C.E. 447. Engineering Astronomy

2-3-3. Prerequisite: Math. 208. Spring Quarter.

Study of the celestial sphere including horizon and equator systems. Study of the Sun, Moon, Earth and planets, including man's early theories of the universe.

C.E. 448. Design in Timber and Prestressed Concrete

2-3-3. Prerequisite: C.E. 452.

Principles of behavior of timber and of prestressed concrete structural members; application to the design of elementary structures.

C.E. 449. Engineering Aspects of Environmental Health

3-0-3. Prerequisite: C.E. 458.

Sanitary Engineering in public health administration and the control of environmental health problems.

C.E. 450. Groundwater Hydrology

3-0-3. Prerequisites: C.E. 431. Geol. 203. Spring Quarter.

Occurrence, distribution, and movement of water below the surface of the earth; groundwater resources and dependable supply rates from wells; artificial recharge and waste disposal.

C.E. 451. Metal Structural Components

3-3-4. Prerequisites: C.E. 309 and C.E. 311.

Principles of behavior of tension and compression members, beams, and connections with application to the design of elementary structures.

C.E. 452. Concrete Structural Components

3-3-4. Prerequisites: C.E. 309 and C.E. 311.

Principles of behavior of reinforced concrete beams, columns, and slabs with application to the design of elementary structures.

C.E. 453. Structural Design

2-3-3. Prerequisites: C.E. 451, C.E. 452, and C.E. 460.

Design of structures in metal and concrete with emphasis on buildings and bridges.

C.E. 454. Advanced Surveying II

2-3-3. Prerequisite: C.E. 312. Winter Quarter.

Errors and adjustments of surveying and photogrammetric instruments; analysis of measurement errors; Mercator and Lambert projections; plane table traversing; special control problems; hydrographic surveying.

C.E. 455. Transportation Engineering I

3-3-4. Prerequisite: C.E. 309.

Planning, design, and construction of streets and highways. A computer-oriented laboratory problem will acquaint the student with modern highway design techniques and criteria.

C.E. 456. Transportation Engineering II

3-0-3. Prerequisite: Senior standing.

The history and economics of transportation systems; traffic and planning problems and techniques; planning and design of air, rail, highway and water transportation facilities as a system.

C.E. 457. Sanitary Engineering I

3-0-3. Prerequisite: Junior standing.

Introduction to water treatment. The evaluation of water quality as related to public water supplies. The engineering theory and application of disinfection, chemical precipitation, coagulation, adsorption, sedimentation and filtration to water treatment.

C.E. 458. Sanitary Engineering II

3-0-3. Prerequisites: C.E. 457, C.E. 431.

Introduction to waste treatment. The analysis of the waste assimilative capacity of a stream. The engineering theory and application of sedimentation, chemical processes, bio-kinetics, aerobic and anaerobic fermentation techniques to the treatment of waste water.

C.E. 459. Sanitary Engineering III

2-3-3. Prerequisite: C.E. 458.

The layout and the hydraulic, process, and operational design of water and waste water systems. The laboratory period is for supervised design problems and inspection trips.

C.E. 460. Physical Behavior of Soil and Rock

3-3-4. Prerequisites: C.E. 309, Geol. 203.

An introduction to the engineering properties of soil and rock. The origin, compositions and structure of soils. The effect of water and its control. The physical properties of soil and rock affecting engineering design and construction. Boring and sampling. Laboratory is for soil tests.

C.E. 461. Soil and Rock Engineering

2-3-3. Prerequisite: C.E. 460.

The mechanics of soil and rock masses as applied to civil engineering design and construction: footing and pile foundations, retaining walls, bulkheads, fills, embankments, and the control of landslides.

C.E. 470. Man in His Environment

3-0-3 Prerequisite: None.

An elective course open to students from all fields. Lectures, discussions and workshop sessions on population, resources, wastes and health as related to development of science and technology.

Graduate Courses Offered

C.E.	601	Advanced Aerial Photogrammetry	2-3-3
C.E.	602	Photographic Interpretation	1-3-2
C.E.	603	Geodetic Engineering	2-3-3
C.E.	604	Legal Principles of Land Surveying	2-3-3
C.E.	605	Dock, Harbor, and Shore Structures	3-0-3
C.E.	606	Pavement Design	3-0-3
C.E.	607	Physical and Physico-Chemical Properties of Soils	3-0-3
C.E.	608	Soil Testing	1-3-2
C.E.	611	Advanced Soil Mechanics	3-3-4
C.E.	613	Reinforced Concrete Structures I	4-0-4
C.E.	614	Structural Planning	3-0-3
C.E.	617	Experimental Analysis I	3-0-3
C.E.	621	Indeterminate Structural Theory I	4-0-4
C.E.	622	Indeterminate Structural Theory II	3-0-3
C.E.	625, 6	Steady Flow in Open Channels I and II	3-0-3
C.E.	627	Flow in Enclosed Conduits	3-0-3
C.E.	628	Sedimentation and Sediment Transport	3-0-3
C.E.	629	Mechanics of Flow in Porous Media	3-0-3
C.E.	633	Intermediate Fluid Mechanics	3-0-3
C.E.	635	Airport Planning and Design	2-3-3
C.E.	636	Highway Administration	2-3-3
C.E.	637	Highway Design	2-3-3
C.E.	638	Traffic Engineering	2-3-3
C.E.	639, 40	Sanitary Engineering Design I and II	3-3-4
C.E.	641	Concrete Technology	2-3-3
C.E.	649	Urban Sanitary Facilities	2-3-3
C.E.	650	Urban Transportation Facilities and Policies	3-3-4
C.E.	652	Air Pollution, Measurements, and Control	3-3-4
C.E.	653	Analytical Methods for Air Pollution Studies	3-3-4
C.E.	655	Asphalt Technology	2-3-3
C.E.	657	Advanced Topics in Hydromechanics	3-0-3

C.E.	658	Urban Transportation Planning	3-3-4
C.E.	659	Theory of Traffic Flow	2-3-3
C.E.	663	Technology in Water Resources Development	2-2-3
C.E.	664	Economics of Water Resources Development	2-2-3
C.E.	665	Seminar in Water Resources Engineering	2-2-3
C.E.	666	Flood Management	3-0-3
C.E.	670	Advanced Structural Mechanics	4-0-4
C.E.	671	Plastic Design in Steel	4-0-4
C.E.	672	Reinforced Concrete Structures II	4-0-4
C.E.	677	Soil Construction	2-3-3
C.E.	678	Advanced Foundation Engineering	2-3-3
C.E.	682	Basic Radiological Health	2-3-3
C.E.	683	Environmental Radiation Surveillance	3-3-4
C.E.	684	Industrial Waste Treatment and Disposal	2-3-3
C.E.	685, 6	Sanitary Engineering Processes I and II	3-3-4
C.E.	687	Stream Analysis	3-0-3
C.E.	689	Applied Limnology	2-3-3
C.E.	694	Field Methods in Sanitary Engineering	0-15-5
C.E.	699	Doctor's Examinations Preparation	
C.E.	700	Master's Thesis	
C.E.	704, 5, 6	Special Problems	
C.E.	716	Structural Dynamics	3-0-3
C.E.	727	Theoretical and Applied Soil Mechanics I	4-3-5
C.E.	728	Theoretical and Applied Soil Mechanics II	3-3-4
C.E.	730	Engineering Hydrodynamics	3-0-3
C.E.	735	Reinforced Concrete Structures III	4-0-4
C.E.	737	Gravity-Wave Phenomena	3-0-3
C.E.	746	Seminar in Sanitary Engineering	0-2-1
C.E.	750, 1, 2	Special Problem	
C.E.	753, 4, 5	Special Course	
C.E.	756, 7, 8	Research Topic	
C.E.	760	Hydrologic Models	2-3-3
C.E.	761	Watershed Analysis	2-3-3
C.E.	762	Hydrometeorology	2-3-3
C.E.	763	Urban Hydrology	2-3-3
C.E.	765	Hydrology of Floods	2-3-3
C.E.	767	Hydrologic Simulation	2-3-3
C.E.	771	Seminar in Soil and Rock Mechanics	0-2-1
C.E.	772	Seminar in Foundation Engineering	1-0-1
C.E.	773	Dynamic Characteristics of Soils	3-3-4
C.E.	774	Dynamics of Massive Media	2-3-3
C.E.	779	Mass Transit Planning	3-0-3

C.E.	780	Seminar in Transportation Engineering	1-0-1
C.E.	799	Doctor's Dissertation Preparation	
C.E.	800	Doctor's Thesis	

(Complete details about these courses are contained in the *Graduate Bulletin,* a copy of which is available upon request.)

SCHOOL OF ELECTRICAL ENGINEERING

(Established in 1896)

Director and Professor–Demetrius T. Paris; *Professor Emeritus*–Frank O. Nottingham, Jr., Edward R. Weston; *Regents' Professor*–Kendall L. Su; *Professors*–Benjamin J. Dasher, Daniel C. Fielder, David L. Finn, Joseph L. Hammond, Jr., Robert D. Hayes, John W. Hooper, F. Kenneth Hurd, Maurice W. Long, Howard L. McKinley, George P. Rodrigue, Thomas M. White, Jr.; *Associate Professors*–Cecil O. Alford, Aubrey M. Bush, Ronal W. Larson, Mohamed F. Moad, John B. Peatman, Ray H. Pettit, Dale C. Ray, James R. Rowland, John M. Wallace, Jr., Roger P. Webb; *Adjunct Associate Professors*–Marton Majoros (MD), Robert F. Thompson (MD); *Assistant Professors*–James E. Brown, III, William R. Callen, Jr., Joseph A. Connelly, Robert K. Feeney, Edward B. Joy, John D. Norgard, William E. Sayle, II, Jay H. Schlag, Moiez A. Tapia; *Instructors*–Peter D. Bergstrom, David A. Conner; *Lecturers*–Donald G. Bodnar, H. Neal Nunnally, Edward K. Reedy, Spurgeon L. Robinette, Allen P. Sheppard; *Administrative Assistant to Director*–John G. Barnett; *Principal Secretary*–Mrs. Jean M. Shankel; *Senior Secretary*–Mrs. Diane D. Barrett; *Secretaries*–Mrs. Anita Ashcraft, Miss Doris Carringer, Mrs. Diane DeMillo, Miss Nancy Earle, Miss Lily O'Connor; *Senior Laboratory Mechanic*–Raleigh M. Ford; *Senior Electronics Technician*–Paul G. Branson; *Electronics Technicians*–Joe H. Hammock, John H. Pomakian.

General Information

Almost every part of our society is influenced by the work of electrical engineers. They have long pioneered the fields of electronics, computers, control, power, and communication and, without controlled electricity, industry as we know it simply could not exist. Today electricity and electronics are expanding anew into the non-industrial world–into commerce, medicine, environmental technology, and a seemingly endless array of diverse areas. The computer is becoming as familiar a sight in the insurance company office as it is in the scientific laboratory. The revolutionary achievements of the past have made electricity the servant of society. There is every reason to believe that the achievements of electrical engineering will be even more revolutionary in the future. The past, present, and future importance of electrical engineering as a profession is reflected in one basic fact: electrical energy is the only known form of energy which can be transmitted through vacuum under controlled conditions and by means of which intelligence can be processed and transferred effectively even over extremely long distances.

The School of Electrical Engineering enjoys a reputation for producing graduates recognized for their ability to get things done. The program of the School is designed to maintain and enhance that reputation. It is a well-balanced program of fundamental theory and applications, which prepares the graduate for further academic work, or for a career in any of the many phases of electrical engineering. The basic required program of instruction in fundamental theory and laboratory practice is liberally augmented with elective courses to enable the student to tailor programs to individual need, and includes a broad range of humanistic studies to help the engineer recognize and fulfill his responsibilities as a citizen. A faculty advising program is provided to assist in program selection. In special instances, deviations from the basic required program may be permitted.

The program of the School of Electrical Engineering is intensive, demanding a scholastic average of C or better in the prescribed courses in mathematics, physics, and electrical engineering. In addition, the School requires an overall C average in all senior level electrical engineering courses. It seeks to attract the best students and provide them with a rewarding educational experience that will serve them well in pursuing their varied career goals.

Course of Instruction

Freshman Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Electives*†		....	2-0-2	2-0-2	2-0-2
Hum./S.S./M.L. Electives**		....	3-0-3	3-0-3	3-0-3
Math.	107-8-9	Calculus I, II, III...........	5-0-5	5-0-5	5-0-5
Phys.	227	Particle Dynamics.........	....	....	4-3-5
Chem.	104, 105	General Chemistry........	4-3-5	4-3-5	....
E.Gr.	170, 171	Visual Communication.	2-3-3	2-3-3	....
P.T.	101-2-3	Physical Training..........	0-4-1	0-4-1	0-4-1
Gen.	101	Orientation..................	1-0-0	....	....
		Totals........................	17-10-19	16-10-19	14-7-16

*These free elective courses may be taken at any time during a student's course of study. However, these six credit hours may be satisfied by selecting basic ROTC. If basic ROTC is elected by the student, then it must be scheduled beginning the first quarter the student is enrolled. For further details, see page 28 of the catalogue.

†See page 111.

**See page 38 for the required distribution of these electives.

Sophomore Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
ESM	205	Statics	3-0-3	....	....
ESM	309	Dynamics I	....	....	3-0-3
Hum./S.S./M.L. Electives**			3-0-3	3-0-3	3-0-3
Math.	207	Calculus IV	5-0-5	....	....
Math.	208	Calculus and Linear Algebra	....	5-0-5	....
Math.	209	Ordinary Differential Equations	....	....	5-0-5
Phys.	228	Electromagnetism	4-3-5	....	....
Phys.	229	Optics and Modern Physics	....	4-3-5	....
E.E.	210-11	Elements of Elec. Engr.	....	3-0-3	3-0-3
E.E.	212	Instrumentation Laboratory	....	....	1-3-2
P.T.	201-2-3	Physical Training	0-4-1	0-4-1	0-4-1
		Totals	15-7-17	15-7-17	15-7-17

Junior Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
Electives †			4-0-4	4-0-4	4-0-4
Hum./S.S./M.L. Electives**			3-0-3	3-0-3	3-0-3
E.E.	350-51-52	Electromagnetics	3-0-3	3-0-3	3-0-3
E.E.	355-56	Circuits and Systems	3-0-3	3-0-3	....
E.E.	360	Engineering Electronics	3-0-3	....	....
E.E.	361	Nonlinear Devices and Circuits	....	3-0-3	....
E.E.	362	Electromechanical Systems and Energy Conversion	....	....	3-0-3
E.E.	363	Random Signals and Noise	....	....	3-0-3
E.E.	370-71-72	Junior EE Laboratory I, II, III	0-3-1	0-3-1	0-3-1
		Totals	16-3-17	16-3-17	16-3-17

†See page 111.
**See page 38 for the required distribution of these electives.

Senior Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
Electives†		....	7-0-7	13-0-13	13-0-13
Hum./S.S./M.L. Electives**		....	3-0-3	3-0-3	3-0-3
E.E.	460	Materials Science	3-0-3	....	....
E.E.	461	Communication Systems	3-0-3	....	....
E.E.	470-71	Senior EE Laboratory I, II	0-3-1	0-3-1	....
E.E.	472	Project Laboratory	....	....	0-3-1
		Totals	16-3-17	16-3-17	16-3-17

**See page 38 for the required distribution of these electives.

†Electives: The Electrical Engineering curriculum contains 51 hours of electives, in addition to 36 hours of specified humanities/social sciencies/modern language electives. The 51 hours of electives must include a minimum of

12 hours of technical electives, subject to School approval, outside the major field, including at least one course in thermodynamics; and

18 hours of electives in Electrical Engineering, subject to School approval.

Thus, 21 credit hours of entirely free electives are included in the curriculum.

The 6 hours of free electives in the freshman year may be replaced by 6 hours of basic ROTC. In addition, a maximum of 9 hours of advanced ROTC may be applied as free electives.

NOTES:

1. It is expected that each student, through independent study, attendance of seminars or formal courses, will acquire the ability to program simple problems on one of the digital computers available on campus prior to enrollment in E.E. 210.
2. All students must demonstrate knowledge of the history and constitutions of the United States and Georgia, either by passing appropriate examinations or by completion of certain courses offered by the Department of Social Sciences.

Courses of Instruction

NOTE: 4-3-5 *means* 4 *hours class,* 3 *hours laboratory,* 5 *hours credit.*

E.E. 101. Introduction to Electrical Engineering

1-0-1. Prerequisite: Entrance requirements.

An orientation to electrical engineering, both at Georgia Tech and in industry. A major goal of the course is to provide insight into what electrical engineers do and what exciting directions their profession is taking. Open to freshmen and transfer E.E. students only.

Text: None

E.E. 110. Computer Programming and Graphics

2-3-3. Prerequisite: Entrance Requirements.

An introduction to computer programming and graphical display on the B-5500 and U-1108 digital computers. Emphasis is placed on acquainting the student with the total spectrum of computing facilities available on the Georgia Tech campus. Approximately one-half of the quarter is devoted to presenting ALGOL and GTL for the B-5500 and Fortran V for the U-1108. Graphical displays are presented in order to plot one-dimensional and two-dimensional graphs. Familiarization with the computing facilities including in-and-out procedures, extended memories, and available special software is accomplished through the solution of simple electrical engineering problems on the computers.

Texts: Thurnau, Johnson and Ham, *Algol Programming–A Basic Approach,* and selected manuals.

E.E. 210. Elements of Electrical Engineering

3-0-3. Prerequisites: Physics 227, Math. 207.

Fundamentals of general active and passive circuit analysis. An introduction to the theory of d-c and a-c circuit analysis. Definitions of fundamental parameters, network theorems, general (voltage and current variable) analysis techniques, models of active devices, steady-state and transient solutions.

Texts: Millman and Halkias, *Electronic Devices and Circuits* and Close, *Analysis of Linear Circuits.*

E.E. 211. Elements of Electrical Engineering

3-0-3. Prerequisite: E.E. 210.

Fundamentals of electronic devices and circuits. Physical operation of electronic devices, models from a physical viewpoint, bias techniques, stability, transfer functions, two-port representation, input and output impedance concepts, mutual inductance, introduction to circuit configurations.

Texts: Millman and Halkias, *Electronic Devices and Circuits* and Close, *Analysis of Linear Circuits.*

E.E. 212. Instrumentation Laboratory

1-3-2. Prerequisite: E.E. 210.

An introduction to instrumentation equipment and techniques. Basic laboratory techniques and practice. Data collection presentation and analysis. Operation of oscilloscopes and meters. Measurement of parameters of electrical engineering components and devices.

Text: Wedlock and Roberge, *Electronic Components and Measurements.*

E.E. 315. Mechanical Plant of Buildings

3-0-3. Prerequisites: Junior or Senior Architecture or Building Construction standing. Others may schedule this course only by special permission of the School Directors and with the consent of the instructor. This course is not to be scheduled by Electrical Engineering Students.

A study of the electrical and lighting systems of buildings. Construction and code requirements and personnel safety are covered. Lectures, recitations, and special problems.

Text: McGuinness, Stein, Gay, and Fawcett, *Electrical Equipment for Buildings,* Fourth Edition.

E.E. 325. Electric Circuits and Fields

2-3-3. Prerequisites: Phys. 228, Math. 209. For non-electrical engineering students.

A study of electric circuit elements and the steady state and transient response of such circuits to periodic and step inputs using the Laplace transform method. Lectures, quizzes, recitations, and computation periods.

Text: Smith, *Circuits Devices and Systems.*

E.E. 326. Elementary Electronics

2-3-3. Prerequisites: E.E. 325. For non-electrical engineering students.

This course is an introduction to electronic and semiconductor devices and includes a study of circuits containing these elements.

Text: Smith, *Circuits Devices and Systems.*

E.E. 327. Electric Power Conversion

2-3-3. Prerequisite: E.E. 325. For non-electrical engineering students.

A study of energy conversion principles and devices such as motors, generators, and rectifiers. Lectures, computation, and laboratory periods.

Text: Smith, *Circuits Devices and Systems.*

E.E. 332. Computer Engineering I

3-0-3. Prerequisite: E.E. 110 or equivalent.

A discussion of machine language, machine organization, and the design concepts of digital computers as they affect the language. Emphasis is placed on the interaction between system software and the computing system. A hypothetical language is used for several assembly language programming problems. A major class project is to design an assembler for this language and to simulate the computer on the B-5500 or U-1108.

Text: E. W. Gear, *Computer Organization and Programming.*

E.E. 333. Computer Engineering II

3-3-4. Prerequisite: E.E. 110 or equivalent.

Introduction to AND/OR, NAND/NOR logic, fundamentals of digital computers, number systems and computer arithmetic. A detailed study is made of the arithmetic, memory, control, and input-output sections of digital computers. Each student will be expected to complete one major design problem.

Text: Donald Eadie, *Introduction to the Basic Computer.*

E.E. 334. Computer Engineering III

3-0-3. Prerequisite: E.E. 110 or equivalent.

A study of the upper levels of computer structure: the instruction of sets which define a computer system at the programming level; and the organization of processors, memories, switches, input-output devices, controllers, and communication links which provide the functioning system level. Evaluations are made of several modern computer systems. A framework is developed for computer system analysis and classification. Each student is expected to apply the analysis framework to an existing computer system as a class project.

Text: C. G. Bell and A. Newell, *Computer Structures: Readings and Examples.*

E.E. 335. Introduction to Digital Systems Design

3-3-4. Prerequisite: E.E. 211.

A study of the application of digital techniques to the design of special purpose digital systems. The techniques utilized take advantage of the flexibility inherent in typical commercially available logic modules. Considerable emphasis is placed upon the solution of meaningful design problems. The laboratory work consists of designing, implementing, and debugging several design problems on the digital synthesizer in the Digital Systems Laboratory.

Text: Class notes.

E.E. 336. Computational Methods for Simulation

3-0-3. Prerequisite: Math 209.

The course objective is to develop computational methods suitable for the solution of complex electrical engineering problems. Attention is given to a comparative analysis of the methods and potential difficulties. Emphasis is placed on the application of the various methods to several typical problems.

Text: Notes.

E.E. 342. Electrical Measurements

3-3-4. Prerequisites: E.E. 212, or concurrently.

The theory and practice or measurements of electrical quantities using both analog and digital methods. This course also considers the recording, indication, and processing of measurement data.

E.E. 350. Electromagnetics

3-0-3. Prerequisites: Math. 209, Phys. 228 and E.E. 211.

An introduction to electromagnetic

theory including the study of vector analysis. Maxwell's equations, and static electric and magnetic fields.

Text: Paris and Hurd, *Basic Electromagnetic Theory.*

E.E. 351. Electromagnetics

3-0-3. Prerequisites: E.E. 350 and E.E. 355.

A continuation of E.E. 350. Includes a study of energy and power, steady-state fields, and plane waves in lossless and in dissipative media.

Text: Paris and Hurd, *Basic Electromagnetic Theory.*

E.E. 352. Electromagnetics

3-0-3. Prerequisite: E.E. 351.

A continuation of E.E. 351. Steady state and transient response of lossless transmission lines, dissipative transmission lines, waveguides, radiation, antennas, and quasistatics.

Text: Paris and Hurd, *Basic Electromagnetic Theory.*

E.E. 355. Circuits and Systems

3-0-3. Prerequisite: E.E. 211.

Frequency and time domain analysis of circuits and systems. Phasors, resonance, power, three-phase circuits, singularity functions, Fourier series, Fourier transforms, Laplace transforms and analysis techniques, frequency spectra, initial conditions, and convolution.

Texts: Millman and Halkias, *Electronic Devices and Circuits* and Close, *Analysis of Linear Circuits.*

E.E. 356. Circuits and Systems

3-0-3. Prerequisite: E.E. 355.

Representation of dynamical systems, signal flow and state variable techniques. Properties of closed loop systems. System specifications. Stability analysis.

Text: Melsa and Shultz, *Linear Control Systems.*

E.E. 360. Engineering Electronics

3-0-3. Prerequisite: E.E. 211.

Modeling and analysis of electronic devices at all frequencies, configurations of active devices, multistage amplifiers, integrated circuits, rectifiers and power supplies, feedback amplifiers, oscillators and power amplifiers.

Texts: Millman and Halkias, *Electronic Devices and Circuits,* and Close, *Analysis of Linear Circuits.*

E.E. 361. Nonlinear Devices and Circuits

3-0-3. Prerequisites: E.E. 355 and E.E. 360.

Analysis and synthesis of nonlinear devices and circuits. Nonlinear shaping circuits, logic circuits, general analysis techniques applicable to nonlinear systems.

Text: Millman and Taub, *Pulse, Digital, and Switching Waveforms.*

E.E. 362. Electromechanical Systems and Energy Conversion

3-0-3. Prerequisites: E.E. 351 and E.E. 355.

Fundamentals of electromechanical energy conversion, electromechanical devices and systems. Energy state functions, force energy relationships, basic transducers, introduction to a-c and d-c machines.

Text: Woodson and Melcher, *Electromechanical Dynamics.*

E.E. 363. Random Signals and Noise

3-0-3. Prerequisite: E.E. 355.

An introduction to the theory of random signals and noise. The concepts of probability theory are applied to the characterization of random waveforms through the use of probability distributions, correlation functions, and power spectra. A study is made of the behavior of electrical systems excited by random signals and noise.

Text: Lathi, *Random Signals and Communication Theory.*

E.E. 370-71-72. Junior Electrical Engineering Laboratory I, II, and III

0-3-1. Prerequisite: E.E. 212.

Laboratory experiments in circuits and electromagnetics.

E.E. 412. Electric Energy Conversion

3-3-4. Prerequisite: E.E. 362.

Principles of rotating a-c and d-c machines. Analysis techniques and application studies of individual and interconnected devices. Coordinated laboratory exercises.

Text: To be selected.

E.E. 415. Principles of Feedback Control

3-3-4. Prerequisite: E.E. 362.

A study of automatic control systems. Basic control principles, system modeling and analysis techniques. Design studies of both continuous and discrete data systems. Coordinated laboratory exercises.

Text: Melsa and Schultz, *Linear Control Systems.*

E.E. 417. Pulse Circuits

3-0-3. Prerequisite: E.E. 361.

A study of the analysis and design of devices and circuits for pulse generation and shaping.

Text: To be selected.

E.E. 419. Power System Analysis

3-0-3. Prerequisites: E.E. 362 or consent of instructor.

A study of power system parameters, fault currents, stability, and protective relaying.

Text: Elgerd, *Electric Energy Theory.*

E.E. 420. Solid-State Electronics

3-3-4. Prerequisite: E.E. 460.

A study of crystalline state, waves in crystals, transport properties of solids, semiconductors, semiconductor junctions, and integrated circuits.

Text: Hunter, *Introduction to Semiconductor Phenomena and Devices.*

E.E. 421. Electromagnetic Properties of Solids

3-3-4. Prerequisite: E.E. 460.

A study of dielectric and magnetic processes, domain magnetics, thin film electronics, and quantum electronics.

Text: Kittel, *Introduction to Solid State Physics.*

E.E. 422. Industrial Electronics

3-3-4. Prerequisite: E.E. 356.

Components and analysis of continuous and two-position industrial control systems, including polyphase and controlled rectifiers, transducers, photosensitive devices, and timing circuits.

Text: Zeines, *Principles of Industrial Electronics.*

E.E. 428. Communication Engineering

3-3-4. Prerequisite: E.E. 356.

A study of circuit components in the radio-frequency region below one kilomegahertz. The theory and operating characteristics of low-pass and band-pass amplifiers at radio frequencies. Distortion in amplifiers and the application of feedback are included in the study. Laboratory and computation are included.

Text: Terman, *Electronic and Radio Engineering.*

E.E. 430. Communication Engineering

3-3-4. Prerequisite: E.E. 356.

A study of relaxation oscillators, wave shaping techniques, pulse generation, and kindred subjects. Noise, interference, propagation, antenna systems, and the problem of frequency allocation are studied. Receivers and transmitters for radio and television are also studied.

Text: Terman, *Electronic and Radio Engineering.*

E.E. 432. Communication Circuits

3-3-4. Prerequisite: E.E. 356.

A study of two-port communication circuits by means of methods of modern network synthesis.

Text: Kuh and Pederson, *Principles of Circuit Synthesis.*

E.E. 434. High-Frequency Measurements

3-0-3. Prerequisite: E.E. 352.

A study of high-frequency measurements. The course emphasizes the operating characteristics of standard laboratory equipment, techniques of high-frequency measurements, design of systems to make specialized measurements, and the state-of-the-art of high-frequency measurement equipment. The course makes use of manufacturer application notes and current technical notes.

Text: To be selected.

E.E. 436. Ultra-High-Frequency Techniques

3-3-4. Prerequisite: E.E. 352.

Primarily concerned with rectangular and cylindrical waveguides and resonators; qualitative study of klystrons, magnetrons, and traveling wave tubes; introduction to ferrite devices, such as gyrators and ferrite isolators. Coordinated laboratory exercises concerned with basic measurements at microwave frequencies.

Texts: Ishii, *Microwave Engineering;* Hewlett Packard Engineering Staff, *Microwave Theory and Measurements.*

E.E. 437. Antennas

3-3-4. Prerequisite: E.E. 352.

An introductory course in antenna theory and practice for senior students. Topics emphasized are the linear antenna, antenna arrays, aperture antennas, antenna patterns, and antenna gain. The important characteristics of specialized antennas such as the helix, the rhombic, and the log-periodic, etc. are presented.

Text: Kraus, *Antennas.*

E.E. 438. Laser Theory and Applications

3-0-3. Prerequisite: E.E. 460.

An introduction to the theory and application of lasers and related instrumentation. Lasers discussed include ruby, He-Ne, and semiconductor lasers. Nonlinear optical effects, Q-switching, and applications in communication and medicine are considered.

Text: Siegman, *Introduction to Lasers and Masers.*

E.E. 442. Electrical Design

3-3-4. Prerequisite: E.E. 356.

Design problems of various types of electrical and electronic systems. Lectures and computation periods.

Text: To be selected.

E.E. 443. Linear Graph Theory

3-0-3. Prerequisite: E.E. 355.

Formal graph theory for electrical engineers. Course includes comprehensive and unified study of oriented and non-oriented graphs for use in the examination of Kirchoff's laws, network topology, communication networks, network analysis and synthesis, and signal-flow theory. Development of flow graphs as working tools. Lectures, problem assignments, examinations.

Text: Shu-Park, *Introductory Topological Analysis of Electrical Networks.*

E.E. 450. Special Topics

3-0-3. Prerequisite: Senior standing.

Special topics of unusual current interest; introductory treatments of new developments in electrical engineering technology.

Text: To be selected.

E.E. 452-453-454-455. Special Problems

0-3-1. Prerequisite: Senior E.E. standing.

Special engineering problems will be assigned to the student according to his needs and capabilities.

E.E. 456-457-458-459. Special Topics

Credit to be arranged. Prerequisite: Senior E.E. standing.

New developments in electrical engineering are presented as special lecture courses.

E.E. 460. Materials Science

3-0-3. Prerequisites: E.E. 352 and E.E. 360.

A study of properties of dielectrics in static and alternating fields, magnetic properties of ferrous materials, atomic interpretation of conduction in crystals, photo-conductivity and related optical phenomena.

Text: Wert and Thomson, *Physics of Solids.*

E.E. 461. Communication Systems

3-0-3. Prerequisites: E.E. 360 and E.E. 363.

The definitions and basic concepts of various analog and digital modulation techniques are considered. Modulators for generating the signals and demodulators for information recovery are studied. Applications are discussed.

Text: Lathi, *Random Signals and Communication Theory.*

E.E. 470. Senior Electrical Engineering Laboratory I

0-3-1. Prerequisite: E.E. 362.

Experimental studies in electromechanics and control.

E.E. 471. Senior Electrical Engineering Laboratory II

0-3-1. Prerequisite: E.E. 461.

Experiments in signal processing and communication systems.

E.E. 472. Project Laboratory

0-3-1. Prerequisite: Senior Standing.

Individual student projects tailored to student interests.

E.E. 477. Interfacing Small Computers

3-3-4. Prerequisite: E.E. 335.

The input-output structure of small computers is studied together with the characteristics of a variety of peripheral devices. The design of interface circuitry for these devices makes up the heart of the course. Emphasis is placed on design problem work.

Text: Notes.

E.E. 478. Digital Signal Processing

3-0-3. Prerequisite: E.E. 336.

An introductory treatment of the theory and applications of digital signal processing. The course covers the basic theory of linear discrete systems, Z-transform, digital filter design in the frequency domain and fast Fourier transforms.

Text: Notes.

E.E. 479. Introduction to Automaton Theory

3-0-3. Prerequisite: Senior standing.

The course aims at the study of the properties of linear sequential systems in relation to their applications in various digital tasks such as: computation in ring of polynomials and finite fields, counting, timing, memory addressing, generation of codes, etc.

Text: Gill, *Linear Sequential Systems.*

E.E. 480. Introduction to Sequential Systems

3-0-3. Prerequisite: Senior Standing.

The course aims at developing procedures for synthesis of synchronous and asynchronous sequential systems. Models related to practical design problems will be studied.

Text: Wood, *Switching Theory.*

E.E. 481. Introduction to Bio-electronics

3-0-3. Prerequisite: E.E. 360 or consent of instructor for non-EE students.

An introduction to the study of the electrical phenomena of biological systems. Emphasis is placed on the application of electrical engineering techniques to the measurement and control of biological systems.

E.E. 482. Linear System Theory

3-0-3. Prerequisite: E.E. 356.

Linear system theory is developed with emphasis placed on transform methods, state variable methods, and analysis of time varying systems. Applications to both continuous and discrete control and information systems are given.

E.E. 483. Computer Simulation of Systems

3-3-4. Prerequisite: E.E. 356.

A study of simulation methods using analog computers, digital computers, and hybrid computers. Emphasis is placed on simulation languages and applications of the three techniques to actual problems.

Text: R. E. Stephenson, *Computer Simulation for Engineers.*

E.E. 484. Transistor Circuit Analysis

3-0-3. Prerequisite: E.E. 360. Corequisite: E.E. 485.

A study of the application of linear electronic circuits in the design of special purpose amplifiers. Specific topics studied include large signal amplifiers, tuned circuit amplifiers, field-effect and bipolar transistors, multistage amplifier design, and linear integrated circuits.

E.E. 485. Electronic Design Laboratory

0-3-1. Corequisite: E.E. 484.

Practical design problems which emphasize creativity and imagination are posed and their solutions are individually implemented in the laboratory.

E.E. 490. E.E. Senior Seminar

1-0-1. Prerequisite: Second quarter Senior E.E. standing or above.

This seminar is intended to serve as a bridge between an undergraduate education and a postgraduate career. The program will generally be a talk followed by a question and answer period with various authorities. Offered only in the Spring Quarter and open only to Senior E.E. students nearing graduation. Junior and first quarter seniors will be admitted to the Seminar if they will have graduated before the Seminar is offered during the following year.

Graduate Courses Offered

E.E.	601, 2, 3	Automaton Theory	3-0-3
E.E.	622, 3	Advanced Electrical Transients	3-0-3
E.E.	624	Advanced Electrical Measurements	3-3-4
E.E.	633	Digital Systems Engineering Laboratory	0-3-1
E.E.	634	Antenna Systems	4-3-5
E.E.	635	Digital Systems Engineering I.	3-0-3
E.E.	636	Digital Systems Engineering II.	3-0-3
E.E.	637	Digital Systems Engineering III	3-0-3
E.E.	638	Random Processes	3-0-3
E.E.	639	Electromagnetic Theory	3-0-3
E.E.	640	Wave Guides and Cavity Resonators	3-0-3
E.E.	641, 2, 3	Computer Simulation	3-0-3
E.E.	646	Atomic Collisions	3-0-3
E.E.	647	Communication Circuits and Signals	3-0-3
E.E.	648	Modulation Theory	3-0-3
E.E.	649	Noise in Communications Systems	3-0-3
E.E.	650	Power System Stability	3-0-3
E.E.	651	Electrical Properties of Materials	3-0-3
E.E.	652	Magnetic and Dielectric Properties of Materials	3-0-3
E.E.	653	Solid State Electronic Devices	3-0-3
E.E.	654	System Design Methodology	2-3-3
E.E.	655, 6	Complex Systems Design	2-4-3
E.E.	659	Information Theory	3-0-3
E.E.	660	Optimum Linear Filters	3-0-3
E.E.	661	Statistical Detection Theory	3-0-3
E.E.	662, 3, 4	Advanced Network Theory	3-3-4
E.E.	669	Introduction to Plasma Dynamics	3-0-3
E.E.	670	Plasma Diagnostics	3-3-4
E.E.	671	Hydromagnetics	3-0-3
E.E.	684, 5, 6	Feedback Control Systems	3-0-3
E.E.	694, 5, 6	Feedback Control Systems Laboratory	0-3-1
E.E.	699	Preparation for Ph.D. Qualifying Exams	Non-Credit
E.E.	700	Master's Thesis	
E.E.	701, 2, 3	Seminar	1-0-0
E.E.	704, 5, 6, 8	Special Problems	
E.E.	709	Special Topics	
E.E.	745, 6, 7	Advanced Electromagnetic Theory	3-3-4
E.E.	753, 4, 5	Advanced Communication Theory	3-0-3
E.E.	762, 3, 4	Advanced Network Theory II.	3-0-3
E.E.	771, 2, 3	Advanced Feedback Control Theory	3-0-3
E.E.	800	Doctor's Thesis	
E.E.	801, 2, 3, 4	Seminar	1-0-1

(Complete details about these courses are contained in the *Graduate Bulletin*, a copy of which is available upon request.)

DEPARTMENT OF ENGINEERING GRAPHICS

(Established in 1962)

Department Head—R. Kenneth Jacobs; *Assistant Head*—H. William Streitman; *Professor*—Joseph C. Durden, Jr.; *Associate Professors*—John D. Hutcheson, Earl M. Wheby, Ira E. Wilks; *Assistant Professors*—William M. Baggs, James M. Lenowitz, John R. Murphy, August J. Nechi, John G. Nevitt, Hardy J. Smith; *Instructor*—James T. Kindley; *Lecturer*—Glen F. Hart; *Principal Secretary*—Mrs. Hugh C. Murphy.

General Information

Graphics has long been a language of the Engineer. It has endured through the years because it is the most flawless means of communication yet invented by man. Where the spoken word or the written document is always subject to misinterpretation, a well executed graphical analysis conveys the thought or plan exactly as intended.

As the line of demarcation between the efforts of engineers and scientists continues to diminish, it becomes increasingly imperative that rapid communication between them be extended and improved. Engineering Graphics, or Graphic Science, not only supplies the common language linking the closely oriented fields of engineering and science, it also takes on the added task of providing the engineer with means of expression in his newer role in the area of analysis and synthesis without relinquishing his command in design, which has long been his primary responsibility. This nowise ignores the cultural attainments arising from study in this discipline which, for many, initiates first steps into our modern and ever changing world of precise measurements, spatial relationships, and clear thinking.

To visualize in three dimensions and to express thoughts and ideas in concise form readily understood by those conversant with the common language is one of the essentials for growth in engineering and allied sciences. Setting a climate conducive to the student's development in this phase of his education is the aim and purpose of the department.

It is, therefore, expected that the able student will reach that level of graphics literacy whereby he may live comfortably within his professional environment.

Courses of Instruction

NOTE: 4-3-5 *means* 4 *hours class,* 3 *hours laboratory,* 5 *hours credit. Students are expected to use drawing instruments approved by the Department of Engineering Graphics.*

E.Gr. 105. Managerial Graphics

0-6-2. Prerequisite: None. Not open, generally, to students with credit in E.Gr. 113.

Study of effective graphic communication through sketches, multiview orthographic projection, auxiliary views, sectional views, and pictorial drawings. Design and construction of charts for illustrative purposes. Translating statistical data into meaningful graphic forms.

Texts: *GMSH, Technical Drawing, 5th Edition;* Murphy, *Managerial Graphics.*

E.Gr. 113. Introduction to Engineering Graphics

0-6-2. Prerequisite: None.

An introduction to graphics in engineering and science. Primary emphasis on effective graphic communication through freehand and instrument representation of multiview orthographic projections, sections and conventions, primary auxiliary views, isometric and oblique drawings.

Text: *GMSH, Technical Drawing, 5th Edition.*

E.Gr. 114. Engineering Descriptive Geometry

0-6-2. Prerequisite: E.Gr. 113 or E.Gr. 170

Graphic solutions of engineering problems utilizing auxiliary views and rotation methods. Point, line, and plane relationships. Intersections of lines, planes, and solid geometric forms. Development of surfaces. Solutions of concurrent vector systems.

Text: Slaby, *Fundamentals of Three-Dimensional Descriptive Geometry.*

E.Gr. 115. Engineering Graphics

0-6-2. Prerequisite: E.Gr. 170 or E.Gr. 113.

Use of the graphic techniques of sectioning, dimensioning, pictorial representation, detail and assembly sketches and drawings in engineering design. Application of graphical computations (graphic algebra, graphic calculus, nomography and empirical equations) to the analysis and synthesis of engineering problems.

Text: *GMSH, Technical Drawing, 5th Edition.*

E.Gr. 170. Introduction to Visual Communication and Engineering Design I

2-3-3. Prerequisite: None.

This is the first of a multi-discipline two-course sequence in visual communication and engineering design. The engineering design portion of this course introduces the student to 1) the theory of design, through a lecture series on the design process, and 2) the application of this problem-solving process, through the completion of an assigned design project. In the area of visual communications, the student is introduced to those elements of projection theory and those techniques of engineering graphics which will enhance 1) his ability toward rapid visualization and 2) his ability to communicate through graphic presentation.

Texts: GMSHL, *Engineering Graphics;* Krick, *An introduction to Engineering and Engineering Design.*

E.Gr. 171. Introduction to Visual Communication and Engineering Design II

2-3-3. Prerequisite: E.Gr. 170.

In this, the second course of the sequence in visual communication and engineering design, the lecture series builds on the student's previous knowledge of the design process by considering some of the factors which influence good creative design; namely, environmental factors, human factors, material factors, and socio-economic factors. Students are organized into teams for design projects assigned during this course. The visual communications portion of the course provides for an in-depth study of the use of engineering graphics as a tool for engineering analysis, with emphasis on empirical equations, graphic calculus, and nomography.

Texts: GMSHL, *Engineering Graphics;* Krick, *An Introduction to Engineering and Engineering Design;* and Edel, *Introduction to Creative Design.*

E.Gr. 190-191. Special Topics in Engineering Graphics

2-3-3; 2-3-3. Prerequisite: Consent of instructor.

These courses are designed to permit students to pursue common, specialized interests in areas of graphics not represented or treated extensively in other offerings of the Department.

E.Gr. 213. Industrial Graphics

1-6-3. Prerequisites: E.Gr. 114 and E.Gr. 115, or E.Gr. 171.

Sketching and simplified representation techniques as applied to production drawings; advanced study of auxiliary views and sections; threads and fasteners; geometric tolerancing and true-position dimensioning; working drawings and assembly drawings as a part of the design process; use of air brush in technical illustration.

Text: To be selected.

E.Gr. 304. Graphic Statics I

0-3-1. Prerequisite: One of the following courses: ESM 205, ESM 306, or ESM 342.

Graphical solutions of coplanar force systems, resultants, equilibrium of simple structures, funicular polygon through three points, trusses, friction.

Text: *Notes* and *Departmental Work Sheets.*

E.Gr. 305. Graphic Statics II

1-3-2. Prerequisites: E.Gr. 114, E.Gr. 304 or consent of instructor.

Graphical solutions of three dimensional force systems and structures; graphical integration and funicular polygon solutions of areas properties and beam slopes and deflections.

Text: *Notes* and *Departmental Work Sheets.*

E.Gr. 413. Introduction to Graphical Computation

3-0-3. Prerequisites: E.Gr. 115 or E.Gr. 171 or consent of instructor and Math. 209 or equivalent.

An introduction to the use of graphics as an applied science in the solution of engineering problems. Special emphasis on empirical equations, calculus, and differential equations.

Text: Rule and Coons, *Graphics.*

E.Gr. 415. Nomography

3-0-3. Prerequisite: E.Gr. 114 and 115 or E.Gr. 171.

Nomographs by synthetic methods. Nature and properties of functional scales. Methods of scale construction. Altering of scale moduli. Adjacent or conversion scales. Alignment charts with one straight index line, parallel index lines, perpendicular index lines.

Text: Hoelscher, *Graphic Aids in Engineering Computation.*

E.Gr. 423. Descriptive Geometry Systems

3-0-3. Prerequisite: E.Gr. 114 or E.Gr. 171.

A presentatioon of Mongean descriptive geometry theory with a study of applications of different descriptive geometry systems to advanced spatial analysis.

Text: Schumann, *Descriptive Geometry.*

E.Gr. 433. Pictorial Projections

3-0-3. Prerequisite: E.Gr. 213 or consent of instructor.

A study of the communication of engineering information through pictorial representations. The theoretical basis of parallel and perspective pictorial projections including axonometric, oblique, and oblique-axonometric projections; parallel, angular and three-point perspective.

Text: Rule and Coons, *Graphics;* and Lawson, *Practical Perspective Drawing.*

SCHOOL OF ENGINEERING SCIENCE AND MECHANICS

(Established in 1959)

Director–Milton E. Raville; *Regents' Professor Emeritus*–Phil Blasier Narmore; *Regents' Professor*–Andrew W. Marris; *Professor Emeritus*–William B. Johns, Jr.; *Professors*–Helmut F. Bauer, Bryan L. Brown, Francis M. Hill, William J. Lnenicka, Charles E. Stoneking, James T. S. Wang; *Associate Professor Emeritus*–Francis C. Bragg; *Associate Professors*–James H. Armstrong, Michael C. Bernard, Wilton W. King, David J. McGill, George M. Rentzepis, Robert W. Shreeves, George J. Simitses, Charles E. S. Ueng,; *Assistant Professors*–Jerry M. Anderson, Donald G. Berghaus, John C. Clark; *Senior Machinist*–Memory G. Turner; *Principal Secretary*–Peggy A. Stallings; *Secretary*–Ida R. Carter; *Accounting Clerk*–Madelyne B. Watson.

General Information

The undergraduate program administered by the School of Engineering Science and Mechanics leads to the degree, Bachelor of Engineering Science. This degree may be obtained under the regular or the cooperative plan of study.

The primary objective of this curriculum is to prepare students for careers in research and development in the engineering field. With this in mind, the program emphasizes fundamental principles and techniques in mathematics and the engineering sciences–solid mechanics, fluid mechanics, materials science, electrical sciences, heat transfer, and thermodynamics. The program presently provides for 72 hours of elective credit, including 21 hours of free electives, 12 hours of technical electives, 6 hours of mathematics electives, and 33 hours of Humanities/Social Science/Modern Language electives. Even more flexibility is being planned for the curriculum in the near future. It is considered to be vitally important that a student be able to pursue in depth certain technical (or technically-related) areas of particular interest to him.

Graduates of Engineering Science undergraduate programs find employment in a wide variety of areas–aircraft, automotive, electrical and electronic industries, industrial and governmental research laboratories, and many other such organizations. However, it is anticipated that the majority of the graduates will pursue graduate degrees, and to this end they receive a broad education in the fundamentals of several engineering fields. Such study gives the student the widest possible choice for specialization in graduate study; further, his knowledge enables him, should he desire, to work in interdisciplinary research areas, such as bioengineering, systems engineering, or materials science.

The rapid development of our urban society has produced many technologically-related problems that require imaginative and innovative engineering solutions. The engineer who has completed a program that emphasizes flexibility, as well as a broad knowledge of the important fundamentals underlying modern engineering practice, will be able to contribute successfully to the solution of these problems.

A minimum scholastic average of C is required in the prescribed courses in mathematics, physics, and engineering science and mechanics. Students who fail to meet this requirement may continue only on a probationary status.

Several modern experimental research laboratories are maintained for graduate and undergraduate research in the areas of Experimental Stress Analysis, Vibrations, and Materials. A departmental research machine shop under the direction of a competent machinist is maintained for constructing special research equipment and models and for servicing laboratory equipment.

In addition to the four-year undergraduate program of study leading to the degree Bachelor of Engineering Science, the School of Engineering Science and Mechanics offers graduate programs leading to the Master of Science and Doctor of Philosophy degrees. The requirements for the B.S. in Engineering Science are listed on the following pages; the requirements for the M.S. and Ph.D. degrees may be found in the Graduate Bulletin.

Freshman Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Chem.	104-5	Inorganic Chemistry	4-3-5	4-3-5	....
E.Gr.	170-1	Visual Comm. & Eng. Design........................	2-3-3	2-3-3	....
Electives		Humanities, Social Sciences or Modern Language..	3-0-3	3-0-3	3-0-3
Math.	107-8-9	Calculus I, II, III...........	5-0-5	5-0-5	5-0-5
Physics	227	Physics..........................	....	....	4-3-5
P.T.	101-2-3	Physical Training..........	0-4-1	0-4-1	0-4-1
Elective*		Free Electives...............	2-0-2	2-0-2	2-0-2
Gen.	101	Orientation..................	1-0-0	....	....
		Totals........................	17-10-19	16-10-19	14-7-16

NOTE: Under Quarters, 3-3-4 means 3 hours class, 3 hours lab., 4 hours credit.

*These free elective courses may be taken at any time during a student's course of study. However, these six credit hours may be satisfied by selecting basic ROTC. If basic ROTC is elected by the student, then it must be scheduled beginning the first quarter the student is enrolled. for further details, see page 28 of the catalog.

A maximum of nine hours of free electives in junior-senior years may be in advanced ROTC.

Sophomore Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Electives		Humanities, Social Science, or Modern Language .	3-0-3	3-0-3	3-0-3
E.E.	210	Elements of Electrical Engineering...............	....	....	2-3-3
ESM	205	Statics..........................	3-0-3	....	....
ESM	309-10	Dynamics I, II..............	....	3-0-3	3-0-3
Math.	207	Calculus IV..................	5-0-5	....	....
Math.	208	Calculus and Linear Algebra.....................	....	5-0-5	....
Math.	209	Differential Equations..	....	....	5-0-5
Phys.	228-9	Physics.........................	4-3-5	4-3-5	....
P.T.	201-2-3	Physical Training..........	0-4-1	0-4-1	0-4-1
		Totals........................	15-7-17	15-7-17	13-7-15

Junior Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
E.E.	211	Elements of Electrical Engineering...............	2-3-3	....	....
Electives		Humanities, Social Science, or Modern Language..	3-0-3	3-0-3	....
E.E.	212	Instrumentation...........	....	2-0-2	....
ESM	334	Mechanics of Deformable Bodies.......................	5-0-5	....	....
ESM	337	Mechanics of Materials..	....	3-0-3	....
Electives**		Mathematics Electives...	....	3-0-3	3-0-3
ESM	374	Experiments in Engineering Science	....	....	2-3-3
ESM	421	Mechanical Vibrations ..	....	3-0-3	....
ESM	392	Fluid Mechanics...........	....	....	5-0-5
Econ.	204	Survey of Principles of Economics............	3-0-3	....	....
ESM	380	Computer Applications in Engineering Science and Mechanics.................	....	....	2-3-3
Electives		Free Electives..............	3-0-3	3-0-3	3-0-3
		Totals........................	16-3-17	17-0-17	15-6-17

**To be selected from Math 309, 411, 412, 413, 415.

Senior Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Sy.E.	400	Introduction to Systems Theory	3-0-3	....	....
M.E.	326, 327	Thermodynamics	4-0-4	3-0-3	....
ESM	490	Projects in Engineering Science	....	3-0-3	....
M.E.	414	Heat Transfer	....	....	3-0-3
Phys.	321	Quantum Mechanics I	....	....	5-0-5
ESM	480	Materials Science	3-0-3	....	....
Elective		Humanities, Social Science or Modern Language	3-0-3	3-0-3	3-0-3
Electives		Free Electives	3-0-3	3-0-3	....
Electives		Technical Electives	....	6-0-6	6-0-6
		Totals	16-0-16	18-0-18	17-0-17

Courses of Instruction

NOTE: 4-3-5 *means* 4 *hours class,* 3 *hours laboratory,* 5 *hours credit.*

ESM 205. Statics

3-0-3. Prerequisites: Phys. 207; Math. 207.

Topics of study include elements of statics in two and three dimensions; review of centroids; laws of equilibrium applied to machines and structures; friction.

Text: Pestel and Thomson, *Statics.*

ESM 306. Applied Mechanics

5-0-5. Prerequisites: Phys. 207; Math. 208, or concurrently.

Elements of statics in two and three dimensions; laws of equilibrium applied to machines and structures; friction; centroids, centers of gravity, and moments of inertia; kinematics; kinetics of translation, rotation, and plane motion; work-energy and impulse-momentum principles.

Text: Yeh and Abrams, *Principles of Mechanics of Solids and Fluids.*

ESM 308. Dynamics

5-0-5. Prerequisites: ESM 205; Math. 208, or concurrently.

Kinematics of rectilinear and curvilinear motion of particles; kinematics of rotation and plane motion of rigid bodies; kinetics of a particle and system of particles; kinetics of translation, rotation, and plane motion of bodies; general three dimensional kinematics and kinetics; work and energy relations; impulse and momentum principles.

Text: Pestel and Thomson, *Dynamics.*

ESM 309. Dynamics I

3-0-3. Prerequisites: ESM 205, Math 207, or concurrently.

Differentiation of vectors: frames of reference, angular velocity vectors. Kinematics: position, displacement, velocity and acceleration vectors in various frames of reference. Particle kinetics: Newton's force-acceleration law; impulse-momentum; work-energy.

Text: Pestel and Thomson, *Dynamics.*

ESM 310. Dynamics II

3-0-3. Prerequisites: ESM 309.

Application of the laws of Newtonian mechanics to problems involving systems of particles or continuous media. Kinetics of rigid bodies; angular momentum; kinetic energy; work-energy relation; applications.

Text: Pestel and Thomson, *Dynamics.*

ESM 331. Mechanics of Materials

3-0-3. Prerequisites: Math. 208, or concurrently; ESM 205 or ESM 306.

Stress and strain analysis; stresses and displacements due to torsion, bending and axial loading; introduction to elastic stability and vibrations.

Text: Lai and Saibel, *Elements of Mechanics of Elastic Solids.*

ESM 334. Mechanics of Deformable Bodies

5-0-5. Prerequisites: ESM 205 or ESM 306; Math. 208, or concurrently.

Simple stresses and strains; membrane stresses; torsion; shear and bending moment diagrams; flexure stresses and shearing stresses in beams; introduction to plastic bending of beams; combined stresses; deflection of beams; statically indeterminate beams; introduction to strain energy; column theory.

Text: Stippes, Wempner, Stern and Beckett, *The Mechanics of Deformable Bodies.*

ESM 337. Mechanics of Materials

3-0-3. Prerequisite: ESM 334.

Deflection of beams due to bending and shear; statically indeterminate beams; strain energy; theorems of Castigliano; impact loading; curved beams; thick-walled cylinders.

Text: Miller and Doeringsfeld, *Mechanics of Materials;* 2nd Edition.

ESM 344. Statics

3-3-4. Prerequisites: Math. 109, Phys. 211, Arch. 271.

Topics of study include elements of statics in coplanar force systems; equilibrium of particles and rigid bodies; simple structures; centroids, center of gravity; beam shear and bending moment; cables; friction. Algebraic and graphical solutions.

Text: Beer and Johnston, *Statics.* Departmental work sheets.

ESM 345. Mechanics of Materials

3-0-3. Prerequisite: ESM 344.

Topics of study include Hooke's Law; simple stresses and strains; mechanical properties of materials; torsion; shear and bending moment equations and diagrams; area moment equations and diagrams; area moment of inertia; flexure and shearing stresses; compound stresses; design of beams.

Text: Popov, *Mechanics of Materials.*

ESM 346. Mechanics of Materials

3-0-3. Prerequisite: EXM 345.

Topics of study include plane stresses Mohr's circle; combined stresses; deflection of beams; analysis of columns.

Text: Popov, *Mechanics of Materials.*

ESM 374. Experimental Methods in Engineering Science

2-3-3. Prerequisites–E.E. 212, Math. 209, ESM 308 or ESM 310.

Consideration is given to physical parameters studied in engineering problems and to the methods used to observe their behavior. Electronic circuits useful in engineering measurement are treated in sufficient detail to show how they may be applied with transducers and electronic instruments to study engineering problems. Models and analogies are introduced with particular emphasis given to the analog computer.

ESM 380. Computer Applications in Engineering Science and Mechanics

2-3-3. Prerequisites: ESM 337, ESM 421, or consent of instructor.

Introduction to the use of the digital computer; Fortran and Algol languages; computer solutions of problems in statics, dynamics, mechanics of deformable solids, vibrations, and fluid mechanics.

ESM 385. Intermediate Dynamics I

3-0-3. Prerequisite: ESM 308, or consent of instructor.

Topics of study include the two and

three dimensional kinematics and kinetics of particles and systems of particles with application to motion in a resisting medium, central force motion, problems involving redistribution of mass and the motion of a particle allowing for the effects of the earth's rotation.

Text: Marris and Stoneking, *Advanced Dynamics.*

ESM 392. Fluid Mechanics

5-0-5. Prerequisites: Math. 208 or concurrently, ESM 308 or ESM 310.

Hydrostatics, including laws of fluid pressure, fluid equilibrium, pressures on curved surfaces, flotation and stability of floating equilibrium. Kinematics of fluid flow. Material and spatial co-ordinates, acceleration, continuity, vorticity, velocity potential and stream functions. Circulation preserving motions. Kinetics of fluid flow. Motion of a viscous fluid. Navier Stokes equations with applications.

Text: Owczarek, *Introduction to Fluid Mechanics.*

ESM 402. Intermediate Dynamics II

3-0-3. Prerequisite: ESM 385, or consent of instructor.

Topics of study include the two and three dimensional motion of a rigid body, Euler's Equations, and an introduction to energy methods and Lagrange's Equations.

Text: Marris and Stoneking, *Advanced Dynamics.*

ESM 421. Mechanical Vibrations

3-0-3. Prerequisites: Math. 209 or 304 or 305; ESM 308, ESM 334.

Kinematics of vibration; free and forced vibrations of single and many degree of freedom systems, without and with damping; critical speeds.

Text: Thomson, *Vibration Theory and Applications.*

ESM 422. Mechanical Vibrations

3-0-3. Prerequisite: ESM 421.

Continuation of ESM 421. Complex representation; Fourier series; step and impulse loads; many degrees of freedom; influence coefficients; matrix method; stability of solution; beam vibrations; approximate methods.

Text: Thomson, *Vibration Theory and Applications.*

ESM 441. Mechanics of Deformable Bodies

3-0-3. Prerequisite: ESM 334.

The presentation is chiefly scalar with some results summarized in cartesian tensor form. Topics of study include analysis of stress and strain in two and three dimensions; linear stress strain relations; general theorems in linear small strain elasticity; application to problems in generalized plane stress and plane strain; introduction to the torsion of noncircular cross sections; introduction to the technical theory of bending.

ESM 444. Stress Analysis

3-3-4. Prerequisite: ESM 441.

Further treatment of torsion and the membrane analogy; further treatment of the technical theory of bending including shear center, strain energy, virtual work and the reciprocal theorem; symmetrical problems in the bending of thin plates and in simple types of shells; introduction to contact stresses; introduction to numerical methods.

ESM 446. Continuum Mechanics

3-0-3. Prerequisite: ESM 444 or consent of instructor.

Geometrical foundations; concept of stress and strain tensors; analysis of stress and strain; fundamental physical laws; constitutive equations; introduction to elasticity, plasticity, thermoelasticity, viscoelasticity, wave propagation.

ESM 480. Materials Science

3-0-3. Prerequisite: Senior standing.

Topics of study include fatigue; creep; effect of shape, size, temperature, and microstructure of specimen; the more common stress-strain equations, hysteresis, after effect, etc.; theories of failure. Considerable reading and report writing required.

ESM 490. Projects in Engineering Science

3-0-3.

An experimental and/or theoretical investigation of some branch of engineering science. The student will define the problem, design an experiment if required, and correlate theory with experimentation. Both oral and written reports will be required.

ESM 497-8-9. Special Problems in Engineering Science
(Formerly Mech. 497-8-9)

Hours and credit to be arranged.

Graduate Courses Offered

ESM	421	Mechanical Vibrations I	3-0-3
ESM	422	Mechanical Vibrations II	3-0-3
ESM	441	Mechanics of Deformable Bodies	3-0-3
ESM	444	Stress Analysis	3-0-3
ESM	446	Continuum Mechanics	3-0-3
ESM	480	Materials Science	3-0-3
ESM	601	Optimization Techniques I	3-0-3
ESM	602	Optimization Techniques II	3-0-3
ESM	604	Advanced Dynamics I	3-0-3
ESM	605	Advanced Dynamics II	3-0-3
ESM	610	Theory of Oscillations	3-0-3
ESM	613	Vibration of Elastic Bodies	3-0-3
ESM	615	Gyroscopic Motion and Devices	3-0-3
ESM	618	Space Mechanics I	3-0-3
ESM	620	Theory of Experimental Stress Analysis	2-3-3
ESM	622	Energy Methods in Mechanics	3-0-3
ESM	635	Advanced Strength of Materials	3-0-3
ESM	636	Random Vibrations I	3-0-3
ESM	637	Random Vibrations II	3-0-3
ESM	638	Applied Elasticity I	3-0-3
ESM	639	Applied Elasticity II	3-0-3
ESM	640	Introductory Photoelasticity	1-6-3
ESM	643	Photoelasticity	1-6-3
ESM	645	Theory of Elasticity I	3-0-3
ESM	646	Theory of Elasticity II	3-0-3
ESM	647	Theory of Elasticity III	3-0-3
ESM	648	Theory of Elastic Stability I	3-0-3
ESM	649	Theory of Elastic Stability II	3-0-3
ESM	652	Theory of Plates	3-0-3
ESM	654	Theory of Shells	3-0-3
ESM	662	Plasticity	3-0-3
ESM	666	Continuum Mechanics–Solids	3-0-3
ESM	667	Fluid Mechanics I	3-0-3
ESM	668	Fluid Mechanics II	3-0-3

ESM	694	Engineering Acoustics I	3-0-3
ESM	695	Engineering Acoustics II	3-0-3
ESM	700	Master's Thesis	
ESM	701, 2, 3	Seminar	1-0-0
ESM	704, 5, 6	Special Problems in Engineering Science and Mechanics	
ESM	710	Space Mechanics II	3-0-3
ESM	711	Dynamics of Space Vehicles	3-0-3
ESM	726	Advanced Continuum Mechanics of Fluids	3-0-3
ESM	730	Wave Propagation in Continuous Media—Fluids	3-0-3
ESM	731	Wave Propagation in Continuous Media—Solids	3-0-3
ESM	750	Nonlinear Vibrations I	3-0-3
ESM	751	Nonlinear Vibrations II	3-0-3
ESM	752	Selected Topics in Nonlinear Vibrations	3-0-3
ESM	760	Theory of Elasticity IV	3-0-3
ESM	763	Stability of Shells	3-0-3
ESM	800	Ph.D. Thesis	

(Complete details pertaining to these courses are contained in the *Graduate Bulletin,* a copy of which is available upon request.)

DEPARTMENT OF ENGLISH

Department Head—David B. Comer, III; *Assistant Head*—Tom F. Almon; *Professor Emeritus*—Henry W. Adams; *Professors*—Milton Chaikin, James B. Haman, L. Hugh Moore, William B. Mullen, Karl M. Murphy, Glenn W. Rainey, Andrew J. Walker, James D. Young; *Associate Professors*—Irving F. Foote, A. Frank Hamrick, Annibel Jenkins, Samuel C. Ketchin, W. Richard Metcalfe, Helen H. Naugle, John P. O'Neill, Larry J. Rubin, Esta K. Seaton, James P. Smith, Ralph R. Spillman; *Assistant Professors*—Peter M. Baldetti, Ralph Bergamo, Edith H. Blicksilver, Allan A. Brockman, James J. Bynum, Wister J. Cook, Richard J. Corbin, Elizabeth Evans, James R. Frisby, George A. Fuhr, Fred N. Henderson, Robert L. Horn, Sarah E. Jackson, Charles J. Pecor, William R. Spruill, Maxine T. Turner; *Instructors*—May C. Brown, Robert E. Jones, Donald D. Russ, Mary E. Wallace; *Principal Secretary*—Margrit Rub; *Clerk-Typist*—Barbara L. Scoggins.

General Information

The Department of English demands in its sequence of required freshman courses the ability to think logically, to organize material properly, to express ideas in clear and effective prose, and to read and understand literature. These courses consist of introductions to short fiction, drama, and poetry, with emphasis on the relation of form to content.

The Department offers to all sophomores a unified sequence of courses in world literature aimed at a deeper appreciation of the value of the individual in society and a wider acquaintance with some of the great writers and great ideas basic to an understanding of western culture. In all courses, both freshman and sophomore, the student must demonstrate an acceptable proficiency in writing.

Elective courses in communication, written and oral, and electives in literature and language are also available. Credit in drama is granted for participation in Drama Tech productions.

Entering students desiring advanced standing must present advanced placement examinations to be evaluated by the Department. For students from foreign countries a special two-year program serves as an introduction to the American language and to the forms of American life and thought.

Courses of Instruction

NOTE: 4-3-5 *means* 4 *hours class,* 3 *hours laboratory,* 5 *hours credit.*

Engl. 50. Reading for Speed and Comprehension

2-0-0. Prerequisite: None.

Mechanics of reading, exercises in increasing speed and improving comprehension. Recitations, tests, and individual practice.

Text: Brown, *Efficient Reading.*

Engl. 107-8-9. Introduction to Literature.

3-0-3. Freshman year. Courses must be taken in numerical sequence.

Guided analysis of selected literary works, with special attention to the relationship of content and form, and to the expression of ideas in effective prose. Lectures, discussions, quizzes, papers.

Texts: Anthologies of the short story, drama, poetry. A handbook of current English.

Engl. 110. Vocabulary Building

3-0-3. Prerequisite: None.

Development of a useful vocabulary required in technical and scientific courses and general reading. Recitations, written exercises, individual practice and research, quizzes.

Texts: Dean, *Essays on Language and Usage;* Mullen, *Toward Better Vocabulary.*

Engl. 131-2-3. English for International Students

5-0-5. Freshman year, consecutive quarters.

Admission by consent of the Department.

A one-year course designed as an introduction to written and spoken English, stressing American pronunciation, idiomatic phrases, and language appropriate to basic social situations and customs of the American people.

Text: To be announced.

Engl. 201-2-3. Survey of the Humanities

3-0-3. Prerequisite: Engl. 107-8-9.

A sequence of courses studying the contribution of several western civilizations from the Greeks to modern times as revealed in literature. Lectures, reports, papers, quizzes.

Texts: Selected readings in each period.

Engl. 204. Creative Writing

3-0-3. Prerequisite: Engl. 107-8-9.

Study and practice in several forms and methods of composition, with emphasis on effective writing. Recitations, quizzes, compositions.

Engl. 206. Survey of English Literature

3-0-3. Prerequisite: Engl. 107-8-9.

A study of English literature since Shakespeare, with emphasis on significant figures and their works through the 19th century. Lectures, reports, papers, quizzes.

Texts: To be announced. May be substituted for Engl. 203.

Engl. 207. Survey of American Literature

3-0-3. Prerequisite: Engl. 107-8-9.

A study of the development of literature in America with emphasis on significant figures and their works through the 19th century. Lectures, reports, papers, quizzes.

Texts: To be announced. May be substituted for Engl. 203.

Engl. 221-2-3; 331-2-3. Acting and Producing the Play

0-3-1. Prerequisite: Admission by consent of the Department.

Participation in the Drama Tech productions of various kinds of plays, including the presentation of one play before an audience.

Engl. 241-2-3. Literature for International Students

3-0-3. Sophomore year, consecutive quarters. Prerequisite: Engl. 133.

An introduction to American ideas as expressed in American literature, with continued training in writing and speaking the American language.

Texts: Selected texts as announced.

Engl. 301. Contemporary Drama

3-0-3. Prerequisite: Engl. 107-8-9.

An analytical survey of prominent playwrights and trends in contemporary drama. Lectures, reports, collateral reading, quizzes.

Text: To be announced.

Engl. 302. Shakespeare

3-0-3. Prerequisite: Engl. 107-8-9.

A brief statement of the life and times of Shakespeare and a careful study of certain of his principal works. Lectures, reports, papers, quizzes.

Text: *The Complete Plays of Shakespeare.*

Engl. 304. Contemporary Fiction

3-0-3. Prerequisite: Engl. 107-8-9.

An analytical study of prominent writers and trends in contemporary fiction. Lectures, reports, collateral reading, quizzes.

Texts: Selected texts as announced.

Engl. 306. The English Language

3-0-3. Prerequisite: Engl. 107-8-9.

Study of the origin of the English language, its relation to other languages, and its differentiation and development into modern English and American. Lectures, quizzes, term paper.

Text: Pyles, *Origin and Development of the English Language.*

Engl. 315. Public Speaking

3-0-3. Prerequisite: Junior Standing

Instruction in the basic principles of effective public speaking, with emphasis on practice and criticism. The course is conducted as a laboratory.

Text: To be announced.

Engl. 318. Argumentation and Debate

3-0-3. Prerequisite: Admission by consent of the instructor.

Principles of argumentation and persuasion, with emphasis on issues of current public interest.

Text: To be announced.

Engl. 320. Technical Writing

3-0-3. Prerequisite: Engl. 107-8-9.

Study and practice of effective English in business letters, technical papers, engineering reports. Letters, reports, quizzes.

Text: To be announced.

Engl. 324. Advanced Writing

3-0-3. Prerequisite: Engl. 107-8-9.

Intensive practice in composition at an advanced level in informative, argumentative, and persuasive forms; discussion of principles and theory of composing; analytical reading of models of appropriate essays and articles.

Text: To be announced.

Engl. 341. Writers in the Age of Galileo

3-0-3. Prerequisite: Engl. 107-8-9.

Intensive study of the works of three of the following: Donne, Bacon, Jonson, Milton, Defoe. Special attention to the significance of these writers in reflecting the social, scientific, and philosophical attitudes of the age. Lectures, discussions, papers, quizzes.

Texts: To be announced.

Engl. 342. Writers in the Age of Newton

3-0-3. Prerequisite: Engl. 107-8-9.

Intensive study of the works of three of the following: Swift, Fielding, Thoreau, Wordsworth, Keats. Special attention to the significance of these writers in reflecting the social, scientific, and philosophical attitudes of the age. Lectures, discussions, papers, quizzes.

Texts: To be announced.

Engl. 343. Writers in the Age of Darwin

3-0-3. Prerequisite: Engl. 107-8-9.

Intensive study of the works of three of the following: Carlyle, Melville, Arnold, Tennyson, Twain. Special attention to the significance of these writers in reflecting the social, scientific, and philosophical attitudes of the age. Lectures, discussions, papers, quizzes.

Texts: To be announced.

Engl. 344. Writers in the Age of Freud and Einstein

3-0-3. Prerequisite: Engl. 107-8-9.

Intensive study of the works of three of the following: James, Yeats, Shaw, Lawrence, Eliot. Special attention to the significance of these writers in reflecting the social, scientific, and philosophical attitudes of the age. Lectures, discussions, papers, quizzes.

Texts: To be announced.

Engl. 360. The Literature of the Bible

3-0-3. Prerequisite: Engl. 107-8-9.

Study of a number of Biblical selections of unusual literary merit. Lectures, collateral reading, reports, quizzes.

Text: Anderson, *Understanding the Old Testament.*

Engl. 381-2-3. Seminars in Literature

3-0-3. Prerequisite: Consent of the Department.

Intensive study of individual writers, movements, periods, or themes in literature, with the purpose of developing knowledge in depth, critical independence, and expository skill. Discussions, papers, quizzes.

Texts: To be announced.

Engl. 441. Studies in the Novel

3-0-3. Prerequisite: Engl. 107-8-9.

Intensive critical analysis of selected novels, with special emphasis on the artistic excellence and significance of the works in the development of modern scientific and philosophical attitudes. Lectures, discussions, papers, quizzes.

Texts: To be announced.

Engl. 442. Studies in the Drama

3-0-3. Prerequisite: Engl. 107-8-9.

Intensive critical analysis of selected plays, with special emphasis on the artistic excellence and significance of the works in the development of modern scientific and philosophical attitudes. Lectures, discussions, papers, quizzes.

Texts: To be announced.

Engl. 443. Studies in Poetry

3-0-3. Prerequisite: Engl. 107-8-9.

Intensive critical analysis of selected poems, with special emphasis on the artistic excellence and significance of the works in the development of modern scientific and philosophical attitudes. Lectures, discussions, papers, quizzes.

Texts: To be announced.

Engl. 444. Studies in the Essay

3-0-3. Prerequisite: Engl. 107-8-9.

Intensive critical analysis of selected essays, with special emphasis on the artistic excellence and significance of the works in the development of modern scientific and philosophical attitudes. Lectures, discussions, papers, quizzes.

Texts: To be announced.

Engl. 451. Seminar in Themes and Problems in Contemporary Literature

3-0-3. Prerequisite: Engl. 107-8-9.

Intensive study of selected works of modern literature which treat the theme of Man and Himself as these works reflect problems and issues of immediate concern to contemporary times. Discussions, papers, quizzes.

Texts: To be announced.

Engl. 452. Seminar in Themes and Problems in Contemporary Literature

3-0-3. Prerequisite: Engl. 107-8-9.

Intensive study of selected works of modern literature which treat the theme of Man and Society as these works reflect problems and issues of immediate concern to contemporary times. Discussions, papers, quizzes.

Texts: To be announced.

Engl. 453. Seminar in Themes and Problems in Contemporary Literature

3-0-3. Prerequisite: Engl. 107-8-9.

Intensive study of works of modern literature which treat selected issues of immediate concern to contemporary times. Discussions, papers, quizzes.

Texts: To be announced.

SCHOOL OF GEOPHYSICAL SCIENCES

(Established in 1970)

Director and Professor–Charles E. Weaver; *Adjunct Professor*–David W. Menzel; *Associate Professors*–J. Helmut Reuter, J. Marion Wampler; *Assistant Professors* –Kevin C. Beck, L. Timothy Long, Charles O. Pollard, Jr., Herbert L. Windom; *Lecturer*–Charles C. Ostrander; *Supporting Faculty*–R. A. Young; *Senior Secretary*–Dianne Clark.

General Information

The newly established School of Geophysical Sciences offers a graduate study program leading to the M.S. degree, with approval of the Ph.D. degree pending. The term geophysical sciences is used in the broadest context. The program includes the study of both the physics and chemistry of the fluid and solid environment, including the study of the man-modified environment. Joint research with engineers is encouraged so that students can relate their basic scientific studies to the solution of environmental problems. Programs are individually tailored to the student's needs and desires.

The geophysical sciences are multidisciplinary and require a strong background in chemistry, physics, mathematics, biology or engineering. Specialization starts at the graduate level. For these reasons the undergraduate program in geophysical sciences will be developed within existing B.S. programs. Students should enroll in physics, chemistry or civil engineering and take a selected number of geology courses. A curriculum will be worked out between the two schools involved. Undesignated degrees in the areas of geochemistry, geophysics, and engineering geology can be obtained.

Present areas of specialization include geochemistry, mineralogy, sedimentology, marine geology, seismology, and rock magnetism. Interdisciplinary studies can be carried out in such areas as crystallography (crystal physics), geohydrology, engineering geology, nuclear science and engineering, organic geochemistry, and atmospheric science. Research and study in oceanography is conducted in cooperation with the staff of The Skidaway Institute of Oceanography (Savannah, Georgia).

Man must become increasingly concerned about understanding, controlling and protecting his physical environment. As a result, the geophysical scientists will play an increasingly important role in the fight for survival.

Undergraduate Courses of Instruction

NOTE: 2-3-3 *means* 2 *hours class,* 3 *hours laboratory,* 3 *hours credit.*

Geol. 101. Introduction to the Earth Sciences

3-0-3. Prerequisite: None.

An introduction to study of the earth, intended to give general insight into the nature of man's environment.

An introduction to some of the geophysical sciences. A careful examination of the movement of the earth with respect to celestial bodies; of the physical interactions of the earth, sun, and moon; and of the earth's gravitational and magnetic fields. These physical relationships are the basis of an introduction to planetary science, geodesy, meteorology, oceanography and climatology. (Note: Geology 101 does not include a study of the composition and structure of the solid earth.)

Geol. 201. General Geology

3-0-3. Prerequisite: None.

An introduction to Earth's structure, composition, and the records of geologic time.

Geol. 203. Physical Geology

3-3-4. Prerequisite: Chem. 102 or equivalent. Corequisites: Chem. 103 or equivalent and Phys. 207 or equivalent.

Introduction to the nature of minerals and rocks, the processes forming them, and their pattern in space and time. Laboratory exercises on minerals, rocks, and geologic maps.

Geol. 306. The Earth-Moon System

3-0-3. Prerequisites: Chem. 105 and Phys. 229.

An introduction to the earth and moon as a planetary system, with emphasis on topics which are of significance in the geophysical sciences.

Geol. 308. History of the Earth

3-3-4. Prerequisites: Chem. 105 and Geol. 201, or Geol. 203.

Ordering principles in Earth history. Origin of the solar system and planets. Antiquity of the Earth. Differentiation of the solid Earth. Interacting evolution of biosphere, atmosphere, and lithosphere on the primitive Earth. Phanerozoic history and life. Evolution of living systems. The rise of man.

Geol. 311. Mineral Resources

3-0-3. Prerequisite: None.

A study of the causes and effect of the earth's environment with applications in the area of soil development, mineral deposits, and topography.

Geol. 325. Mineralogy

3-3-4. Prerequisites: Chem. 103 (or equivalent), Phys. 209 (or equivalent).

Bonding and symmetry in the crystalline state; mineral structure and crystal chemistry; application to geologically important minerals. Laboratory is devoted to crystal morphology structure models, hand specimen verification, x-ray diffraction, and silicate analysis (x-ray fluorescence, atomic absorption).

Geol. 326. Optical Mineralogy

0-3-1. Prerequisite: Geol. 325.

A brief introduction to the use of the polarizing microscope in petrology.

Geol. 414. Mineralogy

2-3-3. Prerequisites: Geol. 201, 202.

A course in descriptive and determinative mineralogy which includes the determination of important minerals and rocks by their chemical and physical properties.

Geol. 420. Applied Geophysics

2-3-3. Prerequisites: Geol. 203, Phys. 229, Math. 109.

Introduction to theory of geophysical exploration methods. Methods to be considered include electrical, magnetic, gravity, seismic refraction and seismic reflection. Laboratory provides exercises in applications to problems in exploration and in the use of instruments.

Geol. 421. The Influence of man's activities on the global Environment

3-3-4. Prerequisites: Chem. 105 and Geol. 201, or Geol. 203.

The interacting equilibrium of atmosphere, hydrosphere, biosphere and lithosphere. The energy cycle; the water cycle; the carbon cycle; the oxygen cycle; the nitrogen cycle. The interfering effects of man's activities on the cyclic equilibria on the earth.

Geol. 422. Structural Geology

3-3-4. Prerequisite: Geol. 203 or equivalent.

An introduction to the description and analysis of structural features of rocks. Primary structures produced during sedimentation and igneous activity are briefly reviewed, but the major part of the course is devoted to the structures produced by rock deformation during tectonic and metamorphic activity. The laboratory will include several field trips.

Geol. 423. Introduction to Geophysics

3-3-4. Prerequisites: Geol. 203, Phys. 229.

General survey of terrestrial geophysics. Topics discussed include the earth's composition, heat flow, seismicity, gravity field, magnetic field, paleomagnetism and global tectonics.

Geol. 424-25-26. Field Methods in Geology

0-6-2, 0-6-2, 0-6-2. Prerequisites: Geol. 203. Senior standing.

Methods and procedures of areal and subsurface geological mapping.

Geol. 427. Introduction to Physical and Chemical Oceanography

3-0-3. Prerequisites: Geol. 201 or Geol. 203.

Ocean geometry and physiography; physical properties of sea water; theory of water movements and energy fluxes; marine sedimentation; sea water geochemistry; marine geophysics and tectonics; ocean history (sea water origin, sea floor spreading, Pleistocene glaciation.)

Geol. 435. Petrology of the Sedimentary Rocks

2-3-3. Prerequisites: Geol. 203 (or consent of instructor), Geol. 325, and Geol. 326 or Cer.E. 409 or consent of instructor.

Texture, composition, and structure of sediments and sedimentary rocks; sedimentary processes (hydraulics and aqueous geochemistry); analysis of sedimentary environments.

Geol. 436. Petrology of Igneous and Metamorphic Rocks

3-3-4. Prerequisites: Geol. 203 (or consent of instructor), Geol. 325, and Geol. 326 or Cer.E. 409 and Geol. 422.

Composition, texture, and structure of igneous and metamorphic rocks; physical and chemical factors controlling genesis of igneous and metamorphic rocks; (emplacement of magma, equilibrium mineral and melt assemblage in closed and open systems, relation of mineral fabric to stress); geologic conditions controlling metamorphism and igneous activity.

Geol. 443. Engineering Geology

3-3-4. Prerequisites: Geol. 203.

Applications of geological science to problems of civil engineering.

Text: To be selected.

Geol. 450. Special Problems in the Earth Sciences

0-6-2. Prerequisite: Junior or senior standing.

Literature, laboratory or field investigation and preparation of a written or oral report or both covering some branch of earth sciences.

Text: To be selected.

Geol. 460. Introduction to Geochemistry

3-3-4. Prerequisite: Geol. 201 or 203; Geol. 325 or consent of instructor.

Application of chemical principles to geologic processes. A study of the distribution and behavior of the chemical elements and natural organic and inorganic compounds in the earth, its waters and atmosphere.

Graduate Courses Offered

Geol.	601-2-3	Advanced Geological Problems	2-0-2, 2-0-2, 3-0-3
Geol.	607	Geophysics I Seismology and the Earth's Interior	3-3-4
Geol.	608	Geophysics II Gravity and Geomagnetism	3-3-4
Geol.	609	Geophysics III Paleomagnetism and Global Tectonics	3-0-3
Geol.	610	Clay Mineralogy	3-0-3
Geol.	611	Advanced Clay Mineralogy	2-3-3
Geol.	615	Sedimentary Geology	3-3-4
Geol.	616	Stratigraphy and Sedimentation	3-0-3
Geol.	621	Regional Tectonics	3-0-3
Geol.	622	Tectonophysics	3-0-3
Geol.	640	Geology of Ground Water	3-0-3
Geol.	651	Analytical Methods in Geophysics I	3-3-4
Geol.	652	Analytical Methods in Geophysics II	3-3-4
Geol.	655	Observational Seismology	3-3-4
Geol.	656	Theoretical Seismology	3-3-4
Geol.	660	Aqueous Geochemistry	3-0-3
Geol.	661	Organic Geochemistry	2-3-3
Geol.	662	Nuclear Geochemistry	3-0-3
Geol.	670	Igneous Petrology	3-4-4
Geol.	671	Metamorphic Petrology	3-4-4
Geol.	700	Thesis	

GRADUATE COURSES

(Complete details about graduate courses in Geophysical Sciences are contained in the *Graduate Bulletin*, a copy of which is available upon request.)

SCHOOL OF INDUSTRIAL & SYSTEMS ENGINEERING

(Established in 1945—Option in M.E., 1924 - 1945)

Director—Robert N. Lehrer; *Associate Director of Undergraduate Programs*—William N. Cox, Jr.; *Associate Director of Graduate Programs*—William W. Hines; *Professor and Director Emeritus*—Frank F. Groseclose; *Regents' Professor*—Harold E. Smalley; *Professors*—Adam Abruzzi, James M. Apple, L. G. Callahan, Paul T. Eaton, David E. Fyffe, Cecil G. Johnson, Lynwood A. Johnson, Joseph Krol, Rocker T. Staton, Harrison M. Wadsworth; *Associate Professors*—Norman R. Baker, Jerry Banks, Robert B. Cooper, J. Gordon Davis, Willard R. Fey, Nelson K. Rogers, Frank E. Roper, C. M. Shetty, Bobby C. Spradlin, Gerald J. Thuesen, V. E. Unger, Jack R. Walker, Pranas Zunde; *Assistant Professors*—Stan Aaronson, M.S. Bazaraa, Gerald Delon, John J. Jarvis, J. B. Mathews, Douglas C. Montgomery, Thomas L. Sadosky, Daniel M. Sipper, Joseph J. Talavage; *Instructors*—Curtis J. Tampkins; *Lecturers*—William I. Crichton, Ronald E. Stemmler; *Adjunct Lecturer*—George W. Greenwood; *Administrative Assistant*—Shirley J. Whelcher; *Principal Laboratory Mechanic*—Clarence F. Heriford.

General Information

Industrial & Systems Engineering is one of the most liberal of engineering fields, providing both a general and basic engineering foundation as well as a grounding in the interactions between technology and management. Students studying industrial and systems engineering are usually interested in obtaining a fundamental engineering background as the basis for professional specialization dealing with those activities associated with the field—operations research, management science, systems engineering, methods, organization, planning, etc.,—or as preparation for other endeavors, such as management. The study of Industrial & Systems Engineering places emphasis upon developing the student's abilities to analyze and design systems which integrate technical, economic and social-behavioral factors both in industrial and in various service-social-governmental organizations.

The principal strength of the program leading to the Bachelor of Industrial Engineering degree lies in a solid, well coordinated core of courses in systems analysis and systems design, which rely heavily upon the engineering sciences, basic sciences, and social sciences. Flexibility is introduced into the program through the provision of elective hours as well as through the senior year design sequence, which permit a student to place emphasis on operations and facilities system design, information and control systems design, systems engineering, or a variety of other aspects of the field.

Options for Exceptional Students

An Option program is available to encourage students with superior abilities to fully avail themselves of a range of unusual educational opportunities.

Participation in these programs requires demonstrated scholastic excellence, requires prior arrangements with the student's advisor, and provides the following options, individually or in combination:

a. *Graduate level courses in lieu of senior year electives:* for students with a cumulative grade point average of 3.3 or above, up to 18 credit hours of approved graduate level courses may be scheduled. For such students, up to 18 credit hours of senior year electives may be waived. These credits, when approved by the student's advisor, may be made available for subsequent credit toward a graduate degree.
b. *Accelerated study:* for students with a 3.3 or above average during the three preceding quarters (including at least 45 credits) course requirements for any non-project Industrial & Systems Engineering course may be completed at the student's own pace by self study, counseling and guidance by the course instructor, etc. Students may register for any number of courses, but must satisfy instructor and course examination requirements. This may be done at the student's own timing. Class attendance is not required. Arrangements *must* be made with course instructors prior to the start of the quarter.
c. *Individual project and research work:* for students with a 3.0 or above average during the preceding three quarters (including at least 45 credits) up to 18 credits of project and/or research work, done in collaboration with the faculty or advanced graduate students, may be substituted for senior year electives.
d. *Director's Honor Seminar (I.Sy.E. 500):* for senior students with a 3.0 or above cumulative grade point average, the Director's Honor Seminar may be taken as an elective.

Graduate Programs

Graduate programs are available leading to the degree of Master of Science, Master of Science in Industrial Engineering, Master of Science in Operations Research, and Doctor of Philosophy. Enrollment in the graduate program provides opportunity for students from BIE programs to continue their professional preparation, and for students from other engineering and science programs to enrich their educational exposure by study and research which relates engineering, management and science. The growing recognition of the importance of advanced education in this field has caused a substantial growth of graduate study during recent years.

While graduate study within the educational philosophy of the School is a highly individual matter which allows each student to design his own program of study, emphasis in course and research work is typically along the lines of (a) Operations Research and Systems Engineering, (b) Facilities Design (including facilities location, facilities layout, materials handling, transportation and logistics), and (c) Industrial Engineering Contributions to the Health and Medical

Care Fields (including Hospital Industrial Engineering). Other emphases, or cross-discipline programs, may be pursued.

Freshman Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Chem.	104-105	Inorganic Chemistry	4-3-5	4-3-5	....
E.Gr.	170-171	Visual Comm. & Eng. Design	2-3-3	2-3-3	....
*Eng.	107-8-9	Introduction to Literature	3-0-3	3-0-3	3-0-3
Math.	107-8-9	Calculus I, II, III	5-0-5	5-0-5	5-0-5
Phys.	227	Physics..........................	....	....	4-3-5
P.T.	101-2-3	Physical Training	0-4-1	0-4-1	0-4-1
**Free Elec.		....	2-0-2	2-0-2	2-0-2
Gen.		Orientation...................	1-0-0	....	....
		Totals	17-10-19	16-10-19	14-7-16

Note: Under Quarters, 3-3-4 means 3 hours class, 3 hours lab, 4 hours credit.

*English 107-8-9 will apply toward the satisfaction of the Engineering College Hunanities requirement. See page 38 for the Modern Language Option.

**These free elective courses may be taken at any time during a student's course of study. However, these six credit hours may be satisfied by selecting basic ROTC. If basic ROTC is elected by the student, then it must be scheduled beginning the first quarter the student is enrolled. For further details, see page 28 of the catalogue.

Sophomore Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Hum./S.S./M.L.		(Humanities/Social Science /Modern Language).	3-0-3	3-0-3	3-0-3
I.Sy.E.	200	Introduction to Industrial & Systems Engineering..	....	....	3-0-3
ESM	205	Statics..........................	3-0-3	....	....
ESM	309	Dynamics I	....	3-0-3	....
ICS	151	Digital Computer Organization and Programming	....	....	2-3-3
*Econ.	201	Economic Principles and Problems...................	....	....	3-0-3
Math.	207	Calculus IV..................	5-0-5	....	....
Math.	208	Calculus and Linear Algebra	....	5-0-5	....
Math.	209	Ordinary Differential Equations	....	....	5-0-5
Phys.	228-229	Physics..........................	4-3-5	4-3-5	....
P.T.	201-2-3	Physical Training	0-4-1	0-4-1	0-4-1
		Totals	15-7-17	15-7-17	16-7-18

*Economics 201-202 will apply toward the satisfaction of the Engineering College Social Science requirement.

Junior Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
*Econ.	202	Economic Principles & Problems................	3-0-3	....	....
Mgmt.	340	Analysis of Financial Data...........................	....	3-3-4	....
M.E.	320	Thermodynamics..........	....	....	4-0-4
ISyE	310	Man-Machine Systems...	....	3-0-3	....
ISyE	325	Engineering Economy...	....	....	3-0-3
ISyE	333	Deterministic Models in Operations Research..	4-0-4	....	....
ISyE	335	Applications of Probability.................	4-0-4	....	....
ISyE	336	Statistical Methods	....	4-0-4	....
ISyE	444	Simulation....................	....	....	2-3-3
ISyE	448	Systems Design Methodology	....	....	3-0-3
**Electives		....	-6	-6	-3
		Totals	-17	-17	-16

*Economics 201-202 will apply toward the satisfaction of the Engineering College Social Science requirement.

**Electives will include 12 hours of Humanities/Social Science/Modern Language; 18 hours of Industrial & Systems Engineering; 16 hours of Free Electives. The 16 hours of Free Electives may be used to accommodate basic ROTC, 6 credits, and advanced ROTC, 9 credits. Students must select Hunanities and Social Science courses which satisfy the Engineering College requirements.

Senior Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
E.E.	325	Electric Circuits & Fields.........................	2-3-3	....	....
ESM	334	Mechanics of Deformable Bodies.......................	....	5-0-5	....
*Matl. Sci. Elec.		....	3-0-3	....	....
**Design I, II		....	2-6-4	2-6-4	....
***Electives		....	-5	-5	-15
		Totals	7-9-15	7-6-14	-15

*Materials Science elective to be selected from the following courses: Met. 325, Met. 401, M.E. 212, ESM 480, Ch.E. 328, C.E. 309.

**The Design I, II requirement is to be satisfied by selection of one of the following: A. ISyE 471, 472; B. ISyE 481, 482; C. ISyE 461, 462; D. ISyE 451, 452.

***Electives will include: 12 hours of Humanities/Social Science/Modern Language; 18 hours Industrial & Systems Engineering; 16 hours of Free Electives. The 16 hours of Free Electives may be used to accommodate basic ROTC, 6 credits, and Advanced ROTC, 9 credits. Students must select Humanities and Social Science courses which satisfy the Engineering College requirements.

SYSTEMS ENGINEERING PROGRAM

(Established in 1965)

The Systems Engineering program is administered by the School of Industrial & Systems Engineering, in conjunction with a campus-wide Committee which advises on the interrelationship between systems engineering and other engineering programs. It is an interdisciplinary activity dealing with systems implications of engineering, and may be elected as a planned option to supplement and complement curricula in any of the engineering schools. Dr. Pranas Zunde, Associate Professor of Systems Engineering and Information Science, serves as Chairman, Systems Engineering, and is available for consultation and advising students in planning Systems Engineering course work. A designated major in Systems Engineering is currently being planned.

What is Systems Engineering?

Systems engineering emphasizes the coordination of man and machines in complex arrangements. It is largely a development of the last 25 years and has received impetus from the building of defense systems and the rapid development of other forms of modern technology. Computers and automated equipment play a role in virtually all systems engineering efforts.

The concepts of systems engineering are as important today for civil engineers designing complicated highway systems as they are for electrical engineers devising sophisticated communication systems. Teams of engineers and scientist use systems engineering principles to build the systems that make possible flights of missiles, to develop transportation systems and many other complex jobs.

Planned Systems Engineering Programs

Two elective programs in systems engineering are offered. Program A consists of 10 quarter credit hours of course work. This program has been tailored for students who have a limited number of elective hours and who wish to obtain a basic knowledge of systems engineering. Program B involves a minimum of 15 quarter credit hours of course work and has been tailored for students who want to study more about the mathematical bases of systems engineering and who would like to go on to more advanced work in the field. An additional 20 quarter credit hours of advanced work is also available as part of this program.

Case Studies in Systems Engineering (ISyE 461) is contained in both Programs A and B. This course gives the student an opportunity to design a system as a member of a design team, and illustrates the important team approach required in the solution of systems engineering problems.

Program A

Course			*Credit Hours*
ISyE	380	Systems Engineering I	2-3-3

ISyE	381	Systems Engineering II	3-0-3
ISyE	461	Case Studies in Systems Engineering I	2-6-4
		Total	7-9-10

Program B

Course			*Credit Hours*
ISyE	335	Applications of Probability	4-0-4
ISyE	380	Systems Engineering I	2-3-3
ISyE	410	Systems Analysis I	4-0-4
ISyE	461	Case Studies in Systems Engineering I	2-6-4
		Total	12-9-15

Additional Courses

Course			*Credit Hours*
ISyE	390	Computer Methods in Systems Engineering	2-3-3
ISyE	411	Systems Analysis II	4-0-4
ISyE	412	Systems Analysis III	4-0-4
ISyE	417	Modeling and Measurement	3-0-3
ISyE	420	Physical Systems Laboratory	1-3-2
ISyE	462	Case Studies in Systems Engineering II	2-6-4
ISyE	333	Deterministic Models in Operations Research	4-0-4

Courses of Instruction

NOTE: 4-3-5 *means* 4 *hours class,* 3 *hours laboratory,* 5 *hours credit.*

ISyE. 200. Introduction to Industrial and Systems Engineering

3-0-3. Prerequisite: None.

This course introduces the student to the field of Industrial and Systems Engineering and its role in both the organization and society. Subjects covered include an introduction to industrial organization as a basis for the discussion of the several systems operating within the organization. Analytical methodologies are introduced as they apply to the study of the various systems and activities. The course also provides an opportunity for the student to select his field of interest from those offered by the School. ISyE. 200 must be scheduled by ISyE students as their initial ISyE course.

ISyE. 304. Organization for Production

3-0-3. Prerequisite: None.

The principles of organization and administration which are applicable to various engineering and industrial enterprises. An elective course for all non-Industrial Engineering students.

ISyE. 310. Man-Machine Systems

3-0-3. Prerequisite: None.

The purpose of this course is to introduce the student to methods for analysis and design of man-machine systems. The emphasis of the course is placed on the development and use of quantitative techniques in the analysis and design of man-machine systems and their environment. The topics covered deal with both individual work center designs and the broader area of work systems design.

ISyE. 313. Physiological and Biomechanical Analysis of Work

2-0-2. Prerequisite: ISyE 310.

This course is concerned with physiological and biomechanical aspects of work. Emphasis is placed on techniques for collecting physiological and biomechanical data, as well as, on the application of work physiology and biomechanics in tool and work place design. Some of the topics covered are: oxygen consumption measures, heart rate measures, electromyographic measures, acceptable physiological work levels, biomechanical models, and work in hot and cold environments.

ISyE. 314. Systems and Productivity

3-0-3. Prerequisite: ISyE. 310.

Emphasis is placed on the human contributions to productivity and on the interaction of technical advances with human performance. The impact of individual needs, leadership styles, and organizational design on motivation and productivity is examined in depth. The objective is to develop a theoretical and practical understanding of people, productivity, and organizations for students who are primarily oriented toward technological change.

ISyE. 315. Analysis of Production Operations

3-3-4. Prerequisite: None.

This course is concerned with the analysis, synthesis, and improvement of individual operations within a production system, with emphasis upon measurement, data generation, work center design, and work systems design. Not for credit if credit has been earned for ISyE. 310.

ISyE. 325. Engineering Economy

3-0-3. Corequisite: Mgmt. 340.

A study of the important principles and methods of economic analysis in engineering and management science, including developments in decision theory and statistical decision theory. Topics treated include the structure of decision problems, value measurement, interest relationships, criteria for decisions under certainty, risk, and uncertainty, and statistical decision theory.

ISyE. 333. Deterministic Models in Operations Research

4-0-4. Prerequisite: Math. 208.

An introduction to the methodology of operations research in the solution of engineering and management problems. Emphasis is placed on the formulation and solution of deterministic models. Linear programming models, and dynamic programming models are included. Solution algorithms, sensitivity analysis, and the dual problem in linear programming are also covered.

ISyE. 335. Applications of Probability

4-0-4. Prerequisites: Math. 209 or concurrently.

An introduction to applied probability with emphasis on applications in industrial engineering and operations research. This course emphasizes the application of the theory of probability and random variables in the analysis of industrial systems.

ISyE. 336. Applications of Statistical Methods

4-0-4. Prerequisites: ISyE. 335 or equivalent.

This course emphasizes the application of statistical methods. Topics include statistical methods which have broad application in the practice of Industrial Engineering in particular, and engineering research in general.

ISyE. 337. Introduction to Design of Experiments

3-0-3. Prerequisite: ISyE. 336, or equivalent.

The purpose of this course is to introduce the student to concepts of experimental design. Emphasis is placed on the design of the most efficient experiments. Appropriate analytic techniques needed for these designs are also taught. Balanced factorial designs are stressed.

ISyE. 339. Evaluation of Engineering Data

3-0-3. Prerequisite: Math 207 or concurrently.

An introduction to engineering statistics. (Students desiring two-quarter coverage should elect ISyE. 335 and ISyE. 336).

Elementary probability theory, descriptive statistics, theoretical probability distribution, statistical inference, point and confidence interval estimation, simple regression and correlation analysis.

ISyE. 349. Elementary Quality Control

3-0-3. Prerequisite: Not to be scheduled for credit if credit in ISyE. 439 has been earned. Not open to Industrial Engineering students.

An introduction to industrial quality control using statistical methods. This course will include methods of data analysis, sampling, and control charts as applied to manufacturing processes.

ISyE. 380. Systems Engineering I

2-3-3. Prerequisite: Math 208 or equivalent.

This course is designed to introduce the student to systems engineering as a professional area and to expose him to methodological and conceptual foundations which subsequent courses at the undergraduate and graduate level will develop in detail. It will draw on many of the student's previous undergraduate mathematics, physics, and engineering courses such as Linear Algebra, Differential Equations, LaPlace Transforms, and design courses. The courses will integrate them into an overall consideration of the analysis and design of interdisciplinary systems involving electrical, mechanical, hydraulic, and other types of engineered systems.

ISyE. 381. Systems Engineering II

3-0-3. Prerequisite: ISyE. 380.

This course is a continuation of ISyE. 380 and is intended to broaden the student's understanding of systems by extending system engineering concepts to sociological, biological, and economical and other complex systems. It also builds the foundation for systems design capability. Topics include modeling and simulation, man-machine interaction, decision theory, information measures, reliability, and network planning.

ISyE. 390. Computer Methods in Systems Engineering

2-3-3. Prerequisite: ISyE. 380 and ICS. 151 or equivalent.

This course considers the notion of simulation of system behavior from a broad point of view. Several kinds of systems models are considered for simulation by analog and/or digital methods. Special topics, such as hybrid computation, are also covered.

ISyE. 400. Introduction to Systems Theory

3-0-3. Prerequisite: Consent of the Instructor.

Basic concepts of systems. Logical and set theoretical foundations of systems theory. Modeling, examples of mathematical models of systems. Description of input-output time systems. Behavioral and structural classification of time systems. Introduction to finite-state machines and linear dynamical systems. Consideration of the properties of systems such as stability, computability and controllability. (Graduate credit not normally granted for both ISyE. 400 and ISyE. 682.)

ISyE. 404. Optimization Methods

3-0-3. Prerequisite: ISyE. 333 or equivalent.

A study of the theoretical aspects of optimization techniques employed in the solution of system problems. The course will cover the classical optimization methods of calculus including constrained optimization, the theory and development of the simplex method of linear programming, and duality theory.

ISyE. 405. Non-Linear Programming

3-0-3. Prerequisites: ISyE. 333 or equivalent.

Non-linear optimization methods and applications. Topics include univariable and multivariable search procedures for unconstrained problems, penalty function formulations for constrained non-linear models, and geometric programming.

ISyE. 406. Integer and Dynamic Programming

3-0-3. Prerequisites: ISyE. 333 or equivalent.

This course will deal with the solution of optimization problems by integer and dynamic programming. Various applications of these methods will be discussed. Subjects covered will include the solution of integer programming problems by cutting plan methods and implicit enumeration and the solution of multistage decision problems by dynamic programming.

ISyE. 410. Systems Analysis I

4-0-4. Prerequisite: ISyE. 380 and Math. 209 or equivalent.

Linear Deterministic Systems

This course is an extension of ISyE. 380 and is intended to broaden the students understanding of the analysis of linear systems by expanding and developing the methodologies previously introduced. Emphasis is given to modern use of matrix theory and the state variable sets of first order differential equations for system representation, as opposed to the complex function and frequency response analysis.

ISyE. 411. Systems Analysis II

4-0-4. Prerequisite: ISyE. 380 and ISyE. 411 or equivalent.

Linear Stochastic Systems

An introduction to the analysis of systems whose input varies randomly in time. Emphasis is placed upon the statistical description of random processes and the response of linear systems to stationary random input processes. Examples will be drawn from electrical, mechanical, and industrial engineering.

ISyE. 412. Systems Analysis III

4-0-4. Prerequisites: ISyE. 380; ISyE. 410 recommended.

Nonlinear Systems

This course introduces the student to the analysis of nonlinear systems. Techniques for the study of these systems will be presented including analytical and numerical analysis, graphical analysis, and approximation methods.

ISyE. 413. Systems Analysis IV

This course not offered in 1971-1972.

ISyE. 416. Motion and Time Study

2-3-3. Prerequisite: Junior standing; Non-Industrial Engineering students.

An introduction to the philosophy and problems associated with increasing the productivity of processes and operations comprising work systems through the use of methods engineering and work measurement.

ISyE. 417. Modeling and Measurement

3-0-3. Prerequisite: ISyE. 380 and ISyE. 411 or equivalent.

Construction of mathematical models for systems using measured data will be discussed. The characterisitcs and use of physical measurement instruments and the statistical theory of measurements will be presented in a unified manner. The effect on the models of measuring instruments and errors in measurement will be studied.

ISyE. 418. Industrial Engineering in Hospitals

3-0-3. Prerequisite: Senior standing or consent of instructor.

A study of hospital management systems and the means by which such systems may be improved through the application of industrial engineering principles and techniques. The hospital as a managerial environment, characteristics of the management systems utilized in striving toward hospital goals, and the philosophies and approaches involved in improving hospital management systems. An introduction to health systems and a survey of medical terminology are also included.

ISyE. 420. Physical Systems Laboratory

1-3-2. Prerequisites: ISyE. 380 and consent of instructor.

This is a laboratory course designed to give the student experience with systems composed of components from several fields. Experiments are conducted using automatic control systems, human factors, mechanical vibrations, process control systems and statistical systems. The experiments are designed to illustrate important concepts of systems engineering covered in prerequisite courses.

ISyE. 422. Job Evaluation and Wage Incentives

3-0-3. Prerequisite: ISyE. 310.

A course designed to give the student the principles used in establishing wage rates and salaries. The characteristics and objectives of different wage incentive plans and the design and analysis of incentive formulas and curves are considered.

ISyE. 424. Fundamentals of Materials Handling

2-3-3. Prerequisites: ISyE. 310 and ISyE. 325.

A combined lecture and laboratory course dealing with procedures and techniques for the analysis and solution of materials handling problems. Plant trips are utilized to illustrate modern handling methods.

ISyE. 425. Engineering Economy

3-0-3. Prerequisites: Junior standing. Not open to Industrial Engineering students.

The fundamental principles and basic techniques of economic analysis of engineering projects. Topics such as time value of money, economic measures of effectiveness, costs and their estimation, basic comparative models, breakeven analysis, and replacement analysis are included.

ISyE. 428. Introduction to Feedback Dynamics

2-3-3. Prerequisite: None.

This course examines feedback processes as a cause of dynamic behavior in socio-economic and managerial situations, it discusses both the knowledge of feedback processes and the use of computer simulation to analyze the multi-loop, many variable, nonlinear feedback systems encountered in socio-economic and managerial situations.

The fundamental assumption of managerial control is that much of the dynamic behavior seen in the world is caused by feedback processes.

ISyE. 429. Feedback Dynamics Principles

2-3-3.. Prerequisites: ISyE. 428 or consent of instructor.

This course continues ISyE. 428 by presenting the principles of feedback dynamics model building, simulation, feedback system analysis and syntheses. This includes the formulation of level, rate, and auxiliary equations; simulation by hand and using the DYNAMO computer program; isolation of causes of oscillation, growth and decay, frequency sensitivity, and leadlag phasing in feedback models; analysis of noise; model trouble shooting; and model improvement.

ISyE. 433. Electronic Data Processing

3-0-3. Prerequisite: Senior standing.

A survey of electronic data processing, including important applications, characteristics of data processing equipment, programming systems, and methodology for analysis and design of management information systems. Some insight is given into the use of computers for scientific applications, such as systems simulation, mathematical programming, and statistical analysis.

ISyE. 434. Introduction to Operations Research

3-0-3. Prerequisites: ISyE. 333 and ISyE. 335 or equivalents.

An introduction to the methodology of Operations Research in the solution of engineering and management problems. Emphasis is placed on the development and use of mathematical decision models.

ISyE. 435. Project Management Systems Design

2-3-3. Prerequisite: Senior standing.

A study of project planning and control using activity network analysis. Topics included are network logic, scheduling computations, resource scheduling under various constraints, time-cost trade-off algorithms, cost control, and multi-project resource allocation. Laboratory work provides practical applications and use of computer programs.

ISyE. 436. Elements of Safety Engineering

3-0-3. Prerequisites: ISyE. 200, ISyE. 335 and ISyE. 310.

The nature and extent of the industrial accident problem with particular emphasis on the role of the engineer in modern industrial operations. The identification and solution of technical accident problems using appropriate analysis procedures. Design principles and characteristics for accident prevention in the plant, the process, and the work-center. Not to be scheduled for credit if credit for ISyE. 437 has been earned.

ISyE. 437. Industrial Safety Administration

3-0-3. Prerequisites: Senior standing.

The nature and extent of the industrial accident problem. The selection and evaluation of data appropriate to accident control measurements and decisions, including realistic treatment of cost factors. Modern organizational relationships in the safety program. The control of industrial accidents by non-technical measures. Not to be scheduled for credit if credit for ISyE. 436 has been earned.

ISyE. 438. Industrial Fire Prevention and Protection

3-0-3. Prerequisite: Senior standing.

The economics of the industrial fire risk. Design of the plant, process, and work-center of optimum fire hazard. Design of fire protection facilities under varying industrial conditions.

ISyE. 439. Quality Control

3-0-3. Prerequisite: ISyE 336

A detailed study of theory and methods for the design and analysis of quality control systems. Included are quantitative techniques for solution to problems of product specifications, process control, acceptance inspection, and other means of quality assurance.

ISyE. 440. Case Problems in Industrial Engineering

3-0-3. Corequisite: Senior Standing.

The objective of this course is to give the student experience in dealing with problems approximating those encountered by practicing Industrial Engineers. The cases used will simulate actual situations by bearing little or no identification as to the nature of the problem, by containing extraneous information.

ISyE. 441. Sales Engineering

3-0-3. Prerequisite: Senior standing in engineering.

A study of the problems involved in selling technical goods and services requiring engineering skill and knowledge in their application. Particular attention is given to the engineering application and service aspects of this work.

ISyE. 444. Simulation

2-3-3. Prerequisites: IsyE. 333 and ISyE. 336.

A study of simulation methodology including random process generators, timekeeping, calendar structure, statistical considerations, variance reduction; a consideration of discrete unit flow systems and sequencing problems; and a study of simulation languages. Project work will enable the student to develop models and utilize computer facilities for their simulation.

ISyE. 448. Systems Design Methodology

3-0-3. Prerequisite: ISyE. 310. Corequisites: IsyE. 325 and ISyE. 444.

The objective is to develop the student's system design capability, utilizing advanced methodologies and concepts. This is achieved by generating diverse alternatives culminating in operable solutions, and by emphasizing procedural, systematic and creative approaches to a spectrum of real world problems.

ISyE. 451 & 452. Design I, II

2-6-4. Prerequisites: ISyE. 448.

This course sequence is intended to involve students in professional design work associated with the field, requiring systems definition, analysis, synthesis and specification for a systems design. Topical areas will vary, and be drawn from research and professional interests of the faculty, and from interest of student groups. In most cases the project will be insight and require dealing with the real-life situation, with intimate contact with the problem environment on through to presentation of recommendations and formal reporting to the "sponsoring" organization.

ISyE. 461 & 462. Case Studies in Systems Engineering I, II

2-6-4. Prerequisites: ISyE. 380 and ISyE. 381 or consent of instructor.

This course (two-quarter sequence) permits students from all schools to carry out a preliminary design of a significant, complex system via an interdisciplinary team. Deatiled design of subsystems is performed by smaller student groups, with emphasis then placed on trade-offs between subsystems. Necessary background lectures and examination of selected case studies are given by faculty members and invited speakers from industry and government. The project culminates with an oral presentation and publication of a final report.

ISyE. 470. Fundamentals of Operations and Facilities Systems Design

3-3-4. Prerequisites: ISyE. 310 and ISyE. 448 or concurrently.

A study of the fundamental design procedures and techniques involved in creating an economic enterprise which is product or service oriented. Includes a discussion of market analysis; product analysis; process, operations, and material flow design; and equipment and facilities design. Special emphasis is placed on the organization, methods, and performance design of the enterprise.

ISyE. 471. Operations and Facilities Systems Design I

2-6-4. Prerequisites: ISyE. 448 and ISyE. 470.

This is the first course of a two course sequence concerned with the design of operations and facilities required to establish and operate a manufacturing or other enterprise. The organizational relationships, procedures and techniques involved in product design, manufacturing processes, process design, and materials handling are emphasized.

ISyE. 472. Operations and Facilities Systems Design II

2-6-4. Prerequisites: ISyE. 471.

This is a continuation of ISyE. 471, and consists primarily of an off-campus project. This course emphasizes work area design, storage and warehousing, service area planning, space requirements, and the final layout, evaluation and presentation of the plant project.

ISyE. 473. Storage and Distribution Systems Design

3-0-3. Prerequisite: ISyE. 470.

A study of the factors in designing efficient materials and product distribution systems—including storage and warehouse planning, materials flow, information flow, equipment selection, building design, facility location, automated warehousing and transportation.

ISyE. 474. Facilities Management

3-0-3. Prerequisite: ISyE. 470.

A study of the functions, activities, procedures and organizational interrelationships involved in managing the physical facilities of the enterprise—including maintenance and repair policies and procedures, maintenance planning, design and construction liason, safety, facility protection, waste control and salvage, plant location and long range planning.

ISyE. 475. Engineering the Manufacturing Environment

3-0-3. Prerequisite: ISyE. 470.

A study of analysis procedures and methods for designing the environment within which the enterprise must operate including building design concepts, construction methods, cost factors, environmental systems, plant services, noise and vibration, and pollution control.

ISyE. 480. Analysis of Production—Inventory Systems

3-3-4. Prerequisites: ISyE. 333 and ISyE. 335.

A study of analytical methods useful in the design of systems for inventory control, production planning and scheduling.

ISyE. 481. Information and Control Systems Design I

2-6-4. Prerequisites: ISyE. 448 and ISyE. 480.

This sequence is concerned with the design of information and control systems. Design principles and techniques are developed and applied to design problems in production, inventory, distribution, quality, manpower, and fiscal control systems.

ISyE. 482. Information and Control Systems Deisgn II

2-6-4. Prerequisite: IsyE. 481.

This course, a continuation of ISyE. 481 places emphasis on the analysis and synthesis of information-decision systems for managerial control. An off-campus project provides an opportunity to analyze existing systems and to apply design principles and techniques. The integration of information-decision systems, automatic data processing, and the motivational aspects of control are included.

ISyE. 490. Legal and Ethical Phases of Engineering

3-0-3. Prerequisite: Senior standing.

This course covers the subject of contracts, patents, copyrights and trademarks, agency, sales agreements, and engineering specifications. The engineer and his relations to the law, to the public and the ethics of his profession.

ISyE. 491, 492, 493. Special Problems

0-3-1. Senior Year, First, Second and Third Quarters. Prerequisites: Senior standing and special permission.

The student is given an opportunity to develop initiative and to apply fundamental principles by doing semi-original laboratory or research work of an industrial enginering nature.

ISyE. 494, 495, 496. Research and Projects

Credit to be arranged.

Open to students in the Honors Program. Research or project work in conjunction with faculty investigations, which may result in an undergraduate thesis.

ISyE. 497, 498, 499. Topics

Credit to be arranged. Prerequisite: Consent of instructor.

The purpose of this course is to permit the School of Industrial & Systems Engineering to offer formal course work in special topics not included in regular courses.

ISyE. 500. Director's Honor Seminar

3-0-3. Prerequisite: Cumulative Grade Point Average of 3.0 or better and Senior standing in the School of Industrial & Systems Engineering.

An informal discussion-study course dealing with topics to be selected by the course participants, intended to provide an informal and intellectual interchange dealing with topics and issues of significance to the profession, and to the professional development of the student. Offered only in the Winter Quarter and open only to students with superior academic records. Junior students who will not be in school during the Winter Quarter of their Senior year may register.

Graduate Courses Offered

ISyE	601	Modern Organizations	3-0-3
ISyE	602	Project Selection Methodology for Research in Engineering	3-0-3
ISyE	604	The Operating Characteristics of Industrial Engineering Functions	3-0-3
ISyE	607	Management of Improvement	3-0-3
ISyE	610, 611	Safe Design and Utilization of Industrial Facilities	3-0-3
ISyE	612	Design of Industrial Engineering Programs	3-0-3
ISyE	613	The Design of Manufacturing Enterprises	3-0-3
ISyE	615	Analysis of Distribution Systems	3-0-3
ISyE	616	Advanced Work Measurement	3-0-3
ISyE	617	Work Center Design	2-3-3

ISyE	618	Work Systems Design	3-0-3
ISyE	624	Material Flow Systems	3-0-3
ISyE	625	Advanced Engineering Economy	3-0-3
ISyE	628	Econometrics Models in Engineering Economy	3-0-3
ISyE	631	Quality Control	3-0-3
ISyE	634	Methods of Operations Research	5-0-5
ISyE	635	Forecasting Systems	3-0-3
ISyE	636	Inventory Systems	3-0-3
ISyE	637	Scheduling Theory	3-0-3
ISyE	638	Analysis of Production Operations	3-0-3
ISyE	639	Experimental Statistics	4-0-4
ISyE	640	Design of Experiments	3-0-3
ISyE	645	Response Surfaces I	3-0-3
ISyE	646	Response Surfaces II	3-0-3
ISyE	647	Theory of Sampling	3-0-3
ISyE	656	Queuing Theory	3-0-3
ISyE	665	Case Studies in Hospital Management Systems	3-0-3
ISyE	671	Foundations of Optimization	3-0-3
ISyE	672	Optimization: Adjacent Extreme Point Methods	3-0-3
ISyE	673	Non-linear Programming	3-0-3
ISyE	674	Dynamic Programming	3-0-3
ISyE	675	Network Flows	3-0-3
ISyE	677	Integer Programming	3-0-3
ISyE	680-681	Systems Research and Applications, I, II	3-0-3
ISyE	682	Systems Theory I	3-0-3
ISyE	683	Systems Theory II	3-0-3
ISyE	685	Reliability Engineering	3-0-3
ISyE	690, 691, 692	Topics	
ISyE	696, 697, 698	Topics in Safety Engineering	
ISyE	700	Master's Thesis	
ISyE	701, 702, 703	Seminar	1-0-0
ISyE	704, 705, 706	Special Problesm in Industrial Engineering	
ISyE	730	Industrial Dynamics	3-0-3
ISyE	733	Simulation Techniques	1-6-3
ISyE	741	Linear Statistical Models I	3-0-3
ISyE	742	Linear Statistical Models II	3-0-3
ISyE	756	Advanced Queuing Theory	3-0-3
ISyE	765	Porjects in Hospital Management Systems	Credit to be arranged
ISyE	780,781 782	Seminars in Systems Research	
ISyE	785, 786, 787	Seminars in Operations Research	
ISyE	790, 791	Projects in Operations Research	1-6-3
ISyE	800	Doctor's Thesis	

COLLEGE OF INDUSTRIAL MANAGEMENT

(Established in 1935)

Dean—Sherman F. Dallas; *Associate Dean*—R. Earl Green; *Regents' Professor*—Glenn W. Gilman; *Vasser Woolley Professor*—Alex Orden; *Professor Emeritus*—Maurice R. Brewster, Hubert E. Dennison, William J. Proctor, Fred B. Wenn; *Professors*—W. Carl Biven, Everett R. Bollinger, Robert W. Carney, Kong Chu, William A. Flinn, John L. Fulmer, Ramon G. Gamoneda, Paul B. Han*, Roderick F. O'Connor; *Associate Professors*—Aristides F. Abril, Philip Adler, James L. Caldwell, Andrew J. Cooper, III, Jerry L. Dake, John T. Ethridge, John R. Kaatz, Jack Kleiner, George E. Maddox, Mack A. Moore, Lester A. Neidell, Ole Olsen, William A. Schaffer, Ashford Stalnaker, Fred A. Tarpley, Richard D. Teach; *Assistant Professors*—David Cheng, Donald H. Ebbeler, Donald T. Kelley, John A. Knutsen, Marlin V. Law, Richard Leatherwood, Gary M. Mullet, Tracy W. Murray, Paul T. O'Connor, Samuel R. Stivers, Fred E. Williams; *Instructors*—James C. Armstrong, Modesto J. Garcia, Dallas Gay, John M. Stepp, Richard L. Tuley; *Special Lecturers*—David M. Love, David Matthews, James L. Vining; *Administrative Assistant*—Mrs. Grace Groover, Joseph F. Jackson; *Research Associate*—William L. Douglas; *Administrative Secretary*—Miss Frances M. Smith; *General Secretaries*—Mrs. Sarah Born, Miss Kim Craven, Miss Shirley Grier, Mrs. Susan Z. Karelitz, Mrs. Betty Studdard; *Research Secretaries*—Mrs. Mildred Buckalew, Miss Claire Payne; *Instruction Technologist*—Miss Jennifer Gschwind.

General Information

The principal objective of the College of Industrial Management is to provide collegiate education of the highest possible quality to prepare students for careers as managers or for additional study at the graduate level. The continuing growth of industry in Georgia, the South and the nation, and the increasing complexity of modern industrial operations have resulted in a great need for college graduates with formal preparation in management and economics. Georgia Tech's College of Industrial Management concentrates on long-range career objectives rather than attempting to develop specific job knowledge.

The College of Industrial Management offers five undergraduate programs leading to the following degrees:

1. Bachelor of Science in Industrial Management
2. Bachelor of Science in General Management
3. Bachelor of Science in Behavioral Management
4. Bachelor of Science in Managment Science
5. Bachelor of Science in Economics

The General Management degree program has as its primary objective the development of students with a broad interest in the totality of management activities and operating problems of the manager. The program builds upon knowledge of the functional, environmental, behavioral, and economic aspects

*Deceased February 17, 1971.

of business, and provides tools with which managers can analyze complicated business problems. It prepares the student for managerial responsibilities and decision making in the tradition of the generalist. The Industrial Management degree program is designed for students who wish to develop their analytical skills, with an emphasis on the application of these techniques toward the solution of problems faced by complex industrial organizations. It also includes substantial content from the operations areas of production, marketing and finance. The degree programs in Behavioral Management, Management Science, and Economics have been designed to give the student considerable concentration in developing specialized skills and knowledge in managerial or economic tools for complex problem solving and decision making. These programs stress precise and pertinent disciplines.

Since complex problem solving takes place in a technical, social and political environment, the tools of management and economics are sharpened by an understanding of the natural and life sciences, psychology, the environment of the business enterprise and by a knowledge of the internal activities of the enterprise itself. To this end every student is required to take substantial work in laboratory science, English, psychology, and social science. All students must become familiar with the fundamental activities of business by taking courses in areas such as accounting, management, and computer applications.

As much uniformity as possible has been retained in all five degree programs during the first two years so that a student can change his curriculum with little or no loss in hours of credit. In most cases any course taken in one program but not needed after transfer to another may be used as elective hours. A fairly large number of hours of elective courses has been retained in all of the alternative programs to give the student the opportunity to develop an area of concentration within the program of his choice or to broaden himself either within or outside the College of Industrial Management.

Transfers to Industrial Management. Many students who enter Georgia Tech intending to major in one of the engineering or scientific areas become interested in transferring to the College of Industrial Management. Only students who demonstrate their ability to successfully complete the requirements of the program are permitted to transfer. It is, therefore, definitely *to the student's advantage* to determine the requirements which must be met before transfer will be permitted, as early as possible, in consultation with the Associate Dean of the College of Industrial Management.

Graduate Program. The program leading to the degree of Master of Science in Industrial Management provides an opportunity for graduates from a broad range of rigorous undergraduate curricula to prepare themselves for general management or challenging staff responsibility. The courses listed on pages 183 and 184 are described in detail in the *Graduate Catalogue* as are the graduate admission requirements.

Courses for Non-Majors. In addition to courses offered primarily for its own undergraduate and graduate programs, the College of Industrial Management offers several courses designed expressly for non-majors, as follows:

Course		*Title*	*Hours*
Econ.	204	Survey of Principles of Economics	3-0-3
Mgt.	335	Accounting Principles and Applications I	3-0-3
Mgt.	336	Accounting Principles and Applications II	3-0-3
Mgt.	340	Analysis of Financial Data	3-3-4

Bachelor of Science in Industrial Management

The program in Industrial Management is designed to apply the tools of analysis to the management problems encountered in a modern industrial concern. It tends to emphasize quantitative methodology to a greater extent than does the General Management degree program, but the emphasis on these techniques is more toward their application instead of the more theoretical approach of the Management Science degree program.

As in the General Management degree program, much of the required work during the first two years is taken in other schools. Within the first two years, transfers to either the General Management degree program or the Behavioral Management degree program can be easily accomplished without substantial loss of credit.

Curriculum in Industrial Management

Freshman Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Chem.	104-5	Inorganic Chemistry and Elective OR	4-3-5	4-3-5	2-0-2
Biol.	110-111-112	Introduction to Biology I, II, III	3-3-4	3-3-4	3-3-4
Engl.	107-8-9	Introduction to Literature	3-0-3	3-0-3	3-0-3
S.S.	*	Social Science OR	3-0-3	3-0-3	3-0-3
M.L.		Modern Language	....	....	....
Math.	100	College Algebra and Trigonometry	5-0-5	....	....
Math.	105	Calculus for Management I	....	5-0-5	....
Math.	106	Calculus for Management II	....	....	5-0-5
E.Gr.	105	Managerial Graphics	....	....	0-6-2
P.T.	101-2-3	Physical Training	0-4-1	0-4-1	0-4-1

Freshman Year (Cont.)

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
**Free Electives		....	2-0-2	2-0-2	2-0-2
Gen.	101	Orientation..................	1-0-0	....	....
		Totals	17-7-18 (18-7-19)	16-7-18 (17-7-18)	16-13-20 (15-10-18)

*Choice of: (1) two quarters of one of the following: American History, Political Science, Philosophy and History of Science, or Sociology; and the third quarter selected from one of the three remaining areas; or (2) German, 101-2-3; French, 107-8-9, or Spanish, 113-14-15.

**These free elective courses may be taken at any time during a student's course of study. However, these six credit hours may be satisfied by selecting basic ROTC. If basic ROTC is elected by the student, then it must be scheduled beginning the first quarter the student is enrolled. For further details, see page 28 of the catalogue.

Sophomore Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Engl.	201-2-3*	Survey of the Humanities	3-0-3	3-0-3	3-0-3
Econ.	201-2-3**	Principles of Economics	3-0-3	3-0-3	3-0-3
Math.	236	Finite Mathematics.......	5-0-5	....	....
M.Sci.	323-4***	Statistics I, II OR..........	....	3-0-3	3-0-3
Math.	205-6***	Elementary Statistical Analysis.....................	....	....	....
Mgt.	120	Management Orientation	....	1-0-1	....
Mgt.	215-16**	Accounting I, II............	....	3-0-3	3-0-3
M.Sci.	210**	Management Applications of Data Processing.....	2-3-3	....	....
Psy.	303	Introductory Psychology	....	3-0-3	....
Mgt.	220**	Industrial Organization..............	....	....	3-0-3
P.T.	201-2-3	Physical Training	0-4-1	0-4-1	0-4-1
		Totals	13-7-15	16-4-17	15-4-16

*English 206 or 207 may substitute for English 203.

**To receive credit towards the degree B.S. in Industrial Management, a minimum grade of "C" must be earned in each of these courses, viz., Econ. 201, 202, 203, M.Sci. 210, and Mgt. 215, 216, and 220.

***The student must take the two courses in statistics from the same college.

Junior Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
Phys.	211-12-13	Mechanics, Electricity, Heat, Light and Sound	4-0-4	4-0-4	4-0-4
Mgt.	217*	Accounting III	3-0-3	....	....
Econ.	352	Industrial Economic Analysis	....	3-0-3	....
Mgt.	310	Marketing I	....	....	3-0-3
Engl.	315	Public Speaking	3-0-3	....	....
Mgt.	325	Law I	....	3-0-3	....
Mgt.	361	Financial Management I	....	....	3-0-3
M.Sci.	409-10	Analytical Methods in I.M., I, II	3-0-3	3-0-3	....
I.E.	315	Analysis of Production Operations	....	....	4-0-4
Mgt.	320	Industrial Management Principles	3-0-3	....	....
Psy.	410	Social Psychology	......	3-0-3	....
Mgt.	418	Production Management I	....	....	3-0-3
		Totals	16-0-16	16-0-16	17-0-17

*To receive credit toward the degree B.S. in Industrial Management, a minimum grade of "C" must be earned in Mgt. 217.

Senior Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
Mgt.	365	Capital Budgeting	3-0-3	....	....
Econ.	486	National Income and Fiscal Policy	....	3-0-3	....
Mgt.	420	Integrated Management Problems	....	....	3-0-3
Mgt.	311	Marketing II	3-0-3	....	....
Mgt.	491	Seminar**	....	1-0-1	....
M.Sci.	419	Production Management II	3-0-3	....	....
Mgt.	428	Industrial Relations	....	3-0-3	....
Management College Electives			....	3-0-3	3-0-3
Electives			6-0-6	3-0-3	8-0-8
		Totals	15-0-15	13-0-13	14-0-14

*Minimum grade average of "C" must be earned during the student's last three full-time quarters to qualify for graduation.

**Mgt. 491 is offered only during Winter Quarter.

Bachelor of Science in General Management

The General Management program is designed to provide the student with a broadly based course of study which introduces him to the general theory of management; the operational areas of business such as finance, production, and marketing; and the foundation tools, such as economics, statistics, and accounting. The program stresses breadth of concept instead of concentration in a narrow major. The objective of the required courses is to provide a broad knowledge of management. The elective hours can be used for a cluster of courses allowing some degree of specialization in a discipline or functional area in the senior year.

Although quantitative methodology plays an important role in this program, major emphasis is on the application of techniques rather than on their mathematical derivation. Within the first two years, transfer between the General Management degree program and the Behavioral Management degree program can be accomplished without loss of credit hours or the need for additional make-up work.

Freshman Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Chem.	104-5	Inorganic Chemistry and Elective OR	4-3-5	4-3-5	2-0-2
Biol.	110-11-12	Introduction to Biology I, II, III	3-3-4	3-3-4	3-3-4
Engl.	107-8-9	Introduction to Literature	3-0-3	3-0-3	3-0-3
Math.	100	College Algebra and Trignometry	5-0-5	....	....
Math.	105	Calculus for Management I	....	5-0-5	....
Math.	236	Finite Mathematics	....	....	5-0-5
S.S.*		Social Science OR	3-0-3	3-0-3	3-0-3
M.L.		Modern Language	....	....	....
P.T.	101-2-3	Physical Training	0-4-1	0-4-1	0-4-1
**Free Electives		....	2-0-2	2-0-2	2-0-2
Gen.	101	Orientation	1-0-0	....	....
		Totals	17-7-18 (18-7-19)	16-7-18 (17-7-19)	16-7-18 (15-7-16)

*Choice of: (1) two quarters of one of the following: American History, Political Science, Philosophy and History of Science, or Sociology; and the third quarter selected from one of the three remaining areas; or (2) three quarters of Modern Language in either German, French, or Spanish. Three quarters of either M.L. or S.S. are required.

**These free elective courses may be taken at any time during a student's course of study. However, these six credit hours may be satisfied by selecting basic ROTC. If basic ROTC is elected by the student, then it must be scheduled beginning the first quarter the student is enrolled. For further details, see page 28 of the catalogue.

Sophomore Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
Phys.	211-12-13	Mechanics, Electricity, Heat, Light and Sound	4-0-4	4-0-4	4-0-4
Engl.	201-2-3*	Survey of the Humanities	3-0-3	3-0-3	3-0-3
Econ.	201-2-3**	Economics	3-0-3	3-0-3	3-0-3
Mgt.	120	Management Orientation	....	1-0-1	....
Mgt.	215-16-17**	Accounting	3-0-3	3-0-3	3-0-3
E.Gr.	105	Managerial Graphics	0-6-2	....	....
M.Sci.	210	Management Applications of Data Processing	....	2-3-3	....
Mgt.	220**	Industrial Organization	....	....	3-0-3
P.T.	201-2-3	Physical Training	0-4-1	0-4-1	0-4-1
		Totals	13-10-16	16-7-18	16-4-17

*Engl. 206 or 207 may be substitute for Engl. 203.

**To receive credit towards the degree B.S. in I.M., a minimum grade of "C" must be earned in each of these courses, viz., Econ. 201, 202, 203; Mgt. Sci. 210 and Mgt. 215, 216, 217, and 220.

Junior Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
M.Sci.	390	Survey of Statistics I, II	3-0-3	....	....
I.E.	315	Analysis of Production Operations	....	....	4-3-4
Psy.	303	Introductory Psychology	3-0-3	....	....
M.Sci.	301	Introduction to Quantitative Methods	3-0-3	....	....
Mgt.	325	Law I	3-0-3	....	....
Mgt.	320	Industrial Management Principles	3-0-3	....	....
Econ.	352*	Industrial Economic Analysis	....	3-0-3	....
Mgt.	310-11	Marketing I, II	....	3-0-3	3-0-3
Mgt.	361	Financial Management	....	3-0-3	....

Junior Year (Cont.)

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Mgt.	365	Capital Budgeting	....	....	3-0-3
Engl.	315	Public Speaking	....	3-0-3	....
Electives		....	....	3-0-3	6-0-6
		Totals	15-0-15	15-0-15	16-3-16

*Econ. 486 (National Income and Fiscal Policy) may substitute for Econ. 352.

Senior Year*

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Mgt.	418	Production Management	3-0-3	....	....
Mgt.	428	Industrial Relations	3-0-3	....	....
Mgt.	465	Non-Market Environment..............	3-0-3	....	....
Psy.	410	Social Psychology	....	3-0-3	....
Mgt.	491**	Seminar	....	1-0-1	....
Mgt.	470	Contemporary Management Thought....................	....	3-0-3	....
Mgt.	420	Integrated Management Problems...................	....	....	3-0-3
Elective***		....	....	....	3-0-3
Mgt. Col. Electives		....	3-0-3	3-0-3	3-0-3
Electives		....	3-0-3	5-0-5	5-0-5
		Totals	15-0-15	15-0-15	14-0-14

*Minimum grade average of "C" must be earned during the student's last three full-time quarters to qualify for graduation.

**Mgt. 491 is offered only during Winter Quarter.

***These electives must be selected from courses offered in international economics, international marketing, international finance, international labor and international management.

Bachelor of Science in Behavioral Management

One of the greatest challenges our society faces today and for the future is how best to develop and use human resources. The challenge is particularly acute as it thrusts itself into the management of the various agencies on which we depend. The problem is how to take best economic advantage of our technological capability, while at the same time making it possible for the people in our work force to build and maintain an image of their individual importance and worthiness.

The Behavioral program in the undergraduate management curriculum is designed for those students whose capabilities and interests focus their main attention on the individual and group relationships that are inherent in society relative to problems of complex organization and advanced technology that characterize modern enterprise. Primary emphasis remains on management, but the intent is to develop for the management team those people who have special competence for the task of marshalling, organizing, and using effectively the human resources of an enterprise.

Curriculum in Behavioral Management

Freshman Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Biol.	110-11-12	Introduction to Biology I, II, III	3-3-4	3-3-4	3-3-4
Engl.	107-8-9	Introduction to Literature	3-0-3	3-0-3	3-0-3
Soc.	176	Intro. to the Prin. of Soc.	3-0-3	....	....
Soc.	177	Social Institutions.........	....	3-0-3	....
P.H.S.	127	Philosophy & History of Science	....	....	3-0-3
Math.	100	College Algebra and Trigonometry	5-0-5	....	....
Mgt.	105	Calculus for Management I...........	....	5-0-5	....
Math.	236	Finite Mathematics.......	....	....	5-0-5
P.T.	101-2-3	Physical Training..........	0-4-1	0-4-1	0-4-1
Free Electives*		....	2-0-2	2-0-2	2-0-2
Gen.	101	Orientation..................	1-0-0	....	....
		Totals	17-7-18	16-7-18	16-7-18

*These free elective courses may be taken at any time during a student's course of study. However, these six credit hours may be satisfied by selecting basic ROTC. If basic ROTC is elected by the student, then it must be scheduled beginning the first quarter the student is enrolled. For further details, see page 28 of the catalogue.

Sophomore Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
Chem.	101-2-3	Inorganic Chemistry OR	3-3-4	3-3-4	3-3-4
Phys.	211-12-13	Mechanics, Electricity, Heat, Light and Sound	4-0-4	4-0-4	4-0-4
Engl.	201-2-3**	Survey of Humanities	3-0-3	3-0-3	3-0-3
Econ.	201-2-3*	Principles of Economics	3-0-3	3-0-3	3-0-3
Mgt.	120	Management Orientation	....	1-0-1	....
Mgt.	215-16-17*	Accounting I, II, III......	3-0-3	3-0-3	3-0-3
E.Gr.	105	Managerial Graphics......	0-6-2	....	....
P.T.	201-2-3	Physical Training	0-4-1	0-4-1	0-4-1
Mgt.	220*	Industrial Organization	....	....	3-0-3
Psy.	303	General Psychology A...	....	3-0-3	....
		Totals	-16	-18	-17

*To receive credit towards the degree B.S. in Behavioral Mgt., a minimum grade of "C" must be earned in each of these courses, viz., Econ. 201, 202, 203. Mgt. 215, 216, 217 and 220.

**English 206 or 207 may substitute for 203.

Junior Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
M.Sci.	210*	Management Applications of Data Processing	2-3-3	....	....
Mgt.	325	Law I	3-0-3	....	....
Mgt.	320	Industrial Management Principles	3-0-3	....	....
M.Sci.	390	Survey of Statistics	3-0-3	....	....
Psy.	304	General Psychology B ...	3-0-3	....	....
Engl.	315	Public Speaking	....	3-0-3	....
Mgt.	310-11	Marketing I and II.........	....	3-0-3	3-0-3
Mgt.	316	Finance Survey	....	3-0-3	....
Psy. Elect.		(See course listing under senior year)	....	3-0-3	....

Junior Year (Cont.)

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
Mgt.	402	The Management of Organized Effort........	....	....	3-0-3
Soc.	376	Urbanization.................	....	....	3-0-3
Mgt.	322	Organizational Development	....	....	3-0-3
Psy.	401 or 410	Industrial Psychology or Social Psychology	....	3-0-3	....
Free Elect.		....	....	....	3-0-3
		Totals	14-3-15	15-0-15	15-0-15

*To receive credit towards the degree B.S. in Behavioral Mgt. a minimum grade of C must be earned in M.Sci. 210.

Senior Year*

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
Mgt.	480	Analysis of Consumer Behavior	3-0-3	....	....
Mgt.	475	Contemporary Research in Management	3-0-3	....	....
Mgt.	465	Non-Market Environment of the Firm	3-0-3	....	....
Psy. Elective**		....	....	3-0-3	....
Mgt.	440	Organizational Analysis.....................	....	3-0-3	....
Mgt.	491	Seminar	....	1-0-1	....
Mgt.	420	Integrated Management Problems...................	....	....	3-0-3
S.S. Elect.***		....	....	3-0-3	3-0-3
Psy. Elect.**		....	....	....	3-0-3
Free Elect.		....	6-0-6	5-0-5	6-0-6
		Totals	15-0-15	15-0-15	15-0-15

*Minimum grade average of "C" must be earned during the student's last three full-time quarters to qualify for graduation.

**Nine additional hours of psychology electives must be selected from the following courses:

Psy.	401	Industrial Psychology
Psy.	402	Psychology of Adjustment
Psy.	403	Introduction to Psychological Testing
Psy.	404	Psychology of Advertising

Psy.	407	Experimental Psychology I
Psy.	412	Psychology of Learning

***Six additional hours of social science electives must be selected from the following courses:

Pol.	474	Science Technology and Public Policy
Soc.	476	Technology and Society
Soc.	377	Social Ecology
Soc.	477	Urban Sociology
Pol.	362	International Organization
Soc.	379	Demographic Analysis

It is recommended that electives in the College of Industrial Management be selected from the following courses:

Mgt.	347	Techniques of Industrial Communications (Management Communications)
Mgt.	408	Personnel Management Problems
Mgt.	458	Contemporary Unionism an Collective Bargaining
Mgt.	428 and Econ. 429–Industrial Relations	
Mgt.	XXX	International Labor Relations (to be developed)

Bachelor of Science in Management Science

The Management Science program is designed for the student who possesses strength and interest in mathematics and an interest in applying mathematics to managerial problems. The program is based upon a foundation of applied mathematics and the institutional aspects of the modern firm. The advanced work integrates these two areas by developing and applying mathematical models to problems involved in the allocation of resources within the firm. The curriculum also contains a three course sequence of specialization electives which permit the student to either concentrate in an application area or to strengthen his theoretical foundation.

Graduates of the option will typically be employed as staff analysts in industry and government, as systems analysts, or in a wide variety of staff positions where a high degree of analytical ability is required. The program also provides a strong base for graduate study in business, management science, operations research and related areas.

Curriculum in Management Science

Freshman Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
Chem.	104-5	Inorganic Chemistry and Elective OR	4-3-5	4-3-5	2-0-2
Biol.	110-11-12	Introduction to Biology I, II, III	3-3-4	3-3-4	3-3-4
Engl.	107-8-9	Introduction to Literature	3-0-3	3-0-3	3-0-3
Math.	107-8-9	Calculus I, II, III	5-0-5	5-0-5	5-0-5
S.S.	*	Social Science OR	3-0-3	3-0-3	3-0-3
M.L.		Modern Language	....	....	....
P.T.	101-2-3	Physical Training	0-4-1	0-4-1	0-4-1
Free Electives**			2-0-2	2-0-2	2-0-2
Gen.	101	Orientation	1-0-1	....	....
Eng. Gr.	105	Managerial Graphics	....	....	0-6-2
		Totals	16-7-18 (17-7-19)	16-7-18 (17-7-19)	15-13-18 (16-10-20)

*Choice of: (1) two quarters of one of the following: American History, Political Science, Philosophy and History of Science, or Sociology; and the third quarter selected from one of the three remaining areas; or (2) Three quarters of Modern Language in either German, French, or Spanish.

**These free elective courses may be taken at any time during a student's course of study. However, these six credit hours may be satisfied by selecting basic ROTC. If basic ROTC is elected by the student, then it must be scheduled beginning the first quarter the student is enrolled. For further details, see page 28 of the catalogue.

Sophomore Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
Engl.	201-2-3*	Survey of the Humanities	3-0-3	3-0-3	3-0-3
Math.	207	Calculus IV	5-0-5	....	....
Math.	208	Calculus and Linear Algebra	....	5-0-5	....
Mgt.	120	Management Orientation	....	1-0-1	....
M.Sci.	210**	Management Applications of Data Processing	....	....	2-3-3
Phys.	211-12-13	Mechanics, Electricity, Heat, Light and Sound	4-0-4	4-0-4	4-0-4
Econ.	201-2-3**	Economics	3-0-3	3-0-3	3-0-3
P.T.	201-2-3	Physical Training	0-4-1	0-4-1	0-4-1
Math.	309	Introduction to Higher Algebra	....	....	3-0-3
		Totals	15-4-16	16-4-17	15-7-17

*English 206 or 207 may be substituted for English 203.

**To receive credit toward the B.S. in Management Science, a minimum grade of C must be earned in each of these courses, viz., Management Science 210 and Economics 201, 202, and 203.

Junior Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Math.	407	Linear Programming	3-0-3	....	....
Math.	415	Introduction to Probability	3-0-3	....	....
Econ.	352	Industrial Economic Analysis	3-0-3	....	....
Mgt.	310-11	Marketing I, II	3-0-3	3-0-3	....
Mgt.	215,	Accounting I	3-0-3	....	....
Mgt.	336	Accounting Principles and Applications II	....	3-0-3	....
Math.	416	Mathematical Statistics	....	3-0-3	....
Mgt.	361	Financial Management I	....	3-0-3	....
M.Sci.	311, 312	Management Science I, II	....	3-0-3	3-0-3
Math.	417	Mathematical Statistics	....	....	3-0-3
Econ.	328	Introduction to Econometrics	....	....	3-0-3
Mgt.	365	Capital Budgeting	....	....	3-0-3
Mgt.	418	Production Managment I	....	....	3-0-3
		Totals	15-0-15	15-0-15	15-0-15

Senior Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
I.E.	405	Non-Linear Programming	3-0-3	....	....
Mgt.	420	Integrated Management Problems	3-0-3	....	....
I.E.	444	Simulation	3-0-3	....	....
I.E.	406	Integer and Dynamic Programming	....	3-0-3	....
M.Sci.	481, 482	Readings in Management Science I and II	....	3-0-3	3-0-3
M.Sci.	490	Special Project	....	....	6-0-6
Electives*			6-0-6	9-0-9	5-0-5
		Totals	15-0-15	15-0-15	14-0-14

*Nine hours of specialization electives, which may be chosen from the following courses depending upon one's interests, are required. Since most specialization sequences consist of three courses, the sequence should begin during the first quarter of the senior year.

Information Technology

IS	336	Information Engineering
IS	424	Information Theory
IS	436	Information Systems
IS	445	Logistic Systems
IS	456	Computer Systems

Supporting Math Courses

Math.	443-4-5	Numerical Analysis
Math.	435	Information Theory
Math.	438	Mathematical Logic

Mathematical Statistics–Theory and Application

Math.	418-9	Probability
Math.	436	Decision Theory
Math.	437	Stochastic Processes
Math.	446	Game Theory

Systems Analysis

Sy.E.	400	Systems Theory
Sy.E.	410	Linear Systems
E.E.	415	Principles of Feedback Control
M.E.	445	Principles of Automatic Control

Mathematics

Math.	401-2-3-4	Analysis
Math.	405, 414	Modern Algebra
Math.	431	Topology
Math.	491	Advanced Calculus

Economics

Econ.	410	Econometrics II
Econ.	332 & 333	Intermediate Economics II, III

Bachelor of Science in Economics

Among the complex problems facing society today, economic issues stand in the forefront. Social objectives, such as full employment, price stability, economic growth, poverty, adaptation to technological advances, efficiency in the management of complex industrial organizations, and international prosperity all receive high priority in the nation's agenda. The program in economics is designed to prepare the student to understand these problems and to participate in their solution.

Modern economics is quantitatively oriented and analytically rigorous. The curriculum for this option is designed to prepare the student to cope with the advances that have been made in this field of study. The program requires a solid grounding in mathematics, statistics, and economic theory.

The Economics degree within the College of Industrial Management is most suitable for students who wish to major in some basic discipline at the undergraduate level. Students who plan to enter business after receiving their undergraduate degree, but choose to take the economics program will be advised to use a large part of their elective hours in taking carefully selected courses in management. Such students will receive rigorous undergraduate training in a basic discipline but also obtain, through elective courses in management, professional management training. The degree in Economics also provides excellent background for work at the Master's level in management. Further, it is ideally suited for students who plan to go on to graduate work in economics.

Curriculum in Economics

Freshman Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Chem.	104-5	Inorganic Chemistry and Elective OR	4-3-5	4-3-5	2-0-2
Biol.	110-11-12	Introduction to Biology I, II, III	3-3-4	3-3-4	3-3-4
Engl.	107-8-9	Introduction to Literature	3-0-3	3-0-3	3-0-3
S.S.*		Social Science OR.........	3-0-3	3-0-3	3-0-3
M.L.		Modern Language	....	....	....
Math.	107-8-9	Calculus I, II, III...........	5-0-5	5-0-5	5-0-5
P.T.	101-2-3	Physical Training..........	0-4-1	0-4-1	0-4-1
Gen.	101	Orientation..................	1-0-0	....	....
Free Electives**		....	2-0-2	2-0-2	2-0-2
		Totals	17-7-15 (18-7-16)	16-7-18 (17-7-19)	15-7-17 (16-4-18)

*Choice of: (1) two quarters of one of the following: American History, Political Science, Philosophy and History of Science, or Sociology; and the third quarter selected from one of the three remaining areas; or (2) three quarters of Modern Language in either German, French, or Spanish.

**These free elective courses may be taken at any time during a student's course of study. However, these six credit hours may be satisfied by selecting basic ROTC. If basic ROTC is elected by the student, then it must be scheduled beginning the first quarter the student is enrolled. For further details, see page 28 of the catalogue.

Sophomore Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
Phys.	211-12-13	Mechanics, Electricity, Heat, Light and Sound	4-0-4	4-0-4	4-0-4
Mgt.	120	Management Orientation	....	1-0-1	....
Engl.	201-2-3*	Survey of the Humanities	3-0-3	3-0-3	3-0-3
Math.	207	Calculus IV	5-0-5	....	....
Math.	208	Calculus & Linear Algebra	....	5-0-5	....
E.Gr.	105	Graphic Presentation	0-6-2	....	....
Econ.	201-2-3**	Principles of Economics	3-0-3	3-0-3	3-0-3
Mgt.	220**	Industrial Organization	....	....	3-0-3
M.Sci.	409	Analytical Methods in Management	....	....	3-0-3
P.T.	201-2-3	Physical Training	0-4-1	0-4-1	0-4-1
		Totals	15-10-18	16-4-17	16-4-17

*Engl. 206 or 207 may substitute for 203.
**To receive credit towards the degree B.S. a minimum of "C" must be earned in each of those courses, viz., Econ. 201, 202, 203, and Mgt. 220.

Junior Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
Mgt.	215	Accounting I	3-0-3	....	....
Mgt.	336	Accounting Principles and Applications II	....	3-0-3	....
Econ.	331, 332, 333	Intermediate Econ. Theory I, II, III	3-0-3	3-0-3	3-0-3
M.Sci.	323-324*	Statistics I and II	3-0-3	3-0-3	....
Psy. S.S.**	303 or	Introductory Psychology	3-0-3	....	....
Psy. S.S.**	410 or	Social Psychology	....	3-0-3	....
Engl.	315	Public Speaking	....	....	3-0-3
M.Sci.	210	Management Applications of Data Processing	2-3-3	....	....

Junior Year (Cont.)

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Mgt.	325	Law I	....	3-0-3	....
Econ.	328	Introduction to Econometrics	....	....	3-0-3
Econ.	340	Money & Banking	....	....	3-0-3
Electives***		....	....	....	3-0-3
		Totals	14-3-15	15-0-15	15-0-15

*Math 415-416 may substitute for M.Sci. 323-324.

**Social Science Courses substituted for Psychology 303 and 410 must be approved by the student's advisor.

***Of the 38 total hours of electives shown, at least 3 courses (9 hours) in any two of the five economic fields 1-6 listed must be selected, plus at least one course (3 hours) in each of three other fields.

1. Economic stabilization and growth
2. Industrial organization and public control
3. International economics and economic development
4. Economic theory and history
5. Managerial economics
6. Industrial relations

Senior Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Econ.	460	Econometrics II	3-0-3	....	....
Econ.	411	History of Economic Thought	....	3-0-3	....
Econ.	490	Seminar in Economic Policy	....	....	3-0-3
Electives*		....	12-0-12	12-0-12	11-0-11
		Totals	15-0-15	15-0-15	14-0-14

*Of the 24 total hours of Economics electives shown, at least 3 courses (9 hours) in any two of the five economic fields (1-6 listed) must be selected, plus at lease one course (3 hours) in each of two other fields.

1. Economic stabilization and growth
2. Industrial organization and public control
3. International economics and economic development
4. Economic theory and history
5. Managerial economics
6. Industrial relations

Courses of Instruction

NOTE: 4-3-5 *means* 4 *hours class,* 3 *hours laboratory,* 5 *hours credit.*

Management

Management 120. Management Orientation

1-0-1. Prerequisite: None.

An introduction to the field of management and the related areas of economics, and management science. The course will consider the curriculum in the five program options of the College of Industrial Management, jobs in management and the changing roles and responsibilities of management. *Required of all freshmen and optional for transfer sophomores. This course will be offered in winter quarter only. Juniors and seniors may not take the course.*

Text: Selected readings.

Mgt. 215, 216, 217. Accounting I, II, and III

3-0-3. Prerequisite: Sophomore standing.

This three course sequence is designed to provide a basic understanding of general and of cost accounting systems as well as a basis for utilizing the accounting data generated by these systems.

The emphasis in this series is on "use of" rather than the "mechanics of" the systems employed. However, during the first and second quarter of the sequence a basic presentation of the system will be included.

The relationship of accounting data to the decision process in a management environment will be the basis of the presentations in the third quarter of the sequence.

Credit will not be given for Mgt. 215, 216, 217, and Mgt. 335, 336.

Text: To be selected.

Mgt. 220. Industrial Organization

3-0-3. Prerequisite: Econ. 201 and Mgt. 215.

Presents a fundamental understanding of the process, objectives and functional areas of business from the managerial viewpoint as well as the dynamic nature of business and the emerging tools and analytical approaches of modern business.

Text: To be selected.

Mgt. 310. Marketing I

3-0-3. Prerequisite Econ. 203 or equivalent.

The role of marketing in the productive process, the functions performed and the institutional organizations supporting the marketing task are examined. In addition the environmental constraints affecting the marketing process will be studied.

Text: To be selected.

Mgt. 311. Marketing II

3-0-3. Prerequisite Mgt. 310.

Designed to focus the student on the managerial problems of a firm's marketing operations. The planning of marketing strategy and the major decision areas of marketing management are stressed.

Text: To be selected.

Mgt. 316. Finance Survey

3-0-3. Prerequisite: Junior standing.

Designed to acquaint the student with the more popular types of business organizations, with special emphasis on the corporation, its organization, management and types of securities issued. Credit not given for both Mgt. 316 and Mgt. 361.

Mgt. 317. Industrial Marketing

3-0-3. Prerequisite: Junior standing.

Marketing principles and policies, with emphasis on the functions that must be performed by manufacturers and industrial marketing institutions to insure customer satisfaction and profitable operation of the firm.

Text: To be selected.

Mgt. 320. Industrial Management Principles

3-0-3. Prerequisite: Mgt. 220.

A presentation of the evolving theory of management as a framework for the analysis of the interaction between the characteristics of humans, and the social-task environment created by complex industrial organizations and their objectives.

Text: To be selected.

Mgt. 322. Organizational Development

3-0-3. Prerequisites: Mgt. 320.

A study of the process of organization and the resulting development of organization structure, with particular emphasis on the marshalling of human resources toward the accomplishment of agency objectives. Such topics as the nature of, the transformation from and the interaction between informal and formal modes; the agency as an open system; power and authority relationships; the measurement of organizational effectiveness; management strategies and techniques; and the management of change will be treated.

Text: To be selected.

Mgt. 325. Law I

3-0-3. Prerequisite: Junior standing.

Background of the law and legal procedures; the problem of organizing a business; forms it may take and procedure of organization; agency and business organizations.

Text: To be selected

Mgt. 326. Law II

3-0-3. Prerequisite: Junior standing.

This course is conducted on the basis of daily lectures, guest lecturers, outside readings, and class discussion. The student is assigned cases to brief from the State and Federal Reporter Systems and collateral readings from paperback books and library materials, to determine the student's ability to comprehend rules of law and to widen his perspective on the problems of the urban poor. The course stresses the development and function of law, court organization and procedure, and the substantive law in the following areas: family problems, consumer problems, bankruptcy, housing problems, and constitutional guarantees.

Text: To be selected

Mgt. 335, 336. Accounting Principles and Applications I and II.

3-0-3. Prerequisite: Sophomore standing.

This two quarter sequence is designed to provide a basic understanding of general and cost accounting systems and to relate these systems and the data generated by them to the other functions of the business enterprise.

The first quarter will deal with the systems and the nature of information generated by them.

The second quarter will concentrate on the analysis of reports and the interpretation of reported information for decisions in the other functional areas of the enterprise.

Credit will not be given for Mgt. 335, 336 and Mgt. 215, 216, 217.

Text: To be selected.

Mgt. 340. Analysis of Financial Data

3-3-4. Prerequisite: Junior standing. Not open to College of I.M. undergraduates.

A survey in general and cost accounting. The first portion is devoted to familiarizing students with the accounting data collection system and with an examination and evaluation of accounting data output in financial statement form. Considerations involved in the analysis of costs and the development of the control and decision function of management in industrial operations follow. The course emphasizes the use of accounting data in a decision atmosphere rather than the generation of accounting data. Treatment of "accounting mechanics" is minimal. Credit will not be given for Mgt. 340 and Mgt. 215, 216, and 217. Neither will credit be given for Mgt. 340 and Mgt. 335, and 336.

Text: Slavin, Reynolds, and Malchman, *Basic Accounting for Managerial and Financial Control.*

Mgt. 343. Taxation

3-0-3. Prerequisite: Mgt. 215.

This course deals with federal income taxes and is directed toward the management planning necessitated by various tax alternatives. The tax implications of business management are reviewed. Major emphasis is on the business income tax requirements, though some attention will be given to the personal incidence of income tax. Personal incidence is covered relative to tax applications in the partnership and proprietorship forms of business organization.

Text: Raby, *Income Tax and Business Decision; Federal Tax Handbook.*

Mgt. 344. Cases in Management Control through Accounting Analysis

3-0-3. Prerequisites: Mgt. 217 or Mgt. 336. and Econ. 203 or 204.

A case and problems course designed to stress the application of accounting data to decisions in a management framework. Limitations as well as direct applicability of such accounting type data will be studied.

Text: Smith, *Management Through Accounting.*

Mgt. 347. Techniques of Industrial Communications

3-0-3. Prerequisite: Junior standing.

A study of the basic techniques of communication as employed in industry by management, by employees and by the public. Internal and external functions of public relations are covered with emphasis on the application of practical media in achieving definite results.

Text: To be selected.

Mgt. 349. Procurement Management

3-0-3. Prerequisite: Junior standing.

The functions and procedures involved in purchasing for industrial use and in the supervision and management of materials are considered in relation to the development of effective procurement policies.

Text: To be selected.

Mgt. 361. Financial Management

3-0-3. Prerequisites: Econ. 203 and Mgt. 216 (Acct. II).

The objectives of this course are to introduce the concepts of financial management and provide experience in financial decision making. The course acquaints the student with the long term sources of funds, including long term debt, equity instruments and financial leasing. Concepts of corporate valuation and modifications in the capital structure are also studied. Analysis of alternative security issues and the bargain for funds are studied through the use of the case method.

Text: To be selected.

Mgt. 365. Capital Budgeting

3-0-3. Prerequisite: Mgt. 361.

The development and application of analytical techniques pertaining to the capital budgeting decision of the firm, including the theory of cost of capital, measurement of investment profitability, and a treatment of uncertainty.

Text: To be selected.

Mgt. 380. (Psy. 380) Leadership

1-3-2. Prerequisite: None.

The purpose of this course is to foster the development of leadership and communication skills which can facilitate effective functioning of small groups. Topical coverage represents a survey of material which is of immediate usefulness to the student, rather than of material which is of immediate usefulness to the student, rather than intensive treatment of subject matter. Class discussion will be supplemented by opportunities to practice leadership and communication skills in the laboratory.

Mgt. 402. The Management of Organized Effort

3-0-3. Prerequisites: Mgt. 320, Psych. 410 and consent of instructor.

This course builds on and employs the material presented in the prerequisite courses to develop a systematic overview of the management of organized human effort within the complex agencies characteristic of modern society. Emphasis will be shifted from "the management of people," to the use of organization as a managerial vehicle for developing and controlling situations toward which members of organizations act and to which they respond.

Text: Instructor's syllabus and assigned readings.

Mgt. 408. Personnel Management Problems

3-0-3. Prerequisite: Junior standing.

This course concentrates on typical problems encountered by the personnel department in an industrial organization, such as selection, training and placement of workers, merit rating and promotion, and the development of sound personnel management techniques.

Text: To be selected.

Mgt. 409. Career Analysis

3-0-3. Prerequisite: Mgt. 408.

A course designed to enable students to analyze classified jobs in a company to determine career paths, training and development needs of workers for promotion, and programs of guidance and counseling of workers.

Mgt. 411. Public Administration

3-0-3. Prerequisite: Mgt. 320.

An examination of the structure of the Federal Government with emphasis on the role of the administrator in the Federal Civil Service.

Mgt. 418. Production Management, I

3-0-3. Prerequisites: Mgt. 320, and Econ. 352.

The objective of this course is to develop student understanding of the organizational, economic, and physical framework within which the manufacturing division functions and contributes to overall objectives. Students are expected to develop a philosophy of production management as well as analytical insight in solving various production problems.

Text: To be selected.

Mgt. 420. Integrated Management Problems

3-0-3. Prerequisites: Last quarter in residence.

Comprehensive cases are used to integrate knowledge at the policy level about the operations areas of management—production, finance marketing, industrial relations, human relations and administration. Emphasis will also be given to the relationship of managerial decisions to the economic and competitve forces affecting business.

Text: Selected cases.

Mgt. 427. Management as a Creative Force

3-0-3. Prerequisite: Junior standing.

The objective for this course is to assist in preparing students for management roles in an environment of constantly accelerating change. An analysis will be made of management as society's principal tool for coping with change. The innovative management tasks common not only to industry but to all organized activity will be examined as a part of the role of managment in introducing changes into the society and directing these changes toward constructive ends.

Text: None.

Mgt. 428. Industrial Relations

3-0-3. Prerequisite: Junior standing.

Historical development, internal procedures, and legal questions involved, in union-management relations.

Text: To be selected.

Mgt. 430. Management Decision Laboratory

0-3-1. Prerequisite: Senior standing.

This course gives students practice in making certain management decisions. Use is made of computers and simulated operations of manufacturing firms in a competitive market.

Text: Fulmer, *The Theory and Practice of Management Decision-making with Business Simulation Games.*

Mgt. 433. Business Research

3-0-3. Prerequisite: M.Sci. 324 or consent of instructor.

This is a course designed to familiarize the student with techniques used in industrial and business research. Emphasis is put on practical illustrations that allow a discussion of methodologies in a survey of all types of studies commonly used in practice.

Text: None.

Mgt. 440. Organizational Analysis

3-0-3. Prerequisites: Mgt. 320 and Mgt. 475.

The case approach will be used to acquaint students with the practical employment of organization as a managerial tool. Emphasis will be put on the successful as well as the unsuccessful use of organizational development as a managerial strategy for dealing with a changing and dynamic environment, and for the most effective use of the human resources available to an agency.

Text: To be selected.

Mgt. 443. Investments

3-0-3. Prerequisite: Mgt. 361 or Mgt. 316.

A study of the sources of financial information and its interpretation, the operation of stock exchanges, over-the-counter markets, and methods of underwriting. A study is also made of the various types of securities available for investment and tests to determine their investment quality.

Text: To be selected.

Mgt. 455. Marketing III

3-0-3. Prerequisite: Mgt. 311.

This course consists of cases involving the management of marketing activities. Careful consideration is given to the functions of planning, organizing, and controlling the essential elements of the overall marketing program of the firm.

Text: To be selected.

Mgt. 456. Marketing Management Problems

3-0-3. Prerequisite: Mgt. 311 or permission of instructor.

This is an advanced problems course in the field of marketing management.

Text: To be selected.

Mgt. 459. Industrial Relations in the Piedmont Region

3-0-3. Prerequisite: Senior standing.

The ecological, anthropoliogical and social as well as the economic dimensions of the emergence of the Southeastern Piedmont as an industrial region are investigated. This course demonstrates a method of analysis having general applicability for the study of regional industrial development.

Text: To be selected.

Mgt. 460. International Marketing

3-0-3. Prerequisite: Mgt. 311.

This course will focus on the unique management problems of multi-national marketing. Emphasis will be given to comparative analysis, techniques for marketing decisions, the role of marketing in economic development, and marketing strategies and policies of multi-national firms. (This course may be used to fulfill the international elective requirement for the General Management Program.)

Text: To be selected.

Mgt. 465. Nonmarket Environment of the Firm

3-0-3.

Corporate planning relative to social, legal, political, and tax problems as they affect management actions and decisions making.

Mgt. 467. Management Concepts and Issues in World Business

3-0-3. Prerequisite: Senior standing.

No business or industry today is immune to the effects of international business. It is important that every student understand the nature of this swiftly changing field and the implications it has for U.S. industry and the job of the manager.

The course will cover organizing for international business; industrial, economic, political, social, legal, labor, and technological aspects of international business; the changing patterns of world industry, the emergence of common markets; the role of U.S. industry overseas.

Mgt. 470. Contemporary Management Thought

3-0-3. Prerequisite: Mgt. 320.

Through extensive reading and small group discussions, students will develop an understanding of both the agreements and conflicts of current management thought. This course will give a brief historical perspective to modern management to emphasize the interdependencies of social values and management practices.

Text: To be selected.

Mgt. 472. Management of Industrial Research and Development Programs

3-0-3. Prerequisite: Mgt. 320.

An analysis of the fundamental concepts underlying effective management of research and development programs within the industrial environment. Attention is directed to such problem areas as the role and integration of research and development in the industrial organization, project proposal and evaluation, staffing and organizing the project team, project administration, and transition of projects from development in production and marketing.

Text: To be selected.

Mgt. 475. Contemporary Research in Management

3-0-3. Prerequisites: Mgt. 320, Psy. 401/410, and Mgt. 322.

After a brief introduction summarizing the historical development of management research and approaches to the study of management based on it, the course will require students to investigate, analyze and report on current research orientations and their significance to the understanding of management processes.

Text: None.

Mgt. 480. Analysis of Consumer Behavior

3-0-3. Prerequisite: Mgt. 311 (Marketing II).

A course designed to stress the importance of consumer behavior on the marketing function of a firm. Analysis of buyer behavior as a prime determinant of marketing strategy and demand analysis.

Text: To be selected.

Mgt. 491. Seminar

1-0-1. Prerequisite: Junior standing.

This course consists primarily of lectures, and question and answer periods with prominent business, government, labor and educational leaders concerned with aiding the student in making career decisions and preparing him for adjustment to the industrial world. *The course is offered winter quarter only.*

Mgt. 493. Individual Research in Industrial Management

Credit to be arranged.

This course is designed to pursue a particular line of inquiry, not covered, or not covered in desired depth, by studying, independently, books and articles and by reviewing the learning experience with a faculty member. *Students will be permitted to register for this course only upon obtaining a professor's approval in writing of a research proposal.*

Mgt. 496, 497, 498. Special Topics in Industrial Management

2-0-2. Prerequisite: Consent of the instructor.

A course designed to permit groups of students to pursue a common, specialized interest in an area of industrial management which is not extensively treated in the offerings of the College, or to engage in minor research or special problems involving analytical or experimental investigations.

Text: Selected readings.

Mgt. 499. Industrial Management Honors Seminar

3-0-3. Prerequisite: Last or next to last quarter seniors by invitation of the Faculty of the College of Industrial Management.

This course is designed to give a selected group of outstanding seniors in the College of Industrial Management an opportunity to research, analyze, and discuss current management and economic problems with specialists in the various areas.

Text: Selected readings.

Management Science

M.Sci. 210. Management Applications of Data Processing

2-3-3. Prerequisite: Sophomore standing.

The objective of this course is to provide (1) the technical foundation for the development of computer-based management systems and (2) the competence to successfully use the computer in subsequent courses. Computing concepts, programming, time-sharing and other information technology developments applicable to business are presented. Assignments involve use of the computer for the solution of problems in economics, statistics and the functional areas of management.

Text: To be selected.

M.Sci. 301. Introduction to Quantitative Methods

3-0-3. Prerequsites: Math. 236. (Not open to Industrial Management students.)

The objective of this course is to provide an introduction to the formulation and application of deterministic quantitative models to managerial decision processes. Major emphasis is in the use of basic linear programming and its specialized applications to production and scheduling type problems and in the optimization of general models of one variable in such areas as inventory control and investment analysis.

Text: To be selected.

M.Sci. 311. Management Science I

3-0-3. Prerequisites: Math. 407 or equivalent.

Applications of linear programming to the analysis of managerial problems. Topics include duality, transportation problems, network flows, postoptimality analysis, and decomposition. Emphasis is placed on the application of these analytical methods to significant managerial and economic problems.

Text: To be selected.

M.Sci. 312. Management Science II

3-0-3. Prerequisite: Math. 415.

This second course in the methodology and application of management science is concerned with the development and use of stochastic models in the analysis of managerial and economic decision making. Included are utility theory, introduction to the theory and use of games, Bayesian decision principles, queueing problems and inventory theory. Even though the course is primarily devoted to developing the basic concepts underlying these topics, comprehensive examples of application will be included.

Text: To be selected.

M.Sci. 323, 324. Statistics I, II

3-0-3. Prerequisite: Junior standing and must have completed differential and integral calculus.

The first course deals with statistical descriptions, probability and statistical inference.

The second course covers regression and correlation, analysis of variance, time series, introduction to multivariate analysis and sampling with applications to industry and business.

Text: To be selected.

M.Sci. 330. Decision Analysis in Management

3-0-3. Prerequisite: Math. 236.

An introduction to decision models for management situtations under risk and uncertainty. The fundamental economic concepts of a theory of rational choice are developed, examined, and applied to decision situations of managerial and/or economic interest. Topics include the basic structure of decision problems under risk and uncertainty, expected monetary value, elementary utility theory, the use of judgmental probability, the normal form of analysis, the economics of sampling, and risk sharing and group decision making.

Text: *Decision Analysis* by Howard Raiffa.

M.Sci. 390. Survey of Statistics

3-0-3. Prerequisite: Math 236.

A survey of discrete statistics with

special emphasis on economic and business applications. Includes sampling, the normal distribution, hypothesis testing, linear regressions and correlation, time series and index numbers.

Text: To be selected.

M.Sci. 409-410. Analytical Methods in Industrial Management I, II

3-0-3. Prerequisites: M.Sci. 323 and Math. 236.

This sequence of courses is an introduction to analytical models and their use in industrial management. The first course is concerned with decision models and optimization theory in general. Specific topics include linear programming models, the simplex method, transportation problems, and sensitivity analysis. The second course includes introductions to the theory and applications of dynamic programming, integer programming, and nonlinear programming. Emphasis in both courses is on the solution of managerial problems.

M.Sci. 415. Automation and Management

3-0-3. Prerequisite: M.Sci. 210 or equivalent and Senior standing.

The objective of this course is to establish and apply the principles of analysis and design of computer-based management systems. Case studies are employed to illustrate the current and potential applications in industry of system development concepts–particularly the concept of the integrated or "total information system." Assignments involve the application of optimization techniques in system design, simulation by computer, computer time sharing and other information technology developments.

Text: To be selected.

M.Sci. 419. Production Management, II

3-0-3. Prerequisites: M.Sci. 410 and Mgt. 418.

A course requiring students to apply quantitative and non-quantitative analytical methods to production management case problems.

Text: To be selected.

M.Sci. 430. Introduction to Sampling

3-0-3. Prerequisites: M.Sci. 390 or Equivalent.

Will emphasize, and use illustrations from, surveys of human populations, but will consider inanimate as well. The methods will be developed as tools to substantive research problems. Formulas will be given, but the underlying assumptions and theory, as well as limitations, will not be neglected. It is anticipated that the student will actually design and draw a sample, possibly in conjunction with one of his concurrent courses.

Text: *Survey Sampling* by Leslie Kish (or equivalent).

M.Sci. 436. Nonparametric Statistics

3-0-3. Prerequisites: M.Sei. 390 or Equivalent.

Paticularly in the behavioral areas, many of the assumptions necessary to classical statistical analyses are either violated or not verifiable and therefore there has been a recent growth of methods not dependent upon these restrictions. This course will offer a survey of some of the more widely used techniques, primarily from an applied point of view, although the underlying theories will not be altogether neglected. The student will be expected to gather and analyze actual data from the Tech community.

Text: *Nonparametric Statistics for the Behavioral Sciences* by Sidney Siegel.

M.Sci. 473. Statistical Analysis

3-0-3. Prerequisite: Graduate standing.

An analysis of statistical principles. The course has been planned for students who come from different schools with different undergraduate degrees. The course covers probabilities, distributions, estimation, and test of hypotheses with emphasis on decision making. Also included in the syllabus are linear regression and analysis of variance.

NOTE: Enrollment only by permission of the College of Industrial Management.

Text: To be selected.

M.Sci. 481, 482. Readings in Management Science

3-0-3. Prerequisite: Consent of instructor.

These two courses provide an opportunity for the student to study and report on applications of management science reported in the current literature. Readings will be structured in such a way as to provide comprehensive coverage of such topics as investment analysis, scheduling methods, media selection and other substantive areas in which management science has been applied. Also included will be case studies which may be analyzed by use of both quantitative and qualitative techniques.

Text: Selected readings.

M.Sci. 490. Special Project

6-0-6. Prerequisite: Consent of instructor.

The special project is designed to permit the student an opportunity to apply his full training to the solution of an applied or theoretical problem. The problem will generally be selected by the individual student, and his progress will be monitored by an individual faculty member. Typical problems could consist of the simulation of a complex industrial system, extension of an algorithm, creation of a new algorithm or research into an unsolved problem.

Text: None.

Economics

Econ. 201, 202, 203. Economic Principles and Problems

3-0-3. Prerequisite: Sophomore standing or permission of instructor.

This three-course sequence begins with an examination of the scope and method of economics. It continues with a study of the theory of markets and distribution. It concludes with an examination of national income theory and international trade.

Text: McConnell, *Economics.*

Econ. 204. Survey of Principles of Economics

3-0-3. Prerequisite: Sophomore standing. Not open to College of I.M. students.

A survey and an introduction to economics. It includes an examination of the two major areas of economics: national income and employment theory, and the theory of markets, distribution, and the behavior of the firm.

Text: To be selected.

Econ. 328. Econometrics I

3-0-3. Prerequisites: Economics 202, M.Sci. 324 or equivalent.

The objective for this course is to introduce methods of estimating the quantitative relationships among economic variables. The course will be concerned with problems of specification, estimation, prediction and verification. Tools used will include two and three variable linear regression models, simultaneous equation models and non-linear models.

Text: To be selected.

Econ. 331, 332, 333. Intermediate Economics, I, II, III

3-0-3. Prerequisites: Econ. 203 and Math. 208.

This three-course sequence consists of advanced economic theory for those in the economics option. The sequence begins with a theoretical analysis of the determination of prices and quantities sold of both commodities and factors of production under alternative market structures. The sequence continues with a concentration of aggregate economic theory. It stresses relationships between income, consumption, investment, employment, interest, credit, and the general price level in the context of classical models, Keynesian models, Chicago models, and growth models. Successful completion of the sequence should permit a critical analysis of public policy.

Text: To be selected.

Econ. 340. Money and Banking

3-0-3. Prerequisites: Econ. 203.

This course is concerned with the nature of money, its creation by banks, and monetary history of the United States, with emphasis on the Federal Reserve System and the instruments of monetary policy. Treasury debt operations and the significance of non-bank financial intermediaries for policy are also discussed.

Text: To be selected.

Econ. 345. Public Finance

3-0-3. Prerequisites: Econ. 201, 202, and 203.

An analysis of the decision making procedures relating to government expenditures and revenue collection. Principal topics include government fiscal policy, tax theory, the budgeting process and income redistribution.

Econ. 350. The Process of American Industrial Development.

3-0-3. Prerequisite: Econ. 203.

This course is designed to acquaint the student with the forces, unique characterisitcs, and problems associated with the American industrialization experience. Special attention will be given to technological progress, concomitant changes in the form of business organization, and the transformation of basic economic institutions.

Text: To be selected.

Econ. 352. Industrial Economic Analysis

3-0-3. Prerequisite: Econ. 203.

An advanced course in micro-eonomics, concerned with the scope and methods of economics, production and distribution theory, and the structure of markets, which emphasizes managerial applications of economic theory. Not open to Economics majors.

Texts: Watson, *Price Theory in Action;* Watson, *Price Theory and its Uses.*

Econ. 371. Economic Development

3-0-3. Prerequisite: Econ. 203.

A survey of theories of economic development, an analysis of factors contributing to the development of a national economy, and an examination of economic development policy and planning techniques currently adopted by the developing nations. Students will be required to write a paper on a development problem of a given nation.

Econ. 411. History of Economic Thought

3-0-3. Prerequisites: Economics 333 or consent of instructor.

A historical survey of schools of economic thought. A brief introduction to Greek and Roman thought is followed by a review of the early stages of capitalism. The main body of the course is concerned with classical, neoclassical, Kaynesian, and modern economic thought.

Text: Rima, I.H., *Development of Economic Analysis.* Irwin, 1967.

Econ. 429. Economics of the Labor Market

3-0-3. Prerequisite: Junior standing.

The application of micro economic theory to the process of matching workers with jobs in the market place, under conditions of perfect and imperfect competition. By studying the level and composition of the labor force, as influenced by such institutional factors as minimum wages and various public and private programs of income maintenance, this course emphasized the *structural* problems in achieving maximum employment and productivity.

Text: To be selected.

Econ. 454. Labor Relations Problems

3-0-3. Prerequisite: Mgt. 428.

An analysis of public policy in labor relations as reflected in legislative enactments, court decisions, and the common law. Emphasis will be given to management-labor problems arising out of strikes, labor injunctions, picketing, union security, contract negotiation, and other matters as affected by and related to recent laws such as the Norris-LaGuardia Act, Wage-Hour Act, Wagner Act, Taft-Hartley Act and Landrum-Griffin Act.

Text: To be selected.

Econ. 458. Contemporary Unionism and Collective Bargaining

3-0-3. Prerequisite: Mgt. 428.

This is a study of the organization and structure of unions in the United States and includes such subjects as union policies and aims, the theory of collective bargaining, collective bargaining procedures and techniques, and analysis of union-management contracts with attention given to typical clauses such as provisions for grievance machinery, technological changes, lay-offs, and union security.

Text: Beal and Wickersham, *Collective Bargaining.*

Econ. 460. Econometrics II.

3-0-3. Prerequisite: Econmetrics I.

This course is concerned with analyzing properties of different estimation methods, which include: direct least squares, two stage least squares, three stage least squares, limited information and full information maximum likelihood. Also discussed are data problems (such as auto-correlation and heteroscedasticity) and methods of adjusting inadequate data (such as pooling of cross-section and time series data, Monte Carlo method of generating random variates from an hypothesized disturbance distribution). The course also introduces spectral analysis as a method of analyzing time series data.

Text: To be selected.

Econ. 470. Mathematical Economics

3-0-3. Prerequisite: Consent of instructor.

This course translates economic problems and relationships into mathematical terms. The mathematics involve calculus, vectors and matrices, linear programming, difference and differential equations. Topics include: the multiplier, the accelerator, business cycles, input-output analysis, allocation techniques (linear programming), competitive strategy (game theory), and economic regulation (control systems).

Text: To be selected.

Econ. 474. Industrial Development in Latin America

3-0-3. Prerequisites: Econ. 203 or Econ. 204; knowledge of Spanish; and consent of the instructor.

A course designed to acquaint the student with the latest theories and principles of industrial development in developing countries. The student will prepare an analysis of the problems and opportunities in industrial development in a specific Latin American country.

Text: Powelson, *Latin America.*

Econ. 478. International Economics

3-0-3. Prerequisite: Restricted to majors in economics unless with consent of instructor.

This course is an introduction to the theory of international economic relations. It is concerned primarily with the pure theory of international trade and the interdependencies that exist between a country's foreign and domestic economic policies.

Text: To be selected.

Econ. 480. Economic Forecasting

3-0-3. Prerequisites: Econ. 203 and Senior standing.

This course reviews the theories of macroeconomics in terms of the national economic structure, changes in it, and trends in major industries. The strength of factors causing change in the national income sectors are assessed and economic forecasts prepared for 2-4 quarters in the future, and the implications of the economic outlook analyzed for management decision making in industry and business.

Text: To be selected.

Econ. 485. International Trade

3-0-3. Prerequisite: Econ. 203 or equivalent.

This course deals with the foreign exchange market, foreign trade and commercial policy, international finance and the achievement of equilibrium in the balance of payments and current problems of international economics.

Text: To be selected.

Econ. 486. National Income and Fiscal Policy.

3-0-3. Prerequisite: Econ. 203. Not open to majors in economics.

An intermediate macroeconomic

theory course designed to develop the student's understanding of the national economic environment within which the firm operates. Principal topics are: analysis of the national income model and its components, and contemporary fiscal and monetary theory.

Text: To be selected.

Econ. 487. Comparative Economic Systems

3-0-3. Prerequisite: Econ. 203 or equivalent.

A critical study is made of the methods by which various economic systems meet common fundamental problems in production, exchange, and distribution, consumption, and capital formation. Comparative analyses of the major theories underlying these methods are undertaken, and their efficacy considered in the light of modern technology.

Text: Selected readings.

Econ. 488. Economics of Industrial Competition

3-0-3. Prerequisite: Senior standing.

A study of the competitive structure of industry in terms of theoretical models and contemporary business organization, alternative public policy goals, and a critical review and appraisal of antitrust legislation.

Text: Wilcox, *Public Policies Toward Business.*

Econ. 489. Economics of Regulated Industries

3-0-3. Prerequisite: Econ. 203.

The purpose of this course is to introduce the students to the special characteristics and problems of public utility industries. The economic characteristics of public utilities industry will be presented and the development of the public utility concept and the commission form of regulation will be traced. Special emphasis will be given to the current problems and controversy in the regulated industry.

Text: To be selected.

Econ. 490. Seminar in Economic Policy

3-0-3. Prerequisite: Limited to economics majors.

This seminar is the capstone course for majors in economics. The topics for discussion will be chosen to encourage the student to focus his understanding of economic theory acquired in his undergraduate program on a substantive problem.

Econ. 493. Individual Research in Economics

Credit to be arranged.

This course is designed to pursue a particular line of inquiry, not covered, or not covered in desired depth, in other courses, by studying, independently, books and articles and by reviewing the learning experience with a faculty member.

Text: None.

Econ. 495. Economics of Industrial Location

3-0-3. Prerequisites: Econ. 203 and Mgt. 311 or equivalent.

A survey of economic factors influencing industrial location. General consideration will be given to locational patterns, processes of economic growth, and the public policy aspects of managerial decisions. More particular attention will be directed to the impact of transfer and processing costs, land use competition and technological change on problems of plant location.

Text: Hoover, *The Location of Economic Activity.*

Econ. 496, 497, 498. Selected Topics in Economics

TBA. Prerequisite: Consent of the instructor.

A course designed to permit groups of students to pursue a common, specialized interest in an area of economics which is not extensively treated in the offerings of the College, or to engage in minor research or special problems involving analytical or experimental investigations.

Text: Selected readings.

Graduate Courses Offered

Econ.	602	Regional Economics	3-0-3
Econ.	603	Economics of Industrialization	3-0-3
Econ.	604	Developmental Finance	2-0-2
Econ.	606	Research Methods in Development	3-0-3
M.Sci.	612	Computer Simulation of Management Problems	3-0-3
Mgt.	613	Management Systems Analysis	3-0-3
M.Sci.	614	Analytical Methods in Management	3-0-3
Mgt.	618	The Law of Market	3-0-3
Mgt.	620	The Theory of Industrial Organization	3-0-3
Mgt.	622	Development of Management Thought	3-0-3
Econ.	624	Economics of Production	3-0-3
Econ.	626	Development of Economic Thought	3-0-3
Mgt.	630	Production Management	3-0-3
M.Sci.	632	Manugacturing Management Problems	3-0-3
Mgt.	634	Management Control	3-0-3
Mgt.	635	Managerial Accounting	3-0-3
Mgt.	636	Problems in Accounting Control	3-0-3
Mgt.	640	Analysis and Budgeting for Management Control	3-0-3
Mgt.	649	Financial Management I	3-0-3
Mgt.	650	Financial Management II	3-0-3
Econ.	653	Industry and Government	3-0-3
Mgt.	654	Personnel Administration	3-0-3
Mgt.	656	Administrative Practices in Human Relations	3-0-3
Mgt.	657	Marketing Management	3-0-3
Mgt.	658	Cases in Marketing Management	3-0-3
Mgt.	659	Marketing Research and Analysis	3-0-3
Econ.	660	Economic Forecasting	3-0-3
Econ.	663	Financial Management and Economics of Nuclear Power	3-0-3
Mgt.	667	Labor Problems	3-0-3
Econ.	671	Labor and the Economy	3-0-3
Econ.	672	Manpower Legislation	3-0-3
Econ.	673	Macroeconomic Analysis	3-0-3
M.Sci.	674	Application of Statistical Methods to Management Decision-Making	3-0-3
Econ.	678	Wage and Employment Theory	3-0-3
Mgt.	680	Executive Development and Motivation	3-0-3
Mgt.	681	Management Policy in a Dynamic Environment	3-0-3
Mgt.	698	The Entrepreneur, Innovation and Change	3-0-3
Mgt.	700	Master's Thesis	
Mgt.	701,2,3	Seminar	1-0-0
Mgt.	704,5,6	Industrial Management Research	TBA
Econ.	707	Development Seminar I	1-0-1

Econ.	708	Development Seminar II	3-0-3
Mgt.	709	Seminar In Management Reserach Methods	3-0-3
Mgt.	713	Seminar on Psychology and Management	3-0-3
M.Sci.	714	Mathematical Programming in Management and Economics	3-0-3
M.Sci.	715	Seminar in Mathematical Programming for Management	3-0-3
Mgt.	723	Seminar in Management Systems Theory	3-0-3
Econ.	724	Microeconomic Analysis	3-0-3
Econ.	725	Seminar in Microeconomics	3-0-3
Econ.	730	Econometrics	3-0-3
Econ.	735	Seminar in Econometrics	3-0-3
Econ.	773	Advanced Macroeconomic Analysis	3-0-3
Econ.	775	Seminar in Macroeconomics	3-0-3
Mgt.	791	Seminar in Management and Economic Research	3-0-3

SCHOOL OF INFORMATION AND COMPUTER SCIENCE

(Established in 1963)

Director and Professor—Vladimir Slamecka; *Professors*—Lucio Chiaraviglio, Edward G. Roberts, Miroslav Valach; *Associate Professors*—James Gough, Jr., Philip J. Siegmann, Pranas Zunde; *Senior Research Engineer*—Alton P. Jensen; *Assistant Professors*—John M. Gwynn, Jr., M.D. Kelly, David H. Kraus, David E. Rogers, Joseph J. Talavage; *Instructors*—John J. Goda, Jr., D. D. Goglia; *Research Associates*—Margaret E. Dexter, Kenneth B. Dunham, Charls R. Pearson, Robert M. Siegmann; *Administrative Assistant*—Edmond F. Rumiano; *Principal Secretary*—Mrs. Adele L. Champaign; *Secretary*—Miss Judith K. Childs; *Report Typist*—Mrs. Linda D. Pefley.

General Information

The School of Information and Computer Science, although only a graduate degree granting department, offers two types of non-degree programs in the information sciences and professions to the Undergraduate Division of the Institute. The programs provide the equivalent of, respectively, a "minor" and a "major" in these fields. Either program is open to undergraduate students registered in any degree granting department of the Institute who have (a) completed ICS 151—Digital Computer Organization and Programming (or an equivalent course), and (b) secured the approval of their departmental advisors.

The "Minor" in Information and Computer Science. This program is designed flexibly to serve two categories of students: (a) those interested in information/computer science as a formal discipline of study; and (b) those interested in information processing and computing techniques and their application to other fields of knowledge or professions. The academic program recommended for the first type of student is shown below; it consists, in addition to ICS 151, of eight 3-hour courses providing a balanced treatment of the formal core of this science. The second category of students, interested in techniques and applications of ICS to their disciplines and professions, should substitute ICS 325, 342, 406 and 410 with 12 hours of electives appropriate to their objectives. These electives may be in areas such as systems analysis; computer programming; numerical analysis; computing applications in management, engineering process control, or automation; switching theory, logic design and hardware architecture; or others. While the School of Information and Computer Science offers courses in several of these areas, students are encouraged to pursue elective courses offered by their departments.

Recommended "MINOR" in Information/Computer Science

Year	*Quarter*	*Course*	*Hrs.*
Freshman	F W SP	ICS 151-Digital Computer Organization and Programming (or equivalent)	2-3-3
Sophomore	F W	ICS 256-Computer and Programming Systems	3-0-3
	SP	Math 239-Introduction to Set-Theoretic Concepts	3-0-3
Junior	F	ICS 325-Introduction to Cybernetics	3-0-3
	W	ICS 310-Computer-Oriented Numerical Methods	2-3-3
	SP	ICS 355-Information Structures and Processes	3-0-3
Senior	F	ICS 342-Introduction to Semiotics	3-0-3
	W	ICS 406-Computing Languages	3-0-3
	SP	ICS 410-Problem Solving	3-0-3

The Undesignated B.S. in Information and Computer Science. The Institute offers experimentally an undesignated baccalaureate degree, the mechanism of which permits certain students to virtually major in information/computer science. Interested and qualified students should arrange an interview with the Director of the School of Information and Computer Science prior to seeking a formal approval of such a program by the Curriculum Committee.

While neither of these undergraduate programs is intended to be a prerequisite for admission to graduate study in information and computer science, students successfully completing either of the above options may consider themselves well prepared for pursuing graduate work in this discipline. Inquiries concerning these programs should be addressed to Mr. John J. Goda, ICS Undergraduate Advisor; or to Director, School of Information and Computer Science, Georgia Institute of Technology, Atlanta, Georgia 30332.

At the graduate level, the School of Information and Computer Science offers two types of advanced degree programs, each having a different objective and content: a professionally oriented program in information and computer systems engineering leading to the designated Master of Science degree, and a research-oriented program emphasizing theory and leading to the degree of Doctor of Philosophy.

Students' preparation for graduate work in information and computer science should include, as a minimum, substantial work in mathematics, at least through the calculus, differential equations, introductory modern algebra, and some probability. Entering graduate students are also expected to have knowledge of computer programming at the level of ICS 151, 256, and 355.

Courses of Instruction

NOTE: 3-0-3 *means* 3 *hours class,* 0 *hours laboratory,* 3 *hours credit.*

ICS 151. Digital Computer Organization and Programming

2-3-3. Prerequisite: Entrance algebra and trigonometry.

Algorithmic processes of problem solving; concept and properties of algorithms. Organization and characteristics of digital computers; concept and properties of machine and problem-oriented languages. Development of computational algorithms for elementary numerical and non-numeric problems; pseudo-machine and problem-oriented language (ALGOL) programming for computing equipment currently available at Georgia Tech.

ICS 215. Technical Information Resources

1-0-1.

An introduction to information sources of science, engineering and management. The Georgia Tech Library as an information system. Planning and methodology of carrying out various types of information searches.

ICS 251. Automatic Data Processing

2-3-3. Prerequisite: ICS 151 or equivalent training in programming.

An introduction to computer file structures (tables, arrays, matrices; linear, inverted, and list structures) and their handling in conventional operations (searching, sorting, maintenance, etc.) on different types of memory devices. Criteria of efficiency in file systems design. COBOL and other problem-oriented languages for non-numeric applications.

ICS 256. Computer and Programming Systems

3-0-3. Prerequisite: ICS 151 or equivalent.

This course is designed to provide a broad understanding of analog and digital computer systems, with emphasis on the latter. The internal characteristics of computers and peripheral devices are reviewed and placed in perspective with the problem of programming. Software devices are examined and related to both machines and problems. The complex relationships between hardware, software and machine operations are reviewed in terms of cost and organizational goals.

ICS 310. Computer-Oriented Numerical Methods

2-3-3. Prerequisite: ICS 151 or equivalent, Math. 208.

An introduction to computer-oriented numerical methods for error analysis, evaluation of functions, integration, solution of equations, systems of linear equations, matrices, curve-fitting, interpolation, numerical differentiation, and solution of ordinary differential equations. Emphasis is placed on methods of proven value in computer solution of present-day problems in engineering science and on the efficient use of existing computer facilities.

ICS 325. Introduction to Cybernetics

3-0-3. Prerequisite: Math. 239.

The objective of this course is to introduce the history and branches of cybernetics. The fundamental cybernetic concepts of structure, system, modelling, information communication and control are treated with respect to both natural and artificial systems. Self-organizing and cognitive systems are surveyed, and the impact of cybernetics discussed.

ICS 336. Introduction to Information Engineering

3-0-3.

An introduction to the fundamentals, methodology, products and implications of information engineering. Topics covered include: the nature and properties of information; the structure and uses of the "information utility"; information-based models of problem solving and communication processes; the methodology of information system design; and social and other implications of information engineering.

ICS 342. Introduction to Semiotics

3-0-3. Prerequisite: Math. 239.

Semiotics is the study of signs and sign processes and basic semiotic concepts that have important application to the understanding of artificial and natural information processors. The course brings together a number of concepts that are fundamental to logic, epistomology, grammar, theories of automata and machines, and theories of information. The concepts surveyed, their illustration, and the discussion on their interrelation are designed to give the beginning students a fundamental orientation in the field of computer and information science.

ICS 355. Information Structures and Processes

3-0-3. Prerequisites: Math. 239, ICS 256 or concurrent registration in ICS 458.

Introduction to information structures and processes. Logical data structures. Processes on data structures including scanning, searching, sorting and stressing list processing techniques. Machine representation of data structures. File structures and processes. Data management systems.

ICS 401, 402. Languages for Science and Technology

3-0-3, 3-0-3.

A survey of the principal languages in which scientific and technical literature is published. Emphasis is on the orthography, phonology, basic grammatical structure, and technical bibliographic vocabulary of German, French, Russian, with limited examination of other important languages.

ICS 404. Topics in Linguistics

3-0-3.

A general treatment of morphology, syntax and lexicology of natural language, with emphasis on generative grammar.

ICS 406. Computing Languages

3-0-3. Prerequisites: ICS 355 or permission of instructor.

This course develops a formal definition of programming languages and a system for their classification. Algorithmic language structures are examined to develop an understanding of statement types, the scope of declarations and their relationship to resource allocation, and the relationships of hardware and software. The structure of non-algorithmic languages is also examined with emphasis on simulation and list processing. Interactive languages are considered relative to on-line information processes.

ICS 410. Problem Solving

3-0-3. Prerequisites: Math. 239 or equivalent.

The purpose of this course is to present a descriptive and a formal approach to problem-solving in science. The course is structured around the use of the scientific method in problem-solving, and around the understanding of formal theories as well as heuristic approaches to problem-solving.

ICS 415. The Literature of Science and Engineering

2-3-3. Prerequisite: Senior standing or consent of instructor.

Study of the reference and bibliographic sources of scientific and engineering literature, stressing strategies of searching. Major search project in student's field of study.

ICS 423. Mathematical Techniques for Information Science

3-0-3. Prerequisite: Graduate Standing.

Mathematical techniques of relevance in information/computer science which are not explicitly included in the required core program are presented with emphasis on numerical solution procedures. Primary areas of study include abstracts from modern algebra, vectors and vector spaces, matrices, countability, classical optimization theory, and topics related to linear differential equations and their solution.

ICS 424. Elements of Information Theory

3-0-3. Prerequisites: Math. 205 or 415, or equivalent training in probability.

A mathematical approach to information theory primarily through probability on finite spaces; the uniqueness and function; transmission rate, channel capacity, coding theorem for discrete memoryless channel; decision schemes and date processing; applications.

ICS 436. Information Systems

3-0-3. Prerequisite: Senior (or higher) standing.

The course is based on the concept of a general abstract information system and related notions such as general systems theory and information flow. From this foundation, the following real-world systems are discussed as information systems: computers, companies, and humans. Each system is investigated from the point of view of (1) structure, (2) control mechanism, (3) types of input and output information, and (4) information networks. Emphasis is placed on the discussion of corporate information systems.

ICS 445. Logistic Systems

3-0-3. Prerequisite: Math. 239 or equivalent.

The course is an introduction to logistic systems and their metatheory. Stress is placed on understanding the basic concepts of logic and their place in the computer and information sciences. Axiomatic formulation of the propositional calculus, predicate calculus, and set theory are presented briefly. The major metatheorems are described and interrelated. Extensive sketches of the proofs of Post's completeness theorem for the propositional calculus, Gödel's completeness theorem for the predicate calculus, and Gödel's incompleteness theorem for arithmetic are given. Church's and Turing's theses and the role of the limitation theorems are described. The course presupposes that the student has developed a reasonable set of skills in logical technique and symbol manipulation.

Text: Delong, H. *A Profile of Mathematical Logic,* Addison-Wesley, Reading, Massachusetts, 1970.

ICS 452. Logic Design and Switching Theory

3-0-3. Prerequisites: ICS 151 or equivalent, ICS 445 or training in Boolean algebra.

Theory of computer circuit design is introduced together with its application. Boolean functions and relations are presented as structures in logic space. Combinatorial and sequential circuit design methods are introduced as two basic methods of computer logic design. In addition, time functions, simultaneous Boolean equations and design automation problems are used to show the trends in theory and technology of computer logic design.

ICS 458. Computer Systems

5-3-6. Prerequisite: ICS 151 or equivalent. Prerequisite or Corequisite: ICS 355.

An intensive introduction to computer organization, assembly language programming, and systems programming concepts. Topics include computer structure, machine language, characteristics of peripheral devices, language translators, program segmentation and linkage, recursion, macros, dynamic storage allocation, and operating systems. Laboratory work emphasized programming and use of available computer systems.

Graduate Courses Offered

Applications for admission to the graduate programs in information and computer science will be considered from qualified students with undergraduate backgrounds which included substantial training in mathematics (at least through calculus and differential equations). With the approval of their advisor and the director of the School of Information and Computer Science, students in their senior undergraduate year may also take a graduate course in information and computer science. The following graduate level courses will be offered in 1971-72:

ICS	607	Communication and Control of Information	3-0-3
ICS	608	Syntax of Natural Languages	3-0-3

ICS	609	Mathematical Linguistics	3-0-3
ICS	612	Graph Theory	3-0-3
ICS	616	Information Control Methods	3-0-3
ICS	621	Theory of Communication	3-0-3
ICS	625	Cybernetics	3-0-3
ICS	626,627	Information Processes I, II	3-0-3, 3-0-3
ICS	628	Theory of Models	3-0-3
ICS	629	Information Measures	3-0-3
ICS	632	Equipment of Information Systems	3-0-3
ICS	636,637	Information Systems Design I, II	3-0-3, 3-0-3
ICS	638	Problems in Systems Design	0-6-2
ICS	642	Advanced Semiotics	3-0-3
ICS	645	Advanced Logic	3-0-3
ICS	646	Philosophy of Mind	3-0-3
ICS	647	Artificial Intelligence	3-0-3
ICS	652	Advanced Computer Organization	3-0-3
ICS	653	Computer Techniques for Information Storage and Retrieval	2-2-3
ICS	656	Computer Operating Systems	3-0-3
ICS	657	Design of Computer Operating Systems	3-0-3
ICS	658	Evaluation of Computer Systems	2-3-3
ICS	661	Computer Language Design	3-0-3
ICS	673	Organization and Management of Information Industry	3-0-3
ICS	682,683	Systems Theory I, II	3-0-3, 3-0-3
ICS	700	Master's Thesis	
ICS	701,2,3	Seminar	
ICS	704,5,6	Special Problems in Information and Computer Science	Hours and Credit to be arranged
ICS	704	Combinatory Logic and the Calculi of Lambda-Conversion (Special Problems Course)	3-0-3
ICS	706	Pattern Recognition (Special Problems Course)	3-0-3
ICS	706	Management Information Systems Design (Special Problems Course)	3-0-3
ICS	710	Philosophy of Language	3-0-3
ICS	726	Theory of Automata	3-0-3
ICS	736	Information Systems Optimization	3-0-3
ICS	738	Advanced Systems Design	3-0-3
ICS	761	Syntax-Directed Compilation	3-0-3
ICS	799	Ph.D. Dissertation Preparation	
ICS	800	Doctor's Thesis	

SCHOOL OF MATHEMATICS

(Established in 1952)

Acting Director–John D. Neff; *Associate Director*–George C. Caldwell; *Regents' Professor*–Marvin B. Sledd; *Professors*–Alson H. Bailey, John C. Currie, Bertram M. Drucker, Eric R. Immel, Robert H. Kasriel, M. Zuhair Nashed*, Austin L. Starrett, James W. Walker; *Associate Professors*–James C. Brooks, George L. Cain, Jr., Samuel H. Coleman, Donald M. Friedlen, Jamie J. Goode, James V. Herod, Dar-Veig Ho, Roger D. Johnson, William J. Kammerer, John P. Line, William A. Martin, Albert L. Mullikin, James M. Osborn, Daniel A. Robinson, William R. Smythe, Jr., Frank W. Stallard, Michael P. Stallybrass, C. Robert Swenson, Joe W. Wray; *Assistant Professors*–Arthur E. Fulton, John M. Gwynn, Jr., Harvey J. Iglarsh, David L. Morgan, E. Juanita Pitts, W. Hallam Purcell, Jr., Ronald W. Shonkwiler, Wayne G. Sullivan, John R. Vail, San Wan, Stanley J. Wertheimer, Guy A. York; *Instructors*–William G. Christian, David L. Lovelady, William P. McKibben, George W. Reddien, Laddie W. Rollins, Stephen E. Scherer; *Principal Secretary*–Frances W. Fowler; *Secretaries*–Ginger L. Colquitt, Jean C. Kelly.

General Information

The School of Mathematics has two functions: (1) to train students in basic mathematics and in its use as an effective tool in engineering, the sciences, and management; (2) to provide more advanced mathematical training for those who plan to make mathematics their profession.

In addition to the usual undergraduate service courses, programs of study are offered which lead to the degrees of

Bachelor of Science in Applied Mathematics
Master of Science in Applied Mathematics
Doctor of Philosophy

Numerous advanced undergraduate and graduate courses are offered which may be used as electives by students in the schools of engineering and the sciences. Close cooperation is maintained with the staff of the Rich Electronic Computer Center, which is located on the campus.

Students of especial ability are invited to participate in an Honors Program which extends through a large part of the freshman and sophomore years.

The requirements for the B.S. in Applied Mathematics are listed on the following pages; the requirements for the graduate degrees may be found in the Graduate Bulletin.

Departmental Degree Requirements

The following institutional regulation concerning degrees is quoted from the publication *Student Rules and Regulations* as revised in 1968:

*on leave

"To be a candidate for a degree, a student must have passed all courses required for the degree, must have a scholastic average for his entire academic program of at least 2.0 and must have done creditable work in his departmental courses so as to merit the recommendation for the degree by the director of his school and by the dean of the undergraduate division. (X, A2, p. 10)."

The School of Mathematics interprets "creditable work in departmental courses" to mean a minimum grade of C in each mathematics course required in the curriculum. In cases where this rule appears to work unreasonably or unjustly, exceptions may be made by the Director or Associate Director of the School of Mathematics.

Freshman Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Chem.	104-5	Inorganic Chemistry.....	4-3-5	4-3-5	....
E. Gr.	113	Engineering Graphics....	....	....	0-6-2
Engl.	107-8-9	Introduction to Literature	3-0-3	3-0-3	3-0-3
Math.	107-8-9	Calculus I, II, III..........	5-0-5	5-0-5	5-0-5
M.L.	*	Modern Language OR			
S.S.	**	Social Science...............	3-0-3	3-0-3	3-0-3
P.T.	101-2-3	Physical Training..........	0-4-1	0-4-1	0-4-1
***Electives		....	2-0-2	2-0-2	2-0-2
Gen.	101	Orientation..................	1-0-0	....	....
		Totals	18-7-19	17-7-19	13-10-16

NOTE: Under Quarters, 3-3-4 means 3 hours class, 3 hours lab., 4 hours credit.

*The School of Mathematics recommends that French, German or Russian be taken in the freshman year. Should this not be done, French, German or Russian must be elected in the junior year.

**Choice of: (1) two quarters of one of the following: American History, Political Science, Philosophy and History of Science, or Sociology; and the third quarter selected from one of the three remaining areas; or (2) three quarters of Modern Language in either German, French, or Spanish. Three quarters of either M.L. or S.S. are required.

***ROTC is an optional requirement and those students not scheduling ROTC courses are required to earn 6 credit hours in elective courses as a substitute. Only 6 credit hours in basic ROTC may be applied toward the requirements for a degree. If ROTC is elected by the student, it must be scheduled beginning the first quarter the student is enrolled.

Sophomore Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
Engl.	201-2-3	Survey of the Humanities	3-0-3	3-0-3	3-0-3
Math.	207	Calculus IV and Linear Algebra	5-0-5	....	....
Math.	208	Calculus V	....	5-0-5	....
Math.	209	Differential Equations	....	....	5-0-5
Phys.	227-8-9	Physics	4-3-5	4-3-5	4-3-5
P.T.	201-2-3	Physical Training	0-4-1	0-4-1	0-4-1
Electives		Electives (Note 1)	....	3-0-3	3-0-3
		Totals	12-7-14	15-7-17	15-7-17

*ROTC is an optional requirement and those students not scheduling ROTC courses are required to earn 6 credit hours in elective courses as a substitute. Only 6 credit hours in basic ROTC may be applied toward the requirements for a degree.

Junior Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
Engl.	320	Technical Writing	3-0-3	....	....
Engl.	315	Public Speaking	....	3-0-3	....
Math.	309	Introd. to Higher Algebra	3-0-3	....	....
Math.	401-2-3	Introd. to Analysis	3-0-3	3-0-3	3-0-3
Math.	405-414	Modern Algebra	....	3-0-3	3-0-3
Phys.	308	Intermediate Electricity	....	3-0-3	....
Phys.	319	Modern Physics for Engineers	....	....	3-0-3
Electives		Electives (Note 1)	6-0-6	6-0-6	9-0-9
		Totals	15-0-15	18-0-18	18-0-18

Senior Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Math.	404	Introd. to Analysis........	3-0-3	....	....
Math.	427-8-9	Seminar	2-0-2	2-0-2	2-0-2
Math.		(Any four Math. Courses at the 400 level or higher)	3-0-3	3-0-3	6-0-6
Phys.	301	Mechanics.....................	....	5-0-5	....
Elective		Electives (Note 1).........	9-0-9	9-0-9	9-0-9
		Totals	17-0-17	19-0-19	17-0-17

NOTE 1: The total of 54 hours of electives in the sophomore, junior, and senior years must include at least 9 hours of humanistic-social studies from the list on page 40 and at least 12 additional hours of course work in fields other than mathematics and advanced ROTC. The total of 54 hours must not include more than 9 hours of advanced ROTC.

Courses of Instruction

Math. 100. College Algebra and Trigonometry

5-0-5. Prerequisite: Entrance algebra. (No credit toward graduation for engineering or science degrees.)

The function concept; exponential, logarithmic, and trigonometric functions; theory of equations including trigonometric equations.

Text: Johnson, Lendsey, Slesnick, Bates, *Algebra and Elementary Functions.*

Math. 105. Calculus for Management I

5-0-5. Prerequisite: Math. 100.

Background for calculus; the limit concept; the derivative; techniques and applications of the derivative.

Text: McBrien, *Introduction to Calculus.*

Math 106. Calculus for Management II

5-0-5. Prerequisite: Math. 105 or Math. 107.

The definite integral; calculus of trigonometric functions; the partial derivative functions.

Text: McBrien, *Introduction to Calculus.*

Math. 107. Calculus I

5-0-5. Prerequisite: Entrance algebra and trigonometry.

The rate of change of a function; limits; derivatives of algebraic functions; applications; curves and equations; tangents and normals; Newton's method; equations of loci.

Text: Thomas, *Calculus and Analytic Geometry* (4th ed.)

Math. 108. Calculus II

5-0-5. Prerequisite: Math. 107.

The circle, parabola, ellipse, and hyperbola; second degree curves; invariants and the discriminant; sections of a cone; integration; applications of the definite integral; transcendental functions.

Text: Thomas, *Calculus and Analytic Geometry* (4th ed.)

Math. 109. Calculus III

5-0-5. Prerequisite: Math. 108

Hyperbolic functions; methods of integration; polar coordinates; vectors and parametric equations.

Text: Thomas, *Calculus and Analytic Geometry* (4th ed.)

Math. 117, 118, 119. Honors Calculus I, II, III

5-0-5.

This sequence of courses is designed for students with superior mathematical ability and training. Although the topics covered parallel those in Math. 107-108-109, the treatment of the subject matter is more intensive and rigorous. Participation is by invitation of the School of Mathematics.

Math. 205. Elementary Statistical Analysis

3-0-3. Prerequisite: Entrance algebra.

Construction of consistent probability measures for finite sequences of statistical experiments; independent trials; random variables, their means, variances and distributions; sampling; estimation and testing of hypotheses; nonparametric tests of association. Entire development restricted to finite sample spaces.

Text: Kurtz, *Basic Statistics.*

Math. 206. Elementary Statistical Analysis

3-0-3. Prerequisites: Math. 205; Math. 108 or concurrently.

Motivation and definition of random variables with continuous distributions; normal distribution and the Central Limit Theorem; non-parametric tests; estimation and testing hypotheses in normal distributions; simple regression and correlation.

Text: Kurtz, *Basic Statistics.*

Math. 207. Calculus IV

5-0-5. Prerequisite: Math. 109.

Determinants and linear equations; linear algebra; vectors in n-space; vector functions and their derivatives; partial differentiation.

Text: Thomas, *Calculus and Analytic Geometry* (4th ed.)

Math. 208. Calculus V

5-0-5. Prerequisite: Math. 207.

Multiple integrals; vector analysis, infinite series.

Text: Thomas, *Calculus and Analytic Geometry* (4th ed.)

Math. 209. Differential Equations

5-0-5. Prerequisite: Math. 208.

Linear differential equations and their applications in engineering and the natural sciences. Systems of linear equations, equations with variable coefficients, series solutions. Simple nonlinear equations.

Text: Spiegel, *Applied Differential Equations.*

Math. 217, 218. Honors Calculus IV, V.

5-0-5.

A continuation of Math. 117-118-119. The coverage parallels that of Math. 207-208.

Math. 236. Finite Mathematics

5-0-5. Prerequisite: Math. 105 or Math. 107.

Elements of logic: connectives, truth tables. Sets, subsets, operations involving sets. Permutations and combinations. Probability: probability as a measure, independent events, conditional events, Bayes' theorem. Introduction to linear programming. Linear equations, matrices, and determinants. Vector spaces, linear dependence and basis. Rank and the general solution to linear equations.

Text: Lipschutz, *Theory and Problems of Finite Mathematics.*

Math. 239. Introduction to Set-Theoretic Concepts

3-0-3. Prerequisite: Math. 108.

Set operations, set identities, cartesian product, relations, equivalence classes, functions, mappings, sequences, cardinality of sets.

Text: To be selected.

Math. 309. Introduction to Higher Algebra

3-0-3. Prerequisite: Math. 208.

Vectors, vector spaces, matrices, systems of linear equations, transformations of coordinates in a vector space, quadratic forms, diagonalization, characteristic values.

Text: Shields, *Elementary Linear Algebra.*

Math. 400. Special Topics

3-0-3. For example Math. 400 (a) could be Optimization Techniques, a companion course to Math. 407.

The purpose here is to enable the School of Mathematics to comply with requests for courses in selected topics. Given on demand.

Math. 401. Introduction to Analysis

3-0-3. Prerequisite: Math. 209 or 305 or concurrently.

The first of four courses on fundamentals of analysis, real and complex number systems, normed linear and metric spaces, stressing Euclidean, completeness, compactness, connectedness, continuous functions, limits.

Text: *Introduction to Analysis,* Rosenlicht.

Math. 402. Introduction to Analysis

3-0-3. Prerequisite: Math. 401.

Differentiation, Taylor's theorem, Riemann integration, series, sequences and series of functions, uniform convergence and basic applications.

Text: *Introduction to Analysis,* Rosenlicht.

Math. 403. Introduction to Analysis

3-0-3. Prerequisite: Math. 402.

Improper integrals, uniform convergence of improper integrals, with applications, contraction maps, with applications, polynomial approximation results, introduction to differentiation of mappings between Euclidean spaces, derivative as a linear map, chain rule.

Text: *Introduction to Analysis,* Rosenlicht.

Math. 404. Introduction to Analysis

3-0-3. Prerequisite: Math. 403.

Chain rule and applications, higher order derivatives, Taylor formula, inverse function and implicit function theorems, multiple integrals, Jordan measurable sets, change of variables, introduction to differential forms.

Text: To be selected.

Math. 405. Modern Algebra

3-0-3. Prerequisite: Math. 309.

A survey of modern algebraic systems including groups, rings, fields, and finite-dimensional vector spaces.

Text: Herstein, *Topics in Algebra.*

Math. 407. Linear Programming

3-0-3. Prerequisite: Math. 208 or concurrently.

Mathematical structure of the linear programming problem. Requisite topics in linear algebra. Simplex method. Applications.

Text: Smythe and Johnson, *Introduction to Linear Programming.*

Math. 409. Fundamental Concepts in Mathematics

3-0-3. Prerequisite: Differential equations or consent of instructor.

A course designed for mathematics majors and beginning graduate students. Unifies and extends certain basic notions of college mathematics.

Text: To be selected.

Math. 411. Advanced Engineering Mathematics

3-0-3. Prerequisite: Math. 209 or 305.

The Laplace transformation and its properties. Elementary applications to physical systems involving the solution of ordinary and partial differential equations.

Text: Churchill, *Operational Mathematics.*

Math. 412. Advanced Engineering Mathematics

3-0-3. Prerequisite: Math. 209 or 306 or consent of instructor.

Fourier series, Bessel functions, partial differential equations.

Text: Churchill, *Fourier Series and Boundary Value Problems.*

Math. 413. Advanced Engineering Mathematics

3-0-3. Prerequisite: Math. 209 or 305 or consent of instructor.

Topics from complex function theory including conformal mapping and contour integration.

Text: Churchill, *Complex Variables and Applications.*

Math. 414. Modern Algebra

3-0-3. Prerequisite: Math. 405.

A continuation of Math. 405. Linear transformations on finite dimensional vector spaces, matrix interpretation and inner product spaces.

Text: Herstein, *Topics in Algebra.*

Math. 415. Introduction to Probability

3-0-3. Prerequisite: Math. 208 or concurrently.

An introduction to probability theory and its applications; discrete and non-discrete probability distributions; laws of large numbers.

Text: Meyer, *Introductory Probability and Statistical Applications.*

Math. 416. Mathematical Statistics

3-0-3. Prerequisite: Math. 415.

A general study of discrete, continuous, and limiting distributions with emphasis on the normal distribution and the central limit theorem; exact sampling distributions, selected topics in estimation and testing hypotheses.

Text: Tucker, *An Introduction to Probability and Mathematical Statistics.*

Math. 417. Mathematical Statistics

3-0-3. Prerequisite: Math. 416.

A continuation (from Math. 416) of estimation and of testing hypotheses; regression theory, design of experiments, analysis of variance, distribution-free methods.

Text: Tucker, *An Introduction to Probability and Mathematical Statistics.*

Math. 418. Probability with Applications

3-0-3. Prerequisite: Math. 208.

An introduction to random processes with the necessary preliminary study of discrete sample spaces, combinatorial analysis, and basic laws of probability.

Text: Feller, *An Introduction to Probability Theory and Its Applications.*

Math. 419. Probability with Applications

3-0-3. Prerequisites: Math. 418; Math. 309 or concurrently.

A continuation of Math. 418. Laws of large numbers, branching process, recurrent events, Markov chain processes, random walks and diffusion, time-dependent stochastic processes.

Text: To be selected.

Math. 420. Vector Analysis

3-0-3. Prerequisite: Math. 209 or 306 or consent of instructor.

Vector algebra, vector calculus, line and surface integrals, divergence and curl, and their invariant definitions, theorems of Green, Gauss, and Stokes, applications.

Text: Davis, *Introduction to Vector Analysis.*

Math. 425. Principles of Digital Computers

3-0-3. Prerequisite: Math. 208.

Organization and characteristics of digital computers; development of algorithms for elementary numerical methods; natural language and problem oriented language programming for machines currently available at the Rich Electronic Computer Center; the digital computer as a tool for experimental analysis.

Text: To be selected.

Math. 426. Computer Programming and Coding

3-0-3. Prerequisites: Math. 425, 443; Math. 444 or concurrently or consent of instructor.

Application of the digital computing equipment currently available at the Rich Electronic Computer Center to implement and investigate methods studied in numerical analysis.

Text: To be selected.

Math. 427. Seminar

2-0-2. Prerequisites: Math. 309, 402, and either 306 or 209.

Study and discussion intended to enhance investigative independence and expository skill. Content varying from year to year, usually beginning with solution of a series of related problems.

Math. 428. Seminar

2-0-2. Prerequisite: Math. 427.

A continuation of Math. 427 with greater emphasis on individual study. Oral and written presentation of results.

Math. 429. Seminar

2-0-2. Prerequisite: Math. 428.

Individual investigations of problems of moderate difficulty with a suitable account of results.

Math. 430. Mathematical Methods in Continuum Mechanics

3-0-3. Prerequisite: Math. 208.

An elementary tensorial treatment of various geometric and mechanical concepts needed in the study of hydrodynamics, elasticity, and plasticity.

Text: Prager, *Introduction to Mechanics of Continua.*

Math. 431. Introductory Topology

3-0-3. Prerequisite: Math. 401 or consent of instructor.

A course to provide background for the use of topological methods in analysis. Topological spaces, continuous transformations, metric spaces.

Text: To be selected.

Math. 434. Differential Geometry

3-0-3. Prerequisite: Math. 208.

The theory of curves and surfaces, including the first and second fundamental forms of a surface and topics related to them.

Text: To be selected.

Math. 435. Elements of Information Theory

3-0-3. Prerequisite: Math. 205 or 415 or equivalent training in probability.

A mathematical approach to information theory primarily through probability on finite spaces: the uniqueness and basic properties of the information function; transmission rate, channel capacity, coding theorem for discrete memoryless channel, decision schemes and data processing; applications.

Text: Ash, *Information Theory.*

Math. 436. Elementary Decision Theory

3-0-3. Prerequisite: Math. 205 or 415 or equivalent training in probability.

A mathematical approach to the concepts of decision theory based primarily on probability for finite spaces: loss and risk functions and expectations; bayesian and minimax strategies in response to statistical uncertainty; the special cases of classical statistics; applications.

Text: Weiss, *Statistical Decision Theory.*

Math. 437. Introduction to Stochastic Processes

3-0-3. Prerequisite: Math. 415 or equivalent level of probability.

Description of a process by means of probability laws; the Wiener and Poisson processes; tools from conditional probability theory; mean and covariance of a process; stationarity; normal processes; Markov processes; applications.

Text: Parzen, *Stochastic Processes.*

Math. 438. Mathematical Logic

3-0-3. Prerequisite: Math. 208 or consent of instructor.

An introductory course in the basic topics of set theory, the statement calculus, the restricted predicate calculus. Additional topics considered to the extent that time permits include the relationship of logic to the foundations of mathematics, recursive functions (Turing machines), formal languages, extended predicate calculus, decision problems.

Text: Stoll, *Introduction to Set Theory and Logic.*

Math. 441. Theory of Groups

3-0-3. Prerequisite: Math. 309.

An introductory course in group theory suitable for students of mathematics, chemistry, and physics.

Text: Barnes, *Introduction to Abstract Algebra.*

Math. 443. Numerical Analysis I

3-0-3. Prerequisite: Math. 208.

Numerical solutions of systems of linear and nonlinear equations; interpolation and approximation of functions; finite difference calculus.

Text: To be selected.

Math. 444. Numerical Analysis II

3-0-3. Prerequistes: Math. 209 or 306; Math. 443 or consent of instructor.

Numerical differentiation, numerical integration; difference equations; numerical solutions of ordinary differential equations.

Text: To be selected.

Math. 445. Numerical Analysis III

3-0-3. Prerequisite: Math. 444 or consent of instructor.

Numerical approximation of solutions of integral equations and partial differential equations; eigenvalue problems; selected topics of current interest.

Text: To be selected.

Math. 446. Introduction to Game Theory

3-0-3. Prerequisites: Math. 236 or Math. 309 or Math. 407 or consent of instructor.

An introduction to game theory with emphasis on zero-sum two-person games. Military, economic, and recreational illustrations. Discussion of connections with linear programming and decision functions.

Text: Dresher, *Games of Strategy.*

Math. 447. Introduction to Partial Differential Equations

3-0-3. Prerequisite: Math. 209 or 306.

The one-dimensional wave equation; characteristics; classification of second-order linear differential operators; properties of elliptic and parabolic equations; the method of separation of variables; Fourier series; methods for solving non-homogeneous problems including, for example, Green's function.

Text: Weinberger, *A First Course in Partial Differential Equations.*

Math. 448. Introduction to Partial Differential Equations

3-0-3. Prerequisite: Math. 447.

Sturm-Liouville theory, general Fourier expansions (eigenvalues and eigenfunctions, Bessel functions, Legendre polynomials); elementary theory of analytic functions of a complex variable and applications to Laplace's equation and the evaluation of improper integrals.

Text: Weinberger, *A First Course in Partial Differential Equations.*

Math. 449. Introduction to Partial Differential Equations

3-0-3. Prerequisite: Math. 448.

Theory and application of the Fourier and Laplace transforms; methods of approximating solution.

Text: Weinberger, *A First Course in Partial Differential Equations.*

Math. 491. Topics from Advanced Calculus

3-0-3. Prerequisite: Math. 208.

A course designed to furnish a broader foundation in analysis for students in the engineering curricula. Jacobians and the implicit function theorems, Riemann-Stieltjes integral, uniform continuity, theorems of Green, Stokes, and Gauss, uniform convergence of infinite series and improper integrals.

Text: Widder, *Advanced Calculus.*

Graduate Courses Offered

NOTE: 4-3-5 *means* 4 *hours class,* 3 *hours laboratory,* 5 *hours credit.*

Math.	600	Special Topics	3-0-3
Math.	601,2,3	Methods of Applied Mathematics	3-0-3
Math.	604,5,6	Modern Abstract Algebra I, II, III	3-0-3
Math.	607,8,9	Ordinary Differential Equations	3-0-3
Math.	624	Harmonic Analysis	3-0-3
Math.	631,2,3	Functions of a Real Variable	3-0-3
Math.	634,5,6	Functions of a Complex Variable	3-0-3
Math.	637,8,9	Partial Differential Equations	3-0-3
Math.	641,2,3	Mathematical Statistics	3-0-3
Math.	644,5,6	Functional Analysis I, II, III	3-0-3
Math.	651,2,3	General Topology	3-0-3
Math.	661,2,3	Algebraic Topology	3-0-3
Math.	671,2,3	Mathematical Methods of Applied Science	5-0-5
Math.	691	Calculus of Variations	3-0-3
Math.	692	Integral Transforms	3-0-3
Math.	693	Integral Equations	3-0-3
Math.	694	Special Functions of Higher Mathematics	3-0-3
Math.	696	Tensor Analysis	3-0-3
Math.	697	Field Theory with Applications	3-0-3
Math.	700	Master's Thesis	
Math.	701,2,3	Seminar	1-0-0
Math.	704,5,6	Special Topics	Credit to be arranged
Math.	707,8,9	Advanced Problems in Ordinary Differential Equations	3-0-3
Math.	712,13,14	Methods of Applied Mathematics	3-0-3
Math.	715,16,17	Advanced Topics in Algebra	3-0-3
Math.	731,2,3	Advanced Topics in Real Analysis	3-0-3
Math.	734,5,6	Advanced Problems in Complex Variables	3-0-3
Math.	741,2,3	Studies in Advanced Probability and Statistics	3-0-3
Math.	744,5,6	Advanced Topics in Numerical Analysis	3-0-3
Math.	751,2,3	Advanced Topics in Topology	3-0-3
Math.	800	Doctor's Thesis	

NOTE: For requirements for the graduate degree in Mathematics, consult the *Graduate Bulletin.*

SCHOOL OF MECHANICAL ENGINEERING

(Established in 1888)

Director and Professor–Stothe P. Kezios; *Professor and Director Emeritus*–Homer S. Weber; *Professors Emeritus*–Richard A. Trotter; *Fuller E. Callaway Professor*–Novak Zuber; *Regents Professor*–Mario Goglia; *Professors*–Samuel C. Barnett, Arthur E. Bergles, Walter O. Carlson, William R. Clough, William A. Hinton, Thomas W. Jackson, Miodrag M. Novakovic; *Associate Professors*William Z. Black, Stephen L. Dickerson, Pandeli Durbetaki, Horace O. Foster, A. Louis Holliman, Harold L. Johnson, John H. Murphy, Kadaba V. Prasanna, Ward O. Winer, Wolfgang Wulff; *Assistant Professors*–James M. Bradford, Jr., Gene T. Colwell, Prateen V. Desai, Robert B. Evans, William D. McLeod, David M. Sanborn, Phillip G. Sexton, Samuel V. Shelton, Kent C. Williams, Wendell M. Williams; *Lecturer*–Raymond G. Grim; *Administrative Assistant to the Director*–Col. T. D. Ashworth; *Activities Manager*–Billy H. Allen; *M.E. Lead Technician*–John W. Davis; *Principal Laboratory Mechanic*–Joseph G. Doyal; *Senior Laboratory Mechanic*–Louis A. Cavalli; *Electronics Technician*–Neel T. Martin; *Laboratory Mechanic*–Clifford R. Bannister; *Machinists*–Harry J. Carr, Bobby L. Wallace; *Principal Secretary*–Mrs. Lucille Whitt; *Senior Secretary*–Mrs. Louise K. Barge; *Secretaries*–Mrs. Sharon Butler, Mrs. Lallias Hodge; *Clerk-Typists*–Mrs. Toni Nicholson, Mrs. Judy Turner; *Clerk-Receptionist*–Mrs. Dianna Kilpatrick.

General Information

Mechanical Engineering is perhaps the broadest of the engineering disciplines and therefore it embraces such diverse activities as the science and art of the generation, conversion, transmission, and utilization of thermal and mechanical energy, the design as well as the production of tools and machines and their products, the consideration of the fundamental characteristics of materials as applied to design, and the synthesis and analysis of mechanical, thermal and fluidic systems, as well as their individual components, including feedback and control. Design, production, operation, administration, economics and research are functional aspects of this branch of professional engineering.

The course of study is designed to cover the fundamental aspects of the field of Mechanical Engineering, to impress basic principles upon the student, and to educate him in the use of these principles in reaching solutions to engineering situations and problems through optimal design. Specific design subject matter and materials are drawn from such newer engineering activities as oceanography and bio-mechanical systems, as well as from the more traditional areas of the field.

Emphasis, in the freshman and sophomore years, is placed on mathematics, chemistry, and physics and, in the junior and senior years, on the strength and the metallurgy of materials, applied mechanics, thermodynamics, heat transfer and fluid mechanics, and the application of those fundamental subjects to the diverse problems of mechanical engineering.

Satisfactory completion of the curriculum leads to the degree, Bachelor of Mechanical Engineering.

Optional Programs

While the curriculum is designed and structured to meet the general educational goals of the majority of mechanical engineering students, the School regularly considers and approves major modifications of the basic program to allow a student with certain well-defined educational objectives to pursue minor fields within the School or within Georgia Tech while winning a major degree in Mechanical Engineering. In this way a student may achieve his basic engineering degree in Mechanical Engineering whil minoring in any one of a large number of other fields as well. Aside from the rather broad flexibility afforded by such special programs, a student has a number of electives in the curriculum as well as special problems and projects allowing for the exercise of latitude in the pursuit of his educational goals and areas of special interest.

Exceptional students can elect a planned sequence of graduate courses in lieu of senior electives with the approval of the School.

Graduate Programs

The School of Mechanical Engineering has a rapidly expanding and vigorous graduate program which encompasses advanced study and research in the areas of automatic controls, bioengineering, combustion, complex system design, controlled machine tools, dynamics and vibration, energy conversion, engineering design, environmental quality control, flammability, fluid mechanics, fluidics and fluid power, heat transfer, high temperature design, lubrication, magnetogasdynamcis, materials processing, materials science and engineering, mechanisms (synthesis and analysis), power and propulsion, thermal systems (analysis and design), thermodynamics (equilibrium and irreversible), transport processes, and two-phase flows.

Graduate programs are based on the areas listed above, leading to the degrees of Master of Science in Mechanical Engineering, Master of Science, and Doctor of Philosophy, for qualified graduates having backgrounds in engineering, mechanics, mathematics, physical sciences and biological sciences.

Freshman Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Chem.	104-5	General Chemistry........	4-3-5	4-3-5	....
Phys.	227	Particle Dynamics.........	....	....	4-3-5
Math.	107-8-9	Calculus I, II, III...........	5-0-5	5-0-5	5-0-5
E.Gr.	170-1	Visual Comm. & Engr. Des.	2-3-3	2-3-3	....
M.E.	101	Introduction to M.E.	....	....	1-0-1
****Hum./S.S./M.L.		....	3-0-3	3-0-3	3-0-3
P.T.	101-2-3	Physical Training..........	0-4-1	0-4-1	0-4-1
*Free Elective		....	2-0-2	2-0-2	2-0-2
Gen.	101	Orientation..................	1-0-0	....	....
		Totals........................	17-10-19	16-10-19	15-7-17

Sophomore Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Phys.	228	Electromagnetism.........	4-3-5	....	....
Phys.	229	Optics & Modern Physics	....	4-3-5	....
Math.	207	Calculus IV..................	5-0-5	....	....
Math.	208	Calculus & Linear Algebra......................	....	5-0-5	....
Math.	209	Differential Equations..	....	....	5-0-5
ESM	205	Statics..........................	3-0-3	....	....
ESM	309	Dynamics I..................	....	3-0-3	....
ESM	334	Mechanics of Deformable Bodies.......................	....	....	5-0-5
M.E.	212	Materials Science..........	....	....	3-0-3
****Hum./S.S./M.L.		....	3-0-3	3-0-3	3-0-3
P.T.	201-2-3	Physical Training..........	0-4-1	0-4-1	0-4-1
		Totals........................	15-7-17	15-7-17	16-4-17

Junior Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
M.E.	322-3-4	Thermodynamics..........	3-0-3	3-0-3	3-0-3
M.E.	342-3-4	Transport Phenomena I, II, III.........................	3-0-3	3-0-3	3-3-4
E.E.	325	Electric Circuits & Fields........................	2-3-3	....	....
E.E.	326	Elementary Electronics.	....	2-3-3	....

Junior Year (Cont.)

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
E.E.	327	Elect. Power Conversion	....	....	2-3-3
M.E.	312	Materials Technology....	3-3-4	....	....
M.E.	316	M.E. Comp. Applications	....	2-3-3	....
M.E.	355	Experimental Methodology	....	....	1-3-2
M.E.	313	Mechanisms, Analysis & Synthesis	3-0-3	....	....
M.E.	413	Dynamics of Machinery	....	3-0-3	....
****Hum./S.S./M.L..		....	....	3-0-3	3-0-3
****Hum./S.S./M.L..		....	....	....	3-0-3
		Totals	14-6-16	16-6-18	15-9-18

Senior Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
M.E.	481	Machine Elements.........	3-3-4	....	....
M.E.	483	Design Theory	....	3-0-3	....
M.E.	484	Design Engineering	....	....	0-6-2
M.E.	484	Design Engineering	....	....	0-6-2
M.E.	416-7	Thermal Systems Anal. I, II...........................	3-0-3	2-3-3	....
M.E.	455	Exp. Engineering	....	....	1-3-2
M.E.	444	Transport Phenomena IV	3-0-3	....	....
M.E.	412	Material Processes.........	....	3-3-4	....
M.E.	445	Pr. of Automatic Control.....................	3-0-3	....	....
I.E.	425	Engineering Economy...	....	....	3-0-3
Tech. Elective*		....	(3-0-3	3-0-3	3-0-3
		or	(2-3-3	2-3-3	2-3-3
****Hum./S.S./M.L..		....	....	....	3-0-3
****Hum./S.S./M.L..		....	....	3-0-3	3-0-3
		Totals	(15-3-16	14-6-16	13-9-16
		or	(14-6-16	13-9-16	12-12-16

*These free elective courses may be taken at any time during the course of study. If ROTC is elected by the student these 6 credit hours may be applied for basic ROTC and basic ROTC must be scheduled beginning the first quarter the student is enrolled.

**Nine hours of technical electives chosen from the list of M.E. Interest Area Courses shown below. Courses other than these may be selected from mathematics, physics, chemistry, biology, another field of engineering or graduate courses. A student who wishes to take courses not listed below must so notify the Director of his choice and obtain approval at advance registration for the first quarter of his Senior year.

A student completing his Junior year with a grade average of 2.5 or higher may elect one technical elective from the Special Problem courses M.E. 496-7-8-9. (The particular course selected depending on the number of hours of credit needed.) This student will follow a course of individual study under the guidance of a faculty member with the approval of the School Director.

***Nine hours of electives may be replaced by Advanced ROTC.

****For selection of acceptable courses see page 38 in this catalogue.

M.E. Interest Area Courses

Listed below are elective courses in various topical areas of interest to mechanical engineers:

M.E. 403	Metal Cutting Principles
M.E. 420	Internal Combustion Engines
M.E. 421	Heating, Ventilating, and Air Conditioning
M.E. 422	Power Plant Engineering
M.E. 425	Engineering Analysis
M.E. 426	Principles of Turbomachinery
M.E. 427	Combustion and Flames
M.E. 428	Elements of Rocket Systems
M.E. 429	One-Dimensional Compressible Flow
M.E. 431	Refrigeration
M.E. 439	Gas Turbines
M.E. 443	Heating, Ventilation, and Air Conditioning Design
M.E. 447	Elements of Nuclear Engineering
M.E. 448	Fluidics
M.E. 449	Numerical Control of Machine Tools
M.E. 462	Analytical Instrumentation in Materials Engineering
M.E. 463	Mechanical Testing of Materials
M.E. 465	Materials
M.E. 485	Mechanics of Machines

Course of Instruction

NOTE: 4-3-5 *means* 4 *hours class,* 3 *hours laboratory,* 5 *hours credit.*

M.E. 101. Introduction to Mechanical Engineering

1-0-1. Prerequisite: Math. 107.

Mechanical Engineering is briefly surveyed to acquaint the student with the profession. What it is, what its functions are, what its working tools are, and what must be studied and learned to practice mechanical engineering successfully are the major topics considered.

Texts: Smith, *Engineering as a Career,* 2nd Ed.; Florman, *Engineering and the Liberal Arts.*

M.E. 212. Materials Science

3-0-3. Prerequisites: Math. 209 or concurrently and Phys. 229 or concurrently.

The course emphasizes those principles which relate the properties and behavior of different classes of materials to their structure and enviornment.

Text: To be selected.

M.E. 312. Materials Technology

3-3-4. Prerequisite: M.E. 212.

The course discusses the mechanical and physical properties of metallic and non-metallic materials and the relationship of these properties to behavior under service conditions.

Text: To be selected.

M.E. 313. Mechanisms, Analysis and Synthesis

3-0-3. Prerequisite: ESM 309.

Analysis of the motion of linkages, cams and gears. An introduction of curvature theory and its application to the synthesis of plane linkages.

Text: Shigley, *Kinematic Analysis of Mechanics.*

M.E. 316. Mechanical Engineering Computer Applications

2-3-3. Prerequisite: Math. 209 or concurrently.

An introduction to the organization and application of digital and analogue computers. Batch and remote processing. Representative mechanical engineering problems are solved through appropriate numerical techniques. Basic electrical analogues and circuits are used to solve initial value problems and to simulate engineering systems.

M.E. 320. Thermodynamics

4-0-4. Prerequisites: Phys. 229 or parallel; Math. 208 or parallel.

The fundamentals of engineering thermodynamics are covered. The properties of fluids, energy equations, and practical applications are included.

Text: To be selected.

M.E. 322. Thermodynamics

3-0-3. Prerequisites: Phys. 229 or parallel; Math. 208 or parallel.

A study of the fundamental laws of engineering thermodynamics and the properties of systems. Processes in the perfect gas was considered.

Texts: Van Wylen and Sonntag, *Fundamentals of Classical Thermodynamics;* Keenan and Keyes, *Thermodynamic Properties of Steam.*

M.E. 323. Thermodynamics

3-0-3. Prerequisite: M.E. 322.

A continuation of M.E. 322 including semi-perfect gases, real gases, vapors, mixtures, solutions, and general thermodynamic relations.

Text: Van Wylen and Sonntag, *Fundamentals of Classical Thermodynamics.*

M.E. 324. Thermodynamics

3-0-3. Prerequisite: M.E. 323.

A continuation of M.E. 323 including power and refrigeration cycles, combustion, introduction to phase and chemical equilibrium.

Text: Van Wylen and Sonntag, *Fundamentals of Classical Thermodynamics.*

M.E. 326-7. Thermodynamics

4-0-4, 3-0-3. Prerequisites: Phys. 229 or parallel; Math. 209 or parallel.

The concepts, basic definitions and principles of classical equilibrium thermodynamics are introduced and discussed in view of state and path functions. The macroscopic formalism is introduced along with some equations of state for pure and ideal substances; this is applied to processes involving gases, liquids and solids. Phase transitions are studied.

Some molecular models are studied with classical and quantum mechanical considerations. Appropriate statistics are used for the predictions of thermodynamic properties. Partition functions are derived for systems of independent particles and thermodynamic properties are calculated for monatomic gases, monatomic solids and polyatomic gases.

M.E. 334. Mechanical Equipment of Buildings

3-0-3. Prerequisite: Phys. 229 or 213.

Principles of water supply, plumbing and heating are studied. Design features of various types of heating systems are considered.

Text: McGuinness, et al., *Mechanical and Electrical Equipment of Buildings.*

M.E. 335. Mechanical Equipment of Buildings

2-3-3. Prerequisite: M.E. 334.

Principles of air conditioning are studied. Application of heating and air conditioning principles to practical design problems is carried out during the laboratory period.

Text: McGuinness, et al., *Mechanical and Electrical Equipment of Buildings.*

M.E. 342. Transport Phenomena I

3-0-3. Prerequisites: Math. 209, M.E. 322 or concurrently.

Introduction to conductive heat transfer, steady one-dimensional conduction, two- and three-dimensional steady-state conduction, conduction of heat in the unsteady state, and kinematics of fluid flow.

Texts: Hansen, *Fluid Mechanics;* Holman, *Heat Transfer,* 2nd ed.

M.E. 343. Transport Phenomena II

3-0-3. Prerequisites: M.E. 342 ESM 205 and concurrent M.E. 323.

One-dimensional energy equation, fluid statics, Euler and Bernoulli equations, momentum equation, introduction to compressible flow, nozzles and shocks.

Texts: Hansen, *Fluid Mechanics;* Holman, *Heat Transfer,* 2nd ed.

M.E. 344. Transport Phenomena III

3-3-4. Prerequisites: M.E. 343, and concurrent M.E. 324 and M.E. 355.

Radiation heat transfer, fluid properties and flow characteristics, incompressible and compressible flow in ducts, flow over immersed bodies.

Texts: Hansen, *Fluid Mechanics;* Holman, *Heat Transfer,* 2nd ed.

M.E. 353. Materials Laboratory

0-3-1. Prerequisites: ESM 334 or ESM 343 or parallel.

Basic methods of determining and evaluating phenomenological properties of engineering materials are experimented with. Stress analysis instrumentation is introduced.

Text: To be selected.

M.E. 355. Experimental Methodology

1-3-2. Prerequisites: Math. 209, ESM 309 and M.E. 322.

Three major areas are considered: the calibration of instruments for meaningful experimental data; the interpertation of collections of data, to demonstrate the role of random error and the importance of confidence levels; and the response of physical systems, to correlate the measurements taken with the dynamic behavior of instruments.

Text: To be selected.

M.E. 403. Material Removal Principles

2-3-3. Prerequisites: M.E. 412, ESM 334.

The following topics are studied: Mechanics, mechanism and metallurgy of chip formation. Lubrication, wear and cutting fluids, grinding, electrical machining processes, temperatures in metal cutting, economics. Experiments concerned with a study of chip formation, the effect of speed, feed, and rake angle on tool forces, tool temperature, lubrication and wear are performed.

Text: Amerego and Brown, *The Machinery of Metals.*

M.E. 412. Material Processes

3-3-4. Prerequisite: M.E. 312.

Fundamentals of the various techniques used in working materials. Casting, metal forming, extrusion, metal joining and metal cutting are among the topics included.

Text: To be selected.

M.E. 413. Dynamics of Machinery

3-0-3. Prerequisites: M.E. 313, Math. 209.

A continuation of the study of mechanism analysis and synthesis. Single position force analysis of mechanisms is covered in both the static and dynamic cases. The effects of friction are treated. Continuous positional analysis of rotating and reciprocating systems, including balancing, is also studied.

Text: Phelan, *Dynamics of Machinery.*

M.E. 414. Heat Transfer

3-0-3. Prerequisite: M.E. 327.

Elements of transport processes. Fundamental concepts of conduction and convection. Boundary layer concepts and their application to convective flows, laminar and turbulent. Stationary systems, including external/internal resistance criteria. Radiation fundamentals and general interchange optics.

M.E. 416. Thermal System Analysis I

3-0-3. Prerequisites: M.E. 324 and M.E. 444 or concurrently.

The application of the principles of thermodynamics and transport phenomena to the analysis of thermal systems. Typical thermal systems such as steam power plants, internal combustion engines, refrigeration, nuclear power, and direct energy conversion are analyzed.

Text: To be selected.

M.E. 417. Thermal System Analysis II

2-3-3. Prerequisite: M.E. 416.

Continuation of the work of the prerequisite course. In the laboratory the student will attempt to verify experimentally the analytical predictions of system performance.

Text: To be selected.

M.E. 420. Internal Combustion Engines

3-3-4. Prerequisites: M.E. 324, and 343.

The mechanical construction, engine cycles, ignition, fuels, fuel feeds, combustion, and performance of internal combustion engines, with reference to aeronautical, automotive, and industrial use. The laboratory is devoted to experimental study of engines and their component parts.

Text: Obert, *Internal Combustion Engines.*

M.E. 421. Heating, Ventilating and Air Conditioning

3-3-4. Prerequisites: M.E. 324, M.E. 344 or parallel.

The theory of heating, ventilating and air conditioning and its application to engineering systems. The laboratory work includes tests on equipment and materials pertinent to the field.

Text: Carrier, Cherne, Grant and Roberts, *Modern Air Conditioning, Heating and Ventilating.*

M.E. 422. Power Plant Engineering

3-3-4. Prerequisite: M.E. 324 and 444 or consent of instructor.

Modern power plant cycles, pumps, piping, fans, fuels, steam generators, boiler auxiliaries, heat exchangers and the economics of power plants are studied. The laboratory work consists of tests of equipment pertaining to the subject.

Text: To be selected.

M.E. 425. Engineering Analysis

3-0-3. Prerequisite: Consent of instructor.

Emphasis is placed on well-ordered analytical thought processes required in the application of familiar fundamental principles of engineering scineces to the analysis of unfamiliar engineering situations.

M.E. 426. Principles of Turbomachinery

3-0-3. Prerequisite: M.E. 344, or consent of instructor.

Principles underlying all forms of turbomachinery are studied. Application of these principles is made to give a unified treatment of pumps, compressors, and turbines.

Text: Shepherd, *Principles of Turbomachinery.*

M.E. 427. Combustion and Flames

3-0-3. Prerequisite: M.E. 324 and 444 or consent of instructor.

Stoichiometric and thermochemical analysis of the principal fuel air reactions are examined. Concepts of modern theories of combustion and flame propagation are presented.

M.E. 428. Elements of Rocket Systems

3-0-3. Prerequisite: M.E. 444 or parallel.

Basic elements, ballistics, and technical problems associated with the design of propulsion systems for solid and liquid propellant rockets are considered.

Text: To be selected.

M.E. 429. One-Dimensional Compressible Flow

3-0-3. Prerequisite: M.E. 444 or parallel.

An intermediate study of various one dimensional compressible flow systems relevant to mechanical engineering.

Text: Shapiro, *The Dynamics and Thermodynamics of Compressible Fluid Flow.*

M.E. 431. Refrigeration

3-0-3. Prerequisite: M.E. 324.

A study of the compressor, condenser, piping and accessories of the refrigeration plant, and other practical applications of the principles of refrigeration.

Text: Jordan and Priester, *Refrigeration.*

M.E. 439. Gas Turbines

3-0-3. Prerequisites: M.E. 324 and 344.

The theory and design of gas turbines and jet engines and the various applications of these engines.

Text: To be selected.

M.E. 443. Heating, Ventilation, and Air Conditioning Design

3-0-3. Prerequisite: M.E. 421.

A continuation of M.E. 421. The subject matter emphasizes the design of various systems, including automatic controls, and the selection of equipment.

Text: Carrier, Cherne, and Grant, *Modern Air Conditioning, Heating and Ventilating.*

M.E. 444. Transport Phenomena IV

3-0-3. Prerequisites: M.E. 344.

Free and forced convection on immersed bodies, dimensional analysis, forced convection in ducts, heat transfer with phase changes, heat exchangers.

Texts: Hansen, *Fluid Mechanics,* Holman, *Heat Transfer,* 2nd ed.

M.E. 445. Principles of Automatic Control

3-0-3. Prerequisite: Math. 209.

Fundamental principles and generalized behavior of closed loop linear systems are examined. Classical techniques based on frequency response and eigenvalue analysis are presented as well as state variable approaches in the time domain. Examples are drawn from hydraulic, thermal, pneumatic, mechanical and electrical applications to physical systems.

Text: Harrison and Bollinger, *Introduction to Automatic Control,* 2nd ed.

M.E. 447. Elements of Nuclear Engineering

3-0-3. Prerequisites: Physics 209 and Math. 209.

A study of characteristics of nuclear power systems. Nuclear physics and nuclear reactions will be used for establishing some reactor principles and reactor types.

Text: To be selected.

M.E. 448. Fluidics

3-3-4. Prerequisites: M.E. 343 and M.E. 445 or concurrently.

The fluid mechanics of fluidic devices are presented. Digital proportional, diaphragm, and vortex devices in fluidics and their characteristics are studied. Fluid-electrical analogs are introduced. Aspects of line dynamics are treated. Engineering applications of fluidic systems are examined with reference to power economy, reliability, staging, and interconnections.

M.E. 449. Numerical Control of Machine Tools

3-0-3. Prerequisite: M.E. 445 or concurrently.

A study of the design and the operation of typical digital control systems for machine tools. The flow and manipulation of control signals is followed and studied as they progress through the system from the tape input to the machined-part output.

Texts: Childs, *Principles of Numerical Control;* Jakobowitz, *Electronic Computers;* Notes and references.

M.E. 455. Experimental Engineering

1-3-2. Prerequisites: M.E. Final quarter standing.

Engineering situations involving various disciplines are solved by experimental means. Students must seek understanding of the purpose of experimentation, plan the experiments and gather and interpret the results.

Text: To be selected.

M.E. 462. Analytical Instrumentation in Materials Engineering

3-0-3. Prerequisite: M.E. 412.

Introduction to modern analytical instrumentation in materials engineering. Review of structure of materials. Material investigations using X-ray, electron microprobe, and emission spectroscopy analysis. Milcroscopic analysis using electron microscope and scanning electron microscope.

M.E. 463. Mechanical Testing of Materials

3-3-4. Prerequisites: Met. 402 or M.E. 312 or consent of instructor.

Destructive and non-destructive test methods are treated for both metallic and non-metallic materials. The emphasis will be on the significance of results and the choice of materials based on test data. Effects of strengthening mechanisms will be considered.

M.E. 465. Materials Science and Engineering

3-0-3. Prerequisite: M.E. 312.

Molecular materials: polymers and the formation and behavior of polymeric materials. Structure and diffraction: crystal binding, defects, annealing, diffusion. Phases, solid solutions, precipitation hardening, equilibrium, phase diagrams. Solidification. Twinning, martensite formation. Hardenability. Failure.

M.E. 481. Machine Elements

3-3-4. Prerequisites: ESM 337 and M.E. 412.

Principles of design – synthesis and analysis – are introduced. The application of engineering mechanics to the design and selection of machine elements is then pursued. Component design projects are undertaken in the laboratory.

Texts: Faires, *Design of Machine Elements*, 4th ed.; Faires and Wingren, *Problems on the Design of Machine Elements*, 4th ed.

M.E. 483. Design Theory

3-0-3. Prerequisite: M.E. 481 or concurrently.

The design process including decision theory, creativity concepts, human factors, systems engineering, optimization techniques, reliability and ethics is studied. Some case studies are analyzed to illustrate application and the professional approach.

Text: Middendorf, *Engineering Design.*

M.E. 484. Design Engineering

0-6-2. Prerequisite: Final quarter standing.

The design process is applied to the team solution of real multidisciplinary engineering problem situations.

Text: To be selected.

M.E. 485. Mechanics of Machines

3-3-4. Prerequisites: M.E. 413, Math. 209.

A continuation of M.E. 413 with emphasis on advanced analytical and graphical techniques for the dynamic analysis of machines. Coincident point acceleration analysis; energy balance analysis, and equivalent mechanism analysis are featured. Effects of rotational and translational friction are considered. Analog computer simulation of the dynamic response of a kinematic chain is covered.

M.E. 491. Seminar

1-0-1. (Winter quarter only). Prerequisite: Senior standing in Mechanical Engineering.

Civic and professional responsibilities and opportunities are brought to students by leaders in engineering, business, and community affairs.

M.E. 496-7-8-9. Special Problems in Mechanical Engineering

0-9-3, 0-6-2, 0-3-1, 0-12-4, respectively. Prerequisite: Senior standing in Mechanical Engineering.

These courses are for the student who is interested in creative work.

Graduate Courses Offered

M.E.	607*	Thermodynamics of Gases	4-0-4
M.E.	608, 609*	Combustion I & II	3-0-3
M.E.	611, 12	Direct Energy Conversion I & II	3-0-3
M.E.	622, 23, 24	Thermodynamics I, II & III	3-0-3
M.E.	625	Information Theory Thermodynamics	3-0-3
M.E.	627	High Vacuum Science and Technology	3-0-3
M.E.	630	Heating, Ventilation and Air Conditioning	3-0-3
M.E.	631	Advanced Refrigeration	3-0-3
M.E.	635	Heat Transfer	3-0-3
M.E.	636	Internal Combustion Engine Design	3-0-3
M.E.	637	Kiesel Engines	3-0-3
M.E.	639	Turbines	3-0-3
M.E.	643, 44	Fluid Flow	3-0-3
M.E.	645, 46	Heat Transfer	3-0-3
M.E.	647	Fluid Flow	3-0-3
M.E.	648	Advanced Theory of Heat Transfer	3-0-3
M.E.	649	Theory of Jets	3-0-3
M.E.	654**	System Design Methodology	2-3-3
M.E.	655-656**	Complex Systems Design	2-4-3
M.E.	658	Mechanism Synthesis I	3-0-3
M.E.	659	Engineering Design	3-6-5
M.E.	661	Advanced Dynamics of Machinery	3-0-3
M.E.	662	Machine Vibration	3-0-3
M.E.	663	Elastic Yield Designs of Machine Members	3-0-3
M.E.	665	Mechanism Synthesis II; Computer Methods	2-3-3
M.E.	666	Mechanisms in Space	3-0-3
M.E.	669	Materials for Design	3-0-3
M.E.	671	Deformation of Metals	3-0-3
M.E.	672, 73	Fabrication of Metals	3-0-3
M.E.	674, 75	Variational Methods in Engineering	3-0-3
M.E.	676, 77, 78	High Temperature Design	3-0-3
M.E.	683	Lubrication	3-0-3
M.E.	684, 85, 86	Feedback Control Systems I, II, III	3-0-3
M.E.	687, 88	Digital Control Systems I, II	3-0-3, 3-3-4
M.E.	689	Control System Components	2-1-3
M.E.	690	Fluid-Power Control Systems	3-0-3
M.E.	691	Control of Engineering Processes	3-0-3
M.E.	699	Preparation for Ph.D. Qualifying Examinations	
M.E.	700	Master's Thesis	
M.E.	701, 2, 3	Seminar	1-0-0
M.E.	704, 5, 6	Special Problems in Mechanical Engineering	
M.E.	707, 8, 9	Special Topics	

M.E.	711, 12, 13***	Magnetogasdynamics I, II & III	3-0-3
M.E.	714***	Methods of Experimental Magnetogasdynamics	2-3-3
M.E.	720	High Temperature Environment–Material Interactions	3-0-3
M.E.	722	Thermodynamics of Irreversible Processes I	3-0-3
M.E.	723	Thermodynamics of Irreversible Processes II	3-0-3
M.E.	735	Numerical Methods in Heat Transfer	3-0-3
M.E.	736	Forced Convection Heat Exchange	3-0-3
M.E.	738	Advanced Topics in Heat Transfer	3-0-3
M.E.	739	Heat Transfer Seminar	1-0-1
M.E.	740	Fluid Mechanics Seminar	TBA
M.E.	741, 742	Transport Phenomena in Two-phase Flow I, II	3-0-3
M.E.	762	Advanced Machine Vibrations	3-0-3
M.E.	763	Design of Resident Machine Members	3-0-3
M.E.	772	Fracture of Materials I	3-0-3
M.E.	773	Fracture of Materials II	3-0-3
M.E.	800	Doctor's Thesis	

*Also taught as A.E. 607, 608, and 609, respectively.

**Also taught as A.E. 645, 655, 656; and E.E. 654, 655, 656, respectively.

***Also taught as as A.E. 711, 712, 713, and 714, respectively.

(Complete details about these courses are contained in the *Graduate Bulletin,* a copy of which is available upon request.)

DEPARTMENT OF MILITARY SCIENCE

(Established in 1917)

Commandant and Professor of Military Science—Colonel Wayne W. Bridges; *Assistant Professors*—Lieutenant Colonel William E. Branch, Majors Donald M. Harris, Richard T. Holder, David B. Porch, Johnny R. Rudd, Andrew J. Seremeth, Jr., Thurman O. Sturdivant, III, Robert E. Tozier, Robert B. Williams, Captains David A. Cunningham, Ignazio J. Licata, John F. Lucas; *Instructors*—Sergeant Major Billy G. Warren, Master Sergeant Clifford M. Manning, Sergeants First Class Roosevelt Everett, Milton G. Milliken, Eugene Mullinax, Melvin L. Richardson, Staff Sergeants Joseph Bullard, Carl E. Mattson; *Secretaries*—Josephine P. Hodges, Thelma Kitchens, Mildred W. Norton, Kathleen W. Porte.

RESERVE OFFICERS' TRAINING CORPS

The U. S. Army offers instruction at the Georgia Institute of Technology, a Senior Division of the Army Reserve Officers' Training Corps, in the two- and four-year programs.

The purpose of the Senior Division, Army ROTC Program is to select for commissioning in the Reserve or Regular components of the Army of the United States, college students who achieve a baccalaureate or higher degree and successfully complete a course of instruction in Military Science.

The course of instruction of the Army ROTC is divided into two parts, the Basic and Advanced Courses, each of two year's duration. Both courses are voluntary and may be chosen as an elective.

The ROTC program emphasizes instruction in military leadership, subjects common to all branches of the Army, and branch-related subjects.

The two-year program is open to both undergraduates and graduate students who elect to take the Advanced Course, but who cannot complete the Basic Course in the required time. Prior to enrollment in the Advanced Course, the student must attend a six weeks Basic Summer Camp to cover those subjects otherwise required in the freshman and sophomore years of Basic ROTC.

ACADEMIC CREDIT

Academic credit is granted for the completion of Military Science Courses as indicated in the sections that follow. However, not more than 6 hours credit in basic ROTC courses and not more than 9 hours credit in Advanced ROTC Courses may be applied toward a degree.

	1st Q.	*2nd Q.*	*3rd Q.*	*Credit Hrs.*
Basic 1st year	1	1	0	2
Basic 2nd year	2	2	3	7
Advanced 1st year	3	3	0	6
Advanced 2nd year	2	3	0	5
TOTAL ACADEMIC CREDIT				20

UNIFORMS

Basic Course cadets are furnished the ROTC uniforms by the United States Army on a loan basis. A $25.00 deposit must be paid by the cadet to the school cashier before the uniform is issued. The cadet bears the expense of maintaining the unifrom while it is in his possession, and must return it to the Army ROTC Supply Room upon termination of Military Science or upon leaving school for any period in excess of one quarter.

The $25.00 deposit, less charges for any uniform items negligently lost or destroyed, will be refunded after return of the uniform. Students who fail to return the uniform within two academic quarters of nonparticipation in the program will forfeit the deposit.

A cadet entering the Advanced Course is required to purchase a new uniform through the Georgia Institute of Technology at a cost of approximately $110.00. He will receive reimbursement of $101.00 upon completion of the Advanced Course or upon disenrollment without prejudice, and be allowed to retain the uniform.

TEXTS AND EQUIPMENT

The necessary equipment and textbooks are furnished by the Department of the Army.

SCHOLARSHIP PROGRAM

The United States Army offers financial assistance in the form of one, two, three and four year scholarships for outstanding students who are interested in a career as an Army Officer. Each scholarship provides for free tuition, textbooks, laboratory fees and supplies in addition to subsistence pay of $50.00 per month for the period that the scholarship is in effect.

Applications for the four-year scholarships will be submitted to the appropriate Army headquarters. Recipients of the four-year scholarship may attend the Georgia Institute of Technology if accepted for enrollment by the school.

Applications for the one, two, or three-year scholarships may be submitted to the Professor of Military Science at Georgia Tech by any one who is enrolled in the ROTC program. Additional information may be obtained from the Professor of Military Science (PMS).

THE BASIC COURSE CURRICULUM

The Basic Course is a systematic study of military leadership and the exercise of command. Students enrolled in the Basic Course will follow a curriculum of six sequential Military Science (M.S.) courses, M.S. 110, M.S. 120, M.S. 104, M.S. 210, M.S. 220 and M.S. 230. Students will attend class and drill weekly in all courses except M.S. 104, which is a drill only course (Leadership Development) normally completed the third quarter of the Freshman year. All quarters include instruction and practical work in Leadership, Drill and the exercise of Command to provide for leadership training and the development of initiative and self-confidence through ›progressive training. Normally, selection of students eligible for enrollment in the Advanced Course will be made during the sophomore year.

BASIC COURSE OFFERINGS

NOTE: 1-1-1 *indicates* 1 *hours class,* 1 *hour Leadership Development (Drill) and* 1 *hour credit.*

M.S. 110. Orientation: The Military Role in Perspective

1-1-1.

Deatiled orientation for first quarter freshmen on the ROTC program beginning in the specific context of the Georgia Tech community; concept of the citizen soldier; the role of a military officer; the role of military force as a component of national security; civilian control of military forces; Department of Defense mission, organization and objectives. Preparation for practice in leadership.

M.S. 120. Terrain Analysis and Land Navigation

1-1-1.

A study of military maps and aerial photographs as basic intelligence documents for terrain analysis, land navigation, position finding and fire direction. A study of military symbology and its use in conjunction with maps for operational planning. Preparation for practical exercises in land navigation to be conducted during field exercises.

M.S. 104. Leadership Development

0-1-0. Prerequsiite: At least one quarter of basic ROTC or permission of the PMS.

A one hour weekly period devoted to furtherance of basic military skills, leadership, drill and command. Command voice and individual execution of above are stressed.

M.S. 210. Analysis of Command and Leadership

2-1-2.

A study of group dynamics, individual motivation and the function of leadership at the small unit level. Application of leadership principles to the solution of problems using extensive case studies, individual presentations and repetitive critiques. Examination of peer group relations as a special leadership problem.

M.S. 220. Seminar in Communications and Instructional Methods

2-1-2.

An intensive analysis of effective instruction as a necessary skill for Military Officers. Studies in fundamental techniques and methods of instruction with emphasis on individual presentation, group conferences and critiques. Subjects researched and presented are selected to augment learning objectives of other Military Science courses.

M.S. 230. Military History

3-1-3.

Studies of U.S. Military History with emphasis on the principles of war and their interactions with decision making, leadership and management. Consideration of political, economic, social, and technological factors as inseparable components of military history. Student class participation is stressed requiring individual research and presentations.

ADVANCED COURSES

OBJECTIVES

The Advanced Course is a systematic study of leadership and the exercise of command and management at the professional level. Particular emphasis is placed on the technical and human resource factors that influence the exercise of command by military leaders.

ENROLLMENT

Those applicants who have demonstrated a high leadership potential and meet the following requirements may be selected by the Professor of Military Science for enrollment in the Advance Course: (1) completed the Basic Course or Basic Summer Camp; (2) passed the ROTC Qualifying Examination; (3) passed the officer physical examination (given by the U.S. Army at no cost to the applicant); (4) normally have six quarters of academic training remaining; (5) be recommended by a Board of Officers; (6) and if selected, enlist in the enlisted reserves.

The student when selected must sign a written contract agreeing to meet certain requirements as to completion of the course and hours devoted to it, including one summer training camp and acceptance of a commission, if tendered.

BRANCH SELECTION

The Advance Course curriculum of the Army ROTC at Georgia Tech offers instruction in six branches of the Army. These branches are Air Defense, Chemical Corps, Corps of Engineers, Infantry, Ordnance and Signal Corps. Army ROTC students select the branch in which they desire to be commissioned, from the six offered, and if qualified, pursue the branch-material curriculum. Final branch selection must be made by mid-quarter or the first academic quarter's enrollment in the Advanced Course.

SUBSISTENCE ALLOWANCE

Students formally enrolled in the ROTC and pursuing the Advanced Course will receive a subsistence allowance of fifty (50) dollars a month, which is nontaxable.

ADVANCED SUMMER CAMP

Members of the Advanced Course are required to attend Advanced Summer Camp, normally between the Junior and Senior years. All students going to summer camp receive mileage for the round trip at the rate of six (6) cents per mile and are provided meals, housing, uniforms, and given medical and dental attention at government expense while attending camp. Students will receive pay at the rate of 50% of the base pay of a second Lieutenant or currently $208.80 per month. The duration of Summer Camp approximates six weeks, beginning about 15 June each year.

COMMISSIONS

Upon graduation, students who satisfactorily complete the Advanced Course, including Advanced Summer Camp, and are qualified for appointment as Second

Lieutenants prior to reaching 28 years of age, are offered Commissions by the President of the United States as Second Lieutenants, United States Army Reserve.

ROTC graduates who meet special requirements may select direct Regular Army appointment or may volunteer for extended active duty tours with a view to being selected for Regular Army appointment.

ACTIVE DUTY OBLIGATIONS

Reserve Officers serve either three to six months or two years of active duty. This obligation is one to three years less than required by the other uniformed services. Educational delays to pursue a graduate degree may be granted on application depending upon needs of the service.

THE CURRICULUM

The Advance Course curriculum consists of six sequential Military Science courses and one of three elective Political Science courses presented by the Department of Social Sciences.

Four of the Military Science courses (M.S. 310, M.S. 304, M.S. 410 and M.S. 404) comprise a core curriculum and must be completed by all students enrolled in the Advanced Course. The remaining two Military Science courses are selected from the Branch-Material course offerings and will be appropriate to the branch in which the commission is sought.

All students enrolled in the Advanced Course must satisfactorily complete either Political Science 353, Political Science 354 or Political Science 356 prior to commissioning. These are three credit hour courses presented by the Department of Social Sciences and may be applied against the humanities and Social Science requirements in all curricula leading to an undergraduate degree. Prerequisites for each course will be waived by the Social Sciences Department for Advanced ROTC Cadets.

Students enrolled in M.S. 310 and the Branch Material Courses will attend three hours of class and one hour of drill (Leadership Laboratory) each week. Students enrolled in M.S. 410 will attend two hours of class and one hour of drill each week. Military Science 304 and 404 are drill only (Leadership Laboratory) courses and are attended during one quarter each of the Junior and Senior years.

ADVANCED COURSE OFFERINGS

NOTE: 3-1-3 *means* 3 *hours class,* 1 *hour drill,* 3 *hours credit.*

REQUIRED COURSES

M.S. 310. Problem Solving for Military Operations

3-1-3.

A study of five functions of land combat (fire, maneuver, intelligence, logistics and communications/command/control) applied to the solution of tactical problems at the small unit level. Practical exercises in the logic and formats required to estimate, plan and execute these tactical solutions.

M.S. 304. Leadership Development.

0-1-0. Prerequisite: Advance ROTC standing.

A one hour weekly period devoted to furtherance of intermediate leadership and management skills. Leadership and management applications through effective oral communications and instructions are stressed.

M.S. 410.

2-1-2. Prerequisite: Advanced ROTC standing.

A study of the basic concepts and fundamentals of military administration and military justice.

M.S. 404. Leadership Development.

0-1-0. Prerequisite: Advanced ROTC standing.

A one hour weekly period devoted to furtherance of advanced leadership and management skills. Cadets apply and extend their skills by assuming full responsibility for the planning, leadership and execution of the entire leadership development program.

BRANCH MATERIAL COURSE OFFERINGS

Each student should apply for his desired branch of instruction (and commission) as early as possible. Acceptance will be based on the student's academic standing and major field of study. Since branch selections must be completed not later than mid-quarter of the student's first academic quarter in the Advanced Course, care must be taken to insure that the student selects the appropriate branch material course offered in succeeding quarters.

AIR DEFENSE ARTILLERY

M.S. 313. Forward Area Air Defense

3-1-3. Prerequisite: First year in Advanced ROTC.

A study of air defense problems from intercontinental ballistic missiles to conventional aircraft and defense systems with emphasis on equipment and tactics for close-in defense of field units.

M.S. 413. Air Defense Operations

3-1-3. Prerequisite: Second year in Advanced ROTC.

A study of Air Defense operations with practical exercises in selected duties of the air defense officer, including the managerial functions of logistics, training and administration.

CHEMICAL CORPS

M.S. 323. Chemical Corps Tactics and Techniques

3-1-3. Prerequisite: First year in Advanced ROTC.

A study of the mission, organization and functions of the Chemical Corps in the tactics and techniques of chemical, biological and radiological (CBR) Operations, to include CBR employment, detection, defense, decontamination and application.

M.S. 423. Management of CBR Offensive and Defensive Systems.

3-1-3. Prerequisite: Second year in Advanced ROTC.

An analysis of chemical, biological and radiological (CBR) weapons employment as it affects management/command decisions. A study of CBR protective measures and equipment available to commanders, as well as an analysis of the special logistical requirements needed in a CBR environment.

CORPS OF ENGINEERS

M.S. 333. Combat Engineering

3-1-3. Prerequisite: First year in Advanced ROTC.

A study of military engineering performed in a combat environment. Emphasis is placed on military structure to include military fixed and floating bridges; characteristics and use of U.S. Military explosives; characteristics and employment of barriers and obstacles.

M.S. 433. Military Construction Management

3-1-3. Prerequisite: Second year in Advanced ROTC.

A study of logistics to include research and development; materiel management and logistic system models within type Field Armies. Base development within a Theater of Operations oriented towards developing specified construction requirements inherent therein. Project planning and control using activity network analysis as an aid to decision making. Includes background in probability determination, and estimation techniques.

INFANTRY

M.S. 343. Tactics and Techniques of Small Unit Operations and Employment

3-1-3. Prerequisite: First year in Advanced ROTC.

A study of the fundamentals and principles of offensive, defensive, patrolling, retrograde, and counterinsurgency tactics on a small unit level. The study encompasses the organization of Infantry Units to include battalion, brigade and division. Staff and command estimate and orders are provided through a series of practical situation applications, which require the student to participate in problem solving processes.

M.S. 443. Advanced Infantry Tactics and Techniques: Planning and Functions in the Employment of the Combined Arms Team.

3-1-3. Prerequisite: Second year in Advanced ROTC.

A study of staff organizations, functions, responsibilities, and relationships to command requirements for unit employment. It combines staff and command actions, estimates and orders in the employment of Infantry units and supporting elements from other branches and services under the combined arms concept. Practical application is provided in situation requirements involving student interchange of ideas and solutions.

ORDANCE CORPS

M.S. 353. Ordnance Tactics and Techniques.

3-1-3. Prerequisite: First year in Advanced ROTC.

An analysis of materiel influences on logistics management by a survey of mobility and weapons systems. Emphasis is placed on studies of engineering principles, capabilities and trends of combat materiel, including vehicles, weapons, explosives, guided missiles and nuclear weapons.

M.S. 453. Logistics Management

3-1-3. Prerequisite: Second year in Advanced ROTC.

An analysis of the influence of human factors on logistics management by a survey of management concepts, practices and techniques and their application to Army management structures. Emphasis is placed on studies of management functions, human relations, Army management systems and management aspects of automatic data processing. Instruction will be by conference and practical exercise.

SIGNAL CORPS

M.S. 363. Tactical Communications-Electronics Systems

3-1-3. Prerequisite: First year in Advanced ROTC.

A study of Signal field communications system engineering and communications control in the brigade, division, corps, field Army, and theater Army; introduction to wire, radio, and multichannel communications systems to include telephomy, telegraphy, carrier, HF radio, VHF radio, and microwave systems. An introduction to the global communications network of the U.S. Army.

M.S. 463. Strategic Communications-Electronics Systems

3-1-3. Prerequisite: Second year in Advanced ROTC.

An analysis of critical components of Signal Communications, emphasizing: applications of automatic data processing; developmental trends in communications-electronics; human and technical engineering problems encountered by Signal Corps Officers in the planning, execution and maintenance of strategic communications systems and facilities. A study of administrative and logistical requirements to support effective Signal operations.

DEPARTMENT OF MODERN LANGUAGES

Department Head—James D. Wright; *Professor Emeritus*—Joseph A. Campoamor; *Professors*—George F. Walker, Louis J. Zahn; *Assistant Professors*—Charles I. Gale, Richard L. Hawkey, Roy O. Wyatt; *Instructors*—Gunilla H. Driver, Charles R. Fitzpatrick, Christian B. Gauster, Tatjana Gregory, Ann C. Griffin, Charles L. Johnston, Maria S. Venable.

General Information

The Department of Modern Languages seeks first to give the student sufficient mastery of a foreign language to enable him to read and understand with reasonable facility the scientific and technical literature of that language. Further, it seeks to inform the student, through the medium of the foreign language, of the civilization and literature of the countries where that language is spoken. In facilitation of the effort to attain these goals the Department reserves the right to section, according to ability and/or preparation, its first- and/or second-year students of those languages which attract enrollments either large enough to support such sectioning or specifically qualified to do so.

A student taking a language in which he has two or more years of high school credit is encouraged to register initially for a course not lower in .number than the first course of the 200 series in that language. However, if such a student is convinced that his knowledge of the language in question is inadequate for successful participation in this 200 series course, then he may, instead, register for any less advanced course in the same language which is available and to which his preparation is believed to be equal. Beginning with that less advanced course, he may then take for full credit toward graduation the entire complement of language courses approved for his program of study. A student who elects to take courses in a language which he speaks as a native language *must* schedule, as his first course, one not lower in number than Fren. 401, Ger. 211, Russ. 301, or Span. 401. Otherwise the student in either of these situations may schedule the beginning course of another language.

A student may take any course for which he has the prerequisites. Credit will be given on a quarterly basis, as specified in the catalogue description. However, students are urged to plan at least a three-quarter sequence in a language in order to achieve at least a minimum level of proficiency.

Since the enrollment in German is considerably greater than that in any of the other languages, all of the three regular elementary German courses (Ger. 101-102-103) are normally available each quarter. Consequently students who are enrolled only every other quarter can easily complete the first year of their language study in German but might do so only with great loss of time in the other languages.

Placement examinations are not required but are available in French, German, and Spanish. Students may resort to these examinations as a means of determining the level of lower-divisional course advancement to which their preparation is equal. The examinations are held at the beginning of each fall quarter – during orientation week.

Courses of Instruction

NOTE: 4-3-5 *means* 4 *hours class,* 3 *hours laboratory,* 5 *hours credit.*

Chinese

In our program of instruction in Chinese, the effort is made to prepare the student, in both the spoken and the written language, well enough to enable him to continue his study, without professional assistance, after his completion of the program. This effort is naturally facilitated by the admission of chiefly those students who have had such formal language training as that prescribed in the course descriptions below and who have demonstrated in that training innate ability for language study. It is also facilitated, however, by the admission of those students who do not have these formal prerequisites to offer but who possess exceptional specific motivation. Students belonging to the former group are admittedly more numerous and more easily identified than are those belonging to the latter. But recognition of the value of each group prevents a natural preference for the former from excluding the latter.

Chin. 101. Introduction to Chinese

3-2-4. Prerequisite: One year college-level foreign language study, or equivalent, and permission of instructor.

Emphasis on the spoken language; during three class hours – to be scheduled at registration – conventional study and testing of grammar; during two laboratory hours – to be scheduled after registration – intensive study of spoken language patterns.

Chin. 102. Introduction to Chinese

3-2-4. Prerequisite: Chin. 101 or equivalent.

Continuation of Chin. 101; introduction to the Chinese writing system.

Chin. 103. Introduction to Chinese

3-2-4. Prerequisite: Chin. 102 or equivalent.

Continuation of Chin. 102; proportionately more emphasis on written Chinese.

French

Those students who have had two years of high school training in French and those who have had more than two are encouraged to register initially for a course not lower in number than Fren. 201. The gradation of the series Fren. 201-202-203 and the instructional variety within that series are such that qualified students from both groups can profitably take the courses.

With permission of the instructor, exceptionally well prepared matriculating freshmen who have had three or more years of high school training in the language *may* be admitted to the series Fren. 301-302-303 – or even to the series Fren. 401-402-403. These series are intended primarily, however, for students who have completed respective minima of two and three years of college training or the equivalent.

Fren. 001. Elementary French for Graduate Students

5-0-0. Prerequisite: None (Available in summer quarter only.)

Pronunciation; minimum grammar; acquisition of vocabulary, both basic and scientific, from appropriate reading; translation of scientific literature into English. By preparing the student in one quarter for admission into the first course of the second-year series, Fren. 201, this course affords him an opportunity to shorten the period of time normally required for his preparation for the Ph.D. reading-knowledge examination.

Fren. 101. Elementary French

3-0-3. Prerequisite: None.

Essential principles of French grammar; acquisition of vocabulary through simple conversational exercises and the reading of simple selections.

Fren. 102. Elementary French

3-0-3. Prerequisite: Fren. 101 or equivalent.

Continuation of Fren. 101; extension of the survey of French grammar; acquisition of a large general vocabulary through conversation and the reading of texts containing the most frequently occurring words and idioms.

Fren. 103. Elementary French

3-0-3. Prerequisite: Fren. 102 or equivalent.

Reading of selected texts; composition; completion of the survey of French grammar.

Fren. 201. French Civilization from the Beginning to 1700.

3-0-3. Prerequisite: Fren. 103 or equivalent.

History of France with emphasis upon social conditions and changes, and upon the psychology which resulted in France's contribution to civilization in numerous areas, including architecture and other fine arts.

Fren. 202. French Civilization from 1700 to 1800.

3-0-3. Prerequisite: Fren. 201 or equivalent.

Continuation of Fren. 201 with emphasis upon France's contribution to democratic ideal and to the fine arts. Readings from political scientists and philosophers, such as Montesquieu, Voltaire, and Rousseau.

Fren. 203. French Civilization from 1800 to the Present.

3-0-3. Prerequisite: Fren. 202 or equivalent.

Continuation of Fren. 202. Readings from authors identified with the progress of democratic ideals and the scientific awakening.

Fren. 301-302-303

Survey of French Literature from circa 1800 to the Present.

Class and collateral study of prose, drama, and lyric poetry by representative authors through indicated literary movements; course conducted in French.

Fren. 301. Period: c. 1800-1850. Romanticism: The Re-appearance of Lyric Poetry; The Importance of the Individual, as Opposed to Classical Anonymity.

3-0-3. Prerequisite: Fren. 203 or equivalent.

Fren. 302. Period: c. 1850-1900. Parnassianism and Symbolism: Developments in Poetry; Realism and Naturalism: Trends in Prose, with Emphasis on the Development of the Novel.

3-0-3. Prerequisite: Fren. 203 or equivalent.

Fren. 303. Period: c. 1900–. Exploration of Currents in Modern Prose, Poetry, and Drama.

3-0-3. Prerequisite: Fren. 203 or equivalent.

Fren. 401. Seventeenth Century French Prose and Poetry

3-0-3. Prerequisite: Fren. 303 or equivalent.

Introduction to French classical theory; study of the literary transition from the 16th to the 17th century; reading selections from Malherbe, Descartes, Pascal, La Rochefoucauld, La Fontaine, and La Bruyère; preparation for the study of French classic drama; term report.

Fren. 402. Classic French Drama

3-0-3. Prerequisite: Fren. 303 or equivalent.

A brief survey of French drama from its origins in the Middle Ages up to the seventeenth century; reading of the major works of Corneille, Molière, and Racine; emphasis on the seventeenth century or "Classic Age" of French drama; brief survey of later developments in French drama; reading of selected works of Beaumarchais and Voltaire; term report.

Fren. 403. The French Novel

3-0-3. Prerequisite: Fren. 303 or equivalent.

A brief survey of the development of French prose; the development of the novel in the seventeenth century; influence of the picaresque novel; the classic nineteenth-century novel; modern developments in the novel; term report.

German

Those students who have completed Ger. 101 with distinction will be offered the opportunity to participate in a special honors program which comprises the two courses Ger. 105-106. Participants in this program complete their study of elementary German under instruction which is more direct in presentation, more intensive in character, and more comprehensive in content than is that of the regular series of courses. The program is offered during the winter and spring quarters of each academic year in which there is sufficient demand Participation in this honors program is completely voluntary on the part of the student.

Students who have two or more years of high school credit are encouraged to register initially for a course in either of the two series Ger. 201-202-203 and Ger. 211-212-213. Those who are interested in acquiring an active knowledge of the language for use not merely as a tool of research but also as a medium of cultural development, should register for the series Ger. 201-202-203. Those who are interested in acquiring a passive knowledge of the language for use as a tool of research only, are advised to register for the series Ger. 211-212-213. Each of these two series may be taken for full credit toward graduation, and either series may be taken first. Either series also offers excellent preparation for graduate reading-knowledge examinations.

Matriculating freshmen who have three or more years of high school credit, or who have participated in special programs of German study in the United States, or who have studied in one of the German-speaking countries of the world, are invited to apply for admission to 300- or 400-level courses. Recommendations will be made on the basis of the individual student's level of achievement – and in consultation with the instructor of the course in question. Similarly, all other interested students who have had the benefit of some special form of preparation in German are urged to discuss their particular situations with the appropriate staff members of the department in order that the best possible class assignments may be made.

Ger. 001. Elementary German for Graduate Students

5-0-0. Prerequisite: None. (Available in summer quarter only.)

Pronunciation; skeletal presentation of German grammar; translation of scientific literature into English. (By preparing the student in one quarter for admission into the first course of the appropriate second-year series – normally Ger. 211 – this course affords him an opportunity to shorten the period of time usually required for his preparation for the Ph.D. reading-knowledge examination.)

Ger. 101. Elementary German

3-0-3. Prerequisite: None.

Pronunciation; essential principles of German grammar; rapid acquisition of vocabulary by the reading of simple selections; elementary composition.

Ger. 102. Elementary German

3-0-3. Prerequisite: Ger. 101 or equivalent.

Continuation of Ger. 101.

Ger. 103. Elementary German

3-0-3. Prerequisite: Ger. 102 or equivalent.

Reading of general German material and the acquisition of a large vocabulary; continued study of German grammar; composition.

Ger. 105. Intensive Elementary German

3-1-3. Prerequisite: Departmental selection on the basis of achievement in Ger. 101.

Except for intensification, acceleration, regular practice in conversation, and a weekly one-hour laboratory requirement, essentially the same course as Ger. 102.

Ger. 106. Intensive Elementary German

3-1-4. Prerequisite: Ger. 105.

Continuation of Ger. 105.

Ger. 201. Introduction to Modern German Culture I

3-0-3. Prerequisite: Ger. 103, Ger. 106, or equivalent.

Selected readings in German on the contributions to the development of modern thought by such major German figures as Marx, Nietzsche, Freud, Einstein, and Spengler. Class discussion of reading material. Review of grammar.

Ger. 202. Introduction to Modern German Culture II

3-0-3. Prerequisite: Ger. 201 or equivalent.

Continuation of Ger. 201.

Ger. 203. Introduction to Modern German Culture III

3-0-3. Prerequisite: Ger. 202 or equivalent.

Continuation of Ger. 202.

Ger. 211. Intermediate German (Scientific)

3-0-3. Prerequisite: Ger. 103 or equivalent.

Reading of German scientific and technical material; individual problems to conform, whenever possible, with the student's special field of study.

Ger. 212. Intermediate German (Scientific)

3-0-3. Prerequisite: Ger. 211 or equivalent.

Continuation of training given in Ger. 211.

Ger. 213. Intermediate German (Scientific)

3-0-3. Prerequisite: Ger. 212 or equivalent.

Reading of German prose in support of the development achieved in Ger. 211 and 212.

Ger. 301. Introduction to German Literature I

3-0-3. Prerequisite: Ger. 203, Ger. 213, or equivalent.

Development of a critical appreciation of German literature through the study of selected masterpieces in the language from medieval times to the present day. Class and collateral study of prose, drama, and lyric poetry by representative authors in various literary movements. Period covered during the first term: Middle Ages to ca. 1750.

Ger. 302. Introduction to German Literature II

3-0-3. Prerequisite: Ger. 203, Ger. 213, or equivalent.

Continuation of Ger. 301. Period covered: ca. 1750-1840.

Ger. 303. Introduction to German Literature III

3-0-3. Prerequisite: Ger. 203, Ger. 213, or equivalent.

Continuation of Ger. 302. Period covered: ca. 1840-present.

Ger. 401. German Writers of the 20th Century I

3-0-3. Prerequisite: Ger. 203, Ger. 213, or equivalent.

A study of the leading German authors from Naturalism to ca. 1920. Collateral and class readings; lectures; class discussion. Course conducted in German.

Ger. 402. German Writers of the 20th Century II

3-0-3. Prerequisite: Ger. 203, Ger. 213, or equivalent.

A continuation of the material under study in Ger. 401, with emphasis on authors and works from ca. 1920 to the present time. Course conducted in German.

Ger. 403. Modern German Drama

3-0-3. Prerequisite: Ger. 203, Ger. 213, or equivalent.

A study of the leading German dramatists from the period of Naturalism to the present time. Lectures; parallel readings; discussions. Course conducted in German.

Ger. 421. The Age of Goethe I

3-0-3. Prerequisite: Ger. 203, Ger. 213, or equivalent.

The rise of German literature in the eighteenth century to the time of Goethe and Schiller. Collateral and class readings; lectures; class discussions. Course conducted in German.

Ger. 422. The Age of Goethe II

3-0-3. Prerequisite: Ger. 203, Ger. 213, or equivalent.

A continuation of Ger. 421. The mature works of Goethe and Schiller. Course conducted in German.

Ger. 423. Selected Readings in German Literature

3-0-3. Prerequisite: Ger. 203, Ger. 213, or equivalent.

Reading and discussion of selected authors, movements, genres, and forms in German literature. Topics presented will vary from year to year. Parallel readings, reports, and papers may be required.

Russian

Of those students who indicate interest in the study of elementary Russian, only a select few are admitted to the course. Whether they are matriculating freshmen or others, they are restricted in number by the prerequisites for admission which the exacting limits of our Russian program impose. The result of this careful selection is that the competition which the students naturally afford each other makes the Russian program more intensive in character than it otherwise would be.

Russ. 101. Elementary Russian

3-2-4. Prerequisite: For matriculating freshmen at least two years of high school training in any foreign language(s), ancient or modern. For all other students, college credit for at least one year's study of a foreign language. For all students, selection on the basis of departmentally established criteria. Exceptions at the discretion of the staff.

During three class hours – to be scheduled at registration – conventional study of grammar and illustrative reading. During two laboratory hours – also scheduled at registration – intensive familiarization with recorded study material.

Russ. 102. Elementary Russian

3-2-4. Prerequisite: Russ. 101 or equivalent.

Continuation of Russ. 101; introduction of additional reading material as progress of class permits.

Russ. 103. Elementary Russian

3-2-4. Prerequisite: Russ. 102 or equivalent.

Continuation of Russ. 102; emphasis on the reading of simple prose.

Russ. 201. History and Culture of Russia I

3-0-3. Prerequisite: Russ. 103 or equivalent.

Reading of selected materials in Russian on high lights of Russian history and culture. Period of history: ninth century to eighteenth. Review of grammar; oral practice.

Russ. 202. History and Culture of Russia II

3-0-3. Prerequisite: Russ. 201 or equivalent.

Continuation of Russ. 201. Period of history: eighteenth century to 1917.

Russ. 203. History and Culture of Russia III

3-0-3. Prerequisite: Russ. 202 or equivalent.

Continuation of Russ. 202. Period of history: 1917–.

Russ. 301-302-303

Survey of Russian Literature from 1800 to the present

Class and collateral study of prose, drama, and poetry by representative authors, according to the indicated time periods and literary movements; readings in Russian.

Russ. 301. Period: c. 1800-1860. Romanticism; The Golden Age of Russian Poetry; Naturalism.

3-0-3. Prerequisite: Russ. 203 or equivalent.

Russ. 302. Period: c. 1860-1900. The Golden Age of Russian Prose; Realism.

3-0-3. Prerequisite: Russ. 203 or equivalent.

Russ. 303. Period: c. 1900 to the present. Symbolism; Futurism; Soviet Literature.

3-0-3. Prerequisite: Russ. 203 or equivalent.

Spanish

Students are encouraged to select their courses according to the following plan: those who have credit for two years of high school study should enroll initially in a 200-level course; those who have credit for three years, in a 300-level course; and those who either have credit for as many as four years, or who possess native or virtually native proficiency in the language, should enroll in one of the 400-level courses. All students who need the counsel of the staff in the matter of placement will find it readily available. No student will be required to take courses which are too advanced for his preparation.

Span. 101. Elementary Spanish

3-0-3. Prerequisite: None.

Pronunciation; grammar; reading; composition; simple conversational exercises.

Span. 102. Elementary Spanish

3-0-3. Prerequisite: Span. 101 or equivalent.

Continuation of Span. 101; increased emphasis on reading and conversation.

Span. 103. Elementary Spanish

3-0-3. Prerequisite: Span. 102 or equivalent.

Continuation of Span. 102; completion of fundamentals of Spanish grammar.

Span. 201. Cultural History of Spain I

3-0-3. Prerequiste: Span. 103 or equivalent.

Cultural development of Spain from prehistoric times through the Middle Ages. Linguistic exercises, lectures, discussions.

Span. 202. Cultural History of Spain II

3-0-3. Prerequisite: Span. 201 or equivalent.

Cultural development of Spain from 1450-1700. Linguistic exercises, lectures, discussions.

Span. 203. Cultural History of Spain III

3-0-3. Prerequisite: Span. 202 or equivalent.

Cultural development of Spain since 1700. Linguistic exercises, lectures, discussions.

Span. 301. Spanish-American Literature Before 1895

3-0-3. Prerequisite: Span. 203 or equivalent.

An introduction to Spanish-American civilization as reflected in representative literary works. Introduction to literary criticism. Lectures; discussions. Conducted in Spanish.

Span. 302. Spanish-American Literature Since 1895

3-0-3. Prerequisite: Span. 203 or equivalent.

Continuation of Span. 301.

Span. 303. Introduction to Spanish Literature

3-0-3. Prerequisite: Span. 203 or equivalent.

The cultural heritage of Spain in the Americas as reflected in representative European and Spanish-American literary works. Conducted in Spanish.

Span. 304. Cultural History of Mexico

3-0-3. Prerequisite: Span. 203 or equivalent.

Readings from representative authors. Vocabulary building; lectures; discussions; conversation and composition.

Span. 305. Contemporary Latin America

3-0-3. Prerequisite: Span. 203 or equivalent.

Selected contemporary essays, speeches, and diverse documents reflecting social, economic, and political problems. Conducted in Spanish.

Span. 306. Intensive Grammar Review and Composition

3-0-3. Prerequisite: Span. 203 or equivalent.

Grammar review through conversational drills in language laboratory; composition.

Span. 401. Spanish Drama Before 1700

3-0-3. Prerequisite: Span. 306 or equivalent.

Emphasis on Lope de Vega and Calderón; contributions to western literature. Conducted in Spanish.

Span. 402. Spanish Drama Since 1700

3-0-3. Prerequisite: Span. 306 or equivalent.

Emphasis on Lorca and Casona; continuation of Span. 401.

Span. 403. Spanish Prose Before 1700

3-0-3. Prerequisite: Span. 306 or equivalent.

Emphasis on the *Celestina;* contributions to western literature. Conducted in Spanish.

Span. 404. Spanish Prose Since 1700

3-0-3. Prerequisite: Span. 306 or equivalent.

Emphasis on the Generation of 1898; continuation of Span. 403.

Span. 405. *Don Quixote*

3-0-3. Prerequisite: Span. 306 or equivalent.

Detailed study of Cervantes' masterpiece as the vortex of Spanish literature, the prototype of the modern novel, and the essence of Renaissance and Baroque Literature. Conducted in Spanish.

Span. 406. Spanish Philology

3-0-3. Prerequisite: Span. 306 or equivalent.

Detailed linguistic and literary analysis of the *Libro de buen amor.* Conducted in Spanish.

STUDY ABROAD PROGRAMS OF THE UNIVERSITY SYSTEM OF GEORGIA

Ger. 491-492-493. GERMAN STUDY ABROAD. 5-0-5 each.

Span. 494-495-496. SPANISH STUDY ABROAD. 5-0-5 each.

Fren. 497-498-499. FRENCH STUDY ABROAD. 5-0-5 each.

These courses are catalogue courses only. They are never staffed or taught at Georgia Tech. Their only purpose is that of a bookkeeping device which facilitates the recording of credit earned by successful participation in the Study Abroad Programs of the University System of Georgia – fifteen (15) quarter-hours credit for each summer course.

Linguistics

The courses listed below are offered as a contribution to the further development of a rising student interest in the science of linguistics.

Ling. 201. Introduction to Language I

3-0-3. Prerequisite: None.

Survey of major language families of the world and relationships within language families; comparison of dialects and "standard" languages.

Ling. 202. Introduction to Language II

3-0-3. Prerequisite: Ling. 201 or permission of the instructor.

Survey of the types of linguistic change and development; comparison of generic and genetic linguistic relationships; linguistic borrowing.

Ling. 203. Introduction to Language III

3-0-3. Prerequisite: Ling. 202 or permission of the instructor.

Survey of the universal structural units of language; survey of major writing systems and the principles of the graphological representation of languages; introduction of the methods of descriptive linguistics.

Ling. 301. Introduction to Articulatory Phonetics

3-0-3. Prerequisite: None.

General introduction to phonetics, both acoustic and articulatory; study of the physiology of the organs used in the production of speech sound; presentation of the methodology for scientific analysis of human speech sound; examination of data from English and from other natural languages, such as French, German, Spanish, Russian and Chinese; emphasis on the practical ability to record in phonetic script and to reproduce various possible types of human speech sound. Collateral readings; term report.

Ling. 302. Introduction to Structural Linguistics I

3-0-3. Prerequisite: Ling. 301 or permission of instructor.

Presentation of methodology for scientific analysis of language; examination of data from hypothetical languages of increasing complexity prior to examination of natural languages; emphasis on phonetics and phonemics. Collateral readings; reports.

Ling. 303. Introduction to Structural Linguistics II

3-0-3. Prerequisite: Ling. 302 or permission of instructor.

Continuation of Ling. 302 with emphasis on morphology and syntax. Collateral readings; reports.

Ling. 401. History of Linguistics

3-0-3. Prerequisite: Prior study of linguistics or permission of instructor.

Survey of the theoretical developments in linguistic scinece, with major emphasis on the developments of the nineteenth and early twentieth centuries.

Ling. 402. Current Developments in Linguistics

3-0-3. Prerequisite: Prior study of linguistics or permission of instructor.

Live issues in the field, and approaches favored by various contemporary schools.

Ling. 403. Semantics and Linguistic Structure

3-0-3. Prerequisite: Prior study of linguistics or permission of instructor.

Various approaches to the problem of dealing with meaning in linguistic analysis.

Department of Music

Department Chairman and Director of Bands—Ben Logan Sisk; *Assistant Professor and Director of Glee Clubs*—Jerry L. Black; *Assiatant Director of Bands*—C. Lloyd Tarpley

General Information

Musical activities at Georgia Tech have become increasingly important. Courses are offered for academic credit to those taking part in the Band and the Glee Club.

The Band is nationally known through television at Football Bowl Games, as well as regular season games. During the Winter and Spring Quarters, the band functions as a symphonic organization doing considerable sight-reading as well as performing the very best in band literature.

The Glee Club, with a history of several trips abroad and two appearances on the Ed Sullivan Show, annually performs at a number of girls' colleges in the Southeast and in numerous local concerts.

Courses of Instruction

Music 201. Choral Music—History

1-2-1. Prerequisite: 1. Satisfactory completion of three quarters in Glee Club; 2. Approval of the Glee Club Director.

Course will consist of two hours practical and laboratory work, rehearsing and performing choral music. Third hour will be given to study of the history and development of choral music, from Gregorian chant through Palestrina and Bach to the present.

Text: Stringham, *Listening to Music Creatively.*

Music 202. Choral Music—Conducting

1-2-1. Prerequisites: 1. Satisfactory completion of three quarters in Glee Club; 2. Approval of the Glee Club Director.

Laboratory work will consist of rehearsal or performance of choral music. Third hour will include practice conducting by the students.

Text: Bauman, *Elementary Musicianship.*

Music 203. Choral Music—Appreciation

1-2-1. Sophomore, Junior or Senior Year, Spring Quarter. Prerequisites: 1. Satisfactory completion of three quarters in Glee Club; 2. Approval of the Glee Club Director.

The theoretical material of this course is a study of the operas presented during the spring quarter in Atlanta by the Metropolitan Opera Association, which can be attended free of charge by the Glee Club members.

Music 301. Marching Band

0-3-1. Junior or Senior Year, Fall Quarter. Prerequisites: 1. Satisfactory completion of three (3) quarters participation in band as a Freshman or Sophomore; 2. Approval of the Band Director.

Precision drilling, Special Maneuvers. Military Parade Procedure. (Students completing this course are expected to be able to direct as well as participate in these routines).

Text: Dvorak, *"The Marching Band."*

Music 302. Concert Band

0-3-1. Junior or Senior Year, Winter Quarter. Prerequisites: 1. Satisfactory completion of three (3) quarters participation in band as Freshman or Sophomore; 2. Approval of the Band Director.

Performance and appreciation of concert music. Baton technique and student conducting. Radio and television broadcasting techniques.

Text: *"National School Band Manual."*

Music 303. Concert and Marching Band

0-3-1. Junior or Senior Year, Spring Quarter. Prerequisites: 1. Satisfactory completion of three (3) quarters participation in band as a Freshman or Sophomore; 2. Approval of the Band Director.

Continuation of all procedures listed under Music 302 plus a resumption of the marching drill and performance which is begun in Music 301.

Text: *"National School Band Manual."* Dvorak, *"The Marching Band."*

Music 401. Marching Band

0-3-1. Senior year, Fall Quarter. Prerequisites: Satisfactory completion of Music 303, and approval of the Band Director.

A continuation of the 300-series music courses.

Music 402. Concert Band

0-3-1. Senior year, Winter Quarter. Prerequisites: Satisfactory completion of Music 401 and approval of the Band Director.

A continuation of the 300-series music courses.

Music 403. Concert Band

0-3-1. Senior Year, Spring Quarter. Prerequisites: Satisfactory completion of Music 402 and approval of the Band Director.

A continuation of the 300-series music courses.

Department of Naval Science

(Established in 1926)

Commanding Officer and Professor of Naval Science—Captain Forrester C. Auman, USN; *Associate Professor*—Commander William B. Wright, USN; *Assistant Professors*—Lieutenant Commander Bernard Crook, USN, Major Alton L. Amidon, USMC, Lieutenant Commander Richard C. Albright, USN, Lieutenant Thomas C. Kildebeck, USN, Lieutenant Richard H. Schmidt, USN; *Instructors*—Chief Gunner's Mate James H. Ansley, Master Sergeant W. R. Morningstar, USMC, Chief Quartermaster Norman L. Murphy, Chief Yeoman Harold Anderson, Chief Storekeeper Louis T. Charles; *Secretaries*—Mrs. F. Inez Hale and Mrs. Virginia M. McDonald.

General Information

Naval ROTC students are enrolled for the full four-year period. Students desiring commissions in the Marine Corps follow a different curriculum during the Junior and Senior years. Students may apply for flight or nuclear power training or for a commission in the Civil Engineer Corps, Supply Corps, or for the Unrestricted Line during the Senior year. A government financed Flight Indoctrination Program consisting of ground and flight training is conducted by a civilian flying school during the junior or senior year for qualified students. Successful completion of this program leads to the granting of a private pilot's license. The NROTC is composed of two types of students: Scholarship and College program.

Scholarship Students

These students are appointed Midshipman, USNR, after nation-wide competition. They have their tuition, fees and textbooks paid for by the Navy for a period not exceeding four years, are uniformed at government expense, and receive retainer pay at the rate of $50 per month. Students in this classification will not be entitled to receive simultaneous education benefits under the G. I. Bill. They must obligate themselves to complete the prescribed Naval Science curriculum, to make a cruise of from six to eight weeks each summer, to accept a commission as Ensign, USN, or Second Lieutenant, USMC, upon graduation, and to serve on active duty for four years after commissioning unless earlier released by the Navy Department. At the end of this period their active duty obligation to the Navy or Marine Corps is fulfilled. If they do not desire to remain on active duty in the Regular Navy or Marine Corps, they are ordered to inactive duty in the Naval or Marine Corps Reserve.

College Program Students

These students are enrolled under the provision of Public Law 88-647. They are uniformed at government expense and during their junior and senior years are paid retainer pay of $50.00 per month. They must obligate themselves to complete the prescribed Naval Science curriculum, to make a summer cruise of approximately six weeks duration during the summer after the junior year; and to accept a commission on graduation as Ensign, USNR or Second Lieutenant, USMCR.

In consideration for the benefits accrued by reason of membership in the NROTC College Program, the student is required to enlist in the U. S. Naval Reserve for a period of six years prior to starting the junior year. These students are deferred from the draft, but must agree to serve on active duty for not less than three years after appointment to commissioned rank in the U. S. Naval Reserve or Marine Corps Reserve and to retain their commission until the sixth anniversary of receipt of original commission. After receiving their commissions, application may be made for a commission in the Regular Navy or Marine Corps. Students receiving these benefits may receive them in addition to G.I. Benefits to which they are entitled.

Naval Science Students

Any regularly enrolled undergraduate student may enroll as a Naval Science student. Normally these students are potential replacements for vacancies among College Program students. Those enrolled as Naval Science students take Naval Science courses as electives and have no contract with the Navy. They have no assurance of ultimate commissioning nor do they derive any of the financial benefits available to Scholarship and College Program students. They have no draft deferments.

Selection Procedure

Scholarship students are selected in nation-wide competitive examinations. The NROTC at Georgia Tech has no part in this selection, although information about the Scholarship Program is available. In addition, the Professor of Naval Science may annually nominate several College Program students to the Chief of Naval Personnel for a scholarship.

To apply for the College Program, a student must:

1. Be enrolled in Georgia Tech, or attending an accredited college or university in the near vicinity.
2. Be at least 17 and not over 21 years of age.

Applicants are selected to fill the quota based on:

1. Physical qualifications.
2. Interview by Naval officers.
3. Score on Navy examination.
4. High School record.

Applicants for the College Program should apply at the Naval Armory during the designated days of Freshman Orientation Week for the Fall Quarter.

Three candidates may be nominated each year by the President of the Georgia Institute of Technology for competitive examinations for entrance to the United States Naval Academy. These nominations are normally made during the Winter Quarter. Both Scholarship and College Program students are eligible.

Curriculum

All NROTC students follow the same curriculum during their freshman and sophomore years, attending two hours of Naval Science class and one hour of associated laboratory or drill each week.

Junior and senior Line students attend three hours of Naval Science class and one or two hours of associated laboratory and drill each week.

Junior and Senior Marine Option students attend three hours of Naval Science class and two hours of associated laboratory and drill each week of the Fall and Winter Quarters. Junior and Senior Marine Option students attend two hours of laboratory and drill each week of the Spring Quarter. In addition, during each of the junior and senior years, the Marine Option will be required to take a three or four credit course selected from the following areas of study and approved by the Professor of Naval Scinece: Sociology, English, Systems Engineering, Information Science, Psychology, Philosophy and History of Science, Industrial Engineering, Industrial Management, Modern Languages, History, Political Science.

In addition to the required Naval Science courses, the NROTC student must successfully complete the following courses which are civilian-taught catalogue courses with full credit:

Math. 107, 108 or Math. 105, 106
Phys, 211, 212, 213 or Phys. 227, 228, 229 or Chem. 104, 105
P.T. 101
ICS 151 or Math. 425 or I.M. 210
POL 353, 354

These specific course requirements may be varied as course offerings vary.

No more than six hours of credit in Basic Naval Science courses and no more than nine hours of credit in Advanced Naval Science courses may be applied toward a degree.

Courses of Instruction

NOTE: 3-2-3 *means* 3 *hours class,* 2 *hours laboratory,* 3 *hours credit.*

N.S. 111. Naval Organization and Sea Power

2-1-2. Prerequisites: None.

Introduction to the structure and principles of the organization of the Navy, including analysis of its mission, traditions, customs, and the duties of midshipmen. Included are a series of discussions on the nature of sea power and maritime affairs and the relationship of these to the Navy.

Text: *Naval Orientation Division Officers Guide,* Fourth Edition.

N.S. 112. Naval Ships Systems I

2-1-2. Prerequisites: None.

Introduction in o the types, structure and purpose of naval ships, including ship design and construction, ship propulsion, and supporting subsystems.

Text: *Principles of Naval Engineering; Gilmer, Fundamentals of Construction and Stability of Naval Ships,* Second Edition.

N.S. 113. Naval Ships Systems II

2-1-2. Prerequisites: NS 112 or consent.

Continuation of N.S. 112 which covers shipboard electrical and communications systems, damage control, nuclear power plants and new developments in naval engineering.

Text: *Principles of Naval Engineering.*

N.S. 211. Naval Management

2-1-2. Prerequisite: None.

Introduction to the principles of organization and management. The relationship and applicability of these fundamentals to naval organization and management is stressed throughout. The course is based on the concept that management is a process applicable to many enterprises including the military. Included are human relations, management functions, supervision and subordinate evaluation with their military applications.

Text: To be announced.

N.S. 212. Naval Administration.

2-1-1. Prerequisites: N.S. 211 or consent.

The broad area of naval administration is presented. Emphasis is placed on naval correspondence format, the directive and filing systems, enlisted personnel matters, and those administrative areas of knowledge necessary for effective officer performance.

Text: To be announced.

N.S. 213. Military Law

2-1-1. Prerequisites: N.S. 211 and N.S. 212 or consent.

Those aspects of military law essential for effective naval officer performance are covered. Emphasis is placed on the areas of military law that are peculiar to the naval service, concentrating on elements wherein newly commissioned officers will be actively involved. International law, especially that pertinent to maritime affairs, and the Code of Conduct are also covered.

Texts: *Manual for Courts-Martial United States 1969* (Revised Edition); Britton and Watson, *International Law for Seagoing Officers,* Second Edition.

N.S. 347. Navigation I

3-2-3. Prerequisites: None.

Procedures and mathematical techniques involved in determining position at sea through the use of navigational aids, instruments and tables. Areas of emphasis are: dead reckoning, piloting, and international and U.S. regulations governing waterborne traffic.

Texts: *Dutton's Navigation and Piloting,* Twelfth Edition. *Farwell's Rules of the Nautical Road,* Fourth Edition.

N.S. 348. Navigation II

3-2-3. Prerequisites: N.S. 346 or consent.

The science of celestial and electronic navigation. Application of the theory and principles of nautical astronomy and spherical trigonometry is emphasized in celestial navigation. Coverage extends to nautical astronomy, star identification, the navigational triangle, celestial coordinate systems, concepts of time, and plotting celestial lines of position.

Electronic navigation stresses practical application of loran, radar, inertial, and satellite navigation.

Text: *Dutton's Navigation and Piloting,* Twelfth Edition.

N.S. 349. Naval Operations and Analysis

3-2-3. Prerequisites: None.

Elements and principles of operations at sea designed to provide an understanding of command responsibility and to develop command capabilities. Emphasis is placed on current tactical doctrine, relative movement problems, and tactical communications, Naval applications of probability theory and game theory are included as an introduction to naval operations analysis.

Text: To be announced.

N.S. 411. Naval Weapons Systems I

3-1-3. Prerequisites: None.

Concepts of weapons systems and the systems approach are explored. Techniques of linear analysis of ballistics and weapons are introduced. The dynamics of the basic components of weapons control systems are investigated and stated as transfer functions. A basis is provided for further development of students' understanding of principles that underlie all modern naval weapons systems.

Texts: *Principles of Naval Ordnance and Gunnery; Principles of Guided Missiles and Nuclear Weapons; Weapons Systems Fundamentals*, (Three volumes).

N.S. 412. Naval Weapons Systems II

3-1-3. Prerequisites: N.S. 411, Calculus, College Physics.

Principles of selected phases of the weapons control problem, including propulsion systems, trajectories, flight paths and damage criteria. Investigation of design and testing of weapons components including warheads, fuses, guidance and control. Includes procedures for evaluating weapons system effectiveness and kill probability.

Texts: *Principles of Naval Ordnance and Gunnery; Principles of Guided Missilies and Nuclear Weapons; Weapons Systems Fundamentals* (Three volumes)

N.S. 413. Naval Personnel Administration

3-1-3. Prerequisites: N.S. 201, N.S. 202.

Broad areas of personnel administration and management are covered including recruitment, selection, training, placement, promotion, evaluation, and remuneration. A comparison is made between civilian industrial practices and naval methods in the same areas. Emphasis is placed on the topics most directly applicable to the naval profession.

Texts: *Bureau of Naval Personnel Manual; Navy Comptroller Manual.*

MARINE CORPS OPTION

N.S. 362, 363. Evolution of Warfare I and II

3-2-3.

This two quarter sequence is designed to explore the forms of warfare practiced by great peoples in history in order to formulate the senses of continuity and of change in the evolution of warfare; develop a basic sense of strategy; demonstrate the alternatives of possible military actions; discover the ingredients of success in the great captains; and explore the impact of historical precedent of military thought and action. Selected campaigns and classic battles are studied with emphasis on the Principles of War, the impact of leadership, and the evolution of tactics and weaponry.

N.S. 316. Naval Science Laboratory

0-2-0.

Marine Corps laboratory exercises and military drill, emphasizing leadership. No preparation is required and no tests will be given. The grade of "S" will be given for satisfactory completion of this course. Aptitude marks will be assigned. This course must be taken by all Junior Marine Corps Option Midshipment during the Spring Quarter.

N.S. 461, 462. Amphibious Warfare I and II

3-2-3.

This two quarter sequence is designed to be a study of the projection of sea power ashore, with special emphasis on the evolution of amphibious warfare in the 20th century. Strategic concepts and current doctrine are discussed.

N.S. 466. Naval Science Laboratory

0-2-0.

Marine Corps laboratory exercises and military drill, emphasizing leadership to prepare the Senior Marine Option for commissioning, and to establish a basis for subsequent professional development. The grade of "S" will be given for satisfactory completion of the course.

N.S. 491, 492, 493. Special Problems in Naval Science

Hours: To be arranged.

Prerequisites: Submission of a 500 word statement detailing the expected area of study to the Professor of Naval Science; permission from the Professor of Naval Science to enroll.

These courses are designed for, but not limited to the naval-career oriented student who desires to pursue creative research in a specialized area of naval science. Each student accepted into the course will be assigned to the supervision of a Naval Science staff officer whose career specialty is in the field to be studied. Professional papers of appropriate depth and of publishable quality will be sought. Expected areas of study include Naval Aviation, Oceanography and Ocean Engineering, Logistics, Submarine Systems, Operations Analysis of Surface Warfare Problems, and Amphibious Warfare.

Students electing this course will have the option of studying for 1, 2 or 3 credit hours per quarter, and of pursuing their study for 1, 2 or 3 quarters of the academic year.

Text: To be announced.

SCHOOL OF NUCLEAR ENGINEERING

(Established in 1962)

Director–C. J. Roberts; *Professors*–J. D. Clement, G. G. Eichholz, D. S. Harmer, G. W. Leddicotte; *Associate Professors*–F. W. Chambers, Jr., W. W. Graham, J. H. Rust; *Assistant Professors*–R. J. Johnson, J. M. Kallfelz, J. R. Williams; *Research Engineer*–J. C. Alderman, Jr.; *Collaborating staff members of other schools and departments*–H. M. Neumann, Chemistry; R. H. Fetner, Applied Biology; L. J. Gallaher, Rich Electronic Computer Center.

General Information

Nuclear technology is an important aspect of our civilization and its impact on society is increasing daily. Students are invited to consider nuclear engineering electives in order to strengthen their technical background in areas such as energy production or to broaden their appreciation of the societal implications of technology. Undergraduates also may wish to elect nuclear engineering courses as an introduction to graduate study in the field.

The School offers a number of courses in support of the B.S. health physics option in the School of Physics. This curriculum is intended to prepare students for careers related to the environmental protection and public health aspects of technology.

At the graduate level, the School administers programs leading to degrees of Master of Science and Doctor of Philosophy. Students with undergraduate degrees in engineering, science or mathematics are eligible to apply for admission. The intent of these programs in nuclear engineering is to provide suitable educational experience to carefully selected students for careers which require a knowledge of nuclear energy and its applications. The programs at the M.S. level provide four areas of emphasis–reactor engineering, radiation technology, radiological science and reactor operation and management and the respective curricula are constructed from various combinations of the graduate level nuclear engineering courses listed below, supplemented with courses in other departments as needed.

For students planning a career in electric utility management, a program in nuclear power economics is offered in cooperation with the College of Industrial Management. Courses leading toward an M.S. in I.M. or N.E. are taken in both departments.

Depending on the career objectives of the student, a thesis may be encouraged as part of an M.S. program. When appropriate, approved courses and research experience on a special problem or satisfactory performance at an engineering practice school may be substituted for a thesis. Students also are encouraged to enroll in relevant non-technical elective courses as part of their programs.

The Ph.D. program is designed with great latitude so as to capitalize on variations in experience as well as interests of each student. The graduate bulletin contains a large number of additional courses relevant to nuclear engineering.

Facilities for the support of these graduate programs are unexcelled on any campus. The Emerson Building (Radioisotope and Bioengineering Laboratory) and the Frank H. Neely Nuclear Research Center provide Georgia Tech with outstanding research capability in fields of interest to nuclear engineering. Included are a heavy-water moderated, five-megawatt research reactor, a low power training reactor, a sub-critical assembly, PDP-8 data acquisition system, hot cells for handling highly radioactive materials remotely, a 12,000 curie cesium-137 radiation source, a one-million-volt Van de Graaff accelerator, and a californium-252 neutron source. Additional assets of importance are the Price Gilbert Memorial Library, with its collection of A.E.C. documents, and the Rich Electronic Computer Center.

Undergraduate students contemplating a future academic program in nuclear engineering are encouraged to take advanced mathematics, engineering thermodynamics, and a course in modern physics, such as Physics 319. Their attention is invited to the pertinent senior-level electives, such as N.E. 420, N.E. 447 or N.E. 411-2-3, Physics 404 or Met. 403. Those who are not familiar with the use of digital computers will be expected to gain this experience during their first quarter of graduate study.

Many opportunities exist for undergraduates to undertake independent study or research directed by a member of the N.E. faculty. Academic credit is available as N.E. 454, Special Problems.

For further information, please contact the Director, School of Nuclear Engineering or the Dean, Division of Graduate Studies and Research.

Undergraduate Courses of Instruction

NOTE: 2-3-3 *means* 2 *hours class,* 3 *hours laboratory,* 3 *hours credit.*

N.E. 201, 202, 203. Introduction to Health Physics

1-0-1. Prerequisite: Sophomore standing.

A course designed to familiarize the student with the health physics profession. Objectives are to clarify the role of the health physicist in the industrial, medical and public health environments, trace the development of the profession and identify current problems in research and applied areas. The course will draw heavily on current literature including news media and on invited lecturers. Visits to radiological installations will be included.

N.E. 405, 406, 407. Health Physics Seminar

1-0-1. Prerequisite: N.E. 427 or consent of instructor.

This seminar is intended primarily for students who plan a career in health physics. The focus will be on current activities in this profession and in related fields. Students will review current literature and discuss their critiques with other participants.

N.E. 411. Nuclear Reactor Engineering I

2-3-3. Prerequisites: Math. 207, Phys. 209.

The sequence N.E. 411-2-3 together constitutes a thorough, comprehensive course in nuclear reactor engineering. It is intended for the student of engineering or science whose career may involve the design, operation, evaluation or development of nuclear systems or components. Topics include nuclear reactions, radiation and its interactions, health physics, behavior of neutrons in matter and steady state reactor theory.

Text: Glasstone and Sesonske, *Nuclear Reactor Engineering.*

N.E. 412. Nuclear Reactor Engineering II

2-3-3. Prerequisite: N.E. 411.

Covers reactor kinetics, control of nuclear reactors, reactor materials and fuels, and nuclear radiation shielding. Laboratory experiments utilize a subcritical assembly and the critical reactors.

N.E. 413. Nuclear Reactor Engineering III

3-0-3. Prerequisite: N.E. 412.

Emphasizes the reactor system as a whole. Topics include energy removal and conversion, reactor safeguards and siting, preliminary reactor design, reactor systems and nuclear power costs.

N.E. 420. Nuclear Technology and the Environment

3-0-3. Prerequisites: Senior standing in science or engineering or consent of instructor.

A survey of those aspects of current nuclear technology that have an impact on the natural environment and of the techniques of analysis and tracer methodology that are of value in the study of pollution and ecosystems.

Text: To be selected.

N.E. 425. Radiation Physics

3-3-4. Prerequisites: Math. 209, Phys. 209.

This course provides the physical basis for understanding the effects of ionizing radiation on matter, for developing a philosophy of radiation protection for individuals and the environment (N.E. 426) and for implementing radiation protection programs (N.E. 427).

N.E. 426. Principles of Health Physics

3-0-3. Prerequisite: N.E. 425 or consent of instructor.

As an introduction to the practice of health physics, this course emphasizes the biophysical bases of radiation protection and the development of protection criteria. It provides an understanding of the philosophy and methodology of applied health physics.

N.E. 427. Applied Health Physics.

3-3-4. Prerequisites: N.E. 426 or consent of instructor.

This course is designed to acquaint the student with the practice of health physics in our society. Classroom description will be enhanced by laboratory practice simulating the control of radiation in industry and medicine. Topics covered include personnel monitoring, biossay, air sampling and respiratory protection, radiation surveys of nuclear reactors, accelerators, radioisotope laboratories, and X-ray installations, emergency planning and control of emergency conditions, professional ethics and judgement, and governmental regulation of ionizing radiation.

N.E. 430. Isotopic Tracer Methodology

2-3-3. Prerequisites: Senior standing in science and engineering or consent of the instructor.

This course will introduce the student to the use of isotopic tracer techniques for scientific research and technology in either the biological, physical, medical, or environmental sciences. The laboratory work is built about experiments that provide each student with the opportunity of developing techniques for applying isotopic tracers to problem areas in his own discipline.

Text: Selected references.

N.E. 447. Elements of Nuclear Engineering

3-0-3. Prerequisites: Math. 207, Phys. 209.

An introductory course which presents a general survey of radiation, fission, fusion and other nuclear transformations with examples of how these phenomena may be exploited in industrial and engineering applications. Material covered includes an engineering treatment of pertinent areas of nuclear physics, simplified reactor theory, and a survey of radiation, its measurement, associated hazards and uses.

Text: Foster and Wright, *Basic Nuclear Engineering.*

N.E. 454-455-456-457. Special Problems

Credit to be arranged. Prerequisite: Consent of instructor.

An opportunity for the advanced undergraduate to undertake a nuclear engineering project appropriate to his capabilities. The student is encouraged to exercise his resourcefulness and originality in attacking a problem of special interest to himself and a member of the N.E. faculty.

N.E. 494-495-496. Special Topics

Credit to be arranged. Prerequisite: Consent of instructor.

The purpose of this course is to permit the School of Nuclear Engineering to offer formal courses on topics of special interest on an ad hoc basis.

Graduate Courses

N.E.	601, 2, 3	Reactor Technology	3-0-3
N.E.	606	Introduction to Nuclear Materials	3-0-3
N.E.	610	Radiation Detection	2-6-4
N.E.	611, 12	Nuclear Engineering Laboratory	1-6-3
N.E.	613	Radiation Technology Laboratory	1-6-3
N.E.	620	Nuclear Engineering Design	2-6-4
N.E.	625	Nuclear Engineering Calculations	3-0-3
N.E.	626	Monte Carlo Methods in Nuclear Engineering	3-0-3
N.E.	630	Reactor Control	3-0-3
N.E.	632	Radioisotopes Engineering	3-0-3
N.E.	640	Radiation Protection	3-0-3
N.E.	641	Particle Accelerators	2-3-3
N.E.	647	Fundamentals of Nuclear Engineering	3-0-3
N.E.	663	Economics of Nuclear Power	3-0-3
N.E.	654,5,6,7	Special Problems in Nuclear Engineering	
N.E.	671, 2, 3	Reactor Physics	3-0-3
N.E.	679	Radiation Attenuation	3-3-4
N.E.	680	Advanced Reactor Theory	5-0-5
N.E.	681	Environmental Surveillance and Radioactive Waste Disposal	3-0-3
N.E.	690	Engineering with Nuclear Explosives	3-0-3
N.E.	699	Preparation for Ph.D. Qualifying Examination	
N.E.	700	Master's Thesis	
N.E.	701, 2, 3	Seminar	
N.E.	704,5,6,7	Special Topics	
N.E.	710	Advanced Radiation Detection	3-0-3
N.E.	721	Nuclear Reactor Safety	3-0-3
N.E.	730	Radiation Effects on Materials	3-0-3
N.E.	732	Radioisotopes Engineering II	3-0-3
N.E.	740	Radiation Dosimetry	3-0-3
N.E.	741	Applied Radiological Physics	2-3-3
N.E.	751	Fast Reactor Physics	3-0-3

N.E.	752	Thermal Neutron Fields	3-0-3
N.E.	780, 1	Advanced Energy Conversion I	3-0-3
N.E.	782	Aerospace Nuclear Propulsion	3-0-3
N.E.	799	Preparation for Ph.D. Dissertation	
N.E.	800	Doctor's Thesis	

DEPARTMENT OF PHYSICAL TRAINING

Department Head—John McKenna; *Associate Professors*—Norris C. Dean, Byron Gilbreath, John C. Hyder, James H. McAuley, Tommy Plaxico; *Assistant Professor*—Bill Beavers, Douglas L. Fowlkes, David W. Houser, Robert Nelson; *Secretary*—Mrs. Joyce M. Stembridge.

General Information

All male students entering Georgia Institute of Technology as freshmen or sophomores are required to take Physical Training 4 hours per week, receiving 1 hour credit. The schedule will call for two, two-hour periods on alternate days; one hour for physical training, thirty minutes for dressing and thirty minutes for shower. The health information record (see page 20) will determine any exemptions from physical training. Students bringing certificates of disability from personal physicians must have the certificates endorsed by the school physician before they will be accepted by the department.

All male freshman and sophmore students will be required to take Physical Training, except the following who will be exempt: Students not physically able; students twenty-one years of age, or over, on first admission to the Georgia Institute of Technology; and transfer students who shall receive one quarter exemption for each quarter as a full-time student at another institution. Students may register for only one Physical Training course per quarter. Female students will not be allowed to register for P.T. courses.

NOTE: Men excused from Physical Training are not required to make up the credit hours in additional subjects.

Students taking physical training will be required to purchase a standard uniform consisting of a sweat shirt, gym pants, athletic supporter, socks and shoes. The uniform will be sold at cost and normally should not exceed $12. Locker facilities for those living neither on the campus nor in nearby fraternity houses may be secured by a two-dollar deposit with a refund of $1.50 at the end of the school year if the lock and locker are surrendered in good condition. Dressing room space, showers and towels are provided all students free of charge.

Freshman Physical Training

The object of these courses is to give the students sound basic concepts regarding exercise, physical fitness, and water safety, and to motivate them into achieving and maintaining these goals. One quarter will be devoted to swimming, one to physical fitness, orientation, gymnastics, and one to track. Swimming, tumbling, apparatus work, calisthenics, walking and running are basic to well rounded, sound physical development.

At the end of the year, students who make sufficient progress will be sent on to sophomore physical training.

P.T. 101. Swimming

The primary objective of this course is SURVIVAL, and it is designed to "drown-proof" our students. Emphasis is placed on developing the ability to successfully handle typical Armed Forces swimming emergencies, such as cramps, disabling injuries, and long submersions. The application of basic mechanical principles is stressed to make students think for themselves, rather than accept dogmatic statements.

P.T. 102. Physical Fitness, Orientation, and Gymnastics

The purpose of the course will be to help orient the student through actual experience to some of the basic factors of physical fitness and to show how these factors tie in with greater achievement, not only in performing gymnastic movements, but with better all around physical performance and with higher social standards through life. Through the medium of 70 carefully chosen skills, it will be the goal to develop an appreciation of the significance of good coordination, efficiency of movement, rhythm, kinesthetic sense, confidence, courage, good form and team work, plus a wholesome, practical philosophy of the real value of exercise and of keeping physically fit. Each student shall earn his grade points and 60 points is essential as a minimum to pass the course. Points shall be distributed as follows:

	Points
1. First fitness test	10
2. Second fitness test	20
3. For all 50 skills	60
4. Attitude, hygienic practices and sportsmanship	10
	100

P.T. 103. Track

Instruction and practice will be given in starting, striding, use of the arms in running, and body lean. The object of the course is to build strong legs and to increase lung and heart capacity. The minimum score to pass the course is an average grade of 60.

Grade Scale:

100 Yd. Dash

A	11 to 11.5 sec.
B	11.5 to 12 sec.
C	12 to 12.5 sec
D	12.5 to 13 sec.

220 Yd. Dash

A	26 to 27 sec.
B	27 to 28 sec.
C	28 to 29 sec.
D	29 to 30 sec.

Quarter Mile Run (440 Yds.)

A	58 to 63 sec.
B	63 to 68 sec.
C	68 to 73 sec.
D	73 to 78 sec.

Half Mile Run (880 Yds.)

A	2 min. 30 sec. to 2 min. 40 sec.
B	2 min. 40 sec. to 2 min. 50 sec.
C	2 min. 50 sec. to 3 min.
D	3 min. to 3 min. 10 sec.

Mile Run

A	5 min. 30 sec. to 5 min. 50 sec.
B	5 min. 50 sec. to 6 min. 10 sec.
C	6 min. 10 sec. to 6 min. 30 sec.
D	6 min. 30 sec. to 6 min. 50 sec.

Sophomore Physical Training

This is a maintenance course. The condition developed in the freshman year will be maintained and at the same time skills will be taught in games and other events that appeal to young men. One quarter will be devoted to indoor games, one to outdoor games and one to recreative sports.

P.T. 201. Indoor Games

Basketball will be the game on which the majority of effort will be concentrated. As the physical training facilities are expanded other games may be added. The basic fundamentals of the games will be demonstrated and practiced. After the class has developed some skill, teams will be organized for actual competition.

P.T. 202. Outdoor Games

Softball, touch football and soccer are

the basic games for this course. This course is an exact parallel to the Indoor Games in the methods used and in the instruction and play arrangement.

P.T. 203, Recreative Sports

The class will receive instruction in the fundamentals of tennis, volley ball, or paddle ball. The purpose of the course is to provide recreational exercise and to develop an appreciation of these carry-over sports as recreation and as a means of maintaining a moderate level of physical fitness.

The student shall be graded on the proficiency he demonstrates in these sports. Attendance, attitude, and effort—except when inadequate—shall be considered only to the extent that their diligent application invariably results in greater proficiency.

SCHOOL OF PHYSICS

(Established in 1939)

Director–James R. Stevenson; *Regents' Professors*–Harold A. Gersch, Earl W. McDaniel, L. David Wyly; *Professors Emeritus*–Earle E. Bortell, Joseph H. Howey, Edward T. Prosser; *Professors*–R. Martin Ahrens, Charles H. Braden, Harold R. Brewer, Vernon Crawford, Walter P. Ewalt, Joseph Ford, Don S. Harmer, David W. Martin, Eugene T. Patronis, Jr., Edwin J. Scheibner, Thomas L. Weatherly, Michael K. Wilkinson, J. Quitman Williams, R. A. Young; *Associate Professors*–Harry G. Dulaney, Ian R. Gatland, Augustus L. Stanford, Jr., James M. Tanner, Edward W. Thomas, Oscar B. Wike, LeRoy A. Woodward; *Assistant Professors*–Helmut Biritz, Nisbet S. Kendrick, David J. Kennedy, Roger E. Little, Donald C. O'Shea, William E. Woolf; *Post Doctoral Fellows* –Roger J. Bartlett, Donald A. McClure, Tim Padmore, George M. Thomson; *Administrative Assistant*–Jon C. Barbour; *Laboratory and Demonstration Associate*–Vincent de Paul Mallette; *Academic Shop Foreman*–Kelly B. Springfield; *Senior Machinist*–Donald J. Denmon; *Machinist*–Julian R. Bell; *Senior Electronics Technician*–Jerome T. Callahan; *Research Technician*–Mrs. Elizabeth P. Russell; *Principal Secretary*–Miss Anna Ruth Hale; *Senior Secretary*–Miss Wynette Wright; *Secretary*–Mrs. Dianne Thompson; *Secretary-Receptionist*–Miss Robbie Buffington.

General Information

Physics has been known primarily as a basic science. Today, fundamental research into the principles of physics continues to occupy the attention of many physicists, but, in addition, the study of physics has become increasingly important as a basis for fundamental research in interdisciplinary areas such as biophysics and chemical physics and as an applied science in government and industry. The increased complexity of much fundamental and applied research frequently dictates that scientists trained in many specialties work side by side; often physicists, mathematicians, chemists, psychologists, biologists, several kinds of engineers, and, perhaps, other kinds of scientists may be found working together towards a common goal. Furthermore, as society becomes more technically oriented a trend may be discerned in the direction of scientifically trained individuals assuming a more important role in management and administrative functions. Evidently, it is becoming increasingly important that scientific personnel have, in addition to a high degree of competence in their specialty, some competence in related fields in order that they may work effectively on problems that cut across traditional disciplines.

The School of Physics offers basic service courses to all sophomores, some advanced service courses for students of engineering, science, or mathematics, and advanced work leading to a bachelor's, master's, or doctor's degree in physics. In order to enable students with a wide variety of interests to work out suitable programs of study leading to a bachelor's degree in physics, the School has restricted its required courses to the fundamental principles of physics and has provided a large number of elective hours in the junior and senior years. Furthermore, in order to enable students to concentrate their attention on a few subjects at a time, the requirements are such that only four subjects should be scheduled concurrently in most quarters during the junior and senior years. Accordingly, a high level of performance and substantial independent study will be expected in the junior and senior level physics courses.

A requirement for a bachelor's degree in physics is a point average of at least 2.0 in junior and senior physics courses.

Freshman Year*

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Chem.	104, 105	General Chemistry	4-3-5	4-3-5	....
Phys.	227	General Physics	....	....	4-3-5
Math.	107-8-9	Calculus I, II, III	5-0-5	5-0-5	5-0-5
Engl.	107-8-9	Introduction to Literature	3-0-3	3-0-3	3-0-3
P.T.	101-2-3	Physical Training	0-4-1	0-4-1	0-4-1
M.L.		Modern Language OR			
S.S.		Social Science	3-0-3	3-0-3	3-0-3
Electives**		....	2-0-2	2-0-2	2-0-2
Gen.	101	Orientation	1-0-0	....	....
		Totals	18-7-19	17-7-19	17-7-19

Sophomore Year*

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Phys.	228, 229	General Physics	4-3-5	4-3-5	....
Engl.	201-2-3	Survey of the Humanities	3-0-3	3-0-3	3-0-3
Math.	207	Calculus IV	5-0-5	....	....
Math.	208	Calculus and Linear Algebra	....	5-0-5	....
Math.	209	Ordinary Differential Equations	....	....	5-0-5

[illegible]	[illegible]	[illegible] Radiobiology	3-3-4	....	....
Electives*		....	3-3-3	......	6-0-6
		Totals	17-9-16	13-6-15	14-3-15

Sophomore Year (cont.)

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
P.T.	201-2-3	Physical Training..........	0-4-1	0-4-1	0-4-1
Electives		....	3-0-3	3-0-3	8-0-8
		Totals........................	15-7-17	15-7-17	16-4-17

*It is recommended that physics majors elect Physics 100 "Physics Orientation" during the Freshman year.

If ineligible for P.T., the hours do not have to be made up.

Students should consider electing courses such as I.C.S. 151 or C.E. 211, E.Gr. 113 or 170, Phys. 244, 245, 222, 340.

It is recommended that students who intend to take graduate work schedule French, German, or Russian. The language may be scheduled in the Freshman year, or in any other year as an elective.

**These free elective courses may be taken at any time during a student's course of study. However, these six credit hours may be satisfied by selecting basic ROTC. If basic ROTC is elected by the student, then it must be scheduled beginning the first quarter the student is enrolled. For further details, see page 28 of the catalog.

Junior and Senior Years. The minimum total number of credit hours required for a bachelor's degree in physics is 196. The following list itemizes the courses required of all candidates for the degree, in addition to the courses which have been listed for the freshman and sophomore years. Prior to the senior year it is

Courses of Instruction

NOTE: 4-3-5 *means* 4 *hours class,* 3 *hours laboratory,* 5 *hours credit.*

Phys. 100. Physics Orientation

1-0-1.

The student will be introduced to the various possible career areas they may eventually enter as physicists. The special opportunities available to them in the School of Physics will be explained and the role physicists have in government, industry, and education will be examined.

Phys. 211, 212, 213. Elementary College Physics

4-0-4. Courses should be taken in sequence.

This sequence of courses is designed to meet the needs of the students in the less technical curricula. It includes a basic study of the physical principles of Mechanics, Sound, Heat, Electricity, Light and Modern Physics. Mathematics below the level of calculus is used freely to provide practice in the use of mathematics in logical reasoning. The method of teaching and the subject matter are chosen to give an understanding of the scientific methods and to give a background of scientific information and terminology which is needed today to comprehend the commercial, cultural, and political signifi-

The classical kinematics and dynamics of a particle are presented. Energy, linear momentum, and angular momentum conservation principles (for particle systems) are examined. The generality of the Newtonian mechanics thus developed is demonstrated by a variety of applications. Relativistic kinematics of a particle is introduced, and the necessary modifications of the classical conservation laws are discussed. Facility with these concepts and principles is essential for an understanding of the material presented in Physics 228 and 229.

Empirical verification and utilization of the principles of particle dynamics are accomplished in the laboratory with "frictionless" surfaces and stroboscopic photographic equipment.

Physics 228. Electromagnetism

4-3-5. Prerequisites: Phys. 207 or 227, Math 109.

The interaction of charged particles through electric and magnetic fields is presented. Topics include electric field and potential, the magnetic field, and electromagnetic induction. Conservation principles presented in the preceding course are emphasized. Free use is made of calculus and vectors.

The following courses should be elected by a student who is preparing for graduate study in physics:

Physics courses: 304, 306, 421; two of the following three courses (433, 434, 435); two of the following three courses (423, 436, 441).

Mathematics courses: 309, 447, 448, 449; and nine additional hours of mathematics electives. Senior standing is recommended for 447-8-9.

Health Physics Option

If a student elects to take the Health Physics Option, the freshman and sophomore year requirements are the same as the regular physics option. The junior and senior year requirements are listed below.

Junior Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Phys.	301-2-3	Classical Mech., E and M	5-0-5	5-0-5	5-0-5
Phys.	304	Electronics......	....	5-6-7	....
N.E.	425	Radiation Physics	3-3-4	....	....
N.E.	426	Principles of Health Physics......	....	3-0-3	....
N.E.	427	Applied Health Physics.	....	....	3-3-4
Biol.	429	Biol. Princ. of Radiobiology	3-3-4	....	....
Electives*		......	3-3-3	......	6-0-6
		Totals	17-9-16	13-6-15	14-3-15

SUMMER-HEALTH PHYSICS INTERNSHIP**

Senior Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Phys.	423	Nuclear Physics......	5-0-5	....	....
Phys.	309	Thermal Physics......	....	5-0-5	....
Phys.	321	Quantum Mech. 1	....	....	5-0-5
N.E.	494	Special Topics......	4-3-5	....	....
N.E.	405-6-7	Health Physics Seminar.	1-0-1	1-0-1	1-0-1
C.E.	683	Env. Surveillance	....	....	3-3-4
Electives		......	3-0-3	6-0-6	6-0-6
		Totals	13-3-14	12-0-12	15-3-16
		4 Year Total–196			

*3 hours of electives must be taken in the area of data analysis.

**A Summer-Health Physics Internship is expected to be developed during the next 2 years.

Courses of Instruction

NOTE: 4-3-5 *means* 4 *hours class,* 3 *hours laboratory,* 5 *hours credit.*

Phys. 100. Physics Orientation

1-0-1.

The student will be introduced to the various possible career areas they may eventually enter as physicists. The special opportunities available to them in the School of Physics will be explained and the role physicists have in government, industry, and education will be examined.

Phys. 211, 212, 213. Elementary College Physics

4-0-4. Courses should be taken in sequence.

This sequence of courses is designed to meet the needs of the students in the less technical curricula. It includes a basic study of the physical principles of Mechanics, Sound, Heat, Electricity, Light and Modern Physics. Mathematics below the level of calculus is used freely to provide practice in the use of mathematics in logical reasoning. The method of teaching and the subject matter are chosen to give an understanding of the scientific methods and to give a background of scientific information and terminology which is needed today to comprehend the commercial, cultural, and political significance of scientific progress.

Text: Ballif and Dubble, *Conceptual Physics.*

Phys. 222. Physics of the Weather

3-0-3. Prerequisite: None.

An introductory treatment of the physics of the atmosphere illustrating the application of basic physical laws to the understanding of weather phenomena. The main weather features will be descriptively developed to aid in the understanding of their role in the complex problem of environmental pollution.

Text: *Introduction to Meteorology,* Cole (Wiley 1970).

Phys. 227. Particle Dynamics

4-3-5. Prerequisite: Math. 108. Corequisite: Math. 109.

The classical kinematics and dynamics of a particle are presented. Energy, linear momentum, and angular momentum conservation principles (for particle systems) are examined. The generality of the Newtonian mechanics thus developed is demonstrated by a variety of applications. Relativistic kinematics of a particle is introduced, and the necessary modifications of the classical conservation laws are discussed. Facility with these concepts and principles is essential for an understanding of the material presented in Physics 228 and 229.

Empirical verification and utilization of the principles of particle dynamics are accomplished in the laboratory with "frictionless" surfaces and stroboscopic photographic equipment.

Physics 228. Electromagnetism

4-3-5. Prerequisites: Phys. 207 or 227, Math 109.

The interaction of charged particles through electric and magnetic fields is presented. Topics include electric field and potential, the magnetic field, and electromagnetic induction. Conservation principles presented in the preceding course are emphasized. Free use is made of calculus and vectors.

The laboratory acquaints the students with the use of electrical instruments including oscilloscopes in the observation of fundamental electromagnetic phenomena.

Phys. 229. Optics and Modern Physics

4-3-5. Prerequisites: Phys. 208 or 228, Math 109.

Waves in elastic media. Wave propagation, interference, and diffraction of light. Geometrical Optics. Particle aspects of electromagnetic radiation and wave aspects of material particles. The uncertainty principle in quantum mechanics.

The laboratory is designed to illustrate the character of wave propagation. Visible light is used in the experiments on geometrical optics and atomic spectra. Microwave radiation is employed in the experiments on interference and diffraction.

Phys. 244. Introduction to Astronomy I

3-0-3. Prerequisite: Math. 108.

A survey of astronomy with special emphasis on the applications of physics to astronomical problems. The nature and behavior of the earth and the other members of the solar system will be examined.

Text: Abell, *Exploration of the Universe.*

Phys. 245. Introduction to Astronomy II

3-0-3. Prerequisite: Phys. 244 or consent of instructor.

The nature and behavior of stars and galaxies will be examined.

Text: Abell, *Exploration of the Universe.*

Phys. 300. Special Problems

(Credit to be arranged). Prerequisite: Consent of instructor.

The content of this course will vary and will allow the School of Physics to offer courses in special topics either on demand or on an experimental basis. Individual special problems may be arranged with the consent of a faculty member.

Phys. 301, 302, 303. Classical Mechanics and Electricity and Magnetism

5-0-5. Prerequisites: Phys. 209 or 229 and Math. 209.

A sequence of courses in classical mechanics and electricity and magnetism. Dynamics of particles including oscillations and planetary motion; rotation of rigid bodies; impact; Lagrange's and Hamilton's Equations. Electric and magnetic fields; potentials; resistance, inductance, and capacitance, polarization, magnetic materials; development of Maxwell's Equations and their application to the transmission of electromagnetic waves.

Texts: Constant, *Theoretical Physics;* and Corson and Lorrain, *Introduction to Electromagnetic Fields and Waves.*

Phys. 304. Electronics

5-6-7. Prerequisites: Phys. 209 or 229 and Math. 209.

Basic principles of vacuum tube amplifiers, transistor amplifiers, and some a.c. circuit theory. Special attention is given to systems frequently encountered in experimental physics, such as timing, counting, switching, and shaping circuits.

Text: Korneff, *Introduction to Electronics.*

Phys. 308. Intermediate Electricity and Magnetism

3-0-3. Prerequisites: Phys. 208 or 228 and Math. 209.

This course is for non-physics majors and covers the basic concepts of electric and magnetic fields leading to the formulation of Maxwell's equations. These fundamentals are treated with the free use of differential and integral calculus.

Text: Jifemenko, *Electricity and Magnetism.*

Phys. 309. Thermal Physics

5-0-5. Prerequisites: Phys. 209 or 229 and Math. 209.

Thermodynamic equilibrium and extensive parameters. Entropy postulates. Intensive parameters. Reversible and irreversible quasi-static processes. Extremum principles and thermodynamic potentials. Kinetic theory of ideal gasses. Maxwell-Boltzmann energy distribution. Introduction to Maxwell-Boltzmann statistics.

Text: Sears, *Thermodynamics, the Kinetic Theory of Gases and Statistical Mechanics.*

Phys. 316. Vacuum Ultraviolet Optics

1-3-2.

Laboratory and lecture would be concerned with sources, dispersion techniques, and detectors in the approximate wavelength region of 100 to 2000 Angstrom units.

Phys. 317. Introduction to Elementary Particle Physics

3-0-3. Prerequisite: Phys. 209 or 229.

This course gives a first introduction to the phenomenology of elementary particle physics. The emphasis is on the underlying physical ideas and not on special mathematical models. A topical listing follows: Historical introduction, list of particles, quantum numbers, symmetries, quark model, cross sections, S-matrix, quantum field theory, strong, electromagnetic, and weak interactions.

Phys. 319. Modern Physics for Engineers

3-0-3. Prerequisites: Phys. 207-8-9 or 227-8-9 with a minimum grade of C.

This course covers the more recent developments of physics which are of particular importance for engineers. It includes the structure of bulk matter, the structure of atoms, the properties of elementary particles, the fundamentals of nuclear physics, and the interaction of radiation with matter.

Text: Sproull, *Modern Physics for Engineers.*

Phys. 321. Quantum Mechanics I

5-0-5. Prerequisite: Phys. 301.

Historical introduction, postulational approach to wave mechanics. Discussion of the eigenfunction-eigenvalue problem and solutions to Schroedinger's equation: free particle, particle in a box, the square well, harmonic oscillator, rigid rotator, and hydrogen atom.

Text: Park, *Introduction to Quantum Theory.*

Phys. 322. Nuclear Astrophysics and Stellar Evolution

3-0-3. Prerequisite: Phys. 209 or 229.

A study of the nuclear energy generating processes in stars and stellar evolution. Nucleosynthesis and energy generation in stars, stellar models, the evolution of stars, the origin of the elements, nuclear reactions in main sequence stars, in red giants, and in supernovae, cosmic rays and cosmic neutrinos, neutrino astrophysics. Supermassive stars, quasars, extragalatic radio sources, and galatic explosions. The course is designed for non-physics majors as well as physics majors.

Texts: Fowler, *Nuclear Astrophysics,* and Clayton, *Principles of Stellar Evolution and Nucleosynthesis.*

Phys. 326. Geometrical and Physical Optics

3-0-3. Prerequisites: Phys. 209 or 229, Math. 209.

Development of optical analysis based on rectilinear and wave propagation of light. Coverage includes image formation, stops, aberrations, diffraction and interference. Principles of basic optical instruments are reviewed.

Text: Jenkins and White, *Fundamentals of Optics,* 3rd ed.

Phys. 327. Optical Instruments Laboratory

1-3-2. Prerequisites: Phys. 326 or concurrent.

Use of optical instruments for purposes of observation and measurement. Instrumentation includes spectrometers, interferometers, polariscopes, microscopes and telescopes.

Phys. 328. Quantum and Fourier Optics

3-0-3. Prerequisites: Phys. 209 or 229, Math. 209.

An advanced course in optics that considers the interaction of optical radiation with matter, the theory and application of the laser, coherence, fourier transforms of optical instruments and holography. Emphasis is placed on the application of these subjects to practical optical instruments. It will be assumed that the student is familiar with the differential form of Maxwell's equation.

Phys. 329. Advanced Optical Physics Laboratory

1-3-2. Prerequisites: Phys. 328 or concurrent.

This laboratory is taken at the student's option with Physics. It consists of a small number of experiments designed to exemplify the material presented in the lecture course.

Phys. 340. Selected Problems in Physics

1-6-3. Prerequisites: Physics 209 or 229, Math. 209 concurrent.

Through the study of problems selected from a variety of fields of physics (e.g. mechanics, electricity and magnetism, quantum theory, kinetic theory) the student's experience in the application of physical principles and mathematical techniques will be extended to more realistic problems than could be considered in the General Physics courses. Emphasis will be placed on the numerical solution of problems. Digital computer facilities will be employed in order to introduce the student to the application of numerical methods for the solution of problems in physics, including the reduction of experimental data.

Phys. 350. Introduction to Acoustics

3-0-3. Prerequisites: Sophomore mechanics and electricity.

An introduction to the art and science of acoustics for students of varied backgrounds and interests. The emphasis is on the basic physical mechanisms which underlie all acoustical phenomena. The topics of study include sound generation, sound measurement and control, sound propagation, the reproduction of music, sound reinforcement, and the control of noise.

Phys. 360. Physical Measurements

3-0-3. Prerequisite: Basic electronics.

A study of the theory and the techniques of the measurement of the fundamental electric and magnetic quantities under both static and dynamic conditions. Applications of electrical, electromagnetic, and electronic measuring apparatus in the measurement of other physical variables such as pressure, temperature, etc.

Phys. 361. Physical Measurements Laboratory

0-3-1. Corequisite: Phys. 360.

This laboratory is taken at the student's option with Physics 360. It consists of a set of laboratory exercises exemplifying and reinforcing the material presented in the lecture course.

Phys. 370. Interfacing Laboratory

1-6-3. Prerequisite: Phys. 304 or equivalent.

An introduction to the interfacing of apparatus to computers in accord with current on-line use of small, digital computers in physics experiments. Laboratory work deals with the properties of digital logic elements and simple combinations of such elements followed by the design and assembly of necessary interfacing to operate selected experiments on-line. Apparatus available for the laboratory includes a variety of interfacing logic and a PDP-11 computer. Some prior experience with computer programming, e.g. ICS 151, is helpful although not essential.

Phys. 404. Electronic Instruments for Nuclear Research

2-3-3. Prerequisites: Phys. 304 or E.E. 306, or equivalent.

An intermediate course in electronic instruments and instrumentation as employed in research and general laboratory measurements. Instruments employing both analog and digital techniques are treated from both the design and application points of view. The factors affecting precision, accuracy, resolution, and stability are discussed. Special emphasis is placed on the instruments of nuclear physics.

Text: The course will draw heavily from the following texts: Trimmer, *Response of Physical Systems;* Littauer, *Pulse Electronics;* Chase, *Nuclear Pulse Spectrometry.*

Phys. 421. Quantum Mechanics II

5-0-5. Prerequisite: Phys. 321.

Introduction to perturbation theory, identical particles, spin, and semi-classical radiation theory. Applications to atomic physics.

Text: Park, *Introduction to Quantum Theory.*

Phys. 423. Nuclear Physics

5-0-5. Prerequisite: Phys. 321.

Basic properties of nuclei, interactions of radiation with matter, particle accelerators, radioactivity, nuclear reactions, models of nuclear structure, and properties of elementary particles. Physics 657 is a suitable alternate in the Health Physics Program.

At level of Leighton, *Principles of Modern Physics.*

Phys. 427. Elementary Quantum Mechanics

3-0-3. Prerequisite: Senior standing.

This course is for non-physics majors. It covers a historical development, Schroedinger's equation, and the probabilistic interpretation of quantum mechanics. One dimensional solutions of Schroedinger's equation: free particle, wave packets, particle in a box and linear oscillator. Rigid rotator. Applications to atomic structure.

Phys. 430. Special Problems

(Credit to be arranged). Prerequisite: Consent of instructor.

The content of this course will vary and will allow the School of Physics to offer courses in special topics either on demand or on an experimental basis. Individual special problems may be arranged with the consent of a faculty member.

Phys. 432. Introductory Diffraction Theory

3-0-3. Prerequisites: Senior standing or consent of instructor.

Aspects of crystal symmetry and introductory theory common to electron, neutron, and X-ray diffraction are treated. The reciprocal lattice and geometric portion of the kinematic theory are developed from the Laue-Ewald point of view. Treatment of coherent scattering from continuous distributions is introduced.

Texts: Guinier, *X-ray Diffraction;* and Wilson, *X-ray Optics.*

Phys. 433, 434, 435. Advanced Laboratory I, II, III

1-6-3. Corequisite: Phys. 321.

These courses may be scheduled in any order. Experiments of classical and contemporary importance selected from various fields of physics. The experiments frequently deal with topics that have not been treated in other courses; students will be expected to acquire an understanding of the significance of the experiments through independent study. Coding of simple problems for a digital computer may be required.

Phys. 436. Plasma Physics

5-0-5. Prerequisites: Phys. 303 and Phys. 321.

A description and analysis of the plasma state of matter: Definition of a plasma, Orbit theory, Collision phenomena in ionized gases, Sheaths, the kinetic theory of ionized gases, Oscillations and waves in plasmas, Plasma instabilities, Emission and absorption of radiation by plasmas, Astrophysical and atmospheric phenomena.

Text: Holt and Haskell, *Plasma Dynamics.*

Phys. 438. Vibrations and Wave Motion

3-0-3. Prerequisite: Phys. 303.

Oscillations and wave motion of discrete and continuous mechanical systems. The course will empahsize those aspects of wave motion common to quantum mechanics, classical mechanics, and electromagnetism.

Phys. 440. Special Relativity

3-0-3. Prerequisite: Phys. 303.

The concepts of observer and measurement. Critique of Newton's laws and Maxwell's equations. Aether theory: the Michelson-Morley experiment, Lorentz contraction. Einstein's postulates and the derivation of Einstein's equations. The Doppler effect and other consequences. Lorentz invariance: non-Euclidian spaces, 4-vector analysis. Relativistic mechanics including mass-energy relations and the Compton effect.

Text: Kascer, *Introduction to the Special Theory of Relativity.*

Phys. 441. Molecular and Solid State Physics

5-0-5. Prerequisites: Phys. 321 and Phys. 309.

Application of quantum mechanics to molecules and solids. Molecular bonding and spectra of diatomic molecules. Binding forces and bond theory in solids. Applications to solid state devices.

At level of Kittel, *Introduction to Solid State Physics.*

Phys. 442. X-Ray Diffraction and Crystallography Laboratory

0-6-2. Co- or prerequisite: Phys. 432.

Practical application is made of the principles and techniques covered in Physics 432. Reciprocal space and Fourier transform concepts are emphasized.

Crystal orientation, chemical and physical characterization of crystal-line and amorphous materials, radial distribution functions, diffraction line profile analysis, space group determination, and determination of differences in atomic positions and structural defects are among the topics from which the student may make some selection.

Phys. 456. Elementary Biophysics I

3-0-3. Prerequisite: Phys. 209 or 229.

Applications of the principles and techniques of the physical sciences to areas of the life sciences.

Phys. 457. Elementary Biophysics II

3-0-3. Prerequisite: Phys. 456.

A continuation of topics from Physics 456. Physics of viruses, the central nervous system, and biophysical instrumentation.

Phys. 458. Introductory Biophysics Laboratory

0-3-1. Co-or prerequisite: Phys. 457.

This laboratory is taken at the student's option with Physics 457. It consists of selected laboratory exercises exemplifying and reinforcing material presented in the lecture course.

Phys. 460. Introductory Statistical Physics

3-0-3. Prerequisites: Phys. 209 and Math. 209.

Introduction to the concepts and principles of statistical physics necessary for a microscopic understanding of thermodynamics and related macroscopic phenomena. This course is intended primarily for students with a major other than physics.

Graduate Courses Offered

Phys.	601	Graduate Student Seminar	1-0-1
Phys.	602	Graduate Student Seminar	1-0-1
Phys.	603	Graduate Student Seminar	1-0-1
Phys.	611	Mechanics of Continuous Media	3-0-3
Phys.	613	Physical Crystallography	3-0-3
Phys.	614	Introductory Solid State Physics	3-0-3
Phys.	616	Statistical Mechanics	5-0-5
Phys.	621	Theoretical Mechanics	5-0-5
Phys.	622	Advanced Electricity and Magnetism	5-0-5
Phys.	624	Nuclear Physics	5-0-5
Phys.	627	Quantum Mechanics I	5-0-5
Phys.	628	Electromagnetic Theory	5-0-5
Phys.	631	Principles of Modern Physics	3-0-3
Phys.	633	An Introduction to Collision Theory	3-0-3
Phys.	637	Quantum Mechanics II	5-0-5
Phys.	639	Quantum Mechanics III	5-0-5
Phys.	642	Diatomic Molecules	3-0-3
Phys.	670	Graduate Laboratory	1-6-3
Phys.	675	Principles of Nuclear Physics	4-0-4
Phys.	679	Radiation Attenuation	3-3-4
Phys.	680	Advanced Reactor Theory	
Phys.	682	Plasma Physics and Thermonucleonics	3-0-3
Phys.	710	(See N.E. 710)	
Phys.	714	Optical Properties of Solids	3-0-3

Phys.	715	Quantum Mechanics of Many-Particle Systems	5-0-5
Phys.	724	Theoretical Nuclear Physics	5-0-5
Phys.	731	Molecular Spectra and Stucture	5-0-5
Phys.	734	Introduction to Relativity	5-0-5
Phys.	736	Quantum Field Theory	5-0-5

(Complete details about these courses are contained in the *Graduate Bulletin,* a copy of which is available upon request.)

SCHOOL OF PSYCHOLOGY

(Established in 1959)

Director—Edward H. Loveland; *Regents' Professor Emeritus*—Joseph E. Moore; *Professors*—M. Carr Payne, Jr., Sam C. Webb; *Associate Professors*—E. Jo Baker, Richard K. Davenport, Stanley A. Mulaik, Charles V. Riche, William W. Ronan, C. Michael York; *Assistant Professors*—G. Dale Baskett, M. Jackson Marr, Anderson D. Smith; *Principal Secretary*—Julia M. McHugh.

General Information

The School of Psychology serves a dual function in the Institute. It offers courses which permit the student majoring in architecture, engineering, industrial management, and natural sciences to gain training in the basic and applied aspects of the science of behavior. Also, it offers programs of studies leading to the Bachelor of Science in Applied Psychology, and Master of Science and Doctor of Philosophy in Psychology. The general objective of all courses is to provide an understanding of behavior within an experimental and scientific frame of reference.

The undergraduate curriculum in psychology stresses fundamentals, providing opportunity for broad training in mathematics, chemistry, physics, biology, and a number of basic engineering, management, and humanities subjects. The large number of elective courses which the student takes enables the curriculum to fulfill a wide variety of educational and vocational needs. A small portion of elective courses are restricted; the student must choose these from lists of grouped engineering and management courses prescribed by the psychology faculty. The student is encouraged to broaden his educational development by choosing at least a portion of his unrestricted elective courses from course offerings in the humanities and the social sciences.

The graduate of the Bachelor of Science curriculum in applied psychology will be prepared to work in personnel and training departments in industry, and to serve with a human factors research team investigating human requirements in equipment design. The curriculum provides an excellent preparation for graduate study in psychology as well as in other fields, such as medicine, labor relations, and law.

The graduate program involves intensive exposure to the theoretical and experimental foundations of psychology with a strong emphasis upon quantitative methods. Individual initiative in research and study is strongly encouraged and supported by close faculty-student contact.

Ph.D. and M.S. candidates share a core curriculum of required courses which include Psychology 605, 606, 607, nine additional hours of work in psychology to be prescribed by the student's faculty advisory committee with the approval of the Director of the School of Psychology, and eighteen hours to be chosen by the student, with the approval of his advisory committee, from among courses in psychology and other fields. Permission to substitute another course for a required course may be granted if the student can demonstrate competence in course content by passing a written examination. Ph.D. candidates are expected to complete all requirements for the Master's degree, including a thesis and a demonstrated reading proficiency in one foreign language.

The Master's program is intended to prepare the student for either or both of two activities: (a) continuation of graduate work toward the Ph.D. and/or (b) employment in business, industrial, governmental or educational positions. This degree program will require two years for most students, although a well prepared candidate may complete all requirements for the degree in one calendar year. A Master's thesis is required.

The Doctoral program provides the student with an opportunity for advanced study in either general experimental, industrial or engineering psychology. Each of these programs 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 to the student's area of specialization.

Freshman Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Chem.	104-5	Inorganic Chemistry	4-3-5	4-3-5	....
E.Gr.	113	Engineering Graphics....	....	....	0-6-2
I.S.	151	Digital Computer Organization and Programming......	....	....	2-3-3
Engl.	107-8-9	Introduction to Literature	3-0-3	3-0-3	3-0-3
Math.	107-8-9	Calculus I, II, III...........	5-0-5	5-0-5	5-0-5
M.L.	*	Modern Language OR			
S.S.		Social Science...............	3-0-3	3-0-3	3-0-3
P.T.	101-2-3	Physical Training..........	0-4-1	0-4-1	0-4-1
**Electives		....	2-0-2	2-0-2	2-0-2
Gen.	101	Orientation..................	1-0-0	....	....
		Totals........................	18-7-19	17-7-19	15-13-19

NOTE: Under Quarters, 3-3-4 means 3 hours class, 3 hours lab., 4 hours credit.

*Choice of: (1) two quarters of one of the following: American History, Political Science, Philosophy and History of Science, or Sociology; and the third quarter selected from one of the three remaining areas; or (2) three quarters of Modern Language in either German, French, or Spanish. Three quarters of either M.L. or S.S. are required.

**These free elective courses may be taken at any time during a student's course of study. However, these six credit hours may be satisfied by selecting basic ROTC. If basic ROTC is elected by teh student, then it must be scheduled beginning the first quarter the student is enrolled. For further details, see page 28 of the catalog.

Sophomore Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
Engl.	201-2-3	Survey of the Humanities	3-0-3	3-0-3	3-0-3
Math.	207	Calculus IV	5-0-5	....	....
Math.	208	Calculus and Linear Algebra	....	5-0-5	....
Bio.	210-11	Principles of Biology	5-3-6	5-3-6	....
Psy.	303-4	General Psychology	....	3-0-3	3-0-3
Psy.	401	Industrial Psychology	....	....	3-0-3
P.T.	201-2-3	Physical Training	0-4-1	0-4-1	0-4-1
Electives			....	....	6-0-6
		Totals	15-7-17	16-7-18	15-4-16

Junior Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
Math.	205-6	Elementary Statistical Analysis	3-0-3	3-0-3	....
Psy.	403	Introduction to Psychological Testing	....	3-0-3	....
Psy.	405	Seminar in Organizational Psychology	3-0-3	....	....
Psy.	406	Psychological Statistics	....	....	2-3-3
Psy.	407	Experimental Psychology I	....	....	2-3-3
Psy.	410	Social Psychology	....	....	3-0-3
Phys.	227	Mechanics	4-3-5	....	....
Phys.	228	Electricity	....	4-3-5	....
Phys.	229	Heat, Sound, Light	....	....	4-3-5
Electives **			6-0-6	6-0-6	3-0-3
		Totals	16-3-17	16-3-17	14-9-17

**A total of not more than 9 hours of electives may be in advanced ROTC.

Senior Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
Psy.	411	Experimental Psychology II	3-3-4	....	....
Psy.	412	Psychology of Learning	....	3-3-4	....
Psy.	413*	Applied Experimental Psychology	....	....	3-3-4
Psy.	414	Special Problems	....	0-3-1	....
Psy.	415	Special Problems	....	....	3-3-4
Engl.	315	Public Speaking	....	3-0-3	....
Electives**			15-0-15	9-0-9	12-0-12
		Totals	18-3-19	15-6-17	18-6-20

*Psychology 602 may be substituted for Psychology 413 with the approval of the School of Psychology and Dean of the Graduate School.
**A total of not more than 9 hours of electives may be in advanced ROTC.

Courses of Instruction

NOTE: 4-3-5 *means* 4 *hours class,* 3 *hours laboratory,* 5 *hours credit.*

Psy. 300. Psychology and Contemporary Issues in Society

3-0-3. Prerequisites: None.

This course is designed to acquaint the student with current contributions of the science of behavior toward understanding selected contemporary issues. Course content will focus on human behavior. Topics such as aggressiveness, behavior control, drug addiction, creativity, and sexual behavior will be discussed.

Psy. 303. General Psychology A

3-0-3. Prerequisite: None.

This course is an intensive coverage of the methods and findings of contemporary psychology. Emphasis will be placed upon the scientific approach to the study of behavior and upon topics of maturation and development, learning, and motivation.

Psy. 304. General Psychology B

3-0-3. Prerequisite: Psy. 303.

This is a continuation of Psychology 303. Such topics as individual differences, emotion, perception, and personality will be discussed.

Psy. 400. Developmental Psychology

3-0-3. Prerequisite: Psy. 303.

A comprehensive study of the behavior and development of the child from infancy through adolescence. Emphasis will be given to the results of empirical research on experiences and processes which affect child behavior.

Psy. 401. Industrial Psychology

3-0-3. Prerequisite: None

This course introduces the student to scientific methods of inquiry as they are utilized in the study of human behavior in industry. Emphasis is on scientific and experimental study of individual differences, human relations, psychological aspects of equipment design, learning, and motivation.

Psy. 402. Psychology of Adjustment

3-0-3. Prerequisite: Psy. 303.

This course will deal with the typical individual and the social adjustment problems of normal people. Its chief aim will be to assist the student better to understand himself and his fellow man. The primary approach will be from the view point of objective psychology.

Psy. 403. Introduction to Psychological Testing

3-0-3. Prerequisite: Psy. 401.

This course deals with theoretical and practical issues in psychological measurement, with particular reference to psychological testing. Theoretical concepts of measurement and their implications in testing are stressed. Students have opportunities to administer, take, and evaluate selected tests. Principles of test construction are surveyed.

Psy. 404. Psychology of Advertising

3-0-3. Prerequisites: Psy. 303 and 401.

An analysis of the psychological factors which govern buying activities of consumers. These and other facts are combined to establish the psychological foundations of effective advertising and selling. The psychological aspects of such topics as product testing, advertising media research, copy testing, and consumer and audience research will be discussed.

Psy. 405. Seminar in Organizational Psychology

3-0-3. Prerequisites: Psy. 401 or 410.

The principal focus of this course is on the development and utilization of human resources in an organizational setting. While many of the concepts and methods to be discussed may be utilized in industry, this is not simply a course in "industrial psychology," rather, it is intended to provide the student with knowledge of psychological aspects of organizational functioning, and to encourage the student to equip himself with knowledge, skills and attitudes conducive to further study in this and other areas of psychology.

Psy. 406. Psychological Statistics

2-3-3. Prerequisite: Permission of the instructor.

A study of the applications of statistical techniques to the description, prediction, and control of human behavior. Emphasis will be placed upon the logical aspects of the statistics studied.

Psy. 407. Experimental Psychology I

2-3-3. Prerequisite: Psy. 303.

An introduction to psychological measurement and laboratory techniques. Students will plan, conduct, evaluate, and report experiments dealing with such topics as visual, auditory, tactual, and kinesthetic perception; sensorimotor co-ordination; and human feedback systems. Emphasis will be placed on the applications of the methods of science to the experimental study of human behavior.

Psy. 410. Social Psychology

3-0-3. Prerequisite: Psy. 303.

The behavior of the individual in society is the main concern of this course. Emphasis will be placed on the scientific study of the individual in relation to other individuals and groups.

Psy. 411. Experimental Psychology II

3-3-4. Prerequisites: Psy. 304 and 407, and permission of the instructor.

This course is concerned with the experimental findings in the areas of learning, motivation, and emotion. Students will be required to design and execute several experimental investigations of pertinent problems.

Psy. 412. Psychology of Learning

3-3-4. Prerequisite: Psy. 411, and permission of the instructor.

This course is concerned with an empirical and theoretical analysis of learning. Applications of learning principles to the understanding of human behavior will be considered.

Psy. 413. Applied Experimental Psychology

3-3-4. Prerequisites: Psy. 406 and 412, and permission of the instructor.

Consideration of the applications of the methods and data of experimental psychology.

Psy. 414. Special Problems

0-3-1. Prerequisites: Psy. 406 and 411, and permission of the instructor.

The student will, under the direction of a staff member, do semi-independent work in literature review and/or experimental design.

Psy. 415. Special Problems

3-3-4. Prerequisite: Permission of instructor.

Students will work, under the direction of the instructor, on projects adding to their development beyond the scope of existing courses.

Psy. 420. Special Topics

1-3-2. Prerequisites: Psy. 304 and 407, and permission of the instructor.

The student will, under the guidance of a faculty member, read and study in an area of psychology not represented in the course offerings of the School of Psychology.

Psy. 421. Physiological Psychology

3-0-3. Prerequisites: Psy. 304 and Bio. 211.

This course is designed to acquaint the student with the physiological bases of human and animal behavior. Among the topics to be covered are neurophysiological, endocrinological, and biochemical factors as they relate to sensory and motor functioning, learning, memory, motivation, and behavior disorders.

Psy. 422. Comparative Psychology

2-2-3. Prerequisites: Bio. 211, Psy. 304 and permission of the instructor.

A detailed consideration of the methods and data of comparative psychology, including ethological issues. Students will be expected to read and discuss relevant published literature and to design and conduct, and report, experiments. An effort is made to stress, whenever possible, cross-species behavioral continua.

Psy. 480. (Soc. 480) Socio Psychology—Sociology Measurement Seminar

3-0-3. Prerequisites: Psy. 410 or equivalent and permission of the instructor.

Intensive examination of selected measurement problems in social psychology and sociology. Among topics which may be considered are survey research issues and methodologies, attitude and opinion measurement, sociometric measures, self-report and observational techniques. Specific attention will be given to problems of data processing and analysis. Students will participate in one or more supervised individual or group projects as a means of skill acquisition.

Psy. 484 (Arch. 484) Psychology and Environmental Design I

3-3-4. Prerequisite: Permission of instructor.

This course will include an introduction to, and a review of literature relating to ecological and psychological concepts and issues which are relevant to environmental design, a survey of selected methods for the behavioral assessment of environments, and planning of and participation in a pilot study of a selected setting. The course will be planned and taught conjointly by members of the architecture and psychology faculties.

Psy. 485 (Arch. 485) Psychology and Environmental Design II

3-3-4. Prerequisites: Psy. 484 and permission of instructor.

In this course the student will apply the principles and processes considered in the previous course to the design of a number of small environments. He will be expected to explicitly recognize applicable ecological-psychological issues and his design solutions must be based, insofar as possible, on empirical studies and general behavioral principles. The rationale for selection of specific design options must be presented and defended. The course will be planned and taught conjointly by members of the architecture and psychology faculties.

Psy. 486 (Arch. 486) Special Problems in Psychological Aspects of Environmental Design

Credit to be arranged. Prerequisites: Psy. 484, 485 and permission of instructor.

The student will work on a problem relating to the interaction of environmental design and behavior.

Graduate Courses Offered

NOTE: 4-3-5 *means* 4 *hours class,* 3 *hours laboratory,* 5 *hours credit.*

Psy.	601	Advanced Industrial Psychology	3-0-3
Psy.	602	Applied Experimental Psychology	3-0-3
Psy.	603	Social Psychology	3-0-3
Psy.	604	Human Information Processing	3-0-3
Psy.	605, 6, 7	Proseminar in General Psychology	3-0-3
Psy.	608	Human Motivation	3-0-3
Psy.	609	Social Psychology of Organizations	3-0-3
Psy.	621, 2	Foundations of Psychology	3-0-3
Psy.	623, 4	Design of Psychological Experiments	2-3-3
Psy.	625	Experimental Methods in Psychology	2-3-3
Psy.	626	Response Evaluation	3-0-3
Psy.	627	Human Learning	3-0-3
Psy.	680	Multivariate Analysis	5-0-5
Psy.	700	Master's Thesis	
Psy.	704	Special Problems in Industrial Psychology	Credit to be arranged
Psy.	705	Special Problems in Experimental Psychology	Credit to be arranged
Psy.	706	Special Problems in Engineering Psychology	Credit to be arranged
Psy.	710	Seminar in Industrial Psychology	3-0-3
Psy.	711	Seminar in Experimental Psychology	3-0-3
Psy.	712	Seminar in Engineering Psychology	3-0-3
Psy.	713	Seminar on Psychology and Management	3-0-3
Psy.	721	Sensation and Perception	4-0-4
Psy.	750	Professional Problems	2-0-2
Psy.	800	Doctoral Thesis	

For requirements for the graduate degree in Psychology, consult the *Graduate Bulletin.*

DEPARTMENT OF SOCIAL SCIENCES

Department Head—Patrick Kelly; *Professor Emeritus*—George Hendricks, Robert Scharf; *Callaway Professor of the History of Technology*—Robert S. Woodbury; *Professors*—Edward A. Gaston, Glenn N. Sisk, Willard E. Wright; *Associate Professors*—John C. Gould, Morris Mitzner, Aristotle Scoledes, Sandra W. Thornton; *Assistant Professors*—Numan V. Bartley, James E. Brittain, Jon J. Johnston, James D. McBrayer, Thomas D. Philips, Germaine M. Reed, Lawrence G. Schutte, H. Glyn Thomas; *Instructors*John N. Hines, Willoughby G. Jarrell; *Lecturer*—William H. Peace; *Senior Secretary*—Mrs. Barbara A. Wardlaw.

General Information

The Department of Social Sciences offers course work in four disciplines; History, Philosophy and History of Science, Political Science and Sociology. Each of the four disciplines has a dual function in the academic community of Georgia Tech. On the one hand, they perform their vital traditional roles of helping the student to cultivate a critical awareness and perspective on the perennial evaluative issues that confront man, as an individual and as a member of a complex social order. On the other, they reflect upon and contribute to, the resolution of the scientific and technological issues that are Tech's special province.

United States and Georgia History and Constitution Requirements

The State of Georgia requires that all students must display a knowledge of U.S. and Georgia Constitutions and U.S. and Georgia History.

To complete the requirement in U.S. and Georgia Constitutions, a student must pass Pol. 151 or Pol. 351, or an examination on the U.S. and Georgia constitutions.

To complete the requirements in U.S. and Georgia History, a student must satisfy one of the following conditions:

a. Pass History 101 or 102; or 301 or 302

b. or pass an examination on U.S. and Georgia history

Examinations for both requirements are administered by the Department of Social Sciences during New Student Week each Fall (for entering freshmen only) and each quarter to students who are *first quarter* seniors. Students who elect to take either examination in the first quarter of the senior year have three (3) opportunities that quarter to pass one or both exams. If unsuccessful, the student must then take the appropriate course(s) prior to graduation.

Courses Open Primarily to Freshmen:

NOTE: Freshmen choosing courses in this department are required to take a two-quarter sequence in one of the following fields: History, Philosophy and History of Science, Political Science, Sociology. Then they must take one quarter in one of the other fields of study.

Hist. 101. History of the United States to 1865

3-0-3. Prerequisite: None. *Normally open to freshmen only*

A survey of the social, political and economic history of the United States through the Civil War period with emphasis on selected topics. *Gives exemption from U.S. and Georgia History examination.*

Hist. 102. History of the United States 1865 to Present

3-0-3. Prerequisite: None. *Normally open to freshmen only.*

A survey of the social, political and economic history of the United States from the period of the Civil War to the present with emphasis on selected topics. *Gives exemption from U.S. and Georgia History examination.*

PHS 126. Introduction to Philosophical Analysis

3-0-3. Prerequisite: None.

An understanding of the nature and contribution of philosophy and philosophical analysis is sought through a critical study of selected works. The relation of philosophy to the sciences, religion and society will be emphasized.

PHS 127. Science, Technology and Human Values

3-0-3. Prerequisite: None.

An introductory study of the revolutionary impact of modern science and technology on the characteristic religious, ethical, and social values in the Western tradition. An analysis of the presuppositions and consequences of alternative responses to this revolution will be stressed.

PHS. 128. Intorduction to the History of Science and Technology

3-0-3. Prerequisite: None.

Interpretive study of origins and development of science and technology to the present time. Includes examination of historical details and consequences of scientific, industrial, technological revolutions. Emphasis placed on interaction of science and technology with cultural, social, political, and economic environments.

Pol. 151. Government of the United States

3-0-3. Prerequisite: None.

A study of the structures and functions of the governments of the United States and Georgia. Gives exemption from the United States and Georgia Constitution examination.

Pol. 152. Political Issues

3-0-3. Prerequisite: Pol. 151.

A consideration of selected aspects of governmental policy and current political problems.

Soc. 176. Introduction to the Principles of Sociology

3-0-3. Prerequisite: None.

A study of basic social relations, including social structure and functions, analysis of social processes, and the foundations of personality; and an analysis of social organization, including differentiation, stratification and mobility, population and social change.

Soc. 177. Social Institutions

3-0-3. Prerequisite: Soc. 176.

An analysis of the structure and functions of social institutions, including familial, educational, religious, economic and political; a study of institutional change and social disorganization within the institutions, including crime and deviant behavior, population problems, family instability, juvenile delinquency.

Upper Division Courses:
History

Hist. 301. History of the United States to 1865

3-0-3. Prerequisite: Junior standing. Not open to students who have had History

101.

A survey of the social, political and economic history of the United States through the Civil War period with emphasis on selected topics. Gives exemption from the U.S. and Georgia History Examination.

Hist. 302. History of the United States 1865 to Present

3-0-3. Prerequisite: Junior standing. Not open to students who have had History 102.

A survey of the social, political and economic history of the United States from the period of the Civil War to the present with emphasis on selected topics. *Gives exemption from U.S. and Georgia History Examination.*

Hist. 303. Nineteenth Century Europe

3-0-3.

Modern European history andits impact on world civilization.

Hist. 304. World Problems Since 1914

3-0-3.

A continuation of Hist. 303.

Hist. 306. Recent Latin American History

3-0-3.

Historical evolution of Latin America in recent times, with partioular attention to social change.

Hist. 310. American Diplomatic History

3-0-3. Prerequisite: Hist. 101 or 102, or History Examination.

An historical analysis of United States diplomacy from the Revolutionaly War to the present. Emphasis is placed upon the political, economic, and social factors of American history influencing foreign policy and upon the role of the South in world affairs.

Hist. 312. American Economic History

3-0-3. Prerequisite: Hist. -101 or 102, or History Examination.

Special attention is given to the rise of technology, our industrial system, the westward movement, the development of our banking system, and government regulation of industry.

Hist. 314. History of Georgia

3-0-3. Prerequisite: Hist. 101 or 102, or History Examination.

Through the social, economic and political life of Georgia, the problems which have confronted the state are examined in their historical setting. The relating of Georgia's history to the national scene gives the student a broader perspective of the state's place in the nation.

Hist. 316. United States Colonial History

3-0-3. Prerequisite: Hist. 101 or 102, or History Examination.

Settlement and growth of the English colonies in North America with emphasis on the foundations of American political and economic institutions.

Hist. 317. History of the Old South to 1865

3-0-3. Prerequisite: Hist. 101 or 102, or History Examination.

A study of social, political and economic developments in the South from the colonial period through the Civil War.

Hist. 318. History of the New South Since 1865

3-0-3. Prerequisite: Hist. 101 or 102, or History Examination.

Continues Hist. 317. An examination of social, political and economic developments from the Reconstruction period to the present.

Hist. 320. The American Civil War

3-0-3. Prerequisite: Hist. 101 or 102, or History Examination.

A survey of the major political, economic and military events occurring in both the Union and the Confederacy during the American Civil War.

Hist. 321. Afro-American History

3-0-3. Prerequisite: Hist. 101 or 102, or History Examination.

A historical analysis of the American Negro from the colonial period to the present. Emphasis is placed on the Afro-American's cultural heritage, the institution of slavery, reconstruction, the era of "Jim Crow," and the struggle for civil rights in the twentieth century. Special attention is given to the Negro's contribution to American letters, music and other performing arts.

Hist. 323. United States Social and Intellectual History

3-0-3. Prerequisite: Hist. 101 or 102, or History Examination.

Studies in the social and intellectual traditions of the United States, with emphasis on the more recent period. Assigned readings.

Hist. 336. Technology and Economic Change

3-0-3. Prerequisite: None.

Growth of technology in modern world in its relationship to economic and social change. Craft technology; industrialization invention, origins of mass production and interchangeable parts, power sources, transportation, mechanization of agriculture, technology and large-scale enterprised, new industries.

Hist. 421. The United States Since 1917

3-0-3. Prerequisite: Hist. 101 or 102, or History Examination.

Social, political, economic and diplomatic history of the United States in the middle of the twentieth century is examined as to causes, results and movements.

Philosophy and History of Science

PHS 326. Introduction to Philosophical Analysis

3-0-3. Prerequisite: Not open to students who have had PHS 126.

An understanding of the nature and contribution of philosophical analysis is sought through a critical study of selected works. The relation of philosophy of the sciences, religion, and society will be emphasized.

PHS 328. History of Ancient Philosophy

3-0-3.

A study of the development of philosophy from the early scientific writings of pre-Socratics to Christian thought. The works of Plato and Aristotle will be stressed.

PHS 329. History of Modern Philosophy

3-0-3.

The development of Western thought from Bacon to Kant, with emphasis on the philosophic dimensions of the rise of modern science.

PHS 330. Contemporary Philosophy

3-0-3.

A study of the diverse movements in philosophy from Hegel to Russell, with emphasis on the philosophic response to the development of modern scientific inquiry.

PHS 331. Types of Ethical Theory

3-0-3.

Critical examination of traditional and modern ethical theories; consideration of the theoretical problems of ethics; definitions of "good"; the nature and presuppositions of ethical judgments; the justification of ethical standards.

PHS 334. Contemporary Religious Thought

3-0-3.

An introduction to the development of the most important concepts in modern religious systems. Particular emphasis will be placed on the contributions of both recent philosophical analysis and contemporary theological debate.

PHS 339. Symbolic Logic

3-0-3.

An approach to basic logical notions through use of special symbols.

PHS 341. Survey of Science in the 16th and 17th Centuries

3-0-3.

A study of the scientific discovery and scientific methods from the age of Galileo to the Enlightenment.

PHS 342. A Survey of Science in the 18th and 19th Centuries

3-0-3.

The growth and expansion of modern science from Lavoisier to the close of the 19th century.

PHS 343, 344, 345. History of Engineering

3-0-3.

A study of the development of engineering from ancient times to about 1930. Beginning with a description and analysis of the goals, methods, and status of the engineer in the ancient world set against the social background of the times, the course provides a perspective in terms of which the position and contributions of the engineer in modern times can be evaluated and studied. The development of modern engineering will be treated by concentrating on those key aspects of greatest importance for future engineering development and for economic and social change–coal, steel, textiles, machinery, transportation, electric power, and others.

PHS 346, 347, 348. Philosophy of Science

3-0-3.

An historical and analytic study of the main problems of the philosophy of science, such as the nature of scientific explanation and knowledge, theory and observation, prediction and causality, and criteria of confirmation and the concept of empirical significance.

PHS 428. History of Technology in the United States

3-0-3.

An introduction to the development of technology in the United States as interwoven with its economic and social background and influence. Representative topics: cotton, slavery, and Eli Whitney; interchangeable manufacture and the "American System"; McCormick and prairie agriculture; Samuel Colt and firearms; American machine tools; American shipbuilding–the clipper ship and the iron clad; petroleum–Drake and Rockefeller; the Wright Brothers and aviation; Ford and the automobile.

PHS 430. Theories of Knowledge

3-0-3.

Critical examination of problems related to perception, verification, logic, *a priori* and *a posteriori* knowledge; the meaning and criteria of truth; the presuppositions and cognitive significance of common sense, scientific and philosophical propositions.

PHS 435. Philosophy of Science

3-0-3.

Examination of selected theoretical problems such as: causality, induction, the nature of scientific explanation and the status of inferred entities; consideration of the cultural and philosophical import of certain scientific theories.

PHS 436. History of Electrical Science and Technology

3-0-3. Prerequisite: Senior or Graduate standing.

An interpretive study of the origins and evolution of electrical science and technology since the seventeenth century. Among the topics to be considered are: Franklin's predecessors; Electrical fluids and the mathematization of Electricity; Origins of Electromagnetic Field Theory; Origins of Electrical Technology: Telegraphy, Telephony, and Electrical Lighting; The professionalization of electrical engineering; Developments in electrical power technology: Direct current, Alternating current, High-speed, Turbo-Generator; New technologies of the twentieth century.

PHS 440. Semantics

3-0-3. Prerequisite: Senior standing.

The relations of formal logic and natural languages, sense and referrence, semantical paradoxes, semantic criteria of truth.

PHS 448. Selected topics in the History of Science

TBA.

PHS 449. Selected Topics in the Philosophy of Science

TBA.

Political Science

Pol. 351. American Constitutional Problems

3-0-3.

A study of the structures and functions the United States and Georgia, taught largely through the medium of constitutional law. Such significant problems as federalism, separation of powers, and civil liberties are studied. *Gives exemption from the United States and Georgia Constitution examination.*

Pol. 353. National Defense Policy

3-0-3. Prerequisite: Pol. 151 or consent of Instructor.

An analysis of the security policies of the United States. Emphasis is placed on the methods and instruments in the selection, establishment and execution of the policies within the existent or projected historical domestic and international situation. The elements of national power and state of technology are foci among many relevant variables.

Pol. 354. United States Military Policies

3-0-3.

A critical examination of American military policies and operations from the Revolution to the present. Emphasis is placed on the changing modes of military affairs from the limited wars of the 18th century to the guerrilla wars subsequent to WWII.

Pol. 356. American Foreign Policy

3-0-3. Prerequisite: Hist. 310, or consent of Instructor.

A study of the formulation of foreign policy; the structure and function of the State Department and of other government agencies concerned with the conduct of foreign policy. In-depth consideration of selected aspects of current foreign policy.

Pol. 361. Foundations of National Power and International Relations

3-0-3. Pol. 151 or consent of Instructor.

The course is designed to acquaint the student with the United States' power position in world affairs, relative to that of other powers, and with the events in the world today which have an impact on that position. International relations are emphasized.

Pol. 362. International Organization

3-0-3. Prerequisite: Pol. 361 or consent of Instructor.

An examination of the evolution of international organizations; analysis of their structures and functions; consideration of their impact on international politics; the future of international organizations.

Pol. 365. Latin American Governments and Politics

3-0-3. Prerequisite: Pol. 151 or consent of Instructor.

A survey of governmental and political processes in the Latin American countries.

Pol. 366. The Developing Nations

3-0-3. Prerequisite: Pol. 151 or consent of Instructor.

In-depth study of selected underdeveloped nations; the structures and functions of their governments; the problems of economic and political development; the impact of these nations on world affairs.

Pol. 367. Western European Governments and Politics

3-0-3. Prerequisite: Pol. 151 or consent of Instructor.

Comparative analysis of governmental and political processes in the nations of Western Europe.

Pol. 371. American Political Parties

3-0-3. Prerequisite: Junior standing.

Consideration of the parties' development through history, their functional significance for the institutions of government, and their ability to arouse and sustain mass support at election time. Discussion of recent trends in party behavior.

Pol. 372. Urban Government and Politics

3-0-3. Prerequisite: Pol. 151.

Examines municipal government in U. S. Focuses on: legal position of local forms of government *vis a vis* the state and federal governments, effects of urbanization and urbanism, historical function of municipal government and prospects for the future.

Pol. 373. Urban Political Problems

3-0-3. Prerequisite: Pol. 151.

Examines political behavior of groups and individuals in city politics. Includes politics of ethnic groups, roles of leaders of these groups, and how they interact with the planners and traditional power structure.

Pol. 374. Urban Public Policy

3-0-3. Prerequisites: Urban Government and Politics or Urban Political Problems.

Examines policy-making of urban planning; planning principles, welfare and family planning, citizens' control over policies, means for assessing effects of policy on the city.

Pol. 450. Special Topics in Political Science

TBA.

Pol. 465. Communist Political Systems

3-0-3. Prerequisite: Pol. 151 or consent of Instructor.

An analysis of the governmental and political processes in the communist governments.

Pol. 470. Political Theory

3-0-3.

A study of the development of classical political thought from Plato to the twentieth century.

Pol. 471. Contemporary Political Thought

3-0-3.

An analysis of recent political theory, with emphasis on radical ideologies. The development of Marxism, Fascism, and American ideologies will be considered.

Pol. 474. Science, Technology and Public Policy

3-0-3.

An examination of the relationship between science and government, including the role of science-technology in policy making and the political factors influencing scientific activity. Consideration of selected issues of public policy reflecting the interaction of government and science, such as federally supported research, atomic energy and health.

Pol. 475. Science, Technology and World Politics

3-0-3.

An analysis of the impact of science-technology on the international system; the role of science and technology in the foreign policy process; the patterns of international scientific collaboration and competition. A consideration of selected issues involving science and international politics: the moon race, the uses of outer space, arms control and disarmament.

Sociology

Soc. 376. Urbanization

3-0-3. Prerequisite: Soc. 176.

Growth of metropolitan communities, differentiation of functions; urban complexity; ecological areas; the city as a way of life, measures and trends in the process or urbanization.

Soc. 378. Statistics for Planning

3-0-3.

Statistical principles for analysis of economic, social, and population data; sampling; measures of central tendencies; normal curve; testing of findings; correlation and arriving at conclusions.

Soc. 379. Demographic Analysis

3-0-3. Prerequisite: Soc. 176, Soc. 378.

Factors affecting population problems: population growth, fertility, mortality, migration, distribution and composition.

Soc. 380, 381, 382. Special Topics in Urban Problems

1-6-3.

Direct involvement in socially usful projects dealing with urban problems. Projects to be selected, but would include such things as teaching classes in basic adult education or remedial education, registering voters in slum areas, organizing meaningful recreation programs in low-income areas, and working with co-operatives serving low-income areas. Field work supplemented by readings, research, and weekly classroom discussions.

Soc. 383. Ethnic Minorities in American Society

3-0-3.

An analysis of the social, economic and technological roles and contributions of various racial and cultural minorities in forming the American culture of today. Special emphasis will be placed on intergroup relations in the urban setting, including minority-majority relationships, and relationships among the ethnic minorities themselves.

Soc. 384. Social Stratification and Mobility

3-0-3. Prerequisite: Soc. 176 or consent of Instructor.

Process of stratification, including the criteria for and characteristics of stratification; relationships between social position; vertical and horizontal mobility and implications of stratifications for the functioning of society.

Soc. 385. Social Problems of Industry

3-0-3.

Analysis of the factory and the business enterprise as social institutions, with particular attention to the contrasting functions of formal and informal organization, and to the significance of co-operation, authority, communication, status and group norms in the work situation.

Soc. 386. Individual and Society

3-0-3.

A study of interpersonal relations in the small or informal group, seen in a variety of contexts, such as the family, and in educational, military, or industrial organizations.

Soc. 388. Urban Sociology

3-0-3. Prerequisite: Soc. 176.

Introduces student to basic concepts of sociology as applied to urban phenomena. Concepts covered-characteristics of the city, urban and rural cultures, urbanized social relations, nature of urbanism and consequences for human personality.

Soc. 390. Urban Ecology and Demography

3-0-3. Prerequisite: Soc. 176.

Involves application of ecological perspective to the study of urban phenomena; human spatial distribution in and around cities, relation of pupulation to its physical environment, theories of city location and patterns of city growth.

Soc. 476. Technology and Society

3-0-3. Prerequiste: Senior or graduate standing.

This course analyzes the social conditions which promote or retard technological activity. Particular emphasis is placed on the historical development of technology in Western society and on the social role of the scientific and engineering professions in that development.

Soc. 480. Social Psychology-Sociology Measurement Seminar

3-0-3. Prerequisite: Psy. 410 or equivalent and permission of instructor.

Intensive examination of selected measurement problems in social psychology and sociology. Among topics which may be considered are survey research issues and methodologies, attitude and opinion measurement, sociometric measures, self-report and observational techniques. Specific attention will be given to problems of data processing analysis. Students will participate in one or more supervised individual or group projects as a means of skill acquisition.

490. Special topics in Sociology

TBA.

Soc. 488. Seminar in Contemporary Urban Sociology

3-0-3. Prerequisites: Soc. 176 and consent of instructor.

Extensive and critical review of literature in field. Purpose of course is to keep students abreast of latest thinking concerning urban phenomena and problems.

Soc. 492. Seminar in Comparative Urban Development

3-0-3. Prerequisite: Soc. 176 and consent of instructor.

Entails cross-national comparison of cities and urban regions, most appropriate model for understanding cities and urban regions, differential offices of urbanization on different societies and strategies for handling problems.

Graduate Courses Offered

Pol.	651	Governmental Aspects of Planning	3-0-3
Soc.	677	Planning for People	3-0-3

A. FRENCH TEXTILE SCHOOL

(Established in 1899)

Director—James L. Taylor; *Callaway Professor*—Joseph H. Brant; *Professors*—Walter C. Carter, Raymond K. Flege; *Associate Professor and Assistant Director*—James W. McCarty; *Associate Professors*—Winston C. Boteler, Gerald B. Fletcher, Ralph C. Lathem; *Assistant Professors*—L. Howard Olson, Rick A. Porter*; *Lecturer*—C. Willard Ferguson; *Principal Research Technician*—Jack R. Kilgor; *Senior Laboratory Mechanic*—William R. Tucker; *Laboratory Mechanic*—Howard R. Dotson; *Principal Secretary*—Loretta Pharris; *Senior Secretary*—Dianne Lane.

General Information

This school, housed in the modern Harrison Hightower Building, offers courses leading to the degrees of Bachelor of Textile Engineering, Bachelor of Science in Textile Chemistry and Bachelor of Science in Textiles. Each degree may be taken as a regular four-year course, or in accordance with the five-year cooperative plan.

Graduate courses are also provided leading to the degrees of Master of Science in Textile Engineering, and Master of Science in Textiles.

The school is vitally interested in serving the expanding textile industry, and the courses provided have as their objective the training of students for employment in this industry and its related branches.

During the first two years the work is largely fundamental, including the basic courses of Mathematics, Physics, and Chemistry, followed by more specialized training in the field of Textiles during the Junior and Senior years.

Instruction through classroom, library, and experimental laboratory practice is arranged to give both a theoretical and practical understanding of textile procedure. Original work on the part of the student is encouraged in both regular and graduate courses.

Supervised visits to textile plants in this area are made periodically by Junior and Senior classes, thus giving the student contact with industry, and textile operations on a production scale.

*On leave.

Program for B. of Textile Engineering Degree

Freshman Year

Course	No.	Subject	2st Q.	2nd Q.	3rd Q.
Chem.	104-5	Inorganic Chem.	4-3-5	4-3-5	....
E. Graph.	170-171	Visual Comm. and Eng. Design........................	2-3-3	2-3-3	....
Math.	107-8-9	Calculus I, II, III...........	5-0-5	5-0-5	5-0-5
Physics	227	Physics..........................	....	....	4-3-5
Electives		....	2-0-2	2-0-2	2-0-2
P.T.	101-2-3	Physical Training..........	0-4-1	0-4-1	0-4-1
Gen.	101	Orientation...................	1-0-0	....	....
Text.	101	Textile Orientation.......	1-0-1	....	....
Hum./S.S./M.L.*** Electives		Humanities/Social Science/ Modern Language......	3-0-3	3-0-3	3-0-3
		Totals........................	18-10-20	16-10-19	14-7-16

NOTE: Under Quarters, 3-3-4 means 3 hours class, 3 hours lab., 4 hours credit.

*Choice of: (1) two quarters of one of the following: American History, Political Science, Philosophy and History of Science, or Sociology; and the third quarter selected from one of the three remaining areas; or (2) three quarters of Modern Language in either German, French, or Spanish. Three quarters of eigher M.L. or S.S. are required.

**These free elective courses may be taken at any time during a student's course of study. However, these six credit hours may be satisfied by selecting basic ROTC. If basic ROTC is elected by the student, then it must be scheduled beginning the first quarter the student is enrolled. For further details, see page 28 of the catalog.

Sophomore Year

Course	No.	Subject	1st Q.	2nd Q.	3rd Q.
ESM	205	Statics...........................	3-0-3	....	....
ESM	309	Dynamics I..................	....	3-0-3	....
Math.	207	Calculus IV..................	5-0-5	....	....
Math.	208	Calculus & Linear Algebra.....................	....	5-0-5	....
Math.	209	Ordinary Differential Equations..................	....	....	5-0-5
Physics	228-9	Physics..........................	4-3-5	4-3-5	....
P.T.	201-2-3	Physical Training..........	0-4-1	0-4-1	0-4-1
Text.	202	Survey of Fiber Processing.................	....	....	3-0-3
Hum./S.S./M.L.*** Electives		Humanities/Social Science/ Modern Language......	3-0-3	3-0-3	3-0-3
Free Elective		....	....	....	3-0-3
		Totals........................	15-7-17	15-7-17	14-4-15

Junior Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Text.	470	Fiber Science................	3-0-3	....	....
Text.	471	Fiber Processing Principles..................	....	4-3-5	....
Text.	472	Fabric Construction......	....	....	4-3-5
ESM	334	Mechanics of Deformed Bodies.......................	....	5-0-5	....
M.E.	313	Mechanisms	....	3-0-3	....
M.E.	320	Thermodynamics..........	4-0-4	....	....
Mgt.	204	Survey of Economics....	....	....	3-0-3
C.E.	324	Fluid Mechanics...........	....	....	3-3-4
Hum./S.S./M.L.*** Electives		Humanities/Social Science/ Modern Language	3-0-3	3-0-3	3-0-3
Free Electives		....	6-0-6	....	....
		Totals	16-0-16	15-3-16	13-6-15

Senior Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Text.	414	Phy. Text. Analytical Methods....................	2-3-3	....	....
I.E.	339	Eval. of Engr. Data	3-0-3	....	....
Ch.E.	350	Elem. of Heat & Mass Transfer.....................	3-0-3	....	....
E.E.	325	Elec. Circuits & Fields..	2-3-3	....	....
Text.	453	Textile Plant Engineering...............	....	2-3-3	....
Text.	454	Seminar	....	1-0-1	....
Text.	462	Engr. Analysis of Dyeing Sys................	....	3-3-4	....
E.E.	327	Power Conversion.........	....	2-3-3	....
Engl.	320	Technical Writing..........	....	....	3-0-3
I.E.	425	Engineering Economy...	....	....	3-0-3
Hum./S.S./M.L.*** Electives		Humanities/Social Science/ Modern Language	3-0-3	3-0-3	3-0-3
Free Electives		....	3-0-3	3-0-3	6-0-6
		Totals	16-6-18	14-9-17	15-0-15

***These must be selected from the approved list on page 38 of the current catalog.
Not more than 9 hours of electives may be in Advanced ROTC.
I.E. 304 and 315; or Math. 407 and 425 and one hour electives; or Chem. 340, 341 and 343 may be substituted for Mech. 421 and M.E. 467.

Program for B.S. in Textile Chemistry

Freshman Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Chem.	111-12	General Chemistry........	4-3-5	4-3-5	....
Chem.	209	Chemical Principles.......	....	....	3-3-4
E.Gr.	105-15	Engineering Graphics....	....	0-6-2	0-6-2
Engl.	107-8-9	Introduction to Literature	3-0-3	3-0-3	3-0-3
Math.	107-8-9	Calculus, I, II, III..........	5-0-5	5-0-5	5-0-5
M.L. S.S.	or	Modern Language or Social Sciences.............	3-0-3	3-0-3	3-0-3
P.T.	101-2-3	Physical Training..........	0-4-1	0-4-1	0-4-1
Text.	101	Textile Orientation.......	1-0-1	....	....
Gen.	101	Orientation..................	1-0-0	....	....
Elective*		....	2-0-2	2-0-2	2-0-2
		Totals........................	19-7-20	17-13-21	16-13-20

Sophomore Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Chem.	340-1-2	Organic Chemistry........	3-0-3	3-0-3	3-0-3
Chem.	343-6-7	Organic Chem. Laboratory	0-6-2	0-3-1	0-3-1
Math.	207	Calculus IV..................	5-0-5	....	....
Math.	208	Calculus & Linear Algebra......................	....	5-0-5	....
Phys.	227-8-9	Physics..........................	4-3-5	4-3-5	4-3-5
Engl.	201	Survey of the Humanities................	....	....	3-0-3
P.T.	201-2-3	Physical Training..........	0-4-1	0-4-1	0-4-1
		Totals........................	12-13-16	12-10-15	10-10-13

*These free elective courses may be taken at any time during a student's course of study. However, these six credit hours may be satisfied by selecting basic ROTC. If basic ROTC is elected by the student, then it must be scheduled beginning the first quarter the student is enrolled. For further details, see page 28 of the catalog.

Junior Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Chem.	331-32	Physical Chemistry	3-0-3	3-0-3	....
Chem.	339	Physical Chemistry Lab	....	0-6-2	....
Engl.	202-3	Survey of the Humanities	3-0-3	....	3-0-3
Text.	202	Survey of Fiber Processing..................	3-0-3	....	....
Biol.	413	Air & Water Pollution...	3-0-3	....	....
Text.	392	Structure & Organic Polymers....................	....	3-3-4	....
Text.	470	Fiber Science................	....	3-0-3	....
Text.	471	Fiber Proc. Principles....	....	....	4-3-5
Text.	457	Chem. & Chem. Procl of Fibers Text., I............	....	....	3-3-4
Electives*		....	3-0-3	3-0-3	3-0-3
		Totals	15-0-15	12-9-15	13-6-15

Senior Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
I.E.	339	Eval. of Engineering Data..........................	....	....	3-0-3
Engl.	320	Technical Writing..........	....	3-0-3	....
Text.	414	Physical Text. Analytical Methods.....................	2-3-3	....	....
Text.	458	The Chem. & Chem. Proc. of Fib. & Text II............	3-3-4	....	....
Text.	415	Chem. Text. Analytical Methods.....................	....	2-3-3	....
Text.	454	Seminar	....	1-0-1	....
Text.	461	Textile Chemistry.........	....	3-0-3	....
Text.	438	Textile Cost Analysis....	....	....	3-3-4
Text.	439	Textile Instrumental Analysis.....................	....	....	1-6-3
Electives*		....	3-0-3	6-0-6	6-0-6
Text.	472	Fabric Construction......	4-3-5	....	....
		Totals	12-9-15	15-3-16	13-9-16

*Of the 24 elective hours shown for the Junior and Senior Years, six hours must be taken from the course listed on page 38.

Program for B.S. in Textiles

Freshman Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Chem.	104-5	General Chemistry........	4-3-5	4-3-5	....
Engl.	107-8-9	Introduction to Literature	3-0-3	3-0-3	3-0-3
Math.	100	Algebra & Trigonometry	5-0-5	....	....
Math.	105-6	Calculus for Management	....	5-0-5	5-0-5
M.L.	or	Modern Language or			
S.S.	*	Social Sciences..............	3-0-3	3-0-3	3-0-3
E.Gr.	105	Engineering Graphics....	....	....	0-6-2
Text.	101	Textile Orientation.......	1-0-1	....	....
Gen.	101	Orientation..................	1-0-0	....	....
P.T.	101-2-3	Physical Training..........	0-4-1	0-4-1	0-4-1
Elective**		....	2-0-2	2-0-2	2-0-2
		Totals	19-7-~~20~~ 19	17-7-19	13-10-~~16~~ 17

NOTE: Under Quarters, 3-3-4 means 3 hours class, 3 hours lab., 4 hours credit.

*Choice of: (1) two quarters of one of the following: American History, Political Science, Philosophy and History of Science, or Sociology; and the third quarter selected from one of the three remaining areas; or (2) three quarters of Modern Language in either German, French, or Spanish. Three quarters of either M.L. or S.S. are required.

**These free elective courses may be taken at any time during a student's course of study. However, these six credit hours may be satisfied by selecting basic ROTC. If basic ROTC is elected by the student, then it must be scheduled beginning the first quarter the student is enrolled. For further details, see page 28 of the catalog.

Sophomore Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Phys.	211-12-13	Physics..........................	4-0-4	4-0-4	4-0-4
Engl.	201-2-3	Survey of the Humanities	3-0-3	3-0-3	3-0-3
Econ.	204	Survey of Economics....	3-0-3	....	....
Mgt.	220	Industrial Organization.	....	....	3-0-3
Text.	216-217	Yarn Processing, I, II	3-3-4	3-3-4	....
Text.	271	Computer Applications in Text......................	....	....	2-3-3
P.T.	201-2-3	Physical Training..........	0-4-1	0-4-1	0-4-1
Electives		....	......	3-0-3	2-0-2
		Totals	13-7-15	13-7-15	14-7-16

Junior Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Mgt.	325	Law I	3-0-3	....	....
Mgt.	335	Accounting Prin. & Applications	....	3-0-3	....
I.E.	349	Elementary Quality Control	....	....	3-0-3
I.E.	416	Motion and Time Study	2-3-3	....	....
Text.	334-335	Woven Structures, I, II..	3-3-4	3-3-4	....
Text.	336	Structures other than Woven	....	....	3-3-4
Text.	391	Intro. to Textile Chemistry	3-3-4	....	....
Text.	392	Structure of Organic Polymers	....	3-0-3	....
Text.	457	Chemical Processing of Fibers & Text., I	....	....	3-3-4
Text.	470	Fiber Science	....	....	3-0-3
Engl.	315	Public Speaking	....	3-0-3	....
Electives*			3-0-3	3-0-3	3-0-3
		Totals	14-9-17	15-3-16	15-6-17

Senior Year

Course	*No.*	*Subject*	*1st Q.*	*2nd Q.*	*3rd Q.*
Engl.	320	Technical Writing	3-0-3	....	....
Mgt.	316	Finance Survey for Engr.	....	3-0-3	....
Mgt.	317	Industrial Marketing	3-0-3	....	....
Mgt.	459	Ind. Relations in the Piedmont Reg.	....	....	3-0-3
Text.	458	Chem. Processing of Fibers & Text, II	3-3-4	....	....
Text.	414	Physical Text. Analytical Methods	2-3-3	....	....
Text.	415	Chem. Textile Analytical Methods	....	2-3-3	....
Text.	451	Text. Plant Design & Layout	....	....	3-0-3
Text.	454	Textile Seminar	....	....	1-0-1
Text.	456	Special Problems	....	1-6-3	....
Text.	438	Textile Cost Analysis	....	....	3-3-4
Electives*			3-0-3	6-0-6	6-0-6
		Totals	14-6-16	12-9-15	16-3-17

*Not more than 9 hours of elective may be in advanced ROTC.

Courses of Instruction

NOTE: 4-3-5 *means* 4 *hours class,* 3 *hours laboratory,* 5 *hours credit.*

Tex. 101. Introduction to Textiles

1-0-1.

An orientation to textiles. This course is a preview of the total fibers and textile industry. The student should be in a better position to evaluate his potential interest in a career in textile engineering, manufacturing, marketing, and research.

Tex. 201. Survey of Fibrous Materials

3-0-3.

A thorough survey of natural and synthetic fibers used in the Textile Industry.

Tex. 202. Survey of Fiber Processing

3-0-3.

A survey course in Yarn Manufacturing covering the theory and principles of processing natural and synthetic fibers.

Text. 216. Yarn Processing I

3-3-4. Prerequisite: Sophomore standing.

The first of two courses designed to cover the fundamental theory and practice of processing fibers into yarns. This course covers the processing systems from opening through carding for all types of fibers.

Text. 217. Yarn Processing II

3-3-4. Prerequisite: Textiles 216.

The second course of the two quarter sequence covering the fundamental theory and practice of fiber processing. This course covers processing systems from roving through twisting. Included are the various systems and calculations for long draft equipment and the newer procedures for texturizing and bulking of man-made yarns in several different applications.

Tex. 251. Survey of Fabric Production

3-0-3.

A survey course in the design, construction and utilization of fabrics made from both natural and synthetic fibers. (Not open to Textile Students.)

Tex. 252. Survey of Dyeing and Finishing of Textile Materials

3-0-3.

A survey course covering dyeing and finishing of textile materials made from both natural and synthetic fibeopen to Textile Students.)

Tex. 271. Computer Applications in Textiles

2-3-3. Prerequisite: Sophomore standing.

Emphasis is placed on application of computer oriented techniques to textile problems. Computer languages are not stressed and no previous computer language experience is required. Digital and analog computers are employed in solving various problems. Simulation and linear programming techniques are used in most cases.

Tex. 334. Woven Structures I

3-3-4. Prerequisite: Sophomore standing.

This course covers a study of standard fabrics, fabric construction, and fabric geometry. Also included is a study of the dynamics of weaving machinery and basic structural design.

Tex. 335. Woven Structures II

3-3-4. Prerequisite: Textiles 334.

A study of the more complex mechanisms of weaving machinery including the newer developments in higher speed equipment. The designing of some of the more intricate fabrics and the preparation of warps for weaving is also discussed.

Tex. 336. Fabric Structures Other than Woven

3-3-4. Prerequisite: Tex. 335 or consent of instructor.

The design and production of fabrics other than woven materials. Includes knitted fabrics, tufted fabrics and other classes of fabrics in a general group known as non-woven fabrics.

Tex. 391. Introduction to Textile Chemistry

3-3-4. Prerequisite: Chem. 103.

This course is an introduction to the study of chemistry as it applies to fibers, dyes, finishes, and polymers.

Tex. 392. Structure of Organic Polymers

3-0-3. Prerequisites: Tex. 391 and Phys. 213.

This course includes a study of the chemical and physical structure of organic polymers and the relationship of their structure to properties. Emphasis is placed on naturally occurring fibrous polymers and those synthetic polymers which can be formed into fibers and/or films.

Tex. 414. Physical Textile Analytical Methods

2-3-3. Prerequisites: I.E. 349 and Senior Textile standing.

Ths physical analysis of both natural and man-made fibers and the yarns or other structures made from the different fibers. The use of statistical quality control techniques to make effective use of the developed data is stressed.

Tex. 415. Chemical Textile Analytical Methods

2-3-3. Prerequisite: Textiles 414.

This course is designed to acquaint the student with the chemical analytical procedures employed by the textile industry and to show how these procedures are used in solving industrial technical problems.

Tex. 422. Jacquard Design and Weaving

2-3-3. Prerequisite: Tex. 334.

A course covering the designing of Jacquard patterns and the techniques involved in the transfer of design to the fabric.

Tex. 438. Textile Cost Analysis

3-3-4. Prerequisite: Senior Textile standing.

A course covering the basic principles of distributing the costs of materials, labor, and overhead to the various operations within a textile enterprise. Depreciation and machinery replacement, marketing costs and financial statements are studied. The use of computers to store data and generate needed reports and the interpretation of these reports is also covered.

Tex. 439. Textile Instrumental Analysis

1-6-3. Prerequisite: Tex. 415.

Separation and instrumental analysis of dyes, surfactants, resin finishes and other textile chemicals are covered. Characterization of fibers and elucidation of chemical fiber damage are studied. Computers are used for data reduction. Accent is placed on spectrophotometric, colorimetric, chromatographic and differential thermal analysis although, other methods are used. The course is culminated by the analysis of a commercially compounded textile product.

Tex. 451. Textile Plant Design and Layout

3-0-3. Prerequisite: Tex. 217 and 335.

Includes problems of mill organization, equipment and layout of machinery, equipment cost, problems of conversion when changing machinery to manufacture a different product.

Tex. 453. Textile Plant Engineering

2-3-3. Prerequisites: Tex. 217 and E.E. 325.

This course acquaints the students with the selection and cost of process equipment, organization programs, plant layouts and the proper equipment for air-conditioning, lighting, power and material handling.

Tex. 454. Seminar

1-0-1. Prerequisite: Senior standing.

Specific topics concerned with scientific literature; what industry expects of graduates in textiles and similar subjects are covered by experienced speakers.

Tex. 455. Textile Engineering Problems

1-6-3. Prerequisite: Senior standing in Textile Engineering.

Special problems involving analytical or experimental investigations in the field of Textile Engineering.

Tex. 456. Special Problems in Textiles

1-6-3. Prerequisites: Senior standing in Textiles.

Special problems involving analytical or experimental investigations in the field of textiles and/or textile chemistry.

Tex. 461. Textile Chemistry

3-0-3. Prerequisite: Tex. 457 or Chem. 342.

Chemical principles used in the development of process formulae are discussed. Chemical aspects of finishing processes are considered.

Tex. 462. Engineering Analysis of Dyeing and Finishing Systems

3-3-4. Prerequisites: Ch.E. 350 and C.E. 324.

Design and operating principles of systems employed are covered.

Tex. 464. Dyeing Systems

3-0-3. Prerequisite: Phys. 227 and Senior standing.

The physical structure and mechanical properties of fibers are studied. Methods for evaluating fiber properties of fibers are studied. Methods for evaluating fiber properties and relating them to performance characteristics of yarn and fabric structures are covered.

Tex. 471. Fiber Processing Principles

4-3-5. Prerequisite: Phys. 211 and Senior standing.

Operational methods and physical principles employed for conversion of fibers into yarns and related structures are analyzed and evaluated. Analytical methods for characterizing the yarn and intermediate products are studied.

Tex. 472. Fabric Construction—Analysis and Design

4-3-5. Prerequisite: Tex. 471.

Principles embodied in the design and operation of machines for weaving and knitting are studied. Properties and performance characteristics of fabric are also covered.

Tex. 473. Chemical Processing of Textile Materials

3-0-3. Prerequisite: Chem. 105 and Senior standing.

Acquaints students with those basic chemical principles that are made use of in fiber manufacturing and textile processing.

Graduate Courses Offered

Tex.	601, 2, 3	Dynamics of Fiber Processing Systems	3-0-3
Tex.	607, 608	Problems in Fiber Processing Systems	0-6-2
Tex.	611	Physical Methods of Investigating Textiles	3-6-5
Tex.	612	Process Control in the Textile Industry	3-0-3
Tex.	616	Engineering Properties of Fibrous Materials	3-0-3
Tex.	636	Origin, Preparation and Structure of Fibrous Substrates	5-0-5
Tex.	637	Fundamental Aspects of Dyeing Processes	3-0-3
Tex.	638	Chemical Technology of Stabilization Processes	3-0-3
Tex.	681, 2, 3	Special Topics	3-0-3
Tex.	700	Master's Thesis	
Tex.	701, 2, 3	Seminar	1-0-0
Tex.	704, 5, 6	Special Problems in Textiles and Textile Engineering	Credit to be arranged

(Complete details about these courses are contained in the *Graduate Bulletin*, a copy of which is available upon request.)

BIOENGINEERING CENTER

Interim Director—Edwin J. Scheibner; *Associate Director*—Frederick Dixon; *Professional Staff*—Frank S. Longshore and Robert M. Mason; *Secretary*—Elizabeth M. Younger.

The Bioengineering Center was authorized by the Regents of the University System in November 1969. Edwin J. Scheibner, Ph.D., Research Professor of Physics and Chief of the Physical Sciences Division of the Engineering Experiment Station, was appointed Interim Director for the organization and initial development of the Center, which operates under the Office of the Vice President for Academic Affairs.

Bioengineering has been defined as "the application of the knowledge, techniques, and approaches of the physical and engineering sciences to the problems and research areas of the life sciences." The Center at Georgia Tech is intended to provide a focal point for bioengineering in the University System of Georgia and among other interested organizations and institutions in the Southeast, such as the Emory University School of Medicine. Major functions of the Center include the coordination of technical and personnel resources to provide for effective interaction among the various disciplines and projects, the development of an information and communications exchange for pertinent research proposals to provide assistance in obtaining funding, and the encouragement and promotion of research studies within the broad area of bioengineering. It will, furthermore, maintain an awareness of potential applications of research results and develop methods for transferring such knowledge.

There is no designated degree program in Bioengineering at Georgia Tech. However, the students interested in this interdisciplinary area may prepare for later participation in bioengineering research activities and graduate study by taking appropriate undergraduate electives while following the basic curriculum of the School in which they choose to enroll. Currently available offerings include: Principles of Biology (Biol. 210-1-2), Comparative Anatomy (Biol. 341), Cytology (Biol. 431), General Physiology (Biol. 443-4), Biochemistry (Chem. 447), Elementary Biophysics (Phys. 456-7), Biophysics Laboratory (Phys. 458), Physiological and Biomechanical Analysis of Work (ISyE 313), Bioelectronics (E.E. 481), and Bio-Mechanical Design (M.E. 494). Special Problem course credits are available at the senior level under most degree programs. These afford opportunities for the student to investigate applications of his own field of study to specific problem areas in medicine or biology.

ENVIRONMENTAL RESOURCES CENTER

Director and Regents' Professor–Carl E. Kindsvater; *Assistant Director and Lecturer*–Clarence M. Conway; *Professor*–Willard M. Snyder (part-time); *Associate Professors*–L. Douglas James, Gene E. Willeke; *Assistant Professor*–Eugene A. Laurent; *Instructor*–F. William Kroeck; *Principal Secretary*–Mrs. Willie G. Gibson; *Secretary*–Miss Judith W. Nissley; *Advisory Council*–Harry L. Baker, Jr., Walter L. Bloom, Sherman F. Dallas, Maurice W. Long, Thomas E. Stelson, Sam C. Webb, Henry S. Valk, Carl E. Kindsvater (Chairman).

The Environmental Resources Center at the Georgia Institute of Technology was established in March 1970 by action of the Board of Regents of the University System of Georgia. It is the successor to the Water Resources Center, which was established in 1963. The purpose of the Center is to initiate, facilitate, and coordinate efforts designed to bring the full competence of the Institute to bear on all facets of environmental resources education and research. Its activities and policies are developed and carried out under the guidance of the Advisory Council, which is composed of appropriate administrative officers. Contacts with related research and training programs are maintained through School Directors and Department Heads, with assistance from ad hoc committees composed of faculty and staff representatives.

Through its activities, the Center fosters coordinated programs of education and research related to environmental management. It places special emphasis on multidisciplinary, problem-focused programs which involve interaction between science and technology, socio-economic systems, and the natural environment.

The Center does not offer a designated degree. Instead, it encourages the development of multidepartmental curricula augmented by special courses and directed studies in the interdisciplinary aspects of environmental problems. It stimulates and coordinates Georgia Tech's involvement in off-campus and service activities related to environmental resources. It seeks funds to support education and research in relevant subject areas, and it provides leadership and coordination for interdisciplinary teams, committees, short courses and conferences, and publications. As one of its most important functions, the Environmental Resources Center serves as a center for the storage and exchange of information regarding ongoing research and educational programs and public service activities.

In 1965 the Center (then the Water Resources Center) was authorized by the General Assembly of Georgia to administer Title I of the Federal Water Resources Research Act in the State. To advise the Center in carrying out this responsibility, the Board of Regents appointed a Joint Tech-Georgia Advisory Committee on Water Resources Research comprised of representatives of both Georgia Tech and the University of Georgia.

HEALTH SYSTEMS RESEARCH CENTER

Director and Regents' Professor–Harold E. Smalley.

Adjunct Professors–Walter L. Bloom (Biology), Mark D. Brown (Radiology, MCG), J. Rhodes Haverty (Allied Health Sciences, GSU), William A. Scoggin (Obstetrics and Gynecology, MCG), Vladimir Slamecka (Information and Computer Science), Robert E. Stiemke (Civil Engineering), Richard Wilson (Architecture), George · R. Wren (Health Administration, GSU), Thomas J. Zwemer (Dentistry, MCG); *Adjunct Associate Professors*– Philip Adler, Jr. (Industrial Management), F. Levering Neely (Medicine, Emory), W. Loren Williams (Psychology, MCG).

Assistant Professors– Gerald L. Delon, Joseph A. Harrison, James B. Mathews.

Senior Systems Engineers– Richard M. Bramblett, William G. Sullivan; *Research Engineers* – John W. Coyle, James F. Smith; *Research Scientist*–Robert M. Mason; *Research Assistants*–Jan R. Gustafson, Gerald B. Widegren.

Administrative Assistant–Edwin M. Sheats; *Principal Secretary*–Dorothy C. Brutko; *Senior Secretary*–April Maddox; *Secretary*–Rose M. Combee; *Research Technicians*–Lynn G. Floyd, Karenan P. Stubbs.

Consultants–John R. Freeman (University of Florida), Glenn M. Hogan (Georgia Hospital Association), Frank R. Mark (Regional Medical Program Service, USPHS).

Representatives of Cooperating Institutions–J. Gordon Barrow (Georgia Regional Medical Program), A. Evan Boddy (Cherokee Atomedic Hospital), Russell R. Chambers (Atlanta Area Presbyterian Homes), Rod Clelland (Central State Hospital), Richard E. Gillock (Eugene Talmadge Memorial Hospital, MCG), J. Fred Gunter (South Fulton Hospital), Douglas B. Kendrick (Grady Memorial Hospital), Raphael B. Levine (Metropolitan Atlanta Council for Health), Lee F. Nichols (Holy Family Hospital), William W. Stewart (Forward West Professional Complex), Hulett D. Sumlin (Piedmont Hospital).

General Information

The *Health Systems Research Center* (HSRC) was established in September 1969 by the Regents of the University System of Georgia as an interdisciplinary and interinstitutional program of health-related research, education, and service. HSRC is dedicated to the cause of improved health care principally through the application of *systems science*, including industrial and systems engineering, operations research, and management science. In recognition of the complexity of health systems, the general approach calls for the substantial involvement of other branches of engineering, the physical and behavioral sciences, industrial management, information science, computer technology, architecture, and the various health sciences and professions.

HSRC is based at the Ferst Research Laboratories in the Piedmont Education Building on Peachtree Road in Atlanta. These research offices and labs are used for planning and coordinating programs and for intramural research, non-credit education, and community outreach projects. Offices are also maintained on the Georgia Tech campus in Atlanta and on the Medical College campus in Augusta.

General Aim

The basic philosophy of HSRC is to view health-care delivery as a total system, rather than as isolated components or subsystems. Even though HSRC is not engaged in the direct conduct of biological or medical research, in directly providing health care, or in administering or operating health-care institutions, it closely interacts and collaborates with those individuals, agencies, and groups doing so. The general aim of HSRC is to develop and apply new knowledge with respect to the design, experimentation, evaluation, implementation, and demonstration of new and improved systems for the delivery of health services to the public.

In recognition of the complexity of the health-care system and the growing national concern for better means of providing health care for all people at a reasonable cost, HSRC is particularly interested in the analysis and design of systems which promote health maintenance and minimize hospitalization; which provide feasible alternatives to acute hospital confinement for those persons not requiring such expensive facilities and services; which promote the improved utilization of physicians, dentists, nurses, and other scarce manpower; and which utilize the advantages of advanced technology and modern management methods. HSRC is concerned mainly with developing *systems* for planning, designing, and managing health-care facilities, manpower, and methods.

Georgia Tech Programs

HSRC is an outgrowth and expansion of health-systems programs activated at the Georgia Institute of Technology in 1958. With its most recent expansion HSRC has become an independent division of Georgia Tech, reporting to the Office of the Vice President for Academic Affairs. In this capacity HSRC provides campus-wide leadership for the growth and development of interdepartmental health-systems programs.

Through cooperative relationships and joint faculty appointments with the various schools of instruction, HSRC engages in educational programs which offer its trainees opportunities to pursue academic work leading to the bachelor's, master's, and doctoral degrees in various branches of engineering, science, and management. This educational component is supported by a training grant from the Bureau of Health Manpower Education, U.S. Public Health Service.

A major research effort now in progress is a "Systems Analysis of Medical Records Within Georgia," under a contract with the Health Services and Mental

Health Administration, Department of Health, Education, and Welfare. This project is being pursued by HSRC faculty, staff, and students, in collaboration with the Westinghouse Health Systems Department as a sub-contractor, and in cooperation with the Georgia Regional Medical Program.

Medical College Programs

Through its affiliated Division of Health Systems Engineering at the Medical College of Georgia and by joint faculty appointments, HSRC promotes research, education, and service projects in various areas, including the School of Allied Health Sciences, the School of Dentistry, the Graduate School, the School of Medicine, and the Eugene Talmadge Memorial Hospital. Examples of current projects are an "Analysis of Optimal Radiographic Location Networks," supported by the National Center for Health Services Research and Development, USPHS; the teaching of systems courses for the Department of Medical Record Science; regularly scheduled seminars and short courses in systems engineering for Medical College faculty, staff, and students; the clinical training of graduate students from Georgia Tech; and systems planning of health-education facilities for the Medical College.

Georgia State Programs

Close relationships with Georgia State University are maintained through joint faculty appointments with its Program in Health Administration and its School of Allied Health Sciences. Examples of this collaboration are the joint participation by health administration and industrial engineering graduate students in a computerized hospital management "game"; the teaching of certain quantitatively oriented Georgia State courses by HSRC faculty; regularly scheduled lectures by Georgia State faculty in Georgia Tech courses; and service by faculty members of each institution on thesis and dissertation committees of the other institution.

Other Collaboration

In response to its charge from the Regents, HSRC also serves as a coordinating agency for health-systems programs throughout the University System and for cooperative relationships with other academic and health institutions and agencies throughout Georgia. Among these other institutions and agencies are the Bioengineering Center at Georgia Tech, Emory University, Morehouse College, the Georgia Regional Medical Program, the Metropolitan Atlanta Council for Health, the Fulton County Medical Society, the Governor's Commission on Science and Technology, the Georgia Hospital Association, the Georgia Department of Public Health, individual hospitals and clinics, various governmental agencies, and private industry.

Degree Programs

While HSRC is not a degree-granting school of instruction, it does offer educational opportunities to both undergraduate and graduate students enrolled in various schools, such as the School of Industrial and Systems Engineering, programs of the College of Industrial Management, and the School of Information and Computer Science. A student wishing to emphasize *health systems* in his program of study may do so by obtaining approval of his own school and making application to the Health Systems Research Center. Such "HSRC trainees" typically follow regular curricula or core programs of their own schools, include a sequence of health-related courses as electives, and engage in project work or student research on health-systems problems.

Industrial and Systems Engineering

Through a cooperative arrangement with the School of Industrial and Systems Engineering, students in that School may affiliate with HSRC as a part of the special "Program in Hospital and Medical Systems" which is administered jointly with the Medical College of Georgia. This arrangement enables students to gain a health-systems orientation while pursuing programs of study leading to the BIE, the MSIE, the MS, or the Ph.D. degree.

Undergraduate students normally include ISyE 418 "Industrial Engineering in Hospitals" as an elective, do special projects in the field of health systems, and serve as student assistants on various HSRC research, education, or service projects.

The designated MSIE program is available for students holding the BIE degree and for other engineers who satisfy requisites covering the principal subject matter of the current BIE curriculum. Majors in health systems follow the regular MSIE core program, include a sequence of health-related courses as electives, and write the master's thesis on a health-systems problem, either at the Medical College in Augusta or at the HSRC in Atlanta.

The undesignated MS program is intended primarily for those students who desire in-depth understanding of a particular segment of industrial engineering (for example, operations research in hospitals or medical applications of computer technology), but who do not desire the breadth of knowledge associated with the designated degree. The MS program allows more latitude in program formulation, and while a quantitative orientation is required, admission is not contingent upon an industrial engineering background. This program is available to qualified graduates in engineering, mathematics, operations research, economics, psychology, and certain health sciences.

The doctoral program is intended for highly gifted individuals whose past accomplishments and evaluations indicate a high potential for successful completion of program requirements and a subsequent creative contribution to the field. Formal admission to the program is granted after satisfactory completion of a qualifying examination in industrial engineering. Preparation may be by courses at other institutions, self study, or course work at Georgia Tech. Admission to candidacy is achieved by passing a comprehensive examination on areas of the program of study, demonstration of a reading knowledge of French, German, or Russian, and preparation of an acceptable research proposal for the doctoral dissertation. For majors in health systems, one area of the comprehensive examination and the dissertation are health oriented. The completion and defense of the doctoral dissertation then complete requirements for the degree.

The following health-related courses (described elsewhere in this catalogue) are taught by HSRC faculty members and are available to HSRC trainees:

ISyE 418	Industrial Engineering in Hospitals	3-0-3
ISyE 491, 2, 3	Special Problems	0-3-1
ISyE 665	Case Studies in Hospital Management Systems	3-0-3
ISyE 700	Master's Thesis	*
ISyE 704, 5, 6	Special Problems in Industrial Engineering	*
ISyE 765	Projects in Hospital Management Systems	*
ISyE 800	Doctor's Thesis	*

*Credit arranged on individual basis.

Other Schools

Since HSRC places considerable emphasis upon its educational component and attempts to integrate education, research, and service, arrangements can be made for involvement in HSRC programs by students from various schools on the Georgia Tech campus and from affiliated institutions such as the Medical College of Georgia and Georgia State University. Such cooperative programs are intended to provide a health-systems orientation to graduate work within a given academic discipline, as well as opportunities to employ interdisciplinary approaches to health-systems problems.

Financial Assistance

Adequate financial support is available to HSRC trainees in the form of student assistantships, graduate teaching assistantships, graduate research assistantships, traineeships, fellowships, and part-time employment on the HSRC faculty or staff or with cooperating health-related institutions or agencies. For more information, contact the Director of the Health Systems Research Center.

RICH ELECTRONIC COMPUTER CENTER

Director–Irwin E. Perlin; *Associate Director*–John P. McGovern; *Principal Secretary*–Ann H. Lewis. *SYSTEMS EFFECTIVENESS OFFICE: Head*– S. P. Lenoir, Jr. OPERATIONS BRANCH: *Head*–W. A. Bezaire. RESEARCH BRANCH: *Head*–John P. McGovern.

Mission

The Rich Electronic Computer Center provides a wide range of computing services in the three general fields of instruction, research, and administration. The primary mission of the Computer Center is to provide computing facilities and services for Georgia Tech. However, the Computer Center also provides computing support to other schools in the University System of Georgia, as directed by the Board of Regents.

Computer Center Objectives

a. To provide computer support for the advancement of Georgia Tech's objectives in education (instruction), research, and administration.

b. To make available to every student at Georgia Tech instruction in computing and necessary computing support in order to advance and insure his full professional development.

c. To study and evaluate advances in computer applications and technology in order to insure that the most modern productive tools are used by Georgia Tech.

d. To develop a primary role in the State's program for advancing higher education through the concepts of information processing and computer applications.

e. To provide the best possible computing facilities for the solution of research and development problems of government and industry for which Georgia Tech has been given responsibility.

Facilities

The Rich Electronic Computer Center operates two large scale computers. The Univac 1108 is in the Shared Processor System configuration with batch and remote time sharing facilities. The Burroughs B 5500 is a multiprogramming and multiprocessing system with remote time sharing capabilities. A Calcomp Digital Plotter system and an Analog-to-Digital conversion system are also available.

Staff

The Computer Center has a staff of approximately 65 persons. This includes about 20 professional analysts and programming analysts.

Present Computing Workload in Support of Georgia Tech Activities

Computing for instruction and general (nonsponsored) research represents about 80% of the computing workload. Extensive use is made of the Center's facilities in undergraduate courses, as well as in Master's thesis and Ph.D. dissertation work. Approximately 40% of the students at Tech are now using computers regularly in their academic work. Sponsored research constitutes about 15% of the computing workload. Administration and service activities represent about 5% of the computing workload. In the administrative and service area, computer facilities are used by the Georgia Tech Library and Georgia Tech Alumni Association, and for the Football Stadium Seating Assignment system.

Support for the University System of Georgia Computer Network

Georgia Tech is participating in a National Science Foundation sponsored experiment involving the implementation of a regional computer network. Tech is a lead institution in this experiment along with the University of Georgia.

THE CO-OPERATIVE DIVISION

(Established in 1912)

Co-operative Courses in Aerospace, Chemical, Civil, Electrical, Industrial & Systems, Mechanical, and Textile Engineering; Chemistry, Engineering Science and Mechanics, Industrial Management, Physics, Textile Chemistry, and Textiles

(A Special Bulletin is available and will be mailed on request)

Director—James Gordon Wohlford; *Associate Director*—William Henry Hitch; *Assistant Director*—William Thomas Lee; *Principal Secretary*—Eleanor Cain; *Secretary*—Nancy Kirchhoff.

The engineering and science graduate must have an educational background of sound scientific and economic principles, and he must be acquainted with industrial practices in his field of employment before he can assume responsibility for industrial projects. The interlocking of theory and practice is provided in the co-operative plan of education by the integration of technical theory and practical industrial experience. The Georgia Institute of Technology recognizes the value of this plan and has since 1912 offered a Co-operative Course for those students who desire to acquire their education under the co-operative plan. The correlation of the scientific and engineering practices of classroom and laboratory work and practical industrial experience is accomplished in a five-year course. Co-operative students complete twelve academic quarters and their scheduled industrial quarters. The alternation between campus and industry continues until the student has completed the second or third quarter (depending on the student's section) of the junior year curriculum, at which time the students are scheduled to attend classes continuously until graduation.

Thirteen courses are available to students under this plan. Originally only Mechanical and Electrical Engineering were offered, but Civil, Textile (including Textile Chemistry and Textiles), and Chemical Engineering were added between 1920 and 1928, and in 1946 Aeronautical (now Aerospace) and Industrial Engineering were included. Chemistry, Physics, and Engineering Mechanics were added in 1963, and Industrial Management in 1967.

Students in the Co-operative Division are selected from those who are in the upper third of their high school or preparatory class, or who have made better-than-average records in the Georgia Tech regular course or at some other accredited institution of higher learning. The entrance requirements for the Co-operative Courses include all "Specified or Required Units" on page 16. Only those students who expect to graduate under the Co-operative Division are accepted for these courses. A co-operative student, of course, must make a creditable scholastic record before being recommended for work in industry, and is allowed to continue under the co-operative plan only if he maintains a good record. Upon graduation a Bachelor's Degree, Co-operative Plan, is awarded to a co-operative student in his particular field.

Students in the Co-operative Division are divided into two sections, the first beginning classes in June and the second in September. While Section One is at college three months, Section Two is at work in industry for the same length of time. The two sections alternate or exchange places with each other every three months until the fifth school year, when they merge and remain at college continuously until graduation. A co-operative student get three weeks' vacation during each calendar year—one week at Christmas and two weeks during the summer.

The Institution is co-operating with more than two hundred and sixty firms, including power companies, electric and electronic equipment manufacturers, oil companies, airlines, railroads, manufacturers of machinery and mechanical equipment, pulp and paper mills, chemical industries, textile mills, foundries, steel mills, construction and engineering firms, and state and federal agencies. The area covered by those industries includes the Southeastern States and many sections of the Middle Atlantic and Western Central States.

After satisfactory completion of at least three months' classroom work in the Co-operative Division, a student is recommended for work with an industrial company. Since the firms employing co-operative students offer a wide variety of practical training and many lines of specialization, students are afforded the opportunity to secure work in the field in which they are most interested. Although the Co-operative Division does not guarantee work nor stipulate any certain amount of compensation, every effort is made to place students to their best educational and financial advantage.

The co-operative students receive wages for their work at the prevailing rate in the shops in which they are employed, the employers pay the wages directly to the students. At the present time the average beginning wage for a freshman is around $450.00 per month. The wages increase as the student remains on the job assigned him until he is advanced to a higher grade of work by the company which employs him or by the Co-operative Division. By the time he graduates, a co-operative student will have received training in practically all departments of an industry. A high percentage of students trained in this way follow and succeed in their chosen profession. At the conclusion of the course the co-operative graduate is not obligated to accept employment with the co-operating company; neither is the company obligated to offer employment. In many instances, however, such employment is offered by the company and accepted by the student.

The Director of the Co-operative Division makes frequent visits to employing companies. Through interviews with company officials and shop foremen he brings about co-ordination of industrial work with school curricula and takes care of any adjustments in types of work, wages, and other relevant matters. Before freshmen are sent to work, they attend orientation classes in which they are acquainted with the various aspects of their industrial work and receive pointers on how to succeed on the job, how to make friends with regular shop employees, how to save wisely, and other important factors.

A Georgia freshman should have about $1,100.00 and an out-of-state student about $1,600.00 for the total expenses of his first two academic quarters. Anyone interested in making application for admission into the Co-operative Division should write to J. G. Wohlford, Director, Co-operative Division, for a bulletin which gives full particulars about fees, courses, living expenses, wages paid the students while at work, discipline, school activities, and other pertinent information.

DIVISION OF GRADUATE STUDIES AND RESEARCH

(The Bulletin of the Graduate Division will be sent upon request)

Dean–Sam C. Webb; *Associate Deans*–Maurice W. Long, Dale C. Ray; *Assistant to the Dean*–Karl M. Murphy; *Secretaries*–Hazel Beach, Doris Dean, Edna Hitchens, Yvette Lea.

GRADUATE COUNCIL

SAM C. WEBB, PH.D. .... *Chairman*

Ex-Officio

FRANK E. ROPER, M.S. .... *Registrar*
VERNON CRAWFORD, PH.D. .... *Vice President for Academic Affairs*
THOMAS E. STELSON, PH.D. .... *Dean, Engineering College*
HENRY S. VALK, PH.D. .... *Dean, General College*
SHERMAN F. DALLAS, PH.D. .... *Dean, College of Industrial Management*
MAURICE W. LONG, PH.D. .... *Director, Engineering Experiment Station*
MRS. J. H. CROSLAND .... *Director, Libraries*

Appointment Expiring June 30, 1971:

H. A. FLASHKA, PH.D., *Regents Professor, School of Chemistry*
**B. M. DRUCKER, PH.D., *Professor of Mathematics*
**D. E. FYFFE, PH.D., *Professor of Industrial and Systems Engineering*
**M.C. BERNARD, PH.D., *Associate Professor of Engineering Science and Mechanics*
**S. P. KEZIOS, PH.D., *Director, School of Mechanical Engineering*

Appointment Expiring June 30, 1972:

M. G. LITTLE, M.S., *Director, City Planning*
**G. G. EICHHOLZ, PH.D., *Professor of Nuclear Engineering*
L. DAVID WYLY, JR., PH.D., *Regents Professor, School of Physics*
SANDRA THORNTON, PH.D., *Associate Professor of Social Sciences*

Appointment Expiring June 30, 1973:

**LUCIO CHIARAVIGLIO, PH.D., *Professor of Information and Computer Science*
M. CARR PAYNE, JR., PH.D., *Professor of Psychology*
KENDALL L. SU, PH.D., *Regents Professor, School of Electrical Engineering*
W. T. ZIEGLER, Ph.D., *Regents Professor, School of Chemical Engineering*

Appointment Expiring June 30, 1974:

C. VIRGIL SMITH, SC.D., *Associate Professor of Aerospace Engineering*
P. H. SANDERS, PH.D., *Assistant Director, School of Civil Engineering*
J. L. DAKE, PH.D., *Associate Professor, College of Industrial Management*
W. C. CARTER, PH.D., *Professor of Textile Engineering*

**Executive Committee of Graduate Council.

Degrees and Fields of Study

The degree of Master of Science is offered with or without designation in the following fields: Aerospace Engineering, Applied Mathematics, Applied Biology, Ceramic Engineering, Chemical Engineering, Chemistry, Civil Engineering, Electrical Engineering, Engineering Science and Mechanics, Geophysical Sciences, Industrial & Systems Engineering, Information and Computer Science, Industrial Management, Mechanical Engineering, Metallurgy, Nuclear Engineering, Nuclear Science, Physics, Public Health and Public Health Engineering, Psychology, Safety Engineering, Sanitary Engineering, and Textile Engineering. It may be awarded without designation when the student does not major in the field in which he has earned his bachelor's degree. The degrees of *Master of Architecture and Master of City Planning* are also offered.

The degree of *Doctor of Philosophy* is offered in Aerospace Engineering, Chemical Engineering, Chemistry, Civil Engineering, Electrical Engineering, Engineering Science and Mechanics, Industrial & Systems Engineering, Information and Computer Science, Industrial Management, Mathematics, Mechanical Engineering, Nuclear Engineering, Physics, Psychology, and Sanitary Engineering.

In addition to the fields of study listed above for the *Master of Science* degree, collateral study of an advanced nature is available in Modern Languages and Sociology.

Fellowships

Atlantic Steel Company

A fellowship in Chemical, Civil or Mechanical Engineering; $1,800 stipend, plus tuition and matriculation fees; total grant of $3,000.

Automotive Safety Foundation

A fellowship in Highway Engineering; $1,800 stipend, plus tuition and matriculation fees. Awarded on basis of national competition.

Burlington Industries Fellowship

A fellowship in the amount of $5,000 awarded to the A. French Textile School to be used to provide the fellow's stipend, tuition, and research equipment and supplies.

Celanese Corporation

A fellowship in Textiles or Textile Engineering in the amount of $2,500, including tuition and matriculation fees and other expenses incidental to research.

E. I. DuPont de Nemours & Company, Inc.

A grant of $10,000 to allocated to each of four schools, Chemical Engineering, Chemistry, Electrical Engineering and Mechanical Engineering. It is to be used to enhance or maintain the strength of their instruction in science and engineering.

Eastman Kodak Fellowship

A $6,000 grant to the Textile School. Stipend not less than $2,500 per calendar year or $3,000 if there are dependents, plus tuition and fees. Balance to be used as an unrestricted grant in the school.

General Electric Foundation

A $5,000 grant to the School of Mechanical Engineering.

Gulf Oil Corporation Graduate Fellowship

A fellowship in Chemical Engineering; $2,500 stipend plus tuition and matriculation fees.

Housing and Urban Development Fellowship (HUD)

A fellowship in City Planning; $3,000 stipend plus $500 for each dependent up to two; plus $1,500 cost of education allowance to the school for tuition and fees.

Kaiser Financial Aid Grant

A grant of $4,600 to the School of Chemical Engineering; $3,600 to the recipient and $1,000 to the school.

Loula D. Lasker Fellowship Trust

Graduate Fellowship in City Planning. Awarded on a basis of National competition.

Richard King Mellon Charitable Trusts

Fellowships for graduate work in City Planning. Preference is given to men and women who are working in the field of City Planning and who recognize a need of further graduate training.

Edward Orton, Jr., Ceramic Foundation

A fellowship in Ceramic Engineering; $1,800 stipend for 12 months.

Robert J. Painter Memorial Fellowship

A fellowship to be awarded to an outstanding applicant entering his final year of full-time graduate work leading to a doctor's degree in a field contributing to the science and knowledge of materials. $5,000 to the fellow and $1,500 to the institution. This grant must be awarded by June 1.

The Robert and Company Associates Fellowships for Advanced Study in Architecture

A fellowship in Architecture; $1,200 stipend. Recipient must be a native of Georgia.

The Robert and Company Fellowship

A fellowship to be used in Civil, Electrical or Mechanical Engineering; $1,200 stipend. Recipient must be a native of Georgia.

Sandoz Foundation, Inc.

A grant of $5,000 awarded to the A. French Textile School to be used as a fellowship and supporting funds for tuition, equipment and faculty supervision.

Schlumberger Foundation

Two fellowships in Electrical Engineering and Physics; $2,100 stipend with support for tuition, matriculation fees and research needs.

Shell Companies Foundation

A fellowship for graduate study in Civil Engineering; $2,000 stipend academic year, $2,500 calendar year (married students $2,600 and $3,200 respectively) plus tuition and matriculation fees; $1,000 to the School of Civil Engineering.

Standard Oil Company of California

A fellowship in Chemical Engineering; tuition and matriculation fees, plus $2,000 to the student if single or $2,600 if student has one or more dependents; $1,000 unrestricted grant to the School.

Mary White Staton Fellowship

Mr. Albert H. Staton has established a graduate fellowship for advanced study by a native of Columbia. $2,000 stipend.

T. Earle Stribling Textile Memorial Fellowship Fund

A fellowship for advanced study and research in problems pertaining to the Textile industry has been established in memory of the late T.E. Stribling, an alumnus of Georgia Tech. This fellowship carries a stipend of $2,000 for the calendar year, plus tuition and matriculation fees. Applications are encouraged from men whose preparation has been in the fields of Textile Engineering, Textile Chemistry, Chemical Engineering, Mechanical Engineering, Chemistry or Physics.

Texaco Fellowship

A fellowship in Metallurgical Engineering; $3,000 plus tuition and fees for a calendar year.

Union Camp Fellowship

A $5,000 fellowship in Chemistry and Chemical Engineering; tuition and matriculation fees, plus a minimum of $250 a month to the student for a period of at least nine months, the remaining money to be used for department needs.

United States Steel Foundation

A fellowship in Physics; up to $3,900 per year stipend. The award is made for two years.

Whirlpool Corporation

Two graduate fellowships in engineering; $2,400 stipend, plus tuition and fees.

National Fellowship Programs

National Programs are available through the Institution, including *Fellowships* – National Science Foundation, NDEA Title IV, Atomic Energy Commission Special Fellowships in Nuclear Science and Engineering, Oak Ridge Graduate Fellowship. *Traineeships* – Atomic Energy Commission, National Aeronautics and Space Administration, National Science Foundation, Public Health Service.

FOR FURTHER INFORMATION CONCERNING ANY OF THE FELLOWSHIPS, WRITE THE DEAN OF THE DIVISION OF GRADUATE STUDIES AND RESEARCH.

Graduate Fellowships

Fellowships may be made available through grants to the Institute from National Aeronautics and Space Administration, National Science Foundation, National Institutes of Health, the Atomic Energy Commission, and the National Defense Education Act Title IV Program. These are in addition to the fellowships listed on preceding page.

Instructors and Assistants

A number of part-time instructorships and teaching or research assistantships are available for qualified graduate students through the Schools, Departments, and the Engineering Experiment Station. These appointments are normally for one-third full time and carry stipends ranging from $2,000 for the academic year.

Admission

In general, applicants for admission to graduate study should hold a bachelor's degree from a recognized university, school, or college and should have graduated with academic standing in the upper half of their class. Those applicants who plan to become candidates for the doctorate should have had academic standing in the upper quarter of their baccalaureate class or must have demonstrated, or be prepared to demonstrate, outstanding ability in their work toward a master's degree.

Length of Study and Graduate Requirements

Thirty-three quarter hours of advanced study past the bachelor's degree plus a thesis, or fifty quarter hours of advanced study past the bachelor's degree without a thesis are necessary in fulfillment of the requirements for the master's degree. At least one full academic year in residence past the bachelor's degree must be completed on campus before the master's degree can be awarded.

At least three full academic years of advanced study past the bachelor's degree are necessary for the award of the doctorate. Ordinarily between 67 and 90 quarter hours of advanced course work will be undertaken, the balance of the required time being devoted to research and the preparation of the dissertation. At least three full quarters of the doctorate program must be spent in residence at the Georgia Institute of Technology and unless special permission is obtained, these must be the three immediately preceding the award of the degree.

Graduate Bulletin

A copy of the Graduate Bulletin, discussing requirements for advanced degrees in detail and listing advanced work in courses available in the various departments, may be obtained on request from the Dean of the Division of Graduate Studies and Research.

ENGINEERING EXPERIMENT STATION

Director–Maurice W. Long; *Director Emeritus*–Wyatt C. Whitley; *Assistant Director*–Rudolph L. Yobs; *Assistant to Director*–Thomas F. Jones; *Administrative Secretary*–Claudine Taylor. CHEMICAL SCIENCES & MATERIALS DIVISION: *Chief*–Frederick Bellinger; *Principal Secretary*–Marjorie Wright. ELECTRONICS DIVISION: *Chief*–Richard C. Johnson; *Principal Secretary*–Voncile H. Patrick. HIGH TEMPERATURE MATERIALS DIVISION: *Chief*–J. D. Walton, Jr.; *Principal Secretary*–Jean Williams. INDUSTRIAL DEVELOPMENT DIVISION: *Chief*–Ross W. Hammond; *Principal Secretary*–Margaret Textor. NUCLEAR AND BIOLOGICAL SCIENCES DIVISION: *Chief*–Carlyle J. Roberts. PHYSICAL SCIENCES DIVISION: *Chief*–Edwin J. Scheibner; *Principal Secretary*–Betty R. Jaffe.

PURPOSES

Recognizing that teaching and research are complementary, Georgia Tech believes that a progressive technological institution should carry on, conjointly, a strong educational program and a coordinated fundamental and applied research program. This philosophy is put into practice by a full-time Engineering Experiment Station staff composed of competent engineers, scientists, and technicians, a large number of associated faculty members, and a strong supporting Graduate Division.

At the end of the 1969-70 fiscal year, the Station employed the full-time services of 325 professional, technical, and support personnel and the part-time services of an additional 225 persons. Nearly 300 graduate and undergraduate students were employed at some time during the year, and 60 shared faculty members participated in Station projects. Total Station income was $7 million, and nearly 700 research and service projects were active during the year.

Activities of the Engineering Experiment Station are centered in several major areas of competence: chemical sciences, electronics, high temperature materials, industrial and economic development, nuclear and biological sciences, and physical sciences. Within these areas, specific research strengths have been developed in such diverse fields as micromeritics, cryogenics, fertilizer technology, mineral engineering, metallurgy, water chemistry, electronic communications, radar, applied electromagnetics, materials engineering, ceramic processing, economic resource analysis, biology and bioengineering, radiation chemistry, neutron and reactor physics, solid state physics, crystal physics, biomedical instrumentation, and computer techniques.

The Engineering Experiment Station also provides a wide variety of services to the Institute, the business and industrial community, and the city, state and nation. These include industrial product development, management and technical assistance in economic development, management and technical assistance to business and industry, technology transfer, professional guidance and assistance in economic development principles and techniques, nuclear reactor services, radiation safety control and electron microscopy.

Results of many of the research and service projects conducted by the Engineering Experiment Station are made available to the public by publication in technical journals, in special reports, and through Georgia Tech's bimonthly newsletter, *Tech Topics.* Matters of interest to the state-wide industrial development community are reported monthly in the *Georgia Development News.* Other research topics are reported in the monthly internal publication, "EES Notes."

In facilities, research volume, and staff, the Engineering Experiment Station is one of the largest state engineering experiment stations in the nation. The principal sources of financial support are the United States Government, by means of research contracts administered through the Georgia Tech Research Institute; private industry, through contracts for specific research projects; the State of Georgia, by means of appropriations through the Board of Regents; and gifts, grants-in-aid, and endowments.

Whenever feasible, advanced undergraduate and graduate students are employed on projects in the Engineering Experiment Station to afford them direct experience and training in research and development activities and, when possible, provide support for graduate thesis work.

RESEARCH STAFF

Engineering Experiment Station faculty members and professional staff are listed among the General Faculty beginning on page 369.

THE DEPARTMENT OF CONTINUING EDUCATION

Director–Richard Wiegand; *Associate Director*–Robert S. Herndon; *Assistant Director*–George H. Adams; *Coordinator*–J. K. Collins; *Principal Clerk*–Edward J. Sprole; *Audio Visual Technician*–Mitchel Morgan; *Principal Secretary*–Beverley Stallworth; *Senior Secretary*–Darnell Kay; *Secretaries* – Linda Brittain, Sandra Gaulden, Sheila King, Marylen Phillips, Janie Williams; *Clerks*–Otis Bryant, Anne Riesenburger.

The industrialist and the educator share the responsibility of keeping the professional college graduate abreast of the forward strides being made by the dynamic and burgeoning technology of this twentieth century. The Department of Continuing Education conducts up to 200 programs annually in various subjects to help college graduates and others keep pace. All offerings of the Department are non-credit.

These courses are conducted in specially equipped classrooms on the campus. In addition to these special facilities, the Department has access to regular Georgia Tech classrooms and laboratories which have been made available through the cooperation of the various schools and departments.

Skilled and experienced teaching personnel–and specialists from business and industry–are secured to provide the best in instruction.

Courses, though scheduled for a short duration of time, are very intensive in subject coverage. Special technical and management short courses, as well as conferences and institutes, train key industry personnel by providing information and instruction on new developments and best methods. In addition to these courses, other short courses prepare the engineering and/or professional graduate for state professional examinations.

Short course work emphasizes close cooperation with industry, trade associations, technical and scientific and business organizations in planning and presenting these special educational programs.

SOUTHERN TECHNICAL INSTITUTE

Marietta, Georgia

Dean of Southern Technical Institute–Walter O. Carlson; *Associate Dean of Southern Technical Institute*–Hoyt L. McClure; *Administrative Assistant*–Mrs. Minnie N. Mavity; *Acting Registrar*–Jacob Remeta; *Registrar Emeritus*–Loy Y. Bryant; *Counselor*–William J. Glenn; *Admissions Counselor*–Samuel J. Baker; *Placement Director*–Paul V. Smith; *Executive Secretary to Southern Technical Institute National Alumni Association*–Mrs. Armenta V. Simmons; *Dean of Students*–Lewis G. Van Gorder; *Dean of Students Emeritus*–Cyrus V. Maddox; *Assistant to Dean of Students*–Harry S. Lockhart, Francis A. Florian; *Librarian*–John W. Pattillo; *Assistant Librarian*–Nancy Shofner; *Director Industrial Education*–Dallas B. Cox; *Head In-Plant Training*–Charles A. Duke; *Research and Instructional Materials Specialists*–Paul D. Petty, Jr., Bobby R. Cline; *Fire Service Training Supervisor*–Harold G. Thompson; *Professors*–T. W. Anderson, George L. Carroll, R. C. Carter, R. G. Denning, R. W. Hays, Charles T. Holladay, Robert L. Myatt, Chester R. Orvold, Harry M. Schenk, A. L. Steinkamp (Retired), L. H. Taylor; *Professors Emeritus*–J. E. Lockwood, W. W. Vaughn; *Associate Professors*–Clarence A. Arntson (Retired), Marion E. Blair, Maria T. Bolet, John L. Bosher, Clifford W. Cowan, Lawrence G. Cuba, James B. Dales, Herbert Eller, J. W. Ellington, E. T. Fowler, Charles R. Freeman, William M. Gordon, John L. Keown, George M. Lawson, Edward J. Muller, William S. Newman, III, Wesley C. Royer, Ernest R. Stone, David E. Summers, John W. Van Hoy, Yardy T. Williams, James H. Workman (Retired), Ralph P. Youngblood; *Assistant Professors*–Louis T. Bates, David M. Bennett, George W. Bruce, Walter E. Burton, T. H. Carmichael, Burns C. Cox (Retired), Parker S. Day, Donald S. Dunlap, James P. Goodwin, Jr., Edward B. Harris, Jr., Clarence M. Head, B. Frank Heard, Alfred J. Hunkin, James L. Keen, III, David Carl Lewis, George Shannon Melvin, Ranakumar Nadella, Earl T. Oxford, Lawrence L. Parlett (Adjunct), Philip Lee Secrist, Jasper B. Sojourner (Retired), *Frank C. Taylor, Jr., Hans A. Toremel, Dick B. Weir; *Instructors*–Douglas S. Black, Carlos C. Davis, Charles M. Cooper, Jr., Roberta D. Gates, Woodrow P. Greene, James W. Hardwick, Walter B. Hinton, Jr., Julian R. Lee, William J. Matheny, Ulkanga C. Mudakha, Walter F. Parker, James H. Steward, Charles A. Wimberly, Lewis N. Wynne; *Special Lecturers*–Maurice Halper, John C. Meintzer, Jr.; *Senior Accountant*–Daniel B. Conner; *Principal Electronics Technician*–J. Ray Davis; *Machinist*–Melvin Sorrells; *Administrative Secretary*–Miss Patsy Ginn; *Principal Secretary*–Mrs. Elizabeth C. Severance.

General Objectives

The Southern Technical Institute is that unit of the Engineering College of the Georgia Institute of Technology designed for the student who desires to become an Engineering Technician or an Engineering Technologist.

Ten two- and four-year engineering technology programs leading to the Associate or Baccalaureate degree are offered: Architectural Engineering

Technology, Civil Engineering Technology (Surveying and Construction Option), Civil Engineering Technology (Structural Materials and Design Option), Electrical Engineering Technology (Electronics Option), Electrical Engineering Technology (Electronic Computer and Control Option), Industrial Engineering Technology, Industrial Engineering Technology (Management Option), Mechanical Engineering Technology, Textile Engineering Technology, and Textile Engineering Technology (Apparel Manufacturing Option).

These curricula are designed to provide the basic scientific training, the specialized technical "know-how," and the supervisory and management training needed by the engineering technician. The courses are briefer, more intensive, and more specific in purpose than those of the professional engineering curricula, although they lie in the same fields of industry and engineering. Their aim is to prepare the individual for specific technical positions or lines of activities rather than for broad sectors of engineering practice.

Engineering Technician and Engineering Technology

An engineering technician is one whose education and experience qualify him to work in those areas of engineering which require the application of established scientific and engineering knowledge and methods, combined with technical skills, in the support of engineering or scientific activities toward the accomplishment of engineering objectives.

The engineering technician is the newest member of the Engineering Team. This team is composed of the scientist, the engineer, the engineering technician, and the craftsman. His addition to the team resulted from what may be called the impatience of the 20th century. Prior to World War II the lapse-time between a scientific discovery and its application was of the order of 6 to 10 years. Today our technology is moving so fast that this time is now of the order of 3 to 6 months or less.

This increasing pressure to move more quickly from experiment to product requires engineers to witness, interpret, and make use of scientific discoveries almost as they occur. This change in engineer's work requires engineering education to be more and more in the area of advanced mathematics and the physical sciences, and less and less in applied or operational engineering fields. Today an engineer's work is generally concerned with development and design rather than with applied or operational engineering work.

Because the engineering arts and skills are essential to industry, the American Society for Engineering Education has sponsored the Engineering Technology Program with curricula designed to fill the educational gap caused by the change in the engineer's work and to train men qualified to take over much of the operational engineering work formerly done by large segments of the engineering profession, thus freeing engineers for engineering work requiring a much more scientific and mathematical background.

The engineering technician is concerned with the production and operational aspects of engineering and industry, and he performs specific tasks which usually embrace a specialized field of research, design, development, or construction; or of control and operation of production facilities and manpower.

Graduates from engineering technology courses are in great demand. Engineering technicians with several years' experience have advanced to top positions in Engineering, Management, and Architectural areas.

A full-time day program is available at the Southern Technical Institute campus at Marietta, Georgia. Two academic years or six quarters are required to complete the Associate in Engineering degree programs, and four academic years or twelve quarters are required to complete the Bachelor of Engineering Technology degree programs at the Southern Technical Institute. For complete information regarding this school write for special catalog.

Southern Tech also makes six of its eleven curricula available on a part-time schedule in evening classes on the Southern Tech campus. These are Architectural Engineering Technology, Civil Engineering Technology, Electrical Engineering Technology, Industrial Engineering Technology, Industrial Engineering Technology (Management Option), and Mechanical Engineering Technology. Those who work in Atlanta's metropolitan area may thus avail themselves of the opportunity of obtaining this type of training through evening study.

The job opportunities for engineering technicians are numerous. Studies made by the American Society for Engineering Education reveal that two engineering technicians are needed for every engineer. The Associated Industries of Georgia estimates that there are, in Georgia alone, 5000 well-paying positions for trained engineering technicians, at salaries ranging upward from $7500 per year.

The work offered qualifies the engineering technician graduate for a rapidly expanding number of technical jobs in engineering. His work is closely related to that of the graduate engineer and, in fact, the two usually work as a team.

A special bulletin containing complete information will be sent upon request. Direct such requests to the Registrar, Southern Tech, Marietta, Georgia.

Entrance Requirements

Applicants must be high school graduates or equivalent and must have two credits in algebra, one credit in geometry, two credits in science, and four credits in English. Applicants must have also taken the College Entrance Examination Board Scholastic Aptitude Test (Verbal and Mathematical), and the College Entrance Examination Board Achievement Tests in English and Mathematics (Level I–Standard).

Veteran's Program

Veterans are eligible to enter the Institute under the G. I. Bill of Rights, as established under Public Laws 89-358, 634, 815, and 90-77.

Tuition and Fees

The rates for fees, board, and room are subject to change at the end of any quarter.

DAY CLASSES AND EVENING CLASSES

Full-Time Schedule (12 or More Hours)

	Matriculation Fee per Quarter	Tuition Fee per Quarter	Medical Fee per Quarter	Student Activity Fee per Quarter	TOTAL FEES Per Quarter	Per Academic Year
Resident of Georgia	$110.00	----	$3.50	$9.00	$122.50	$367.50
Non-Resident of Georgia	$110.00	$110.00	$3.50	$9.00	$232.50	$697.50

Part-Time Schedule (Fewer Than 12 Hours)

Resident of Georgia	Non-Resident of Georgia
$10..00 per hour	$20.00 per hour

Day and Evening School students carrying fewer than 6 hours are not required to pay the $3.50 medical fee nor the $9.00 activity fee. Part-time students, however, do not benefit from the medical services that the full-time students do.

ABOVE RATES SUBJECT TO CHANGE WITHOUT NOTICE

The Southern Technical Institute in cooperation with the State Department of Education offers Industrial Education and Firemanship Training Courses over the State as described below. No fees are charged for these courses.

Industrial Education

In conformity with the provisions of the various vocational education acts, this department, in cooperation with the State Department of Education, has a responsibility for training industrial, fire service, and related technical teachers for the following.

1. Evening and part-time classes in public schools and industrial and fire service organizations.
2. All day public trade schools.
3. Supervision courses.

The activities of the department include research to determine specific industrial and fire service education needs of a community, industry or plant; developing courses of study to meet these needs; selecting teachers of the required occupational experience; training these teachers for specialized service, developing specialized instructional materials for use by such teachers; training local teacher trainers in the larger centers; and improving teachers in service after placement.

Because of the specialized local character of this extension work all activities are conducted under special arrangements between the Georgia Institute of Technology, the Georgia State Department of Education, local boards of education, and industrial and fire service organization. The following courses and other activities are conduced at many localities in the state: principles and organization of industrial education, conference leading, methods of teaching, industrial education psychology, course planning, practice teaching, industrial plant surveys, teaching related subjects, and occupational analysis.

The Georgia Fire Institute

The Georgia Fire Institute was established in the Industrial Education Department in 1958 by the Board of Regents through a special appropriation by the State. It is a coordination of both the Georgia Institute of Technology and the State Department of Education, co-operating with local boards of education and fire departments, for amplifying the program of fire service training that has been in development for many years by these agencies, Its aim is the optimum training of Georgia firemen, paid and volunteer, public and private, to reduce and hold to the minimum Georgia's loss of life and property by fire.

Throughout the State the Fire Institute conducts short and long-time classes in local fire departments, short intensive zone fire schools in the special fire service problems of various sections of the State, and short intensive statewide fire schools. In the latter it is successor to the former Georgia State Fire College. The training includes the techniques and technologies of fire prevention, inspection, extinguishment, rescue, and investigation, and fire department officership and administration.

LIBRARY

Director of Libraries–Mrs. J. Henley Crosland; *Associate Director for Readers' Services*– E. Graham Roberts; *Associate Director for Technical Processes*– Arthur T. Kittle; *Head, Technical Information Services*–James B. Dodd; *Head, General Studies Librarian*–Mrs. Anne P. Bugg; *Head, Science Technology Librarian*–Miss Ann Evans; *Readers' Service Librarians*–Mrs. Annabelle Alter, Miss Christine Elkington, Miss Pamela Pickens, Miss Frances Kaiser, Miss Jean Kirkland, Miss Mary Jane Montesinos, John Poe, Rolly L. Simpson, Jr., Miss Patricia VanWezel; *Circulation Librarian*–Miss Lucy Ellen Jones; *Interlibrary Services Librarian*–Miss Ruth Hale; *Patents Librarian*–Miss Safford Harris; *Maps Librarian*–Miss Barbara Walker; *Gifts and Exchange Librarian*–Mrs. Helen Citron; *Head Catalog Librarian*–Miss Mildred Emmons; *Catalog Librarians*– James R. De Jarnatt, Miss Frances Drew, Miss Mary M. Johnson, Miss Maryellen Lo Presti, Mrs. Jeanne Magill, Mrs. Mary Mac Thigpen, Mrs. Helen S. Walzer; *Data Processing Librarian*–John P. Kennedy; *Data Processing Assistants*–Mrs. Teresa Chan, Miss Sharon Gaskill, Mrs. Julia C. Gwynn; *Head, Book Acquisitions Librarian*–Mrs. Beatrice R. Caine; *Head, Periodicals Acquisitions Librarian*–Mrs. Carolyn Dalla Valle; *Acquisitions Librarians*–Mrs. Kay W. Beinke, Miss Evelyn A. Connaly, Mrs. Irene Mallison; *Documents Librarian*–Richard Leacy; *Library Assistants*–Miss Sarah Dennard, Mrs. Bronwyn B. Fowlkes, Mrs. Betty Hilburn, Mrs. Joan R. Hoffman, Mrs. Frances S. Jacobs, Mrs. Judith A. Larson, Mrs. Kathleen B. McCrory, Miss Carolyn Mitchell, Mrs. Elita Moyers, Mrs. Lola Paille, Mrs. Edna A. Parker, Miss Terry T. Uyeno, Miss Barbara S. Walters, Mrs. Elizabeth S. Zivitz; *Architecture Librarian*–Mrs. Helen Martini; *Administrative Secretary*–Mrs. Evelyn B. Sellers; *Other Non-Academic Assistants*–Mrs. Carolyn R. Branton, Mrs. Bonnie Brown, Mrs. Peggy C. Buffington, Mrs. Theresa V. Gallow, Mrs. Cynthia J. Goetze, Mrs. Angela Helm, Mrs. Dianne B. Hopkins, Mrs. Catherine McBrayer, Mrs. Debbie Riggle, Miss Marcia Rushton, William F. Shaw, Mrs. Betty B. Spearman, Miss Susan Stumphf, Howard W. Voigt, Miss Francis R. Waddill, Miss Florence V. Washington, Mrs. Sarah A. Wolfe.

The Price Gilbert Memorial Library is a centralized scientific, technical and management collection of six hundred seventy-nine thousand volumes plus six hundred thousand microtext and other bibliographic units. Outstanding collections in the fields of science and engineering have been developed to support graduate study and research. It is housed in adjoining structures totaling two hundred forty thousand square feet of space. It can house over one million volumes and can seat two thousand users. The Library's United States Patent specification collection is the only one in the Southeastern area. In 1962, the library was designated one of twelve Federal Scientific Report Centers and its collection of reports from the Atomic Energy Commission, the Department of Defense, the National Aeronautics and Space Administration, and the Clearinghouse for Scientific and Technical Information now totals over four hundred fifty thousand titles. Extensive files of standards issued by American associations and societies and a complete file of U.S. Military Standards and Specifications and of British Standards are maintained. The library is also a depository for United States government publications issued by the Government Printing Office and for maps issued by the Army Map Service. More than six thousand company catalogs, available on microfilm, provide information on industrial components.

The library currently receives over twelve thousand nine hundred serials, including four thousand five hundred periodicals. Approximately seventy-five percent are in scientific and technical fields. Especially strong is the collection of abstracts, indices, and bibliographies for science and engineering. Campus and local use is heavy and totaled more than two hundred seventy-three thousand volumes recorded in 1969-70. However, the impact of the library's collections extends far beyond the campus. Last year off-campus service totaled more than twelve thousand requests for information and materials with heaviest use coming from the aerospace and electronics industries. This service is extended to forty-five states and ten foreign countries.

In 1966 the library was selected by the Library of Congress as one of sixteen participating libraries in the MARC 1 pilot project.

Concentration was on the conversion and use of the catalog record to machine-readable form. The catalog record for all material processed since January 1, 1966, is in machine-readable form. Serial records are also in machine-readable form and, because of the largely serial nature of scientific and technical publications, the catalog index to approximately 85% of the total collection is on magnetic tape.

The services of the library are rendered by a staff of over seventy-five persons. Institutional support is excellent with the current budget being slightly over one million dollars.

The library is primarily for the use of students and members of the faculty. All books, not reference or held on reserve, may be withdrawn for home use in accordance with the rules of the Library. The General Library is open from 8:00 a.m. to 12 midnight Monday through Friday. On Saturday the building closes at 6:00 p.m. It is open Sundays from 2:00 p.m. to 12 midnight. Printed Library regulations are given freshmen at the time of matriculation.

OFFICE OF THE DEAN OF STUDENTS

Dean of Students–James E. Dull; *Dean of Students Emeritus*–George C. Griffin; *Associate Dean of Students*–W. Eugene Nichols; *Administrative Assistant*–Mary Lou Smith; *Secretary*–Laura Brooks.

The Dean of Students Office supervises extracurricular activities and student services. It is the focal point in the administration of affairs concerning the life of students in all but the academic field. It stresses the importance of the student as an individual through activities in the form of new student orientation, dormitory programs, international student affairs, student publications, radio communications, fraternity and sorority activities, Student Government student clubs, and Student Center Programs. In addition, the Dean of Students Office offers individual counseling, guidance and testing services, makes available medical and psychiatric facilities, aids in the programming of religious activities, and provides opportunities for Community Service involvement, and leadership development.

The Dean of Students Office has the responsibility and concern for student discipline. The goal of the Dean of Students Office is to assist the student in making the best possible adjustment to college life and to gain the best possible benefit from being a member of the college community through participatory involvement.

Health Services

Director of Health–John A. Wilhelm, M.D.; *Assistant Director*–Philip J. W. Junot; *School Physicians*–Byron E. Holley, M.D., and Jabez O. Marshall, M.D.; *Medical Consultant and Physician to Athletic Association*–Lamont Henry, M.D.; *Psychiatrist*–William B. Anderson, M.D.; *Radiologists*–Albert A. Rayle, Jr., M.S., and J. Frank Walker, M.D.; *Nurse Supervisor*–Mrs. Winifred Cooper, R. N.; *Night Supervisor*–Mrs. Leslie Beavers, R.N.; *Nurses*–Mrs. Ella Anderson, R.N., Mrs. Anne Hogan, R.N., Mrs. Marie Steiner, R.N., Miss Patricia Hunter, R.N., Mrs. Kathryn Holcomb, R.N., Mrs. Mildred Moore, R.N., Mrs. Martha Trnavsky, R.N.; *Technicians*–Miss Lynda Black, Mrs. Leigh Bobbitt, Virgil E. Lloyd, and Vassar Rackley; *Receptionist*–Mrs. Maureen Cooler.

The aim of the Health Service is to keep each Georgia Tech student in the best possible mental and physical health utilizing the most modern preventive and therapeutic techniques available, keeping in mind the problems peculiar to college students, his welfare, and the welfare of the entire student body.

Counseling Center

Director–Dr. James A. Strickland; *Associate Director*–Dr. Eugene C. McLaughlin; *Counselor*–Johnny A. Bonanno; *Counselor*–Nathan T. Pierce; *Psychometric Assistants*–Mrs. Mary Bon Wallace, Miss Ellen E. Seay; *Secretary*–Miss Judy D. Lummus.

The Counseling Center, located in the Dean of Students Building, provides vocational, educational, and personal counseling services for all enrolled Georgia Tech students. These students work with professional counselors in such areas as choosing a vocation, improving study habits, and personal adjustment to college life. A variety of interest, personality, and ability tests are available to help both the student and the counselor in their work together.

Housing

Director–Gary J. Schwarzmueller; *Housing Office Administrator*–Walton Gibbs; *Business Manager*–Raymond S. Gent; *Operations and Activities Coordinator*–Izear Feagins; *Womens Dormitory Director*–Miss Doris A. Bowers; *Senior Clerk, Married Student Housing*–Miss Irma S. Morris; *Senior Secretary*–Mrs. Linda M. Tamburrino; *Secretary*–Deborah T. Jones; *Secretary*–Gwendolyn M. Davis.

The housing administration, organization and operation is intended to express the individual student's personal responsibility for the development of social competence, the values of group living and practice in democratic processes, the elevation of scholastic standards and the fostering of a high academic atmosphere.

Student Center

Director of Student Center–Tim F. Mitchell; *Assistant Director of Student Center*–Edwin P. Kohler, II; *Assistant to the Director, Business*–Walter H. Tripod; *Program Director*–David K. Ness; *House Coordinator*–Rex W. Allen; *Activities Coordinator*–Gerard Chmielewski; *Arts-Music Coordinator*–Becky Kirkland; *Arts-Crafts Coordinator*–Pete S. Matrangos; *Recreation Coordinator*–Wiliam C. Nixon; *Food Service Director*–James R. Greene; *Assistant Food Service Director*–Kenneth A. Anderson; *Principal Secretary*–Patsy K. Helinger; *Senior Secretary*–Vivian C. Sprayberry; *Scheduling Secretary*–Victoria L. Frush; *Secretary, Business*–Dede Troutman; *Secretary, Student Government*–Jeanne Lilley; *Secretary, Calendar*–Debbie Stegemoller; *Receptionist-Secretary*–Gail P. Davenport; *Receptionist-Secretary*–Maurica Paulk.

The Georgia Tech Student Center organization, operation and administration exists and functions as a compliment to and a focal point of the total campus community. The Student Center is an invaluable factor in providing this well-rounded education for the Georgia Tech student. Because of the Center's facilities, students have a greater opportunity to learn from one another and from the faculty in an extra-educational association. Students gain increased opportunities for self-expression by creating and directing various programs within the Center. These programs and facilities do more than promote campus solidarity. They foster increased communication and interaction with the outside community, thus broadening the scope of campus life. The Student Center has become a campus living room, a place where students, faculty, alumni and guests can become better acquainted and can work together toward meeting the individual's needs for a complete education.

Community Service and New Student Orientation

Director–Donald R. Nelson; *Secretary*–Mrs. Lillian Welch.

Involvement, whether in campus activities or community services, is an important aspect of the total educational experience. At Georgia Tech there are a number of programs that direct the unique skills, ingenuity, vocational interest and concerns of the students and faculty to the growing needs of the community, while expanding the student's educational experience. Community service at Tech is designed to apply the resources of the university with its academic direction to the needs of the community and to provide creative outlets for individual response to social problems.

New Student Orientation is designed to familiarize the new student with the activities and academic programs with which he will be associated during his stay at Georgia Tech. A program for new students is developed to acquaint them with various aspects of the institution, its tradition, services and opportunities.

Women Students

Dean of Women–Judith E. Priddy; *Secretary*–Jean Mann.

Women students are enrolled in all nineteen degree granting areas, having first been admitted to Georgia Tech in 1952. It is the intention of the institute to accept as many qualified female students as do apply. Through the promotion of a wide diversification of interests and abilities represented in this group, coeds have made inroads into all phases of campus life. The main thrust of activities centers around five main areas of responsibility–Women's Student Association, Women's Dormitory Council, Alphy Xi Delta, Gamma Psi, and the Society of Women Engineers. Coeds are a small enough group to take advantage of a small school atmosphere within their group while taking advantage of a large school in a large city.

International Students

Assistant Dean of Students (International Student Advisor)–W. Miller Templeton; *Secretary*–Alice A. Lingrel.

Traditionally, Georgia Tech has one of the highest percentages of students from other countries of any technical college in the Southeast. Usually, each year there are approximately 400 students from 60 foreign countries.

Realizing that attending an American university for the first time is a completely new experience for most international students, The Dean of Students Department has created the staff position of International Student Advisor (ISA). The ISA has the responsibility for helping students from other countries to become adjusted to Georgia Tech and to the American culture and customs. He offers frequent help to the students in their dealings with the

Immigration and Naturalization Service–keeping a supply of all necessary INS forms and papers. He is available to help with any problem or situation which rises out of their unfamiliarity with the American College environment. The ISA office offers continuing programs to promote intercultural understanding and adjustment.

Fraternity Affairs

Assistant Dean of Students–Garry M. Bledsoe; *Secretary*–Mrs. Gay Kettle.

The fraternity system and its organization, operation and administration exists to provide students with a self-governing organization by which each student in association with his chosen "brothers" may further his personal development and achieve his personal goals. Fraternities through friendly association and allegiance to common goals seek to develop in their members attitudes and skills which will enhance the educational experience offered by Georgia Tech. Fraternities provide social and recreational activities for their members as well as intramural athletic competition, social service projects, scholarship programs, and opportunities to live in a house which often provides living and dining facilities.

STUDENT ACTIVITIES

Student organizations and related activities at Georgia Tech are associated with a responsible Student Government which in cooperation with the office of the Dean of Students utilizes Student Center resources, facilities and staff and, especially, student life on the campus. The focal point is the Student Council and Graduate Senate which provide the means for self-governance in all areas of institutional student related activity.

Student Government—1969-70

Through the *Student Council* and the *Graduate Student Senate,* the student body maintains responsible self-governance. The various committees of the Student Government provide the student body with valuable services and constructive action within the Institute.

Student Council

The Student Council is the governing unit for the undergraduate student body. The Council, which was first established in 1922 by *ANAK,* is composed of representatives from each degree granting department of the Institute and from each class. The Council is headed by the Student Body President and Vice-President.

Officers

Dan Pittard, *Student Body President*
Sherman Glass, *Student Body Vice-President*
Billy Grist, *Judiciary Cabinet Chairman*
Henry Tharpe, *Secretary of the Student Council*
King Sidwell, *Treasurer of the Student Council*
James E. Dull, *Faculty Advisor*

Senior Class Representatives:

Thorny Parker, *President*
Rich Yunkus, *Vice-President*
Rich Gregory

Junior Class Representatives:

Sam Tyson, *President*
Chris Bagby
Mike Skillman
J.B. Kulakowski
Paul Martin
Joe Hall

Sophomore Class Representatives:

Steve Faber, *President*
Louis Isaf
Steve Romig
Tom McEwen

Sophomore Class (Continued):

Chris Parker
Don Williams
Barbra Bryan
Lynn Milam

Freshman Class Representatives:

Nancy Hamrick, *President*
Jim Dalle Pazze
Bobby Clotworthy
Barry Owens
George Flowers
Tom O'Leary

Departmental Representatives:

Charles Mallis, A.E..
Lee Ettenger, A.E.
Leslie Spencer, Arch.
Rob Rivers, Arch.
Doug Hughes, Ch.E., C.E.
Bill Grist, E.E.
Terrel Tedford, E.E.
Hutch Kinsman, E.E.
Mike Shenk, I.E.
Walt Abel, I.E.
Bob Thorpe, I.E.
Jim Thorne, I.M.
Stan Baumgartner, I.M.
Lenny Newman, I.M.
Bob Acker, Phys., Math., Chem.
Dyches Boddiford, Phys., Math., Chem.
Jerry Staton, Phys., Math., Chem.
Rick Rodgers, M.E.
Tim Swicord, M.E.
Rich Turner, Tex.

Co-op Representatives:

Bruce Milligan
Peter Check
Bill Brooksbank
Ray Helton
Bus Sirmon

Members at Large

Walley Bloom
Ron Blum

Honorary Members:

Barbra Burn, *WSA Representative*
Tom Christian, *Graduate Student Senate Representatives*
Brian Kinsey, *IDC Representative*
Jose Fernadex, *ISO Representative*
Kerry Baker, *Technique Editor*

Graduate Student Senate

The Graduate Student Senate is the governing unit of the graduate student body. The Senate was first established in 1959 as an Ad Hoc Committee to represent the graduate students on the issue of football seating. In just this short time, the Senate has grown to encompass all phases of graduate student problems. The representatives are elected from the various departments of the graduate school. The Senate is led by a group of officers known as the Executive Committee, who are elected by the entire graduate student body.

Officers:

Mike Massey, *President of the Graduate Student Body*
Bill Mikolowsky, *Executive Vice-President*
Tom Christian, *Vice-President for Student Affairs*
Charles Gaylor, *Co-ordinating Vice-President*
Mike Yalksk, *Treasurer*
Felton Bartlett, *Corresponding Secretary*
John Schummers, *Recording Secretary*

Board of Student Publications:

This Board was organized in July, 1945, at the request of the Student Council. The Board is responsible for all student publications on the Georgia Tech campus. Officers of the Board for 1970-71 were:

Chairman and Treasurer: Dean W. Eugene Nichols: *Secretary:* Brent W. Jorgeson

The Technique

Kerry A. Baker .... *Editor*
Patrick B. Hayward .... *Business Manager*
James D. Young .... *Faculty Advisor*

ERATO

Lance W. Ozier .... *Editor*
James J. Bynum .... *Faculty Advisor*

The Blue Print

Aubrey F. Hedrick .... *Editor*
William F. Everitt .... *Business Manager*
A. Frank Beckum, Jr. .... *Faculty Advisor*

The Georgia Tech Engineer

David J. Barrales .... *Editor*
Johnny Jackson .... *Business Manager*
W. Eugene Nichols .... *Faculty Advisor*

Office of Publications

Ben L. Moon .... *Director*

Pi Delta Epsilon

Thomas A. Fletcher .... *Representative*

FRATERNITIES

Interfraternity Council – Composed of one representative from each fraternity at Georgia Tech, and Assistant Dean of Students as Advisor, the Interfraternity Council is the governing body of all fraternities on the campus. The Council establishes such regulations as rush week rules, house rules, and pledge and membership regulations.

Officers 1970-1971

I.F.C.

Stephen S. Drennon	*President*
Ronald M. Ovetsky	*Executive Vice-President*
Thomas R. Pater	*Administrative Vice-President*
Richard F. Rodgers	*Secretary*
John T. Harter	*Treasurer*
Gary M. Bledsoe	*Faculty Advisor*

Fraternity	**Faculty Advisor**
Alpha Epsilon Pi	L. Zalkow
Alpha Tau Omega	P. T. O'Connor
Beta Theta Pi	H. Baker
Chi Phi	P. Sherry
Chi Psi	A. F. Abril
Delta Sigma Phi	W. H. Tripod
Delta Tau Delta	J. J. Bynum
Delta Upsilon	B. A. Gilbreath
Kappa Alpha	D. S. Caine
Kappa Sigma	J. Stepp
Lambda Chi Alpha	G. Davis
Phi Delta Theta	T. H. Hall, III
Phi Gamma Delta	E. M. Wheby
Phi Kappa Sigma	S. C. Ketchin
Phi Kappa Tau	W. M. Williams
Phi Sigma Kappa	J. D. Webster
Pi Kappa Alpha	T. Plaxico
Pi Kappa Phi	G. A. Chmielewski
Sigma Alpha Epsilon	
Sigma Chi	
Sigma Nu	J. H. Schlag
Sigma Phi Epsilon	P. G. Rector
Tau Kappa Epsilon	W. M. Templeton
Theta Chi	S. C. Ketchin
Theta Xi	
Zeta Beta Tau	P. Mayer
Psy Upsilon Colony	

Sorority

Alpha Xi Delta .... R. E. Stiemke

PROFESSIONAL AND TECHNICAL SOCIETIES

Departmental Societies	Faculty Advisor
Alpha Kappa Psi	J. A. Knutson
American Association of Colorists and Chemists	L. F. Porter
American Ceramic Society	J. F. Bensel
American Institute of Aeronautics and Astronautics	D. P. Giddens
American Institute of Architects	J. A. Kelly
American Institute of Chemical Engineers	J. W. Mason
American Institute of Industrial Engineers	J. G. Davis
American Marketing Association	R. G. Gamoneda
American Nuclear Society	J. D. Clement
American Society of Civil Engineers	R. King
Beta Beta Beta (Sigma Chapter)	J. J. Heise
Delta Sigma Pi (International Fraternity)	D. T. Kelly
Industrial Design Students	W. J. Seay
Institute of Electrical and Electronics Engineers	T. M. White
Planner's Society	M. G. Little
Psi Society (Psychology)	E. Jo Baker
Society of Automotive Engineer	W. Williams
Society of Physic Students	E. W. Thomas
Society of Women Engineers	D. T. Eaton

Departmental Honorary Societies

Alpha Pi Mu	D. E. Fyffe
Arnold Air Society	R. V. Dean
Chi Epsilon	R. King
Chi Epsilon Sigma	J. W. Mason
Delta Kappa Phi	H. Olson
Eta Kappa Nu	J. B. Peatman
Kappa Kappa Psi	B. L. Sisk
Keramos - Professional Ceramic Engineering Fraternity	A. T. Chapman
Pi Mu Epsilon	J. M. Osborn
Pi Tau Sigma, M. E. Honorary Fraternity	H. L. Johnson
Scabbard and Blade	R. V. Dean
Sigma Gamma Tau Society	D. W. Dutton
Tau Sigma Delta	J. H. Grady

Honorary Organizations

ANAK....W. R. Beard
Beta Gamma Sigma....E. R. Bollinger
Briarean, Section I....
Briarean, Section II....
Keoseme Society....P. B. Sherry
Omicron Delta Kappa (ODK)....W. Flinn
Order of Omega....G. M. Bledsoe
Phi Eta Sigma....A. H. Bailey
Phi Kappa Phi....
Tau Beta Pi....D. W. Dutton

Religious

Baptist Student Union....D. E. Briscoe
Campus Crusade for Christ....D. McGill
Catholic Student Center....M. DiLella
Christian Science Organization....
Episcopal Church on Campus....P. C. Cato
Inter-Varsity Christian Fellowship....E. Grovenstein
King's Men....R. E. Green
Luthern Student Association....D. A. Donges
Navigators....C. Van Gelder
Presbyterian Student Center....W. McKay, Jr.
Wesley Foundation....C. W. Landiss
YMCA....C. O. Parker
Hillel....H. Epstein

Miscellaneous

Afro American Association....D. Nelson
AIESEC....J. A. Knutsen
Alpha Phi Omega....D. L. Morgan
Angel Flight....R. V. Dean
Aqua-Jackets....D. R. Blakely
Barbell Club....W. M. Templeton
Bulldog Club....T. Plaxico
Cheerleaders....W. M. Templeton
Chess Club....
Chinese Club....J. T. S. Wang
Circle K Club....J. A. Strickland
Co-op Club, Section I....F. E. Roper
Co-op Club, Section II....G. P. Rodrigue
Counter-Insurgency Unit of Georgia Tech....
Dames Club....I. R. Gatland
Drama Tech....A. F. Beckum

Executive Roundtable	J. B. Peatmen
Flying Club	R. B. Logan
Free University	P. B. Sherry
Gamma Beta Phi	C. C. Rogers
Glee Club	J. L. Black
Graduate Student Senate	S. C. Webb
IAESTE	D. L. Cox
Interdormitory Council	G. Schwarzmueller
Interfraternity Council	G. M. Bledsoe
International Student Organization	W. M. Templeton
Judo Club	H. S. Min
Pan American Union	W. M. Templeton
Pershing Rifles	
Photography Club	
Political Forum	R. D. Johnson
Radio Club	J. A. Strickland
Ramblin' Reck Club	W. M. Templeton
Sailing Club	R. J. Gerdes
Soccer Club	M. Crowl
Sport Parachute Club	A. J. Seremeth
Sports Car Club	P. B. Sherry
Student Center	T. F. Mitchell
Student Council	J. E. Dull
T Club	B. Williamson
Tech Band	B. L. Sisk
Toastmasters Gavel Club	D. R. Nelson
USA-USSR Cultural Exchange Program	C. O. Parker
Veterans Club	R. Hutchinson
Women's Student Association	Helen H. Naugle
World Student Fund Committee	C. O. Parker
WREK Radio Station	J. A. Strickland
Young Republican Club	R. W. Allen

UNDERGRADUATE FINANCIAL AID

Financial aid at the Georgia Institute of Technology is intended to assist students in meeting normal college expenses, and it is our intention to help as many students as possible. Our hope is that no student will fail to consider Georgia Tech as a college he might wish to attend because of financial reasons. It is our desire to help, either through our own funds, or by directing the student to other sources. The financial aid applicant should realize, however, that the amount of aid which can be granted seldom meets all the educational expenses, and financial assistance will have to be supplemented by the student, family or other outside sources.

The financial aid office has the responsibility of administering all funds provided to Georgia Tech for the assistance of undergraduate students. Not only does this office award all financial assistance the institution has for the use of undergraduate students, but it also receives and assigns awards forwarded to the institution for the use of individual students from outside agencies. All students wishing to receive scholarships, loans, or any other type of monetary aid, should contact this office for information and service.

INTERNATIONAL STUDENTS may apply for scholarship aid, but due to limited funds and other restrictions, *should not* normally expect assistance.

TRANSFER STUDENTS will be considered for scholarships, loans and work opportunities as other entering students and should adhere to the February 1 deadline, if they wish assistance for any quarter of the year beginning with the subsequent fall quarter, since all scholarships for enrolled and transfer students are awarded during the summer.

Although the Co-operative program at Georgia Tech is not a financial aid program, many of those who attend are able to assist themselves with their college expenses through this program. One-fifth of the undergraduate enrollment attends under the Co-operative plan and earn from $2,000 to $2,800 per year. Co-op enrollment is restricted to students in the fields of engineering, science and industrial management. Financial need is not a prerequisite for consideration, consequently, a student attending under the Co-operative plan will not be denied consideration for other aid because of his enrollment. Students desiring other information on the Co-operative program should write to the Director of the Co-operative Division, Georgia Institute of Technology, Atlanta, Georgia 30332.

Many students obtain institutional part-time employment or part-time employment in the Atlanta area. Our Placement Center attempts to keep an up-to-date listing on opportunities and most students will be able to help themselves through part-time employment, if they so desire.

Request for Specific Assistance

Submission of an application for financial aid to the Financial Aid Office will insure consideration for all programs of aid. However, applicants desiring *specific* types of aid should check the appropriate spaces on their applications. All students should indicate the quarters for which they are applying.

Basic Principle of Financial Aid

We subscribe to the principle that the primary purpose of financial aid is to provide assistance to students, who, without such aid, would be unable to attend college.

The primary responsibility for financing an education rests with the student and his family. Any financial aid is, therefore, awarded according to individual need and individual college costs. Financial aid includes scholarships, loans, and employment, which may be offered to students singly or in combination.

Determination of Award

The family of the applicant is expected to make a *maximum* effort to assist the student with college expenses. Financial assistance from colleges and other sources should be viewed only as supplementary to the efforts of the family.

The student also has a responsibility of contributing to his college expenses. His resources may include savings, summer earnings, contributions from friends and relatives, etc. Summer earnings are normally calculated to be $400.00 prior to the freshman year and are expected to increase for upper-class years at the rate of $100.00 per year. Applicants are expected to contribute at least 1/5 of their savings toward each year's college expenses.

Obtaining and Submission of Application

Applications for financial aid may be obtained by calling or writing:

Director of Financial Aid
Georgia Institute of Technology
Atlanta, Georgia 30332
(404) 873-4211, extension 5335

Requests for further information on any programs of aid should also be directed to the above address.

Need, How Determined

The following table lists the amounts that typical families *with no unusual problems* should normally be able to provide toward each year of college, according to the College Scholarship Service. Families with unusual problems would normally be expected to provide less. (From *A Letter to Parents: Financial Aid for College* by Sidney Margolis – College Entrance Examination Board – 1970-71.)

Net Income before Federal taxes	1	*Number of dependent children* 2	3	4	5
$5,000	$ 250				
6,000	530				
7,000	800	$ 420			
8,000	1,090	630	$ 380	$ 220	
9,000	1,390	850	560	390	$ 310
10,000	1,690	1,080	740	550	470
11,000	2,030	1,310	930	710	620
12,000	2,420	1,540	1,120	870	770
13,000	2,800	1,760	1,310	1,040	930
14,000	3,190	2,060	1,500	1,210	1,090
15,000	3,570	2,360	1,690	1,380	1,250
16,000	3,940	2,660	1,910	1,550	1,410
17,000	4,310	2,960	2,170	1,720	1,570
18,000	4,680	3,260	2,420	1,910	1,730
19,000	5,050	3,550	2,670	2,130	1,900
20,000	5,400	3,840	2,920	2,360	2,110

Obtaining Proceeds of Awards

The Georgia Institute of Technology does not have a system of student accounts whereby a student may have funds deposited and obtain them as needed. Any awards granted by the institution to students or forwarded to the institution to be provided to the students will be deposited in institutional accounts from which checks will be prepared, made payable to the student, and advanced during registration for each quarter. Annual awards will normally be provided in equal quarterly installments.

If you are granted an award by someone other than Tech, and this money is to be sent to Tech for your use, you should ask that the funds be forwarded at least two weeks before the start of the specific quarter to the attention of the Financial Aid Office. Any instructions or restrictions should be forwarded with the award.

Scholarship check, both those awarded by the institution and those awarded by other sources, will be available on registration days in the lobby of the Administration Building and thereafter in the Cashier's Office on the campus. Proceeds from loans granted by the institution may be obtained in the Cashier's Office.

The student should complete registration, except for payment of fees, before he attempts to receive his award. Proof of registration is required before release of funds.

If you have been notified of an award and are not sure it has been sent to Tech, please inquire about it at the Financial Aid Office. Advances cannot be made until funds are received and late receipt of funds may cause delays or late fee penalities.

Aid to International Students

As previously stated, international students will not normally be provided financial aid by Georgia Tech. Almost all funds of the institution are restricted to citizens or permanent residents of the United States.

International students needing monetary assistance should correspond with the American Consulate in their home country or their own Ministry of Education to inquire about other sources of funds.

Army, Air Force and Naval ROTC

Students who have applied for enrollment in the Army, Air Force or Naval ROTC Program as regular students should complete their applications in the same manner as other students since they may not be notified regarding the results of their competition until it becomes too late to apply for aid.

Athletic Scholarships

Under certain circumstances, awards of institutional financial aid may be granted to students with athletic ability being considered as a factor in making the award. The granting of these scholarships or grant-in-aids is administered by the Financial Aid Office. To be considered for an athletic scholarship, a student does not need to submit a regular aid application or the Parents' Confidential Statement. Representatives of Georgia Tech will normally contact those students that they feel are qualified to be considered for athletic scholarships and provide them a letter of intent which may serve as an application for institutional financial aid.

Other students who wish consideration for athletic scholarships should contact the Financial Aid Office stating the reasons they feel they may be qualified.

CONCEPT INDUSTRIES PRESIDENTIAL AWARDS

Twenty-five $500.00 awards will be granted to entering freshmen at the Georgia Institute of Technology. These awards are made possible through the generosity of a friend of Georgia Tech. Criteria for the selection of the students for this award are as follows:

(1) High School Average.
(2) College Board Scholastic Aptitude Test Scores.
(3) Leadership as shown through participation and office in school, community, and religious organiations.
(4) High School Class Standing.
(5) Financial Need for the Funds.

Preference would be given to engineering students form Georgia with approximately 75% of the awards being granted to this group. Any other factors that may indicate the overall outstanding ability of the student will be given consideration in the selection process.

FINANCIAL AID–INSTITUTIONALLY-ADMINISTERED SCHOLARSHIPS

Scholarships granted to applicants will be assigned from the following funds. Georgia Tech is indebted to many generous individuals, foundations, industries, and other friends for these awards. Information on scholarships in general and specific information about each fund is shown.

Rules and Regulations Governing Undergraduate Scholarships

1. The majority of the scholarships which are available through the Georgia Institute of Technology are restricted to those undergraduates who have high academic ability and good character, but lack sufficient funds to begin or continue their college education.

2. A Georgia Institute of Technology scholarship application is required of each applicant. These forms are available from the Financial Aid Office and must be completed by entering freshmen and returned no later than February 15. All other students must submit their application between January 1 and April 1 of the year preceding the term for which the funds are desired. An interview is required when the application is submitted (except for entering freshmen and transfer students who would be required to make a special trip to the campus).

3. The Georgia Institute of Technology is a member of the College Scholarship Service (CSS). Participants in CSS subscribe to the principle that the amount of financial aid granted a student should be based on financial need. The CSS assists colleges and universities and other agencies in determining the student's need for financial assistance. Therefore, all applicants for financial aid must also submit the Parents' Confidential Statement (PCS), designating the Georgia Institute of Technology as one of the recipients in accordance with the following:

   a. The parents of all students under 25 years of age must complete the Parents' Confidential Statement (PCS) each year or sign a statement form provided by the Financial Aid Office that they did not contribute to the students' financial support for the previous year and did not claim him as a dependent for income tax purposes.
   b. If a student is over 25 and has received any financial support from his parents during the preceding year and/or been declared as a dependent for income tax purposes, the parents must likewise complete the PCS each year. If not, the financial resources of the individual student over 25 will be used in determining the amount of the award.
   c. All married students, whatever age, must also complete the Married Students Supplement to the PCS.
   d. Any exception to the PCS requirements will be considered as individual cases by the Financial Aid Officer.

Entering freshmen and transfer students may obtain PCS forms from their high schools or from the Financial Aid Office, Georgia Institute of Technology, Atlanta, Georgia 30332, and must submit them to CSS no later than February 1. All other students must obtain the Parents' Confidential Statement from the Office of Financial Aid and submit them to CSS no later than April 1.

4. Certain scholarships are renewable provided the recipients continue to demonstrate high scholastic ability, outstanding character and financial need. A renewal application is required of students for *all* renewal scholarships. It is the student's responsibility to complete this and provide any other information that may be required by the institution or sponsor during the deadline periods as established by the Director of Financial Aid.

5. All entering freshmen are required to take the College Entrance Examination Board Scholastic Aptitude Test and "certain" Achievement Tests (dependent upon field of study) prior to acceptance at the Georgia Institute of Technology. Results of these tests will be considered by the Director of Financial Aid in granting awards to entering freshmen.

6. An application for a scholarship cannot be considered until the student has been accepted for admission or is enrolled as a student at the Georgia Institute of Technology. Entering freshmen will be notified of awards not later than June 1; all others will receive notification not later than August 15.

7. A student need not apply for a particular scholarship since his eligibility for any scholarship is established upon receipt of the scholarship application and the Parents' Confidential Statement.

8. Scholarship payments are made in equal quarterly installments during the academic year. Payments are made to the individual recipient who in turn may apply the payment against his expenses.

9. The proceeds of financial aid awards shall be used for the payment of tuition and required fees, board and room, and similar living expenses and for instructional equipment, material and books.

10. The Financial Aid Office *must* be notified of any unusual changes in family or personal financial situation. We must be notified of any *additional* financial assistance which is received from other sources and it is understood that such assistance may cause a change in awards that have been offered by Georgia Tech.

11. Financial aid awards may be received only by the student while in school and carrying a full load (12 or more hours) unless special permission is received. If a student accepts funds after being dropped or after withdrawing, the student shall be liable for repayment.

12. If a student or parents of a student *intentionally* falsify any information, the award may be immediately withdrawn and the student will be liable for repayment of funds already received.

13. When, in the opinion of the Director of Financial Aid, a student commits any act that may be reason for disciplinary action, the award may be discontinued. Unusually poor academic achievement, such as academic probation, may also be reason for reconsideration of an award *during* the academic year.

14. By accepting a scholarship, the student gives approval for the institution to provide transcripts of grades and other records that may be requested by the sponsor.

Alcoa Foundation Scholarships (FAO-150)

Six $750 engineering scholarships to any student. Need, ability, and scholastic standing are the prime factors in the selection of candidates. Scholarships are renewable.

Allied Chemical Foundation Scholarships (FAO-100)

A grant of $1,500 to be awarded to students in the A. French Textile School. The amount of each award will be left to the discretion of the Director of Financial Aid, subject to concurrence by the A. French Textile School.

American Association of Textile Chemists and Colorists (FAO-200)

Two scholarships in the amount of $600 each to juniors or seniors in the School of Textile Chemistry. Selection is by the Director of Financial Aid, subject to sponsor approval.

Anonymous Alumnus Scholarship (Class of 1926) (FAO-250)

An $800 annual scholarship to an entering freshman cooperative student. Recipient must acknowledge receipt of the award to the Financial Aid Office.

David J. Arnold Scholarships (FAO-400)

Scholarships to be awarded from the interest on a fund established by Robert O. Arnold in memory of his brother. Award is unrestricted as to field of study and is awarded on the basis of financial need. Preference to residents of Spalding County, Georgia.

Atlanta Chapter Reserve Officers Association - Military Scholarship (FAO-430)

A $300 scholarship, preferably to a senior at Georgia Tech from Fulton or DeKalb County. Recipient must be a participant in the Air Force, Army, or Navy ROTC, and show scholarship, need and leadership ability. The scholarship will rotate to an annual basis beginning with the Air Force in 1969-70. Selection by the Director of Financial Aid with the advice and counsel of the Professor of Military Science of the particular branch.

Atlanta Federal Savings Scholarships (FAO-450)

Two annual $500 scholarships, one made to an entering freshman and one to a senior. The freshman selection is made on the basis of financial need and high school academic excellence. The senior selection is made from students who rank in the upper 25% of their class and on the basis of financial need. Recipients must be male graduates of an accredited high school within Cobb, Clayton, DeKalb, Fulton or Gwinnett County, and must be enrolled or accepted for admission in the College of Industrial Management.

Atlanta Textile Club Scholarship (FAO-500)

One $300 scholarship to be awarded to a junior or senior in the A. French Textile School. Preference will be given to students from the Atlanta area.

Avondale Educational & Charitable Foundation Scholarship (FAO-600)

An annual scholarship of $1,000, renewable for three additional years provided the student remains academically eligible. The recipient of this award should be from Butts County Georgia or the child of an employee of the Avondale Mills in Jackson, Georgia. Preference will be given to students in Textiles, Textile Engineering or Textile Chemistry.

Barrett Architectural Fund Scholarship (FAO-630)

A grant of $1,000 will be awarded to architecture students at the Georgia Institute of Technology. Selection will be made by the Director of Financial Aid, with recommendations from the School of Architecture. Unrestricted as to academic year.

Eugene O. Batson Scholarship Fund (FAO-4400)

This fund of $10,000 was created by Mr. E. O. Batson in memory of his son, the income to be given to deserving students. Unrestricted as to field of study.

Estelle A. Blalock Scholarship Fund (FAO-670)

An endowment fund established in memory of Estelle A. Blalock. Selection of the recipient is to be made by the Director of Financial Aid with major consideration being given to a Georgia resident. Unrestricted as to major and year.

Burlington Industries Foundation Scholarships (FAO-750)

Two annual $500 scholarships to a rising junior and a rising senior. Selection on basis of leadership, scholarship, and financial need. Prefer Textiles, Industrial Management, Industrial Engineering and related fields. Scholarship awarded junior recipient is renewable.

Fuller E. Callaway, Jr. Fund (FAO-2460)

Income from this fund is used to provide National Merit Scholarships to students at the Georgia Institute of Technology.

Coats & Clark, Inc. Scholarships (FAO-950)

Two $500 scholarships to be awarded each year. These scholarships are renewable for three additional years, provided student maintains proper requirements. Awards will be made to a high school graduate entering Georgia Tech for his freshman year in Chemical, Mechanical, Textile, Industrial, Electrical Engineering, as well as Chemistry, Textiles, and Textile Chemistry. If possible, one award will be made to an applicant from North Georgia and one to an applicant from South Georgia with preference to children of employees of Coats & Clark, Inc. Awards will be made on a basis of academic ability and financial need.

Continental Oil Company Scholarships (FAO-1030)

Six scholarships in the amount of $500 each. Three restricted to the use of students from the School of Chemistry and three for the use of students from the School of Chemical Engineering. Recipients should be American citizens, have no permanent job commitment, and not be on leave from a competing company. Scholarship and financial need will be taken into consideration with normally a scholarship being provided to a sophomore, junior, and senior in each participating school.

Crown Zellerbach Foundation Scholarship (FAO-1050)

One scholarship grant of $600 unrestricted as to field of study and for a junior or senior. Merit and ability are the primary considerations without regard to financial need. Scholarships are non-renewable.

Damar, Incorporated Scholarship (FAO-1100)

One $600 scholarship awarded to a Cobb County, Georgia, resident. Award is made on basis of need and ability.

Blanche Mohr Davis Scholarships (FAO-4490)

One (or more) scholarship to any student who desires and deserves a college education.

John Benton Dickey Memorial Scholarship Fund (FAO-5500)

Annual income from an endowment fund of $10,000 to be used to provide one or more scholarships or loans to students of Georgia Tech. Available to students in any field who are academically outstanding and need financial assistance in order to attend college. These funds were left to Georgia Tech by the late Mrs. Kate McCalley Dickey in her Last Will and Testament.

Robert B. Dodds Unit Fund Scholarships (FAO-1150)

Scholarships to be awarded from the income on a capital stock fund to any student selected by the Director of Financial Aid. Preference will be given to qualified applicants from the State of Arkansas.

Dow Chemical Company Scholarship (FAO-1230)

One annual upperclass scholarships; one

for $1,000 to be awarded to a Chemical Engineering student. Selection by the Director of Financial Aid with consideration being given to scholastic ability, leadership and need.

Berl Elder Memorial Scholarship (FAO-1270)

A scholarship of $405.00 given by the Consulting Engineer Council of Georgia in memory of Berl Elder. To be granted to an engineering student whose goal is to be a consulting engineer and one who has or will take the Engineering-in-Training examination prior to graduation or soon thereafter. Award is non-renewable.

Ferro Corporation Scholarship (FAO-1300)

One annual scholarship of $300.00 to be provided to the Ceramic Engineering student who has the highest academic average at the end of the second quarter of his Sophomore year. Award to be granted during the Spring Quarter.

Fieldcrest Mills Scholarship (FAO-1330)

A $1,000 scholarship for a rising junior renewable for the senior year. The recipient is also given the opportunity of summer employment with the company. Academic excellence, willingness to consider textile career after college, and suitable curriculum considerable for future employment in the textile industry, will be the main criteria for selection of this student along with academic ability and financial need.
The recipient must be a U.S. citizen.

Louise M. Fitten Memorial Fund (FAO-5550-5555)

The interest on approximately $1,000,000 annually awarded to deserving students as scholarships. This endowment was provided to the institution from the estate of Miss Louise M. Fitten. Income is available for unrestricted scholarship purposes.

James Swann Floyd Fund (FAO-2460)

Income from this fund is used to provide National Merit Scholarships to students at the Georgia Institute of Technology.

Franklin Foundation Scholarships (FAO-1350)

$3,000 annual scholarship fund established to aid worthy students from the State of Georgia. Awards are made on the basis of need, ability, evidence of good character and scholastic standing.

Fulton Federal Savings Scholarship (FAO-1400)

Three scholarships of $250 each for students majoring in the School of Architecture who are residents of Georgia. Ordinarily one award will go to a sophomore, one to a junior, and one to a senior.

Geigy Dyestuffs Scholarships (FAO-1450)

A $500 scholarship for a student, preferably a junior, majoring in Textile Chemistry. This award will be granted on the basis of financial need, academic ability and evidence of good character.

General Motors Scholarships (FAO-1500)

One scholarship is awarded each year to an entering freshman of demonstrated academic excellence and leadership potential. Unrestricted as to field of study. Stipend ranges from $200 to $2,000 per year, depending on financial need. Renewable for three years subject to fulfillment of academic and leadership promise.

Georgia Institute of Technology Merit Scholarships (FAO-2460)

Thirty scholarships. For National Merit Scholars seeking to enroll at the Georgia Institute of Technology.

Gilman Foundation Scholarship (FAO-1600)

An award of $1,000 for an entering freshman, renewable for three additional years. Preference will be given in the order indicated:

1. Male resident of St. Marys, Georgia who is employed by, or who is a son of a employee of, St. Marys Kraft Corp., St. Marys Railroad Co., or Kraft Bag Company.
2. Any male employee or son of an employee of above mentioned companies, Gilman Paper Co., The Cellucord Corp., or Gilman Electric Light and Power Co., regardless of residence.

E. Barron Glenn Memorial Scholarship Fund (FAO-1630)

An annual award of $1,000 to be provided to students enrolled at Georgia Tech who excell academically and need funds in order to remain in school. This money is given in memory of the founder of Glenn Associates, Inc., E. Barron Glenn and his wife Grace who met an untimely death on June 3, 1962 in the air crash at Orly, France.

Goodyear Foundation Scholarship (FAO-1650)

An award of $1,000 for a junior or senior majoring in Mechanical or Chemical Engineering. Selection on basis of need, leadership, scholarship and ability.

Dean George C. Griffin Scholarships (FAO-1750)

A scholarship amounting to $1,000 a year has been made available for 99 years by Mr. L. Allen Morris of the Allen Morris Foundation and Class of 1936, a resident of Miami, Florida, to set up in honor of George C. Griffin, Dean of Students Emeritus at Ga. Tech. First preference for award of the scholarships will be given to residents of Miami or Dade County, Florida. Second preference will be to those from other sections of Fla. The main qualifications for the scholarships will be academic ability and financial need.

George C. Griffin Scholarship (FAO-5615)

A scholarship fund created from the interest on approximately $35,000 contributed by Georgia Tech alumni and friends honoring Dean Griffin on his retirement as Dean of Students. The scholarships are unrestricted as to field of study and awarded on the basis of financial need.

Col. Frank F. Groseclose Scholarship (FAO-1800)

One scholarship in the amount of $200 to a senior in the School of Industrial Engineering. The recipient must be a member of the Georgia Tech Chapter of the A.I.I.E. The scholarship will be awarded on the basis of financial need rather than scholastic ability alone.

The Robert E. Gross/Lockheed Aircraft Corp. Scholarship (FAO-1850)

Income from $30,000 to be awarded annually by the Director of Financial Aid to any regularly enrolled student in scientific, engineering, economic or other fields applicable to the aerospace, electronic, marine, manufacturing, or construction industries. Recipient must be a U.S. citizen.

Walter J. Hecht Scholarship (FAO-5620)

Endowment estimated at $15,000 in the will of Mr. Walter J. Hecht for the establishment of a scholarship fund at Georgia Tech. Students selected on the basis of academic achievement and financial need. Students from any major and academic year are eligible.

The John P. Holmes Scholarships Honoring Ben Z. and Sallie P. Holmes (FAO-5625)

This scholarship was set up by John P. Holmes in memory of his parents to provide one or more scholarships annually to undergraduates on the basic of academic ability and financial need.

C. A. Jones Memorial Scholarships (FAO-5627)

A request of $50,000 to be invested and net income used for a fellowship and/or scholarships for students from the A. French Textile School at the Georgia Institute of Technology. Selection of the recipient by the Director of Financial Aid and A. French Textile School.

Martin Luther King Memorial Scholarship (FAO-5628)

Full or partial scholarships to be awarded to students whose lives and commitments make them appropriate recipients of the fund. Director of Financial Aid will make awards at the recommendation of a committee appointed by the President of Georgia Tech.

C. D. LeBey Memorial Scholarship (Class of 1922) (FAO-5630)

One scholarship each year, unrestricted as to field of study, has been established in memory of Mr. C. D. LeBey, President, Class of 1922. First preference to residents of Florida, Alabama, and Tennessee. Value, approximately $250.

Julian L. Looney Scholarship Fund (FAO-5660)

A trust fund of approximately $30,000

given by Hazel Betts Looney in honor of her husband. Income from the fund is available for unrestricted scholarship purposes.

Lowry Memorial Scholarship Fund (FAO-5690-5695)

This scholarship was set up by Colonel Robert J. and Emma C. Lowry for the purpose of assisting legal residents of the State of Georgia to obtain a college education, who, because of lack of funds, might otherwise be deprived of this opportunity. The interest on approximately $500,000 is distributed as gift or loan scholarships, depending on the individual needs of the students.

R. L. "Bob" MacDougall Scholarship (FAO-2050)

One scholarship each year, unrestricted as to field of study, has been established in the name of R. L. MacDougall by the Class of 1925 and friends. Value, approximately $300.

Martin-Marietta Freshman Tuition Scholarships (FAO-2150)

One or more annual scholarship grants to cover full tuition for entering freshmen for the cooperative plan during the freshman year. Recipients must be from the Maryland, District of Columbia, or Orlando, Florida areas. Preference will be given to those students in Aerospace Engineering.

McLendon Scholarship Fund (FAO-2200)

Fund of $500 established to be awarded to qualified students of good character, in financial need, and who would be otherwise unable to pursue their education. Unrestricted as to field of study.

Northside Optimist Club Scholarship (FAO-2500)

A scholarship fund in the amount of $2,000 to be awarded entering freshmen from the Greater Atlanta geographic area. Recipients must have high character, leadership potential, and academic ability. Preference will be given to those students with financial need.

Patterson and Dewar Engineers, Inc. (FAO- 2600)

A fund of $400 per year, established by Patterson and Dewar Engineers, Inc., to be awarded to a deserving senior. The scholarship is made in behalf of the clients of the firm in lieu of the Christmas gifts of earlier years. The recipient is requested to assume the responsibility to repay voluntarily to the scholarship the funds received if practical in the future.

Pennsylvania Glass Sand Corporation Merit Award Scholarship (FAO-2650)

An award covering tuition and fees for the senior year to the student in Ceramic Engineering who completes the junior year with the highest average.

Annie Laura Galloway Phillips Scholarship (FAO-2700)

A $200 annual scholarship established to help deserving boys. Award will be made on the basis of scholastic record and financial need.

Jack Phinizy Educational and Charitable Foundation Fund (FAO-2750)

Awards of $200 each for a freshman and a sophomore student in engineering. Restricted to students from Florida, Georgia, or North Carolina. Boys from Richmond County, Georgia, all things being equal, will have preference. Granted on the basis of academic ability, engineering aptitude, and financial need.

The ITT Rayonier Scholarships (FAO-2900)

Two scholarships of $500 each established by the ITT Rayonier Foundation. One of the scholarships is available for a senior in the School of Chemical Engineering and the other for a senior in the College of Industrial Management.

Lucia Reeves Scholarship (FAO-2950)

One or more scholarships for worthy young men and women to be awarded from the income on a capital stock fund. Selection is by the Director of Financial Aid.

Regents' State Scholarships (FAO-5750)

Georgia Tech's share of a fund appropriated by the General Assembly for the University System with the Board of Regents. Scholarships are for Georgia students with average grades and/or predicted grade point average in the upper 25% who possess superior ability and require financial need. The amount of each scholarship is determined by the Director of Financial Aid up to a maximum of $750 per year. Scholarships are renewable and with the provision that recipients must agree to stay and work in the State of Georgia one year for each $1,000 received under this program.

Rohm and Haas Scholarship (FAO-3000)

A $1,000.00 fund to be provided annually to one or two Chemical Engineering students. Recipients must be juniors or seniors and in the upper 20% of their class.

J. D. Rhodes Scholarship (FAO-5760)

One or more scholarships to be awarded from the income of the Trust of the late J. D. Rhodes. Selection is by the Director of Financial Aid.

Edward Schmidt Scholarship Fund (FAO-3170)

A scholarship fund provided by Pucel Enterprises, Inc., Cleveland, Ohio, and administered by the Joseph A. Sedlak Management Consultant Inc. for an Industrial Engineering student who has exhibited interest in becoming involved in plant layout and/or design of material handling systems. Granted to an incoming student in the amount of $300 and renewable for the subsequent years. The student must remain in the upper 25% of his class. Selection is on the basis of the above criteria and financial need.

Schlumberger Foundation (FAO-3150)

One Schlumberger collegiate award in the amount of $1,000.00 to be made to students of high academic standing in their junior or senior year in the Schools of Electrical or Mechanical Engineering or Physics. Students must complete, prior to earning his undergraduate degree, at least twelve hours study in electricity.

Schroeter-Ergenzinger Foundation (FAO-3200)

Two scholarships in the amount of $1,000 each for entering freshmen in the scientific or engineering fields. Recipients must be of good moral character and scholastic ability with economic or financial need. Scholarship is renewable and selection is by the Director of Financial Aid.

Scott Foundation Leadership Award (FAO-9030)

Award given to a rising junior in the amount of $1,000 renewable for the senior year. Restricted to a promising student in the School of Mechanical Engineering. Recipients are chosen by faculty-student committee.

Seydel-Woolley & Company Scholarship (FAO-3250)

One $500 scholarship to be given to an outstanding male sophomore, junior or senior in the field of Textiles.

Shaheen Foundation Scholarship (FAO-3300)

The interest from $5,700 to be awarded to engineering students on the basis of need and ability. Selection by Director of Financial Aid with preference to students from Whitfield County, Georgia.

Smith-Turner Memorial Scholarship Fund (FAO-3400)

Scholarships to be awarded from the interest on a $25,000 Trust Fund established by Mr. Ivy Hendrix Smith in honor of Mr. N. S. Turner and Mr. George T. Smith. Selection is by the Director of Financial Aid to worthy students without restriction to class, curriculum, sex, or other limitations. Preference will be given to a Jacksonville, Florida student.

Southern Woolen and Worsted Association Scholarship (FAO-3410)

An annual award of $400 to worthy students enrolled in the A. French Textile School. Selection is by the Director of Financial Aid.

Standard Oil Company Scholarship (FAO-3430)

A Ch.E. Scholarship in the amount of $500 to be provided to an outstanding senior. Leadership, academic achievement and need will be used as criteria for selection by the Director of Chemical Engineering and the Director of Financial Aid.

Standard Oil Company of California Scholarship (FAO-3440)

Two scholarships in the amount of $500.00 each to awarded to an entering freshman and a sophomore in the School of Chemical Engineering.

Financial need and academic achievement or promise will be the prime criteria for awarding these scholarships.

Starke Patterson Scholarship (FAO-5780)

One or more annual scholarships to be awarded on the basis of academic ability and financial need. Recipients are to be selected from boys in the Cooperative plan from Memphis or Shelby County, Tennessee, high schools. Awards are made on the basis of academic record and financial need.

T. E. Stribling Memorial Textile Fellowship/Scholarship Fund (FAO-3500)

Entire and annual net income from Stribling Trust Fund for one fellowship to include tuition and fees, not less than $2,000 nor more than $2,500, plus $500 misc. expenses. Any excess income may be used for undergraduate scholarships of not more than $600 to members of the junior and senior classes of the Textile School.

The Taulman Company Scholarship (FAO-3530)

A $1,000 scholarship provided by the Taulman Company to be awarded to a student or students in the School of Civil Engineering or Environmental Science. Preference is to be given to a student who wishes a career in Sanitary Engineering or in Environmental Science. Selection is by the Director of Financial Aid in conjunction with the Director of Civil Engineering.

The Textile Engineering Scholarship Plan of the Textile Education Foundation, Inc. (FAO-3600)

The Textile Education Foundation, Inc., of Atlanta, Georgia, established this scholarship plan in 1952 for the purpose of encouraging and assisting worthy young men who seek to obtain an education in Textile Engineering. A maximum of six scholarships will be awarded annually, each scholarship amounting to $750 per scholastic year for each of four scholastic years provided the recipient maintains the requirements. For further information write to: The Director, A. French Textile School, Georgia Institute of Technology, Atlanta, Georgia 30332.

James F. Towers Scholarship (FAO-3650)

Scholarships are to be awarded from the interest on a fund of $15,000 established by James F. Towers. Recipients should major in engineering or science. Preference will be given to male students from Floyd County, Georgia.

Uniform Award-Army ROTC (FAO-3660)

A fund of $200 established by the Georgia Society of Daughters of Founders and Patriots of America to provide assistance to deserving Army ROTC students in purchasing advanced ROTC uniforms. Students must reimburse fund at the completion of ROTC and upon receipt of uniform deposit refund.

Union Oil Company of California Scholarship (FAO-3760)

An annual award of $500 to be given to a Ch.E., who is outstanding academically and needs funds in order to complete his education. Selection by Director of Financial Aid.

Uniroyal Foundation Scholarship (FAO -3780)

Upperclass scholarship from a fund of $800 to be provided to students who have demonstrated academic ability, leadership and need funds to attend college. Recipient must assume a moral obligation to repay 25% of the scholarship after graduation. Selection by Director of Financial Aid.

Universal Oil Products Company Scholarship (FAO-3800)

$1,500 per year scholarship fund established to aid worthy students in their junior or senior years of study. $1,000 will be used for students in Ch.E. and $500 for students in C.E. or M.E. Awards are made on the basis of academic record and financial need.

Universal Oil Products Company Scholarship (FAO-3800)

$1,500 per year scholarship fund estab-

lished to aid worthy students in their junior or senior years of study. $1,000 will be used for students in Ch.E. and $500 for students in C.E. or M.E. Awards are made on the basis of academic record and financial need.

William T. Walton Memorial Scholarship Fund (FAO-3850)

An award to be provided to a student in Chemical Engineering. The widow of William T. Walton, Mrs. Martine Walton, requested on his death that, in lieu of flowers, donations be sent to the Georgia Institute of Technology to establish this fund. The interest from these donations will comprise the scholarship.

Western Electric Fund Scholarships (FAO-4000)

Three scholarships awarded to upperclassmen in the field of Engineering. Awards can be given to first or second year students. Scholarship maximum of $1,500 is based upon the cost of tuition, fees and books. Scholarships are renewable. Preference will be given to those students majoring in Electrical, Industrial, or Mechanical Engineering, and Industrial Management.

Wilcox-Conally Scholarship (FAO-4150)

An award of $300 for any junior or senior of the School of Architecture.

Woman's Aero Club of Atlanta Scholarship (FAO-4200)

An award of $1,000 for any junior or senior majoring in Aerospace Engineering.

James Wright Memorial Scholarship (FAO-850)

One $500 scholarship to be awarded any student in the A. French Textile School. The funds for this award are provided by the A. B. Carter Company, Inc. in memory of Mr. James Wright, a former Tech student. Although this award is not renewable for subsequent years, the student receiving this award will be given prime consideration for other available awards for his future academic years.

Goodloe Yancey Scholarship Fund (FAO-1640)

An annual undergraduate fund of $1,000 to be used at the discretion of the Director of Financial Aid to provide financial assistance to a needy and promising Georgia young man (or men) who are enrolled at Georgia Tech in the School of Civil Engineering.

GEORGIA TECH ALUMNI CLUB SCHOLARSHIPS

Various alumni clubs sponsor scholarship programs for students in their geographic areas. Interested applicants should contact their local high school counselor for further information or contact Mr. W. Roane Beard, Executive Secretary, Georgia Tech Alumni Association, 225 North Avenue, Atlanta, Georgia 30332.

Albany, Georgia Alumni Club (FAO-050)

Two or three scholarships (Co-op) for freshmen from the Albany, Georgia area. Only engineering courses available.

Augusta, Georgia Tech Club (FAO-550)

One, possibly two, $360 scholarships available to freshmen from the Augusta area.

Birmingham, Alabama Georgia Tech Club (FAO-650)

One $1,000 scholarship for freshmen from Birmingham and vicinity.

Cape Kennedy Georgia Tech Club (FAO-820)

One award of $500 for an entering freshman from the Cape Kennedy area.

W. L. Carmichael Academic Scholarship (FAO-1700)

One scholarship to be granted to a student from the Greater Atlanta Georgia Tech Club area by the Club. Selection on basis of academic potential with a stipend of $250 to $1,500 per year, based on information from the Parents' Confidential Statement. Renewal if student remains in upper 25% class.

Chattanooga, Tennessee Georgia Tech Club (FAO-900)

One $400 scholarship available to freshmen from the Chattanooga area pursuing an engineering curriculum under the Cooperative Program. Applicants must rank in the upper 1/3 of their high school class, be of good moral character, and have financial need.

Bobby Dodd Scholarships (FAO-1700)

Fifteen or more freshmen scholarships of $300-$450 each for qualified needy students from the Metropolitan Area provided by the Greater Atlanta Georgia Tech Club. Students are urged to attend on the Co-operative plan. Scholarships are extended for the sophomore year to those students who make a point average of 3.0 or better in their first year.

Huntsville, Alabama Georgia Tech Alumni Club (FAO-1900)

One or more scholarships for students from the Huntsville area.

Jacksonville, Florida - Georgia Tech Alumni Club (FAO-1970)

One or more scholarships from the Jacksonville, Florida area.

Macon, Georgia Tech Club (FAO-2100)

One, possibly two, $360 scholarships available to freshmen from the Macon area.

Middle Tennessee Georgia Tech Club (FAO-3540)

A scholarship fund in the amount of $500 to be awarded entering freshmen who require financial assistance. Recipients must be from the Middle Tennessee area.

Pittsburgh Georgia Tech Club (FAO-2800)

One $1,000 scholarship for high school students in Allegheny County to be awarded to an entering freshman who needs assistance.

Savannah, Georgia Tech Club (FAO-3100)

Two $375 scholarships for students from the Savannah area.

South Texas Alumni Association (Blake R. Van Leer Memorial Scholarship) (FAO -1720)

One $700 scholarship (Co-op) for freshmen from Houston, Texas and nearby cities. Only engineering courses available.

Washington, D.C. Georgia Tech Club (FAO-3900)

Three scholarships for students from the Washington, D.C. area. Scholarships are designated as: Three Musketeers Scholarship , C. Gale Kiplinger Scholarship and General Club Scholarship.

FINANCIAL AID—INSTITUTIONALLY-ADMINISTERED EMERGENCY AND SHORT-TERM LOAN FUNDS

Students may find it difficult to have all necessary funds on registration day and desire to extend the cost over the quarter. To help meet this need, Georgia Tech has an established program of short-term loans. Purposes and rules are as follows:

Rules and Regulations Governing Short-Term Student Loans

1. A written application will be required of each applicant for a short-term loan, and an interview will be required when the application is submitted.

2. Each application must be approved by the Financial Aid Office before the loan will be granted.

3. Each student to whom a loan is granted will be required to sign a promissory note covering principal and interest.

4. There will be a set schedule of repayment which will be made a part of the application for the loan, and will also be made a part of the note to be signed by the student. (This schedule will normally consist of 3 equal installments with the entire balance to be repaid not later than 10 days before the end of the quarter in which funds are obtained.)

5. All notes bear interest at the rate of 5% per annum from the date of the note.

6. A student making application for a loan must state the reason for the loan.

7. The parent or guardian of a student applying for a loan will be so notified.

8. In some cases, an endorser may be required and in such instances, the student shall be notified.

9. *All* sections of the application must be completed in full.

10. A student will not be allowed to have more than *one* outstanding short-term school loan at a time. (An exception to this rule is a loan made for plant trips.)

11. Students may submit applications for short-term loans at any time during a quarter and expect receipt of funds within a normal processing time of one or two days.

IF, HOWEVER, STUDENTS WISH TO RECEIVE FUNDS ON A DAY OF REGISTRATION for payment of fees and tuition, they must anticipate a processing period of two to three weeks before receipt of their checks. Consequently, *applications for Short-Term School Loans must be submitted not later than two weeks in advance of any registration day.*

12. THE ONLY EXCEPTION TO THE ABOVE TIME LIMITS ARE CASES OF EMERGENCY. WHEN SUCH EMERGENCIES OCCUR, WHETHER DURING THE QUARTER, BETWEEN QUARTERS OR ON A DAY OF REGISTRATION, THE STUDENT SHOULD REQUEST SPECIAL CONSIDERATION

FROM THE DIRECTOR OF FINANCIAL AID TO RECEIVE FUNDS ON AN EMERGENCY BASIS.

Loan applications submitted on the first day of registration of any quarter before 3:00 p.m. and *approved on an emergency basis by the Director of Financial Aid* will be processed before late fees apply. Loan applications submitted on the second day of registration will *not* be processed before late fees apply, and applicants with emergency situations must request waiver of late fees through the Director of Financial Aid.

13. Student short-term loans will be considered for the following purposes:
   a. Tuition, fees, room rent, board, books & supplies.
   b. Plant trips and after-graduation relocation.
   c. Emergency expenses not covered above.
   d. Fraternity expenses.

14. A student's repayment record on previous loans of any type will be given prime consideration in the granting of a loan. *Late repayment seriously endangers chances for new loans.* Students with overdue loans will not be allowed to register for the next quarter until the obligation is cleared.

Short-Term Loan Funds

Approved short-term loan applications are assigned to the following funds which have been established through the generous contributions of friends and patrons of the Institute:

George W. Adair Loan Fund	$ 725.00
Fred W. Ajax Memorial Loan Fund	
John I. Alford Loan Fund	1,500.00
William Ott Alston, Jr. Memorial Loan Fund	800.00
American Institute of Architects, Georgia Chapter Loan Fund	325.00
American Society of Mech. Engrs., Roger Martin Memorial Fund	1,475.00
J. Baldwin Loan Fund	65.00
M. R. Berry Loan Fund	4,650.00
James G. Boswell Foundation Loan Fund	740.00
S. F. Boykin Loan Fund	140.00
T. P. Branch Memorial Loan Fund	225.00
Brittain-Busbin-Jarrell Emergency Loan Fund	4,000.00
J. B. Campbell Loan Fund	850.00
The DeWitt F. Capehart Loan Fund	250.00
Class of 1919 Loan Fund	25.00
Class of 1934 Loan Fund	285.00
Josiah Dana Cloudman Loan Fund	16,700.00
Holland Coleman, Jr., Architectural Memorial Scholarship Loan Fund	1,600.00

William B. Coleman Post #51 of the American Legion Loan Fund	540.00
Mrs. Alice Spencer Coon Loan Fund	3,450.00
Creole Foundation Loan Fund	1,800.00
A. C. Dobbs Loan Fund	130.00
Arthur J. Dyer Student Loan Fund	1,350.00
Ford Foundation Loan Fund	194,000.00
A. French Loan Fund	2,900.00
Georgia Federation of Labor Loan Fund	1,425.00
Count Dillon Gibson Memorial Student Loan Fund	2,900.00
Mary Brotherton Griffin Loan Fund	240.00
Mary D. Gude Loan Fund	200.00
Lyman Hall Loan Fund	8,800.00
Harrison-Trabant Loan Fund	500.00
J. M. High Memorial Loan Scholarship Fund	3,500.00
Dr. and Mrs. Thomas P. Hinman Loan Fund	300.00
Irving Subway Grating Company, Inc. Loan Fund	600.00
Al Loeb Emergency Loan Fund	265.00
Louis Gholstin Johnson Loan Fund	775.00
Kappa Alpha Educational Foundation, Inc. Loan Fund	130.00
The Clyde L. King, Jr., and John King Memorial Loan Fund	9,700.00
John King Memorial Loan Fund	30,500.00
Roy Stevenson King Loan Fund	3,300.00
Last Sub Class Loan Fund of 1914	180.00
Malta Lodge #641, F. & A. M. Loan Fund	1,750.00
Lona Mansfield Loan Fund	1,400.00
Mrs. T. O. Marshall Loan Fund	10,000.00
E. P. McBurney Loan Fund	16,950.00
J. A. McFarland Loan Fund	175.00
Thomas E. Mitchell Education Fund of the University of Georgia	7,800.00
Joseph N. Moody Loan Fund	2,800.00
The Gayle Nimmocks Memorial Scholarship	200.00
Cy Perkins Memorial Loan Fund	1,700.00
Quartermaster Loan Fund	730.00
The L. W. (Chip) Robert, Jr. Loan Fund	140.00
Scottish Rite Loan Fund	1,700.00
Second Baptist Church, Bible Class #1	850.00
Sam W. Small Loan Fund	75.00
T. W. Smith Loan Fund	430.00
Smyrna Lions Club Loan Fund	125.00
Stacey-Roberts Loan Fund	120.00

J. P. Stevens Loan Fund	3,000.00
Lynn Strickland Memorial Loan Fund	1,300.00
Joseph M. Terrell Loan Fund	4,500.00
Thomaston Mills Loan Fund	2,500.00
Clark Thornton Memorial Loan Fund	700.00
E. A. Turner Loan Fund	60.00
Arthur Williams Estate Emergency Trust Loan Fund	1,000.00
Mrs. Fannie B. Wright Loan Fund	1,300.00
Carl B. Whyte Emergency Loan Fund	2,100.00

Emergency Loan Funds

Generous friends of the institution have established funds of varying amounts which are used for emergency loans. Loans are made from these funds for emergencies only, and are obtained in the same manner as a regular short-term loan.

Georgia Tech Student Council Emergency Loan Fund (Vernon Shipley Memorial Loan)

A percentage of the donations to the annual Campus Charity Fund is used to finance this project of the Student Council. Loans may be granted for emergency situations to any enrolled student. Except in *very* unusual circumstances, loans will not exceed $100 and must be repaid within 60 days. Applications may be obtained from the Financial Aid Office. Loans bear no interest.

FEDERAL FINANCIAL AID PROGRAMS

We participate in all four federally sponsored financial aid programs. Following are descriptions and regulations on each: National Defense Student Loan, College Work-Study Program, Educational Opportunity Grants, and Cuban Loans. Also included is information on Veterans Administration programs.

Rules and Regulations Governing National Defense Student Loans (FAO 5720-5725)

1. The student should apply for an *annual* amount. The maximum allowable per year (3 quarters) is $1,000 for an undergraduate student, and the maximum total amount for one borrower during an undergraduate degree program is limited to $5,000. A student's total maximum amount of loan may be increased to $10,000 for a graduate degree. The maximum loan a *graduate* student may be awarded is $600 per quarter. The student should indicate the quarters for which the loan is desired on the application form, as well as the amount desired. The deadline for application for *summer only* is March 1.

Loans for four consecutive quarters (except for co-op students) will be considered only as special cases. It is expected that students will seek employment during the summer months to help provide funds for college expenses during the following year.

2. The amount awarded to the student will be determined from information on the Parents' Confidential Statement and will take into consideration other awards received from the Georgia Institute of Technology and/or from other organizations.

3. A student's academic record is considered in the granting of the loan.

A student's credit history at the institution, including repayment record on Short-term School Loans, is taken into account in considering an application for a National Defense Student Loan. A student who is in the best judgment of the Financial Aid Officer a "poor risk" according to his financial record at the institution is ineligible for a National Defense Student Loan.

4. All applicants must complete the Georgia Institute of Technology application *each year.*

The parents of all students under 25 years of age must also complete the Parents' Confidential Statement (PCS) each year or sign a statement on a form provided by the Financial Aid Office that they did not contribute to the student's financial support for the previous year and did not claim him as a dependent for Federal income tax purposes.

If a student is over 25 and has received any financial support from his parents during the preceding year and/or been declared as a dependent for income tax purposes, the parents must likewise complete the PCS each year. If not, the financial resources of the individual student over 25 will be used in determining the amount of the award.

All married students, whatever age, must also complete the Married Students' Supplement to the PCS.

Any exception to these PCS requirements will be considered as individual cases by the Director of Financial Aid.

5. *To insure consideration, upperclass applications for loans must be submitted between November 1 and April 1 of the year preceding the academic year for which the loan is desired.* Applications received after April 1 will be considered only if funds are available and at the discretion of the Director of Financial Aid. The deadline for prospective Freshmen and transfers is February 1. An interview is required when the application is submitted (except for entering freshmen and transfer students who would be required to make a special trip to the campus).

6. The Parents' Confidential Statement should *not* be sent to the Georgia Institute of Technology, but to the address indicated in the information included with the Parents' Confidential Statement.

7. All applicants will be notified by mail of approval or disapproval of their applications.

8. PLEASE NOTE that even though a student may receive notice of approval of an annual amount, he must comply EACH QUARTER with the following requirements or his *loan will not be processed:*

a. A student must remain in *good academic standing* at the Georgia Institute of Technology. If he is placed on academic probation for any quarter covered by the loan, he will be automatically ineligible to receive a loan for that particular quarter and his application for that quarter will be cancelled.

b. A student must be enrolled as a full-time student at the Georgia Institute of Technology for each quarter covered by the loan unless he has received special approval to receive funds as a half-time student.

9. Prior to the receipt of the funds, the borrower must execute a promissory note. The oath and affidavit must be executed.

10. Funds received from these loans can be used only for legitimate educational purposes; payment of tuition and required fees, books and supplies, room, board and similar living expenses.

11. The borrower must, prior to leaving school, make satisfactory arrangements with the Controller's Office for repayment of the loan; repayment to begin no later than the tenth month from the day of leaving the university or graduation with the following exceptions:

a. As long as the borrower is pursuing at least a half-time course of study at any institution of higher learning, no interest shall accrue and no payments need be paid.

b. Payment may also be delayed, not in excess of 3 years, during which the borrower is a member of the Armed Forces of the United States, is in service as a volunteer under the Peace Corps Act, or is a volunteer under VISTA.

c. An amount, not to exceed 50 per cent of any loan plus interest, shall be cancelled for services as a full-time teacher, at the rate of 10 per cent of the amount of the loan (plus interest), which is unpaid on the first day of teaching service, for each complete year of service.

12. Interest at three per cent is charged on the unpaid balance beginning nine months after the borrower ceases to be at least a half-time student.

13. Repayments shall be made in equal monthly installments of at least $15.00 a month.

College Work-Study Program (FAO-4430)

The purpose of this program is to make part-time employment opportunities available to students, particularly those from low-income families, who are in need of the earnings from part-time employment in order to attend institutions of higher education.

Any student who is in need of the earnings from part-time employment in order to pursue a course of studies at an institution of higher education is eligible. Preference for employment must be given to students from "low-income" families, as determined primarily by the level of income and size of family as shown below. Formerly, employment under this program was limited exclusively to students from "low-income" families.

Preference for this aid is determined by the parents' income as shown:

Number of dependent children or other dependents	Family income less than
1	3,200
2	4,000
3	4,700
4	5,300
5	5,800
6	6,200
7	6,600
8	6,900

A limited number of jobs are available full-time during the summer. Those who qualify according to the above scale and desire employment should write the Financial Aid Office for more information.

Educational Opportunity Grants (FAO-5510, 5515, 5520, 5525, 5530)

The purpose of this program is to encourage and enable exceptionally needy high school graduates and college undergraduate students, who otherwise would be unable to continue their education, to pursue their studies at institutions of higher education by providing them with educational opportunity grants.

To qualify for an Educational Opportunity Grant a student must be accepted for full-time enrollment at an institution participating in the program or, in the case of a student already attending such an institution, be in good standing and in full-time attendance there as an undergraduate student. In addition, he must show evidence of academic or creative promise and capability of maintaining good standing in his course of study. Finally, he must be in exceptional financial need, and must show that he would not, except for an educational opportunity grant, be financially able to pursue a course of study at the institution.

No more than one-half of the total "package" of student financial aid (excluding work-study) given by an institution to a student, up to a maximum of $1,000, may be in the form of an Educational Opportunity Grant.

Veterans Administration Programs

Most veterans who served on active duty for more than 180 days, any part of which occurred after January 31, 1955, are generally eligible for financial support to attend college. For specific requirements, the local Veterans Administration Office should be contacted. Before communicating with Georgia Tech about benefits under this program, the prospective recipient must complete all requirements at the Local V.A. Office.

Generally sons and daughters between 18 and 26 years old of deceased veterans, and those of living veterans who have disabilities which are considered to be total and permanent, whose death or disability was a result of service in the Armed Forces are eligible for financial benefits to attend college. See your local Veterans Administration Office fcr complete details.

The local Atlanta Veterans Administration address is: 730 Peachtree Street, N.E., Atlanta, Georgia 30308.

Cuban Students Loan Program (FAO-4460)

The purpose of this loan is to make available funds to Cuban nationals who are presently unable to receive support from sources within Cuba as a result of actions by the Cuban Government, and who are without sufficient resources in the United States to finance their attendance at institutions of higher education.

All new applicants for the Cuban Loan must apply for an annual amount and follow the application procedures and regulations for applicants for the National Defense Student Loan.

An undergraduate student may borrow a maximum of $333 per quarter with a yearly maximum of $1,000, and a graduate student may borrow a maximum of $600 per quarter. The total of all loans for an undergraduate student may not exceed $5,000, and the total of all loans for a graduate student may not exceed $10,000.

In order to be eligible for a loan under this plan, a student must:

(1) Be a Cuban national.
(2) Be enrolled in the Institution as a full-time student on either the undergraduate or graduate level.
(3) Be capable, in the opinion of the Institution, of continuing to maintain satisfactory standing.
(4) Be unable, as a result of action by the Cuban Government, to receive support from inside Cuba.
(5) Be in need of the amount of the loan to pursue his course of study at the Institution.

Each student to whom a loan is granted will be required to sign a promissory note.

A borrower has a "year of grace" after he ceases to be enrolled as a full-time student in an insitution of higher education during which he does not have to make payments on the loan and during which the interest of 3 per cent a year on the unpaid balance does not accrue. After that year elapses, the borrower will begin to repay the principal plus the interest in ten equal annual installments.

Cuban Loan borrowers must report to the Cashier's Office for an *exit interview* before leaving full-time study at the Georgia Institute of Technology due to graudation, transfer to another school or any other reason.

Applications may be secured from the Financial Aid Office at the Georgia Institute of Technology.

STATE FINANCIAL AID PROGRAMS

Many states have established scholarship programs for the use of students attending schools in or out-of-state. Interested students should contact the Department of Education of their state to see if it has a program. In addition, all states now have some type of loan program for college students.

The State of Georgia's scholarship programs are described below. Also, listed is information on the state guaranteed loan program in general and specifically about Georgia.

State of Georgia Scholarship Commission

This program provides scholarships for Georgia residents with financial need and scholastic ability for study in professional and educational fields. Amounts vary according to cost of attending institution offering course of study.

Recipients must repay by practicing professions in approved communities or sites of employment OR in cash at 6% interest.

For further information write to: State Scholarship Commission, 270 Washington St., S.W., Atlanta, Georgia 30334.

State of Georgia Teacher Scholarships

These scholarships provide financial assistance to complete programs of study in preparation for teaching. Available to Georgia residents of high scholastic ability and teaching aptitude.

Scholarships are to be repaid by teaching in the public schools of Georgia for a period of 3, 4, o 5 years, according to amount of scholarship aid received OR in cash at 5% interest.

For further information write to: Scholarships, State Department of Education, Room 247, State Office Building, Atlanta, Georgia 30334.

Regents of the University System of Georgia Scholarships

Georgia residents attending institutions in the University System of Georgia who have financial need and rank, or are predicted to rank, in the top 25% of their class are eligible to apply for Regents' Scholarships.

Recipients must repay in services in Georgia for one year for each $1,000 received OR must repay in cash at 3% simple interest.

For further information refer to write-up under Scholarships.

State Guaranteed Loans for College Students

The Guaranteed Loan Program has one simple purpose: to provide the means for you to borrow money for college at low interest cost, with the Federal Government paying part of the interest for qualified students.

a. A student applies for a loan at a bank or other eligible lending institution.
b. The lender makes the loan directly to the student.
c. A State agency or private non-profit agency "guarantees" the loans–that is, protects the lender against loss in case the borrower defaults on his loan.
d. The Federal Government pays a portion of the interest on behalf of eligible students.

These programs, in most states, include any student who is enrolled or accepted enrollment as eligible to apply for a loan for his educational expenses. The institution may be in any state, Puerto Rico, District of Columbia, Guam, American Samoa, or the Virgin Islands. Graduate and professional students as well as undergraduates are eligible to borrow.

Banks, savings and loan associations, insurance companies, credit unions and similarly supervised institutions are lenders under this program.

If a student cannot obtain a loan from one source, he may apply to another. A list of eligible lenders will be supplied by the appropriate guarantee loan agency in your home state. Write for listing of state agencies to the Financial Aid Office.

Georgia's Guaranteed Loan is administered by the Georgia Higher Education Assistance Corporation. Its procedure is described below and should be similar to that in other states.

The Georgia Higher Education Assistance Corporation Loan (FAO-758)

The Georgia Higher Education Assistance Corporation was created as an independent, non-profit organization by the Georgia State Legislature in 1965 to operate the loan plan as provided by an amendment to the Constitution of Georgia in 1964.

Under this program guaranteed loans are provided for students who are residents of Georgia in attendance at any accredited post-secondary institution of higher education in the State of Georgia or elsewhere.

Loans are approved on a yearly basis except in the case of part-time students, who must apply for a loan to cover only one quarter at a time. The amount that a full-time student may borrow ranges from $1,000 a year for freshman students to $1,500 a year for graduate students. Applications for an academic year should be submitted three months in advance of the beginning of the school term. Applications may also be submitted during the school year, and students should check with their local banks or lending institutions for quarterly deadlines.

A prospective borrower under this loan program attending the Georgia Institute of Technology must first submit his application to the Director of Financial Aid for certification of enrollment. The student must then place the loan with a participating Georgia lending institution and borrow money from the lending insitution on promissory notes.

The family financial statement is important. If the family's adjusted annual income is *under* $15,000 a year, the Federal Government will pay all interest charges on unpaid principal balances while the student is in school. If adjusted family income is *over* $15,000 a year, the loan may be insured, but the student must pay all interest from the start.

Repayment is deferred during the time a student continues his studies and might be deferred under various state agency programs while he serves in the Peace Corps or in the armed services. If loans total more than $2,000, they will be repaid in installments ranging from five to ten years, beginning nine to twelve months after the borrower leaves school. If the total is less than $2,000, the lender may require repayment in less than 5 years.

Additional information and applications for the Georgia Higher Education Assistance Corporation Loan can be obtained from the Georgia Higher Education Assistance Corporation, 703 Trinity-Washington Street Building, 270 Washington Street, S.W., Atlanta, Georgia 30334.

Vocational Rehabilitation—Georgia

College students may receive assistance from the Office of Vocational Rehabilitation in the form of payment of college tuition if they meet certain eligibility requirements. The applicant must possess a physical or mental impairment which would prove to be a vocational handicap.

In order to secure more information regarding this program, an individual should contact the local office of Vocational Rehabilitation in his community.

FINANCIAL AID—OUTSIDE SOURCES OF AID

Many foundations, companies, religious organizations and other groups have established scholarship or loan programs for the use of Georgia Tech students. Some of these programs are exclusively for Tech and others are for use at many institutions. Following are listed some of those that might be of interest.

Student Loan Fund of the American Society of Mechanical Engineers

The Woman's Auxiliary of the American Society of Mechanical Engineers has established a loan fund for students of Mechanical Engineering in good standing who are either juniors, seniors, or graduate students. Correspondence should be addressed to Mrs. W. J. Schell, Jr., Chairman, Student Loan Fund, 151 Idlewood Drive, Stamford, Connecticut 06905.

The General Henry H. Arnold Education Fund

The Air Force Aid Society has created a loan fund to aid unmarried children of Air

Force and Army Air Forces personnel in securing an undergraduate college education, with priority being given to students whose fathers are deceased. Additional information and application material should be requested from the Air Force Aid Society, National Headquarters, Washington, D.C. 20333.

The Lewis H. Beck Fund

The Lewis H. Beck Scholarship Fund is a student loan fund created by the late Mr. Lewis H. Beck of Atlanta, for the benefit of students attending Georgia Institute of Technology who are (1) residents of Georgia, (2) unmarried, (3) between the ages of 16 and 25, and (4) upperclassmen who, if sophomores, have completed their freshman year with a 2.5 or better average or if juniors or seniors, have maintained a 2.0 or better average. The loan is administered by a special Board of Trustees. Applications may be obtained from the Financial Aid Office.

Callaway Educational Asssociation Scholarships

Six general scholarships are awarded annually in the maximum amount of $300 per quarter to applicants who are employees or children of employees of Callaway Mills Company. A maximum of six Co-operative Scholarships may also be awarded to any applicant in the following fields: Chemical, Electrical, Industrial, Mechanical or Textile Engineering. Selection is by the Callaway Scholarship Plan Committee. For further information write: Callaway Mills Company, Scholarship Plan Committee, LaGrange, Georgia.

Ty Cobb Educational Scholarship

An upperclass scholarship for single residents of Georgia. Information should be obtained from the Cobb Foundation, 244 Washington Street, S.W., Room 448, Atlanta, Georgia 30334. Deadline to apply is May 1.

College Aid Plan

College Aid Plan, Inc., a national organization specializing in student financing, provides funds for any or all University expenses with monthly repayment programs which include broad insurance protection. Terms range from 9 to 72 months depending upon needs. Although The Georgia Institute of Technology is agreeable to CAP sending details of their program to parents, its use by them is entirely at their option. Further details may be obtained by writing to College Aid Plan, Inc., 1008 Elm Street, Manchester, New Hampshire 03101.

Columbus High School Class of 1912

Scholarships to be awarded by the Columbus High School in the maximum amount of $400 to their graduates. For further information write the Office of the Principal, Columbus High School, Columbus, Georgia.

Education Funds, Inc.

For students and parents desiring to pay education expenses in monthly installments, a deferred payment program is available through Education Funds, Inc., a nationwide organization specializing in education financing.

All EFI plans include insurance on the life of the parent and the student, total and permanent disability insurance on the parent, plus trust administration in event of the parent's death or disability. Agreements may be wirtten to cover all costs payable to the school over a four-year period in amounts up to $14,000.

Parents desiring further information concerning this deferred payment plan should contact the financier of the school or Education Funds, Inc., 10 Dorrance Street, Providence, Rhode Island 02901.

Floyd County Scholarships

A scholarship fund to assist needy students without reference to politics, religion, or athletic ability. Recipients, as well as at least one of the parents, shall have been born in Floyd County or Rome City, Georgia. Selection is by the Floyd County School Board and the Rome City School Board. For further information write Trust Officer, The National City Bank of Rome, Rome, Georgia.

"Country" Gorman Scholarships

A scholarship for students who are scouts or former scouts. Academic ability and need are considered. Information may be obtained from Atlanta Area Council, Boy Scouts of America, 167 Walton Street, N.W., Atlanta, Georgia 30303, and must be submitted by February 1, prior to entrance to college.

The Methodist Student Loan Fund

This loan is available to students of all classes, including graduates, who have been members of the Methodist church for one year or more immediately prior to application. In addition, applicants must be citizens of the United States, at least seventeen years of age, have earned at least a 2.0 average during the quarter immediately prior to application and be wholly or partially self-supporting. Interested and qualified students should contact the Reverend William Landiss, Director, Wesley Foundation, 189 Fourth Street, N.W., Atlanta, Georgia, for the necessary application forms and further information.

Muscogee Foundation Scholarship

One scholarship in the amount of $600 to an entering freshman in the field of textiles. Selection is by the Muscogee Scholarship Committee. For further information contact Secretary, Muscogee Scholarship Committee, Columbus, Georgia.

National Merit Scholarships

Students who enter the National Merit competition may generally use their award at any school they desire to attend. Many National Merit Scholars are enrolled at Georgia Tech. For further information on this program, see your high school principal or counselor.

Pickett and Hatcher Educational Fund

The late Mr. Claude A. Hatcher of Columbus, Georgia, created an educational loan fund for the purpose of aiding a large number of worthy students in securing courses in broad liberal college training. Loans are available for students of all classes, including graduates. Limitations prevent loans being granted to students of law, medicine and for the ministry.

Applications and requests for additional information should be addressed to Pickett and Hatcher Educational Fund, P.O. Box 2128, Columbus, Georgia.

Piping Promotion Trust Scholarship

A scholarship awarded annually to students entering Georgia Tech who are children of employees of Piping Promotion Trust contributors. Annual amount is $800. Applicants should apply to Trust directly.

Four-Year R.O.T.C. Scholarships

The Army, Air Force and the Navy have scholarship plans which provide most of the cost of education for students enrolled under their program. Students desiring information should contact their local recruiting office, military installation, or write directly to the appropriate military unit at Georgia Tech.

Stevens Bros. Foundation, Inc.

The Foundation was incorporated as a non-profit and charitable corporation which has been primarily engaged in making educational loans to senior and graduate men, provided they are citizens of the United States, in good standing and will commence work at the end of the academic year the loan is requested. Interested students should send a copy of their transcript with full details concerning their status and requirements to The Stevens Bros. Foundation, Inc., 610-612 Endicott Building, St. Paul 1, Minnesota.

Tuition Plan of New Hampshire, Inc.

For parents who prefer to pay their educational expenses in monthly installments, the services of The Tuition Plan of New Hampshire, Inc. are available.

Parents may choose a plan to cover the cost of four years' expenses (tuition, room, board, books, transportation, fraternity and all related educational cost) in a single agreement.

In addition to the agreement covering the full four years' expenses, there are plans covering one, two and three years' expenses.

Any insurable parent has the opportunity of electing life insurance protection on his Tuition Plan program.

Detailed information concerning The Tuition Plan of New Hampshire, Inc. is mailed to parents of new students each summer or you may write to Tuition Plan of New Hampshire, Inc., Concord, New Hampshire 03301.

United Student Aid Funds Loan Program —Institutionally Guaranteed

USA Funds is a private, non-profit service corporation which endorses long-term loans made by local banks to needy college students. To be eligible for this loan, a student must be a full-time student in good standing. This loan is normally limited to non-resident students from states which do not offer a State Guaranteed Loan Program.

A student can borrow up to $1,000 a year. Repayment of this loan begins ten months after graduation and extends over a period of three years.

Application forms and additional information may be obtained from the Financial Aid Office.

MEDALS AND PRIZES

The American Institute of Architects Medal and Certificate

The School Medal of the American Institute of Architects is given annually in Schools of Architecture accredited by the National Architectural Accrediting Boards, to a graduating student in recognition of scholastic achievement, character, and promise of professional ability. The award is made possible through an endowment fund provided by the executors and heirs of the Henry Adams Estate.

Each student so honored receives, in addition to the engraved silver medal, a certificate citing his accomplishment in Architectural studies; the runner-up also may be awarded the certificate if the head of the School so requests.

The Alpha Rho Chi Medal

The Medal of Alpha Rho Chi, national professional architectural fraternity, is given annually upon recommendation of the Faculty of the School of Architecture, to that graduating student who has shown an ability for leadership, performed willing service for his School and gives promise of real professional merit through his attitude and personality.

The Honor Society of Phi Kappa Phi

Among the prizes offered for scholarship by the Georgia Institute of Technology is membership in the honor society, Phi Kappa Phi, to which a limited number of seniors representing all departments are elected annually. Phi Kappa Phi is a national organization with chapters in many of the leading universities and colleges.

The local chapter of Phi Kappa Phi awards annually a scholarship cup to that member of the senior class who, on the basis of all work taken in this institution, ranks scholastically as one of the first two students in the class.

Tau Beta Pi

Tau Beta Pi is a national honorary engineering fraternity with chapters in most of the leading engineering schools of the country. The Alpha Chapter of Georgia offers membership to approximately twenty-five engineering students of each graduating class who can qualify according to the standards of scholarship, character, loyalty, personality, leadership, and school activities. The fact that Tau Beta Pi is the second oldest honorary fraternity in the country and numbers among its members many of our leading engineers, makes membership in the society a coveted honor.

The local chapter of Tau Beta Pi awards annually a scholarship cup to an outstanding engineering senior who ranks among the first five of his class, on the basis of all scholastic work taken in this institution.

Phi Eta Sigma

Phi Eta Sigma is a freshman honor society in which any male student is eligible for membership who has made an average of at least 3.5 on the work of the first term of the freshman year. The society awards a scholarship cup to the freshman who makes the highest average for the first term.

Chi Epsilon Award

The Chi Epsilon Award is given annually by the Georgia Tech Chapter. The recipient is chosen from the five highest members, based on scholarship of the senior class. The final choice of the recipient is made from the five candidates on the basis of leadership, sociability, practicality and scholarship. The winner receives a certificate and his name is placed on an honor roll in the Civil Engineering Building.

Textile Scholarship Medals

The Georgia Textile Manufacturers' Association awards a watch annually to a member of the senior textile class, based on scholarship throughout his course, and for original effort in the work of the Textile Department during his senior year. The American Association of Textile Technologists makes an award annually in the form of a suitable plaque to a member of the graduating class of the A. French Textile School. The award is based on scholarship and other personal qualities which indicate an outstanding student.

Briaerean Scholarship Cup

The Briaerean Society of the Georgia Institute of Technology presents annually a scholarship cup to a senior member of the society whose scholastic average for a period of four and one-half years entitles him to rank as one of the highest three members of the class.

Fraternity Scholarship Cup

The Interfraternity Council awards quarterly a scholastic cup to the chapter of that organization which makes the highest scholastic average.

Alpha Chi Sigma Prize

The professional chemical fraternity, Alpha Chi Sigma, presents annually a handbook to the junior who has made the best record in the Chemistry or Chemical Engineering course.

Eta Kappa Nu

The Eta Kappa Nu Association, national electrical fraternity, awards annually an electrical engineering handbook to the regular sophomore Electrical Engineering student (on the basis of four quarters) or to the co-op pre-junior electrical engineering student (on the basis of four quarters) having the highest scholastic average.

Delta Kappa Phi

The Delta Kappa Phi Plaque is awarded annually to the graduating senior selected as the outstanding graduate in the textile department. A certificate is presented at the annual Honors Day exercises. Delta Kappa Phi is the oldest national honorary textile fraternity in the country.

Pi Tau Sigma

Pi Tau Sigma, national mechanical engineering fraternity, elects to membership outstanding mechanical engineering students in the junior and senior years.

An annual award of an engineering handbook is made to the highest ranking sophomore student in Mechanical Engineering (based upon at least four quarters of work).

Aerospace Engineering Medal

The James Edward Oglethorpe Chapter of the Daughters of the American Colonists presents annually a medal to the member of the graduating class in Aerospace Engineering who has made the highest scholastic average, based on the work of at least four complete quarters.

Industrial Management Certificate

The Industrial Management Society, senior honorary organization for I.M. students, awards annually a certificate of scholarship to the senior in the School of Industrial Management who ranks first in his class on the basis of all scholastic work taken at Georgia Tech.

Gordon Gambill Memorial Endowment Award

An annual award of an appropriate book to the athlete with the highest academic grade each year at the sophomore, junior, or senior level from the following spots: baseball, basketball, football, and track. This award is made in honor of the late Gordon Gambill, Class of 1913.

The William Gilmer Perry Award

The Department of English awards annually a fifty dollar bond to the student in his first year who has done the best work in freshman English. This award is made through the courtesy of the Georgia Tech Foundation, Inc. in honor of Dr. William Gilmer Perry, late Professor of English.

Alpha Pi Mu Award

The Alpha Pi Mu Award is presented yearly to extend recognition and honor to that senior student in Industrial Engineering who has exhibited outstanding scholastic achievement tempered with those individual characteristics which the members of Alpha Pi Mu consider necessary for success. The recipient of the award is chosen from the three top seniors scholastically, and the presentation is made at the Annual Honors Day Exercises.

The American Institute of Industrial Engineers, Atlanta Chapter Award

The American Institute of Industrial Engineers, Atlanta Chapter, award is presented to the Industrial Engineering junior who is most outstanding in scholastic attainment and who has demonstrated such personal qualities as leadership, character, and breadth of interest. The presentation is made annually at the Honors Day Exercises.

The American Institute of Industrial Engineers, Student Chapter Award

The American Institute of Industrial Engineers, Student Chapter, award is presented to the Industrial Engineering sophomore who is chosen from the top three in his individual engineering class as having the best combination of personal and academic qualities. This presentation is made annually at the Honors Day Exercises.

Society for Advancement of Management Award

The S.A.M. Award is presented at the annual Honors Day Exercises to the Industrial Management student who is the most outstanding in scholastic attainment and who has demonstrated such personal qualities as leadership, character, and breadth of interest.

Georgia Engineering Society Awards

Four awards consisting of a cash prize and certificate are awarded each year by the Georgia Engineering Society. Three awards are given to Juniors in the College of Engineering who have earned the highest accumulative grade-point average at the end of the Winter Quarter. Not more than one award is given to students in any one of the schools of engineering. One award is given to the junior in the School of Architecture who is judged by a committee to be the most promising all-around student. The recipients must have completed at least six quarters of work at the Institute.

The American Society of Civil Engineers Award

The American Society of Civil Engineers Award is given annually by the Georgia Section of the ASCE. The recipient is selected by a committee from a list of three candidates who have the highest point average among the graduating members of the Student Chapter of the ASCE and who have completed at least eight quarters of work at the Institute. The Award consists of the Junior Membership entrance fees and a cash prize of $90.00.

Army R.O.T.C. Awards

The Georgia Tech Honor Award is awarded annually to the outstanding Senior Cadet.

The Superior Cadet Ribbon Award is awarded annually to the outstanding cadet in each year for scholastic and military achievements.

The Beta Theta Pi Fraternity, Georgia Tech chapter, presents annually the McGuire Medal to the outstanding Distinguished Military Student of the Army ROTC.

The Georgia Society of Daughters of Colonial Wars presents annually a medal to the ROTC Senior for excellence in Army ROTC Leadership.

The Joseph Habersham Chapter of D. A. R. presents annually a medal to the ROTC Senior who attains the highest rating in Military Science.

The Third Army Certificate of Meritourious Achievement is awarded annually to the ROTC Senior on the basis of leadership development throughout his ROTC career.

The Armed Forces Communication Association presents an award annually to the outstanding senior Army ROTC Cadet in the field of communications and electronics.

The American Legion Post No. 1 awards annually medals to the Army ROTC Junior and Senior for excellence in scholastic achievement.

The American Legion 5th District Award is given annually to the Junior and Senior Army ROTC Cadet for excellence in military achievement.

The Professor of Military Science Awards are presented annually to the ROTC Junior and Senior who are outstanding in the performance of daily military duties.

The Society of American Military Engineers presents annually a medal to the outstanding senior engineering student of the Engineer ROTC Branch.

A medal is given annually by the American Ordnance Association to the Senior Ordnance Cadet who attains the highest rating in Leadership and Ordnance scholarship.

The John S. Gage Memorial Award is awarded annually to a Senior Infantry Cadet who displays distinguished leadership.

The Association of the U.S. Army ROTC Medal is awarded annually to the Outstanding ROTC Junior.

The Association of the United States Army presents annually a medal to the Outstanding Infantry Branch Junior.

The American Legion Medal is presented annually by the Fulton County

Voiture 217, 40 and 8, Honor Society of the American Legion to the second year Basic Cadet who is accorded the highest rating in military subjects, personal qualifications, leadership and scholastic average.

The ANAK Society, presents annually, medals to the three Freshmen who attain the highest ratings for proficiency in Military Science.

Annually awards are made to the three best drilled Basic Cadets.

Air R.O.T.C. Medals and Trophies

The Air Force Association annually gives a medal to the AFROTC junior who attains the highest rating for proficiency in leadership, scholarship and in Air Science.

The Arnold Air Society presents two medals annually, one to the outstanding AFROTC sophomore, and one to the outstanding member of the Drill Team.

The ANAK Society of Georgia Tech annually awards a medal to the freshman who demonstrates the highest proficiency in Air Science.

The Armed Forces Communications Association award is presented annually to the outstanding AFROTC senior in the field of Electrical Engineering.

The Armed Forces Chemical Association award is presented annually to the junior ROTC cadet having the highest scholastic average in Chemistry or Chemical Engineering at this institution.

The American Legion Medal is presented annually by the Fulton County Voiture 217, 40, and 8, Honor Society of the American Legion, to the outstanding freshman AFROTC cadet who is outstanding in leadership, academic achievement and military proficiency.

The Howard Shaw Leadership Trophy is annually awarded by Mr. Howard Shaw to the senior AFROTC cadet who has demonstrated the highest qualities of leadership.

The McGuire Medal, presented by Beta Theta Pi, is annually awarded to the distinguished AFROTC senior.

An appropriate award is presented annually to each AFROTC member of the Georgia Tech Rifle Team for proficiency in rifle marksmanship.

The Society of American Military Engineers' Eagle Award is presented to the ten outstanding senior engineering students of the nationwide AFROTC program.

Gold, silver, and bronze medals are awarded by the Scabbard and Blade Military Society to cadets who achieve the highest individual rating for excellence in military drill.

Various aviation trophies are presented by the major aircraft manufacturers.

Naval R.O.T.C. Medals and Awards

The Georgia State Society "United States Daughters of 1812" awards a gold medal each year to the NROTC senior who achieves the highest rating in Naval Science.

The ANAK Society awards annually two medals; one to the NROTC junior showing highest proficiency in Theoretical and Practical Navigation, and the other to the NROTC freshman showing highest proficiency in Naval Science during his freshman year.

The Scabbard and Blade Society gives annually an award to the outstanding NROTC senior.

The McGuire Medal, awarded by the Beta Theta Pi Fraternity, is presented annually to the distinguished senior regular midshipman and to the distinguished senior contract midshipman.

The Atlanta Chapter of the Reserve Officers of the Naval Service presents annually an award to the sophomore NROTC student showing the greatest proficiency in ordnance, gunnery, and fire control.

An appropriate award is presented each year to each NROTC member of the Georgia Tech Rifle Team for proficiency in rifle marksmanship.

The Armed Forces Chemical Association award is presented annually to the junior ROTC student at each of five NROTC schools, having the highest scholastic average in chemistry or chemical engineering.

The Society of American Military Engineers awards annually 10 engineering medals for the outstanding engineering NROTC seniors and 10 medals for the outstanding engineering NROTC junior, selected from all NROTC schools in the United States.

The United States Naval Institute presents awards annually to the senior Regular NROTC student and senior Contract NROTC student having the highest cruise aptitude marks for summer training.

The Marine Corps Association presents annually an award to the outstanding senior NROTC student who is a candidate for commission in the U.S. Marine Corps.

The Veterans of Foreign Wars of the United States presents the "General Douglas A. MacArthur $1,000 Award" every third year commencing in 1953 to the outstanding Regular NROTC senior in the United States.

The Georgia Society of Professional Engineers Award

An award in recognition of demonstrated awareness of professional concepts in engineering is made annually by the Georgia Society of Professional Engineers. The most outstanding engineering senior in the State of Georgia is chosen on the basis of interest in the professional aspects of engineering as evidenced by unquestioned personal integrity, participation in technical and professional activities, and scholastic standing.

Alpha Kappa Psi Scholarship Award

The Epsilon Sigma Chapter of Alpha Kappa Psi, a professional business fraternity, awards annually the Alpha Kappa Psi Scholarship Key to the male senior student pursuing a degree in the School of Industrial Management, who has attained the highest scholastic average for three years of collegiate work at Georgia Tech.

GEORGIA TECH ATHLETIC ASSOCIATION

Board of Directors

Chairman—Dr. Arthur G. Hansen; *Vice-Chairman*—Dr. W. T. Ziegler; *Faculty Chairman*—Dr. Jesse W. Mason; *Secretary*—W. Carl Biven; *Athletic Director*—Robert L. Dodd; *Faculty members*—Dr. Vernon Crawford, Dr. William Sangster, Prof. Glenn Rainey; *Alumni members*—Larry Morris, John P. Baum, Charles R. Yates; *Student members*—Football Team Representative, Editor of the *Technique*, President of the Student Body; *Honorary alumni members*—L. W. Robert, Jr., Robert H. Tharpe, Sr.;*Business Manager and Treasurer*—John H. O'Neill, Jr.; *Attorney*—G. Arthur Howell; *Advisory members*—Ewell I. Barnes, L. H. Carson, John McKenna, Dr. Paul Weber.

Intercollegiate Staff

Athletic Director—Robert L. Dodd. *Assistant Athletic Director*—John H. McKenna. *Business Manager*—John H. O'Neill, Jr. *Head Football Coach*—L. H. Carson. *Assistants in Football*—Chris Carpenter, Gerald M. Glanville, Jack S. Griffin, Lamar Leachman, William James Lewis, James K. Luck, Tom Moore, William M. Williamson, Joseph Popp. *Freshman Football Coach*—Richard L. Bestwick. *Assistant Freshman Football Coach (retired)*—J. H. Pittard. *Head Recruiter*—Jack Thompson. *Assistant Recruiter*—Giles Smith. *Head Basketball Coach*—J. C. Hyder. *Assistants in Basketball*—Byron Gilbreath, Edward Donald Clifton. *Track Coach*—Buddy Fowlkes. *Swimming Coach*—Herb McAuley. *Baseball Coach*—James K. Luck. *Tennis Coach*—Jack Rodgers. *Cross Country Coach*—George C. Griffin. *Gymnastics Coach*—Bill Beavers. *Golf Coach*—Tommy Plaxico. *Wrestling Coach*—Lowell Lange. *Academic Advisor*—George Slayton. *Athletic Trainer*—Pat Dyer. *Assistant Trainer*—Don Sharpe. *Sports Information Director*—Ned West. *Assistant Sports Information Director*—James A. Schultz. *Ticket Manager*—Mrs. June Owens. *Secretaries*—Mrs. Margie Bennett, Miss Peggy Boleman, Mrs. Martha Lewis, Suzanne Steed, Mrs. Joyce Stembridge. *Receptionist*—Mrs. Judith Mustin. *Purchasing and Travel Agent*—Mrs. Ann Harrell. *Accountant*—Lillian M. Redmon. *Bookkeeper*—Mrs. Margaret Murrah. *Assistant Bookkeeper*—Miss Eva Saggus. *Clerk-Typists*—Mrs. Eunice King, Miss Marcia Stephenson. *PBX Operator*—Mrs. Carol Hunter. *Dietitian*—Miss Helen Twiggs. *Assistant Dietitian*—Mrs. Marianne Roper.

College Athletics

College athletics at the Georgia Institute of Technology are managed by a Board of Directors consisting of seven faculty members, three alumni members and three student members. The President is chairman of the Board and appoints the faculty and alumni members. The student members are the captain of the football team, the editor of *The Technique,* and the president of the Student Council. The Business Manager of Athletics is elected by the Board. The head coaches of the various sports are called into Board meetings from time to time.

The Athletic Board holds regularly monthly meetings and on occasion called meetings at the discretion of the President. The Board aims to secure cooperation of the faculty and students in athletic affairs to maintain a high standard of sportsmanship and to create adequate facilities to give every student an opportunity to take part in some athletic activity.

The liberal policy adopted by the faculty towards athletics has resulted in such interest in college sports that the number engaged in some form of exercise is large.

Intercollegiate schedules are played in football, cross country, basketball, swimming, track, golf, tennis, baseball, gymnastics, and wrestling.

Athletic Plant

The Hugh Inman Grant Field, the football stadium, is located in the center of the campus and occupies two full city blocks. the closed U-shaped stadium seats 59,600 and surrounds one football field and a quarter-mile cinder track. At the North end of the U are located the Naval Armory building, the gymnasium and swimming pool building and the athletic administration building. Under the East Stand, dressing rooms and showers to accommodate 1,000 men have been constructed.

The completion of the Alexander Memorial Center in September of 1956 has given out basketball, Physical Training and Intramural programs a great impetus. The coliseum will seat approximately 7,000 spectators for basketball. It has two full-size basketball courts. This building is also used for numerous school functions and is owned by the Georgia Institute of Technology.

The Physical Training Building adjoining the coliseum has dressing rooms and lockers for Physical Training, basketball, visiting teams, and officials. A full-size basketball court and offices for our Physical Training faculty (sophomore) are in this building.

The "old" gymnasium seats 2,000 for athletic indoor events and 3,000 when set up as an auditorium. The swimming pool seats 400 for acquatic events. This building has locker rooms and showers for both men and women. Offices for P.T. faculty (freshmen) are in this building.

The Naval Armory houses the Navy R.O.T.C. Unit and in addition furnishes a supplementary gymnasium for intramural and physical training activity.

The athletic administration building houses the athletic and business offices and visitors' dressing rooms.

The liberality of Mr. John W. Grant and other money furnished by the Georgia Tech Athletic Association, and the government agencies–C.W.A., P.W.A., and W.P.A.–have resulted in a well equipped sports and recreation center worth well over 6.5 million dollars. Acknowledgement is also made of the money loaned by Mr. Fred M. Kaufman which made possible the construction of the Naval Armory.

In addition to Grant Field, the Board of Directors in 1930 purchased a ten-acre tract located four hundred yards north of the main plant. This field is known as Rose Bowl Field and contains three football fields, a baseball diamond, and baseball stands which seat 700.

Some excellent tennis courts have been built on school property directly across from the Gymnasium in Peters Park. The Park also provides sixteen paddleball courts, two outdoor basketball courts and four volleyball courts.

The land bounded by 8th Street, 10th Street, Fowler and Cherry Streets, has been allocated to athletic purposes by Georgia Tech. This includes twelve additional all-weather tennis courts.

NATIONAL ALUMNI ASSOCIATION

Executive Secretary–W. Roane Beard; *Assistant Secretary*–F. A. Dozier; *Assistant Secretary*–Robert H. Rice; *Editor, The Georgia Tech Alumnus*–Ben L. Moon; *Alumni Placement Director*–Mrs. Mary Peeks; *Accountant*–Mrs. Jennie L. Bradley; *Bookkeeper*–Miss Sandra Arthur; *Secretaries*–Miss Pam Milner, Mrs. Vicky Gerald, Miss Cynthia Reames; *Records Supervisor*–James M. Lynch; *Records and Clerical*–Mrs. Nell Ivey, Miss Linda Butler.

In 1920, under the leadership of William H. Glenn, B.S. in M.E., '91, the various Georgia Tech Alumni Clubs which had been previously organized in Georgia and other states, were banded together into the present Georgia Tech National Alumni Association. Today Georgia Tech alumni, consisting of graduates and former students, are found all over the world.

Some of the worth-while objectives of the association are to:

1. Maintain an up-to-date record of each alumnus of Georgia Tech.
2. Publish *The Georgia Tech Alumnus.*
3. Organize and service local Georgia Tech Alumni Clubs.
4. Operate a placement service for Georgia Tech alumni–without cost to either employer or applicant for employment.
5. Organize special events for alumni, such as class reunions, homecoming activities, club officer weekends, TECH TODAY programs, and alumni participation in commencements.
6. Furnish a medium through which alumni may aid and encourage the President of Georgia Tech and his faculty in maintaining and increasing the prestige of the institution, and assist in providing scholarships for worthy students.
7. Furnish visiting alumni with information, and other such personal services.
8. Through the various media of publicity, acquaint the general public; the people of Georgia; civic, state and federal officials; industries of the United States and institutions of secondary and higher education with the achievements of the Georgia Institute of Technology and its alumni.
9. Raise funds for Georgia Tech through the Annual Alumni Roll Call.

The Alumni Secretary acts as a central contact for Georgia Tech men after their graduation. All Georgia Tech men are urged to keep their files in his office up-to-date, giving their location, activities, and other valuable information, in order that they may be consulted without delay on problems of mutual interest.

Officers and trustees of the Alumni Association for 1970-71: James B. Ramage, '37, President; James P. Poole, '42, Vice-President; J. Frank Stovall, Jr., '41, Vice-President; Thomas V. Patton, '43, Treasurer; W. Roane Beard, '40, Executive Secretary; Ray M. Beck, '53; D. Braxton Blalock, Jr., '34; L. Travis Brannon, Jr., '49; George A. Ewing, '48; James T. Gresham, '60; Joseph A. Hall, III, '35; Morris E. Harrison; '49; I. L. Kunian, '34; Rayford P. Kytle, Jr., '36; A. J. Land, '60; W. E. Marshall, '41; John O. McCarty, '43; Dennis D. O'Brian, '38;

H. G. Pattillo, '49; Frank E. Roper, '61; Chester A. Roush, Jr., '47; Dan P. Shepherd, '50; William J. VanLandingham, '59; Norman J. Walton, '41.

GEORGIA TECH FOUNDATION, INC.

Executive Secretary—Joe W. Guthridge; *Accountant*—Mrs. Jennie L. Bradley.

The Georgia Tech Foundation, Inc. is a non-profit corporation organized and operated solely for the purpose of soliciting and administering funds for the benefit of the Georgia Institute of Technology and its students. The Georgia Tech Foundation, Inc., is directed by a Board of outstanding alumni business leaders, who administer the funds received in such a way as in their judgment would most effectively improve the standard of the school.

The funds received by the Foundation are used presently for the following purposes:

1. To supplement the compensation of faculty members in order to obtain or retain outstanding faculty members and thus improve the standard of education at the Georgia Institute of Technology.
2. To undertake special programs, which cannot be financed by state funds, for the development of Georgia Institute of Technology.
3. To enable faculty members to improve their professional qualifications and standing by grants to obtain advanced degrees, etc.

The majority of donations received are unrestricted and are used by the Foundation at the discretion of its Board of Trustees. Some donations are received for designated purposes and are used by the Foundation only for the purpose designated, provided they are for the use of the Georgia Institute of Technology and within the charter purposes of the Foundation.

Members of the Foundation Board of Trustees are: I. M. Sheffield, Jr., '20, Atlanta, President; Hal L. Smith, '26, Atlanta, Vice President; Robert H. Ferst, '38, Atlanta, Treasurer; Joe W. Guthridge, Executive Secretary; Jack Adair, '33, Atlanta; Ivan Allen, Jr., '33, Atlanta; John P. Baum, '24, Milledgeville, Ga.; Fuller E. Callaway, Jr., '26, LaGrange, Ga.; Oscar G. Davis, '22, Atlanta; Dakin B. Ferris, '50, New York City; Alvin M. Ferst, '43, Atlanta; L. L. Gellerstedt, Jr., '45, Atlanta; Jack F. Glenn, '32, Atlanta; Henry W. Grady*, '18, Atlanta; Ira H. Hardin, '24, Atlanta; Julian T. Hightower*, '19, Thomaston, Ga.; Wayne J. Holman, Jr., '28, New Brunswick, New Jersey; Howard B. Johnson, '34, Atlanta; George W. McCarty*, '08, Atlanta; John J. McDonough, '23, Atlanta; Walter M. Mitchell, '23, Atlanta; Frank H. Neely*, '04, Atlanta; William A. Parker, '19, Atlanta; Hazard E. Reeves, '28, New York City; Glen P. Robinson, Jr., '48, Atlanta; Charles R. Simons, '37, Flowery Branch, Ga.; John C. Staton, '24, Atlanta; Frederick G. Storey, '33, Atlanta; Howard T. Tellepsen, '34, Houston, Texas; William S. Terrell, '30, Charlotte, North Carolina; Robert Tharpe, '34, Atlanta; William C. Wardlaw, '28, Atlanta; George W. Woodruff*, '17, Atlanta; Charles R. Yates, '35, Atlanta.

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*Trustee Emeritus

Income Tax Provisions of Contributions

Funds held by the Georgia Tech Foundation, Inc. are exempt from taxation by both State and Federal Governments, because it is a non-profit educational organization. Contributions made by individuals and industries to the Foundation are deductible from income for income tax purposes. For full details about limitations and savings in income tax, latest State and Federal tax regulations should be consulted.

Bequests

There are various forms of bequests that can be used. Due to differences in the various state laws, an attorney-at-law should be consulted. A suggested simple form that will serve in some cases is as follows:

I hereby give and bequeath to the GEORGIA TECH FOUNDATION, INC., *Atlanta, Georgia, the sum of.......................... dollars to be used by the Board of Trustees in whatever way will best advance the interests of the Georgia Institute of Technology.*

If the bequest is intended to leave the Foundation the remainder of any estate, the form may be: *All the rest, residue, and remainder of my real and personal property of any kind whatsoever, I give and bequeath to the* GEORGIA TECH FOUNDATION, INC., *Atlanta, Georgia, et cetera.*

All money received by the Foundation will be administered and directed by the Board of Trustees according to the wishes of the donors and in the best interests of the Georgia Institute of Technology.

Georgia Tech Annual Alumni Roll Call

The rising cost of higher education has made it imperative that colleges and universities get all possible aid from outside sources. In 1947, the Foundation originated the Georgia Tech Annual Alumni Roll Call, a vehicle by which all Tech men can contribute to their Alma Mater according to their means. The annual Alumni Roll Call began its twenty-fourth year, July, 1970.

The results of the first twenty-three years of the Roll Call have proved the soundness of this plan. The renewed spirit of giving to Georgia Tech by alumni has been very gratifying to all concerned. Additional support is being received from industry and foundations within the state. The Joint Tech-Georgia Development Fund is proving to be very helpful to both Georgia Tech and Georgia.

For four consecutive years, the Georgia Institute of Technology was recognized nationally with the first place award "for sustained alumni support" among all public institutions of higher learning. In 1967, the Institute also received the Alumni Service Award jointly with the University of Georgia for the Joint Tech-Georgia Development Fund. In 1968, the Association was honored with the Alumni Administration Award and in 1969, it received the grand prize for "improvement in alumni giving for all institutions."

The aid realized through the Roll Call supports the work of the National

Alumni Association as well as the Georgia Tech Foundation, Inc. The only use to which these funds are put by the Foundation is for the advancement and benefit of Georgia Tech. The work of the Georgia Tech Foundation, Inc. continues to be one of the most vital factors in the growth and development of the Georgia Institute of Technology.

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Professor of Naval Science

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EVERETT R. BOLLINGER (1)
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Head, Department of Engineering Graphics

*Number in parentheses after faculty representative's name indicates years to be served on Administrative Council.

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MAURICE W. LONG
Director, Engineering Experiment Station

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(As of April 1, 1971)

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