

B. COURSE SYLLABI

CEE 1770: Introduction to Engineering Graphics and Visualization, Required Class

Catalog Description

Introduction to engineering graphics and visualization including freehand sketching, 2D/3D and solid CAD models. Development and interpretation of drawings and specifications for product realization.
Credit hours: 2-3-3. Prerequisites: None.

Textbook(s) and/or Other Required Materials

Textbook: S.D. Lockhart and C.M. Johnson. "Engineering Design Communication: Conveying Design through Graphics", Prentice Hall, 2000. Course web site: <http://courses.ce.gatech.edu> to CEE1770

Educational Objectives

This course has three fundamental goals with objectives to meet each goal. The first is that engineering designs, ideas, and artifacts are communicated by words, drawings and numbers. By the end of the course students will be able to visualize objects and ideas; use, understand, and interpret engineering drawings and schematics; and, communicate in a visual medium. The second goal relates to the use and interpretation of sketches and CAD software. By the end of the course, students will be able to sketch artifacts using common engineering methods; and, will be able to appropriately use two software packages for modeling 2D and 3D objects. The third goal is to foster working in teams. At the end of the course, students will participate constructively on a team activity; and, will be able to utilize introductory project management skills to accomplish/schedule team tasks.

Topics Covered

Introduction to the Engineering Design Process
Schematics for design process and artifact representation
Engineering freehand sketching
Obliques, isometrics, multi-views, and sections
Presentation skills and the incorporation of visualizations
Dimensioning Concepts
Common conventions, notations, symbols, practices and tolerances
Engineering Drawing and Graphic Interpretation
CAD Tools
2D tools, AutoCAD, 3D tools, Solid Edge
Explicit and constraint CAD models, including parametric representations
Virtual Reality, Design walk-throughs, interference checking, CAD interfaces for engineering design programs

Class/Laboratory Schedule

Two 1 hour lectures and one 3 hour laboratory session with hands-on activities/computing software per week.

Contribution to Criterion 4: Professional Component

This class provides the fundamental background needed for students to communicate with others regarding engineering artifacts, analyses and designs. Students are introduced to the concepts of team building, sketching, engineering journals/record keeping, and engineering CAD software for graphics, visualization, and presentation. All students make at least two presentations each term and work on two different teams.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 1770	Engineering Graphics/Visualization		X	X		X	X	X

Person(s) Who Prepared Course Syllabi

Nelson C. Baker, May 2002

CEE 2010: Computational modeling for Civil and Environmental Engineers, Required Class

Catalog Description

Fundamentals and numerical methods and development of programming techniques for implementing them to solve civil and environmental engineering problems via computers. Credit hours: 3-0-3. Prerequisites: MATH1502 or MATH1512, MATH 1522 and PHYS2211

Textbook(s) and/or Other Required Materials

Textbook: D. Hanselman, B.R. Littlefield, Mastering MATLAB 6, Prentice Hall, 2001
Course web site: <http://courses.ce.gatech.edu>, CEE2010. Class newsgroup: git.cee.class.cee2010

Educational Objectives

The course has the objective of developing a working knowledge of MATLAB and numerical methods and use them to solve general and Civil/Environmental Engineering problems of different complexity.

Topics Covered

Programming basics: data types, operators, basic commands in UNIX; Internet, USENET newsgroups, secure shell
Script and function M-files
Arrays
Matrices
2-D and 3-D graphics
Polynomials and root finding
Systems of linear equations
Interpolation and curve fitting
Data analysis
Integration and differentiation
Symbolic analysis
Ordinary differential equations
Statistical analysis
Object-oriented programming and Graphical User Interfaces

Class/Laboratory Schedule

Three 1 hour lectures per week.

Contribution to Criterion 4: Professional Component

This class provides the fundamental background needed for students to model and code solutions of engineering and Civil/Environmental Engineering problems. Students are introduced to the use of UNIX, Linux, and newsgroups to discuss class-related issues. The course emphasizes the fact that MATLAB is one of the possible tools the students can use to model a problem. At the end of the course they will have the necessary background to independently approach other tools/programs/programming languages and run their codes on a Windows platform or a UNIX/Linux platform. Students are asked to turn in professional-looking homework and projects, with description of the problem, results provided with units, plots with clearly labeled curves.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 2010	Computational Modeling for CEE engineers		X					X

Person(s) Who Prepared Course Syllabi

Valeria La Saponara, May 2002

CEE 2020: Statics and Dynamics, Required Class

Catalog Description

Elements of statics in two and three dimensions, centroids, friction, kinematics and kinetics of rigid bodies in plane motion. Credit hours: 3-0-3. Prerequisites: Math 1502 and PHYS 2211.

Textbook(s) and/or Other Required Materials

Textbook: J.L. Meriam and L.G. Kraige. "Engineering Mechanics: Statics and Dynamics", Wiley, 2001.

Educational Objectives

The course is intended to introduce undergraduates to the fundamentals of engineering problem solving, with emphasis on problem identification, formulation and solution. Students will apply skills in mathematics and physics to solve engineering mechanics problems. Students will demonstrate an ability to apply fundamental concepts learned in calculus and physics to set up and solve engineering mechanics problems such as equilibrium problems in two and three dimensions and rigid body kinematics.

Topics Covered

Forces and particle equilibrium
 Moments of a force
 Moments about a line
 Resultants and distributed loading
 Analysis of general equilibrium problems
 Free-body Diagrams
 Interacting bodies or parts of a structure
 Structural applications
 Plane and space trusses
 Friction
 Review of particle kinematics
 Kinematics of rigid bodies in plane motion
 Velocity and angular velocity
 Acceleration and angular acceleration
 Instantaneous center of zero velocity
 Moments and products of inertia
 Kinetics of rigid bodies in plane motion

Class/Laboratory Schedule

Three 1 hour lectures (or two 1.5 hour lectures) per week.

Contribution to Criterion 4: Professional Component

This class provides the fundamental background needed to solve more complicated problems in structural analysis and design. Students are systematically introduced to the concepts of engineering problem solving, with an emphasis on the application of mathematics and physics.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 2020	Statics/Dynamics		X	X				X

Person(s) Who Prepared Course Syllabi

Laurence J. Jacobs, May 2002

CEE 3000: Civil Engineering Systems, Required Class**Catalog Description**

Infrastructure viewed from a systems perspective; analytical approaches and modeling of civil engineered facilities; sustainability; engineering economy applications

Credit hours: 3-0-3. Prerequisites: MATH 2401 or MATH2411 or MATH 15X2.

Textbook(s) and/or Other Required Materials

Course reader. Course web site: <http://courses.ce.gatech.edu> to CEE3000

Educational Objectives

Upon completion of this course, the student is expected to be able to:

- 1) Define the concepts of systems and sustainability and explain how they are relevant in the planning, design, operation and maintenance of engineering projects
- 2) Quantitatively evaluate the performance of civil engineering systems
- 3) Use engineering/economic decision making tools to identify the best economic project alternative
- 4) Discuss the limitations of economic decision tools for incorporating environmental and social impacts in the planning and design of engineering projects
- 5) Discuss approaches for incorporating environmental, social and equity considerations in the planning and design of engineering projects

Topics Covered

Introduction to Civil Engineering Systems and Sustainability;

Systems Representation and Analysis;

Design from a Systems Perspective

Mathematical Optimization: Algebraic Optimization, Linear and Integer Programming; Queuing Theory

Engineering Economic Analysis and Project Evaluation, including Time Value of Money, Present Worth Analysis, Benefit/Cost Analysis

Environmental Impact Analysis

Environmental Justice Analysis

Infrastructure/Asset Management

Eng'g Communication: Written, Visual, Oral

Class/Laboratory Schedule

Two 1-1/2 hour lectures per week.

Contribution to Criterion 4: Professional Component

This class focuses on the role of civil engineers in planning, analyzing, designing and operating civil infrastructure. The role of the civil engineering as it relates to community quality of life and environmental impacts is emphasized. The course uses examples from civil engineering practice to illustrate these concepts. In addition, the students are responsible for working in teams on a term project and for presenting project results to the class. Lectures are used to introduce concepts of good communications strategies.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 3000	Civil Engineering Systems	X	X	X		X	X	X

Person(s) Who Prepared Course Syllabi

Michael D. Meyer, May 2002

CEE 3010: Geomatics, CEE Technical Elective

Catalog Description

Spatial data collection methods including surveying, photogrammetry, remote sensing, and global positioning systems; management, manipulation, and analysis of spatial and associated attribute data. Credit hours: 2-3-3. Prerequisites: CS 1321, CEE 1770 and MATH 2401.

Textbook(s) and/or Other Required Materials

Moffitt, F.R. (1992). *Surveying*, 9th Ed., Harper Collins, New York, 848 pp.

Educational Objectives

The course is intended to introduce undergraduates to the concepts of civil engineering measurements, spatial data analysis, and experimental analysis. Students will demonstrate an ability to apply concepts of visualization, computer analysis and calculus to solve spatial data collection and analysis problems.

Topics Covered

Leveling and Vertical Control
Horizontal and Angular Measurements
Analysis and Adjustments of Measurements
Line Direction/Traverse Computations, Areas and Volumes
Horizontal Control Networking
Topographic/Hydrographic
Horizontal and Vertical Curves
Photogrammetry
Remote Sensing and Image Interpretation
Global Positioning Systems
Map Theory - Datums, projections, transformations
Introduction to Geographic Information Systems
Digital Terrain Modeling
Kriging and geostatistics

Laboratory: Leveling and Measuring Distances; Measuring Angles; Topographic Survey/Planimetric Survey; Staking out; Digital Photogrammetry/Remote Sensing/Image Interpretation; GPS/GIS; Spatial data analysis

Class/Laboratory Schedule

Two 1 hour lectures and one 3 hour laboratory.

Contribution to Criterion 4: Professional Component

This class allows a student to conduct laboratory experiments and to critically analyze and interpret data.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 3010	Geomatics		X	X	X			

Person(s) Who Prepared Course Syllabi

Bill Daniel and Laurence Jacobs, June 2002

CEE 3020: Civil Engineering Materials, Required Class**Catalog Description**

Physical, mechanical, and durability properties of concrete, metals, unreinforced and reinforced plastics, timber, asphalt and asphalt concrete. Credit hours: 2-3-3. Prerequisites: CEE 2020. Co-requisites: CEE 3030

Textbook(s) and/or Other Required Materials

Textbook: J.F. Young, S. Mindess, R.J. Gray, and A. Bentur. "The Science and Technology of Civil Engineering Materials," Prentice-Hall, 1998.

Other Materials: Online laboratory manual

Educational Objectives

This course is intended to build an awareness of material structure, mechanical properties, durability, and cost to promote effective materials selection and design. Relationships between atomic structure, microstructure, and macroscale material behavior are developed. Through a series of laboratory experiments, students will develop an intuitive sense of material behavior. In evaluating the accompanying laboratory reports, emphasis is placed on data analysis, presentation, and interpretation as well as the development of technical writing skills.

Topics Covered

Aggregates
 Portland cement and hydration
 Mineral and chemical admixtures
 Structure and properties of fresh and hardened concrete
 Durability of concrete
 Mixture design
 Atomic structure of metals, alloying, and phase diagrams
 Elastic and plastic behavior of metals
 Fracture and fatigue
 Corrosion
 Structure and properties of polymers
 Types and properties of reinforcing fibers
 Structure and properties of fiber reinforced polymers
 Structure and properties of wood and wood products
 Durability and deterioration of wood and wood products
 Structure and properties of asphalt cement and asphalt concrete
 Test methods and mixture design methods for asphalt concrete

Class/Laboratory Schedule

Two 1-hour lectures per week and six 3-hour laboratory sessions over the course of the semester.

Contribution to Criterion 4: Professional Component

Emphasis on relating structure to properties gives students a basis for fundamental understanding of material performance. This approach will allow them to evaluate, in their professional careers, the suitability of new materials, which may be result from changes to traditional composition and processing. Emphasis on report writing and development of technical writing develops skills necessary for success as a professional engineer.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 3020	Civil Engineering Materials	X	X	X	X	X		X

Person(s) Who Prepared Course Syllabi

Kimberly E. Kurtis, June 2002

CEE 3030: Strength of Materials, Required Class

Catalog Description

Stress and strain, axially loaded members, torsion of circular members, bending of beams, transformation of stress and strain, and column buckling. Credit hours: 3-0-3. Prerequisites: CEE 2020 and MATH 2403.

Textbook(s) and/or Other Required Materials

Textbook: R.R. Craig. "Mechanics of Materials," Wiley, 2000.

Educational Objectives

The course is intended to introduce concepts of mechanics of materials, with emphasis on problem identification, formulation and solution. Students will apply skills learned in statics and mathematics to solve mechanics of solids problems. Students will demonstrate an ability to set up and solve strength of materials problems such as beam bending and stress transformation.

Topics Covered

Definition of stress and strain
 Deformation of axially loaded members
 Thermal deformation
 Torsion of circular bars
 Shear force and bending moment diagrams
 Normal stress in beams
 Properties of sections
 Shear stress in beams
 Built-up beams
 Elastic-perfectly plastic
 Unsymmetric bending
 Beam deflection
 Curvature and beam deflection equation
 Stress and strain transformation at a point
 Principal stresses and maximum shear stress
 Mohr's circle
 Principal stresses in beams
 Combined bending and axial loading
 Column buckling

Class/Laboratory Schedule

Three 1 hour lectures (or two 1.5 hour lectures) per week.

Contribution to Criterion 4: Professional Component

This class provides the fundamental background needed to solve more complicated problems in structural analysis and design. Students are systematically introduced to the concepts of engineering problem solving, with an emphasis on the synthesis and application fundamental engineering concepts.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 3030	Strength of Materials		X	X				X

Person(s) Who Prepared Course Syllabi

Laurence J. Jacobs, May 2002

CEE 3040: Fluid Mechanics, Required Class**Catalog Description**

Elementary mechanics of fluids with emphasis on control volume analysis of flowing fluids using kinematics, continuity, energy, and momentum principles with applications to real fluids. Credit hours: 3-0-3. Prerequisites: CEE 2020

Textbook(s) and/or Other Required Materials

Textbook: Munson, B.R., Young, D.F., and Okiishi, T.H. "Fundamentals of Fluid Mechanics," 4th Ed., John Wiley & Sons, New York, 2002.

Educational Objectives

The course introduces basic concepts of fluid mechanics with emphasis on formulation and solution of flow problems. Students will build on skills acquired in mathematics and statics and dynamics courses to solve flow problems of civil and environmental engineering relevance. Students will demonstrate the ability to apply fundamental flow analysis techniques to fluid systems. The course will provide the analytical tools necessary for more advanced courses and applications.

Topics Covered

Fluid Properties
 Fluid Statics
 Kinematics and Reynolds Transport Theorem
 Conservation of Mass
 Bernoulli Equation
 Conservation of Momentum
 Conservation of Energy
 Dimensional Analysis and Similitude
 Boundary Layers
 Differential Analysis

Class/Laboratory Schedule

Three 1 hour lectures (or two 1.5 hour lectures) per week.

Contribution to Criterion 4: Professional Component

This course introduces the basic concepts of fluid mechanics and environmental transport processes at a fundamental level and provides the foundation of skills and knowledge required for more advanced courses and applications to fluid flow problems of engineering relevance. Importance of fluid mechanics applications to professional engineers is emphasized.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 3040	Fluid Mechanics		X	X				X

Person(s) Who Prepared Course Syllabi

Don Webster, May 2002

CEE 3055: Structural Analysis, CEE Breadth Elective

Catalog Description

Determination of internal forces and deflections in statically determinate trusses, beams, and frames. Introduction to statically indeterminate structures. Credit hours: 3-0-3. Prerequisite: CEE 3030

Textbook(s) and/or Other Required Materials

Textbook: K. M. Leet and C.M. Uang. "Fundamentals of Structural Analysis", McGraw Hill, 2002.

Educational Objectives

The course is intended to teach undergraduates the fundamentals of structural analysis for determinate structures with an introduction to the analysis of indeterminate structures. This course builds on material presented in the statics and strength of materials courses. The students will also be introduced to computerized structural analysis. Students will demonstrate an ability to solve determinate and indeterminate trusses, beams, and frames.

Topics Covered

Overview of Structural Engineering
 Process of Engineering Design
 Structural Idealization
 Loading Sources, Types, & Idealization
 Equilibrium and Compatibility
 Free body diagrams
 Structure and Member Types
 Determinacy and Stability
 Analysis of Determinate Trusses
 Analysis of Determinate Beams and Frames
 Axial force, Shear, and Moment Relationships and Diagrams
 Determining deflections in Determinate Structures Using Unit Load Method
 Introduction to the Analysis of Structures Using the Computer
 Solving Statically Indeterminate Trusses, Beams, and Frames using Consistent Deformation
 Influence Lines for Determinate and Indeterminate Structures
 Approximate Methods of Analysis for Gravity and Lateral Loads

Class/Laboratory Schedule

Three 1 hour lectures (or two 1.5 hour lectures) per week.

Contribution to Criterion 4: Professional Component

This class provides the fundamental background needed to solve structural analysis problems. Students are systematically introduced to the concepts of structural engineering problem solving, with an emphasis on the application of mathematics, statics, and strength of materials. The role of analysis in the process of engineering design is regularly discussed.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 3055	Structural Analysis		X	X				X

Person(s) Who Prepared Course Syllabi

Kenneth M. Will, June 2002

CEE 3770: Statistics And Applications, Required Class

Catalog Description

Introduction to probability, probability distributions, point estimation, confidence intervals, hypothesis testing, linear regression, and analysis of variance. Example applied to the field of civil and environmental engineering. Cross-listed with MATH 3770 and ISYE 3770.

Text book

Probability Concepts in Engineering Planning and Design, by A. H.-S. Ang and W. H. Tang, John Wiley and Sons, Inc., New York, ISBN 0-471-03200-X

Educational Objectives:

This course introduces the mathematical fundamentals of probability theory and statistics in a general civil engineering context, and provides students with basic tools for the analysis of uncertainty in civil engineering structures, foundations, environmental systems, water resources and transportation systems. While the course is taught from an engineering perspective, it nonetheless contains significant mathematical rigor. Students are required to apply knowledge and skills gained in prior mathematics and engineering science coursework to assess the role of uncertain information in solutions to practical engineering problems.

Topics Covered

Basic concepts; events, probability axioms
 Random variables and probability laws
 Common probability distributions; normal, lognormal, exponential, Binomial, etc.
 Jointly distributed random variables; correlation, independence
 Functions of random variables
 Statistical inference
 Confidence intervals
 Hypothesis testing
 Model selection and assessment
 Regression analysis
 Analysis of variance
 Bayesian analysis

Class Schedule

Three 1-hour lectures per week.

Contribution to Criterion 4: Professional Component

This course is aimed at demonstrating the importance of uncertainty in rational engineering decision analysis. It provides mathematical methods that are essential to understanding how demands and capacities of building, environmental and transportation systems vary in space and in time, how the results of laboratory tests or field measurements should be interpreted in an engineering setting, and how to assess design alternatives with respect to system performance objectives.

Relationship to Program Outcomes:

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 3770	Statistics and Applications		X	X	X			X

Person who prepared course syllabus:

Bruce R. Ellingwood, May, 2002

CEE 4090: Capstone Design, Required Class**Catalog Description**

An interdisciplinary civil and environmental design experience. Problem definition, data acquisition, modeling and analysis, evaluation of design alternatives, oral and written presentation of final designs. Credit hours: 2-3-3.

Textbook(s) and/or Other Required Materials

No textbook; extensive use of handout materials

Educational Objectives

The course is intended to provide an integrative design experience for seniors. A real-life design problem is assigned to teams of 3-6 students who, with the aid of faculty and practicing professionals, collect relevant data, analyze possible alternatives, and develop a detailed final design. Important components of the course are the team approach, the use of scheduling tools to track progress, and the need to synthesize and apply the knowledge obtained in at least five of the introductory CE courses. This course also has a strong emphasis on developing both oral and written communications, interpersonal, and leadership skills.

Topics Covered

The topics covered range widely depending on the faculty teaching this course. Design problems range from the development of a preliminary design for a large civil project such as a river crossing in an urban area (where transportation, geotechnical, environmental, structural and construction issues have about the same importance) to the detailed design of an office park (where construction, structural and municipal engineering issues predominate), to the development of a solution of a specific problem such as a point source of contamination (polluted water supply, primarily an environmental topic, or stability of a dam impounding mineral waste, a geotechnical/environmental problem). The emphasis is on the solution of a realistic engineering problem with aid of external experts (PEs) and internal faculty. External experts are used both during the development of alternatives and detailed design phases, as well as judges of the final presentations. Such diverse issues as professional ethics and sustainability are built into the projects to provide additional experiences. Development of good communication skills is another important objective of this course. Two lectures dedicated specifically to this issue are presented by a specialist, and in addition to a preliminary and final written report, at least two oral presentations with the participation of all team members are required. The specialist also helps student develop the presentations and reports and provides strong input in the grading process.

Class/Laboratory Schedule

Five hours total per week, usually divided into two 1 hour lectures and a 3 hour laboratory session or a two laboratory sessions (2 hours + 3 hours).

Contribution to Criterion 4: Professional Component

This class provides the students with the opportunity to look at a problem as it would be approached by a real engineering company. Emphasis on the team approach, where the individual responsibilities are clearly delineated and where missing deadlines may result in a severe penalty, prepare the students for professional practice. Students learn the importance of obtaining a clear definition of the problem from the client, on planning time and resource allocations, on developing economically viable alternatives, establishing reasonable budgets, and being able to articulate the design concepts concisely to both clients and the public.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 4090	Capstone Design	X	X	X	X	X	X	X

Person(s) Who Prepared Course Syllabi

Roberto T. Leon, May 2002

CEE 4100 - Construction Engineering & Management, CEE Breadth Elective

Catalog Description

Fundamental concepts in planning, design, and construction of civil engineering projects. Introduction to project scheduling, cost estimating, controls, procurement, value engineering, quality assurance, and safety.

Credit hours: 3-0-3. Prerequisites: None.

Textbook(s) and/or Other Required Materials

No textbook is required for the course. All course materials are provided to the students via the course Web Site: <http://courses.ce.gatech.edu> to CEE4100.

In addition, an on-line textbook is used as a reference:

C. Hendrickson. "Project Management for Construction: Fundamental Concepts for Owners, Engineers, Architects and Builders." Second Edition, prepared for World Wide Web publication in 2000: <http://www.ce.cmu.edu/~cth>.

Educational Objectives

This course has five fundamental teaching objectives. During the course, the instructor: (a) provides civil and environmental engineering students with a clear understanding of their role and their professional responsibilities within the Architecture/Engineering/Construction (A/E/C) industry in the delivery of high quality constructed facilities; (b) provides an overview of the construction industry, organizations, and projects with an emphasis on the definition and organization of projects, delivery methods and contractual relationships, and the design and construction processes; (c) acquaints students with the principal concepts and issues in the planning, design, and construction phases of projects; (d) introduces students to general concepts and issues in project planning, cost estimating, scheduling, cost/time controls, procurement, value engineering, quality, productivity, and safety in construction; and (e) strengthen students' problem-solving skills, working both individually or in groups, and students' written and oral communication skills.

This course has four fundamental learning objectives. By the end of the course, students will be able to: (a) understand and discuss the complexity of the A/E/C industry, from an industry, an enterprise, and a project perspectives; (b) compare and contrast the various types of organizations; the different project delivery systems and contract types; the design, procurement, and construction processes; and the principal issues surrounding construction labor, materials, and equipment management; (c) identify, describe, and discuss the principal concepts and issues in construction economics; construction project planning; construction cost estimating, scheduling, and cost/time control; quality; productivity; and construction safety; and (d) based on a very general set of project data and information, understand and apply (at an introductory level) the processes used in: developing a project definition package, defining a project execution plan, prepare a design package (plans and specifications), and prepare a construction bid (cost estimate and schedule) for an A/E/C project.

Topics Covered

General Context of the A/E/C Industry
Legal Structures of A/E/C Organizations
Life Cycle of a Civil Engineering Project
Delivery Systems and Contract Types
Organizing and Managing Project Teams
Value, Quality, and Performance
Project Planning and Definition
The Design and the Construction Processes
Construction Planning, Scheduling, Estimating, and Control
Construction Operations
Management of Resources, Quality, and Safety

Class/Laboratory Schedule

Three 1 hour lectures per week.

Contribution to Criterion 4: Professional Component

This class provides the fundamental background needed for students to understand and communicate with others on topics related to the A/E/C industry, A/E/C organizations, and A/E/C projects. Students participate in a semester-long integrated simulation of the project definition, planning and design, bidding, and construction processes for a small design/construction project (recent projects have included a Temporary Festival Enclosure for the display and sale of arts and crafts, and a Temporary Emergency Homeless Shelter for an individual person).

The simulation takes place both inside and outside the class. Students are organized randomly in teams by the instructor, and form a design/build company that has to deliver a simple project in six phases. In the simulation, students are expected to conduct themselves within the role of professionals, playing specific roles, and following specific processes within a set of constraints imposed on each phase. The primary objective of the simulation is to assess the level of understanding that students have of the principal concepts covered in the course, by evaluating how they apply these concepts within the context of a real-world design and construction project of manageable scope.

The six phases are: (I) Forming a Design/Construction Company; (II) Preparing a Project Definition Package; (III) Preparing a Design Package; (IV) Preparing a Bid; (V) Building the Project; and (VI) Preparing the Project Close Out.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 4100	Construction Engineering & Management	X	X	X	X	X	X	X

Person(s) Who Prepared Course Syllabi

Jorge A. Vanegas, May 2002

Catalog Description

An integrated approach to planning, estimating, and scheduling of construction projects, including basic and advanced concepts, applications, and tools for developing plans, estimates, and schedules.

Credit hours: 3-0-3. Prerequisites: None.

Textbook(s) and/or Other Required Materials

No textbook is required for the course. All course materials are provided to the students via the course Web Site: <http://courses.ce.gatech.edu> to CEE4110.

A textbook that had been used in previous course offerings is used as a reference:

F. E. Gould. "Managing the Construction Process: Estimating, Scheduling, and Project Control." Second Edition, Prentice-Hall, Inc., Upper Saddle River, NJ., 1997

In addition, an on-line textbook is used as a reference:

C. Hendrickson. "Project Management for Construction: Fundamental Concepts for Owners, Engineers, Architects and Builders." Second Edition, prepared for World Wide Web publication in 2000: <http://www.ce.cmu.edu/~cth>.

Educational Objectives

This course has four fundamental teaching objectives. During the course, the instructor: (a) provides civil and environmental engineering students with a clear understanding of their role and their professional responsibilities within the Architecture/Engineering/Construction (A/E/C) industry in the planning, cost estimating, and scheduling of high quality constructed facilities; (b) provides an overview of the general context and relationships among planning, cost estimating, and scheduling; (c) introduces students to basic and advanced concepts and tools for planning, cost estimating, and scheduling, and develop skills for the application of these concepts and tools in construction projects; and (d) strengthens students' problem-solving skills, working both individually or in groups, and students' written and oral communication skills.

This course has five fundamental learning objectives. By the end of the course, students will be able to: (a) understand and discuss the complexity of A/E/C projects, from a planning, cost estimating, and scheduling perspective; (b) plan a construction project, including the development of the project definition package, the project execution plan, and the various work breakdown structures; (c) estimate the cost of a construction project, including the development of estimates at the conceptual, schematic, and detailed design stages of design; (d) schedule a construction project, including the definition of activities and their duration, the development of the network, and the calculation of all dates and floats; and (e) based on a real set of project data and information, develop a project definition package, define a project execution plan, develop a work breakdown structure, and prepare a construction bid (cost estimate and schedule) for a A/E/C project.

Topics Covered

General Context and Relationships among Planning, Scheduling, and Estimating

Basic and Advanced Concepts, Tools, and Applications for Planning: overall project planning and work breakdown structures; planning for design; and planning for construction

Basic and Advanced Concepts, Tools, and Applications for Estimating: concept budgetary estimate; schematic estimate; design development estimate; contract document estimate; and estimating during construction

Value Engineering

Basic and Advanced Concepts, Tools, and Applications for Scheduling: activity-on-arrow and precedence network diagrams development; developing activity duration and network calculations; and time-cost tradeoffs

Bidding

Cost, Schedule, and Resource Control

Class/Laboratory Schedule

Three 1 hour lectures per week.

Contribution to Criterion 4: Professional Component

This class provides the fundamental background needed for students to understand and communicate with others on topics related to the planning, estimating, and scheduling processes within A/E/C projects. Students are introduced to the concepts of identification, definition, and documentation of the key project stakeholders, principal project goals and objectives, main characteristics of the physical and the non-physical context of the project, the project scope, the main project risks, and the principal internal and external influences that affect, or can affect, project performance.

In addition, students are introduced to the concepts of analysis of contract documents, development and characterization of cost work breakdown structures, development of quantity take-offs, and development of unit cost analyses, in establishing the costs of A/E/C projects at conceptual, schematic, and detailed design levels.

Also, students are introduced to the concepts of development and characterization of scheduling work breakdown structures, development of scheduling networks, and development of all associated calculations, in establishing the duration of A/E/C projects. All students are required to make presentations and work both individually, and in teams.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 4110	Construction Planning, Estimating, and Scheduling	X	X	X	X	X	X	X

Person(s) Who Prepared Course Syllabi

Jorge A. Vanegas, May 2002

CEE 4120 - Construction Operations, CEE Technical Elective

Catalog Description

An integrated approach to construction operations, including basic and advanced concepts, applications, and tools for planning, design, modeling, and analysis of construction operations.

Credit hours: 3-0-3. Prerequisites: None.

Textbook(s) and/or Other Required Materials

The required textbook is: S. W. Nunnally. "Construction Methods and Management." Fifth Edition, Prentice Hall, Inc., Englewood Cliffs, NJ (2000). All additional course materials are provided to the students via the course Web Site: <http://courses.ce.gatech.edu> to CEE4120.

Educational Objectives

This course has five fundamental teaching objectives. During the course, the instructor: (a) provides civil and environmental engineering students with a clear understanding of their role and their professional responsibilities within the Architecture/Engineering/Construction (A/E/C) industry in the effective and efficient execution of construction operations; (b) provides an overview of the analysis, generation, evaluation, and selection processes associated with the definition, planning, design, and execution of construction operations, within the context of the different types of projects in the A/E/C industry; (c) acquaints students with the principal types and characteristics of construction equipment and methods; (d) introduces students to general concepts and issues in planning, design, and execution of construction operations, particularly concepts of lean construction; and (e) strengthens students' problem-solving skills, working both individually or in groups, and students' written and oral communication skills.

This course has four fundamental learning objectives. By the end of the course, students will be able to: (a) identify, describe, and discuss the principal concepts and issues in the definition, planning, design, and execution of construction operations within different types of projects in the A/E/C industry; (b) compare and contrast the various principal types of construction equipment and methods available in the A/E/C industry; (c) develop a definition package for a construction operation, design a construction operation in response to a definition package, and prepare an execution plan in response to a design for a construction operation; and (d) collect and analyze data on a construction operation, model a construction operation, and develop recommendations to maximize productivity, optimize resource allocation, and minimize resource idleness.

Topics Covered

General Context and Challenges of Construction Operations

Basic Concepts, Tools, and Applications for Utilization and Management of Construction Equipment and Methods: equipment for earthmoving and heavy construction; and equipment for building construction

Basic and Advanced Concepts, Tools, and Applications for Data Collection, Modeling, and Analysis of Construction Operations: construction operations as a system; data collection tools; process system definition; process modeling concepts and strategies; process simulation; and data analysis tools

Basic and Advanced Concepts, Tools, and Applications for Development of Recommendations: to maximize productivity; to optimize resource allocation; and to minimize resource idleness

Class/Laboratory Schedule

Three 1 hour lectures per week.

Contribution to Criterion 4: Professional Component

This class provides the fundamental background needed for students to understand and communicate with others on topics related to construction operations in A/E/C projects. Students participate in a semester-long productivity improvement study of a construction operation of their choice, within a real project under construction in the Atlanta Metropolitan Area. Students are organized randomly in teams by the instructor, and form a consulting company to (1) conduct an in-depth analysis of their selected construction operation; (2) generate two alternatives to the construction operation; and (3) develop specific recommendations for the improvement of the effectiveness, efficiency, and productivity of the operation.

The scope of work in the project includes: (1) identifying a construction project and a construction operation within the project; (2) establishing contact with the key professionals of the companies involved in the operation from an owner, design, and construction perspectives; (3) interviewing these professionals, and conducting the appropriate field studies to collect all relevant data, information, knowledge, and experience on the construction operation; (4) analyzing the data, information, knowledge, and experience collected; (5) generating at least two alternatives to the construction operation from a system and production perspectives; (6) developing recommendations for the improvement of the effectiveness, efficiency, and productivity of the operation; (7) preparing and submitting a technical report on the results of the data collection, the analysis, the proposed alternatives, and the final recommendations in; and (8) delivering a technical oral presentation on the principal findings of your investigation.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 4120	Construction Operations	X	X	X	X	X	X	X

Person(s) Who Prepared Course Syllabi

Jorge A. Vanegas, May 2002

CEE 4200: Hydraulic Engineering, Required Class

Catalog Description

Applications of fluid mechanics to engineering and natural systems including pipe flow, fluid drag, open channel flow, turbomachinery, and environmental hydraulics; laboratory experiments; computational hydraulics. Credit hours: 2-3-3. Prerequisites: CEE 3000 and CEE 3040.

Textbook(s) and/or Other Required Materials

Textbook: Munson, B.R., Young, D.F., and Okiishi, T.H. "Fundamentals of Fluid Mechanics," 4th Ed., John Wiley & Sons, New York, 2002.

Educational Objectives

This course introduces hydraulic engineering applications. Students apply analytical skills acquired in this course and CEE3040, Fluid Mechanics, to solve flow problems relevant to civil and environmental engineering. The laboratory section is an essential component of this course. Students in small teams perform hands-on experiments that are designed to illuminate fundamental fluid mechanics concepts that are introduced in the lectures. Students prepare written lab reports and are graded on technical writing and content. Students also present lab results and analysis in team oral presentations.

Topics Covered

Viscous Flow in Pipes
 Minor Losses and Multiple Pipe Systems
 Turbomachinery
 Lift and Drag
 Open Channel Flow
 Environmental Fluid Mechanics
 Sediment Transport
 Computational Fluid Mechanics

Laboratory (sample experiments):

Bernoulli's Equation Applied to a Venturi Meter
 Conservation of Momentum Principle Applied to the Deflection of a Free Jet
 Laminar and Turbulent Resistance in Pipe Flow
 Centrifugal Pump Performance Curves
 Drag Forces on Cylinders and Spheres
 Hydraulic Jump
 Flow Over Sharp-Crested and Broad-crested Weirs

Class/Laboratory Schedule

Two 1 hour lectures per week. One 3 hour laboratory section per week.

Contribution to Criterion 4: Professional Component

This course develops analytical problem solving skills for fluid mechanics applications of importance to civil and environmental engineering. Students apply skills acquired in this and previous courses to design and analyze flow systems in the engineering and natural environments, and to analyze and interpret experimental data. Technical writing, presentation, and team skills are emphasized in the laboratory section.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 4200	Hydraulic Engineering		X	X	X	X		X

Person(s) Who Prepared Course Syllabi

Don Webster, May 2002

CEE 4210: Hydrology, CEE Technical Elective**Catalog Description**

Global circulation and the hydrologic cycle, precipitation mechanisms and analysis, evaporation and other losses, streamflow, hydrographs, river and reservoir routing, and frequency analysis. Credit hours: 3-0-3. Prerequisites: CEE 3040 and ME 3322.

Textbook(s) and/or Other Required Materials

Textbook: Bedient, P. B. and W. C. Huber, *Hydrology and Floodplain Analysis*, Prentice Hall, 2002.

Course web site: <http://courses.ce.gatech.edu> to CEE4210. Web site includes lecture notes and class discussion items among other course materials

Educational Objectives

The course introduces undergraduates to the subject of hydrology and its engineering application. Building upon earlier courses in fluid mechanics and thermodynamics, components of the hydrologic cycle are examined first from the scientific perspective and then from the engineering viewpoint with frequent reference to applications. Emphasis is placed on sustainability in hydrology and engineered water resources systems. The last third of the course is spent on stormwater design with students working in small groups to complete a comprehensive stormwater design project that includes analysis using industry-standard computer software and submittal of a written design report and oral presentation. Students should leave the course with: an understanding of each of the various components of the hydrologic cycle individually and in sum, with knowledge of the problems that civil engineers are expected to solve that relate to hydrology and the techniques used to solve them, and with experience in designing an engineered solution to a local stormwater problem that meets relevant technical, legal, and ethical requirements.

Topics Covered

Global circulation and the hydrologic cycle

Hydrologic budget

Precipitation mechanisms and data analysis

Evaporation and other precipitation losses

Streamflow and hydrographs

Unit hydrographs and the S-curve technique. Forecasting. Synthetic hydrography.

River routing. Hydrologic reservoir routing.

Integrated hydrologic modeling.

Stormwater engineering: principles, design, and regulatory aspects.

Class/Laboratory Schedule

Three 1 hour lectures (or two 1.5 hour lectures) per week.

Contribution to Criterion 4: Professional Component

This course includes a stormwater engineering design project that must conform with both technical/economic constraints and local regulatory aspects. The project includes instruction on industry-standard software as well as extensive discussion of the limitations of modeling and the need for continual learning and professional development in the field. Projects are executed in groups of two to four (depending on class size), and students are expected to divide tasks equally and review their peers' work.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 4210	Hydrology	X	X	X		X	X	X

Person(s) Who Prepared Course Syllabi

Aris Georgakakos, May 2002

CEE 4230: Environmental Transport Modeling, CEE Technical Elective

Catalog Description

Introduction to mixing of pollutants and natural substances in the surface water environment. Use of mathematical models for mixing zones and water quality. Credit hours: 3-0-3. Prerequisites: CEE 4200

Textbook(s) and/or Other Required Materials

"Environmental Hydraulics," V. J. Singh & W. H. Hager, Eds. Kluwer Academic Publishers, 1996.

"Mixing in Inland and Coastal Waters," H. B. Fischer, et al., Academic Press, 1979.

Educational Objectives

The course introduces undergraduates to the fundamentals of transport and mixing phenomena in surface water systems and the use of mathematical water quality and hydrodynamics models. Through knowledge of fundamental processes, students will learn to choose appropriate models for particular water quality and mixing zone problems and apply them to typical environmental and outfall design problems.

Topics Covered

1. Introduction
Typical environmental problems, course overview
2. Diffusion and Dispersion
Basic ideas of mass transport and mixing. The advective diffusion equation and basic solutions. Mixing in turbulent and shear flows.
3. Rivers
Vertical, transverse, and longitudinal mixing in rivers. Estimation of diffusion coefficients. Thermal dispersion.
4. Lakes And Reservoirs
The annual cycle. Effect of stratification. Surface heat transfer. Dynamics of vertical and horizontal mixing. Estuaries and Coastal Waters. Circulation and tides. Causes of mixing. Salinity intrusion.
5. Mixing Zone Analyses
Concept of a mixing zone for wastewater discharges. Introduction to jets, plumes, and diffusers. Regulatory requirements. Use of mathematical models, CORMIX, RSB, PLUMES.
6. Modeling Concepts
Choice of models for pollution problems. Examples and applications of hydrodynamic and water quality models for rivers, lakes, estuaries, and coastal waters, including ECOM, TABS, FESWMS, CE-QUAL-W2.

Class/Laboratory Schedule

Three 1 hour lectures (or two 1.5 hour lectures) per week.

Contribution to Criterion 4: Professional Component

This class provides the fundamental background needed to solve more complicated problems in environmental engineering. The course includes instruction on industry-standard models and discusses the limitations of modeling and the need for continual learning and professional development in the field.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 4230	Environmental Transport Modeling	X	X	X	X		X	X

Person(s) Who Prepared Course Syllabi

Phil Roberts, May 2002

CEE 4300: Environmental Engineering Systems, CEE Breadth Elective**Catalog Description**

Credit Hours: 3-0-3

Prerequisites: Calculus III (MATH 2501), General Chemistry (CHEM 1211), and Biological Principles (BIOL 1510), and Civil Engineering Systems (CEE 3000)

Environmental engineering issues associated with water, air, and land pollution, including risk assessment, groundwater contamination, global climate change, and sustainable technologies.

Textbook(s) and/or Other Required Materials

Masters, G.M. (1997). *Introduction to Environmental Engineering and Science*, 2nd Ed., Prentice-Hall, Englewood Cliffs, N.J.

Educational Objectives

- 1) Gain a perspective of the need for the use of simple fundamentals, critical-thinking and creativity in the solution of open-ended tasks and problems, recognizing that it is these open-ended problems for which engineers and scientists are best directed to assess and evaluate. This objective must be recognized as an overall approach to learning and preparation for assumption by you of the design and evaluation of engineering systems as a practicing engineer or scientist.
- 2) Develop and use fundamental material balances to assess the fate and effects of contaminants in the natural and built environments.
- 3) Quantitatively describe critical characteristics and properties of air, waters, and soil resources. Understand the role of these characteristics and properties in assessing environmental quality issues and the need for environmental protection, safeguards and reclamation systems by individuals, populations and industry.
- 4) Use equilibrium constants for gas-solubility, ionic-species equilibration for common acids and solubility products to establish pH, alkalinity, ion-balances and inorganic-carbon contents of waters and air and use them in assessing environmental quality and associated actions required.
- 5) Write fundamental redox reactions and associated half-reactions and use them in assessing environmental impacts of inorganic and organic species.
- 6) Quantitatively assess the impacts of the dispersion of oxygen-demanding compounds on water systems and develop management approaches for alleviating impacts on dissolved oxygen resources in streams.
- 7) Quantitatively assess the impacts of dispersion of air emissions on downwind communities and the meteorological interactions, which affect these processes.
- 8) Gain an understanding of the fundamental reclamation facilities and systems used to control air, water and soil emissions to the environment.

Topics Covered

Mass and Energy Transfer
Environmental Chemistry
Mathematics of Growth
Water Pollution Surface and Groundwater Quality
Hazardous Substances and Risk Analysis
Introduction to Engineered Systems for Water and
Wastewater Treatment and Solid Waste Disposal
Air Pollution
Global Changes
Sustainable Technologies

Class/Laboratory Schedule

Three 1 hour lectures (or two 1.5 hour lectures) per week.

Contribution to Criterion 4: Professional Component

Students learn of the fundamental scientific principles used in practice in establishing and evaluating the quality of air, water and land resources. They learn to apply fundamental principles to assess water and air quality parameters, conduct material balances around control volumes and critically assess the impacts of the dispersion of contaminants in air and water discharges. These approaches serve to prepare students for engineering practice in providing the quantitative skills and approaches for the evaluation of design criteria and system performance at many scales.

Relationship to Program Outcomes

		Program Outcome						
Course No.	Title	1	2	3	4	5	6	7
CEE 4300	Environmental Eng. Systems	X	X	X		X	X	X

Person(s) Who Prepared Course Syllabi

Saunders, F. Michael, May 2002

CEE 4310: Water Quality Engineering, CEE Technical Elective

Catalog Description

Credit Hours: 3-0-3

Prerequisites: CEE 4300

Reclamation of water and wastewater for potable and industrial uses, groundwater remediation. Principles of physical, chemical, and biological treatment processes.

Textbook(s) and/or Other Required Materials

Peavy, H.S., Rowe, D. R. & Tschobanglous, G, Environmental Engineering; 1985, Printing no. 15, McGraw Hill Book Co., New York, NY

Educational Objectives

Students are to be able to design and evaluate the performance of reactor systems for fundamental water and wastewater reclamation processes to include the following:

- * fundamental plug flow and CSTR reactors for first-order reactions in single and multiple-reactor systems
- * sedimentation basins for concurrent clarification and thickening

- * coagulation and flocculation reactor systems

- * rapid-sand filtration systems to include hydraulic design for clean filters and assess the backflow velocity requirements

- * disinfection reactors

- * activated sludge systems for organic removal and

- * biotower systems for wastewater reclamation.

Students are to be able to evaluate coagulant doses and sludge-quantity production and calculate lime, soda and CO₂ doses for stoichiometric softening using straight-lime and excess-lime processes.

Students are to gain sufficient insight as to be able to orient the available unit operations and processes for the effective reclamation of raw waters and wastewaters.

Topics Covered

Introduction

Resume development

Water quality characteristics & standards

Water Reclamation Systems & Plants

Distribution systems

Reactor Systems

Chemical Reaction Kinetics; Batch, Plug Flow (PFR) and Completely

Stirred Tank Reactors (CSTR)

Sedimentation

Type 1 and 2 clarification; Clarifier design; Thickening; Thickener design

Sedimentation system design

Coagulation and Flocculation

Colloid stability & destabilization; Flocculation; Design of rapid mix and slow mix units

Softening

Filtration

Disinfection

Wastewater Reclamation Systems

Objectives; Wastewater characteristics

Screening and preliminary treatment

Biological Treatment Systems

Activated sludge systems; Biotowers; Lagoons

Nutrient removal

Residue Treatment and Disposal

Class/Laboratory Schedule

Three 1 hour lectures (or two 1.5 hour lectures) per week.

Contribution to Criterion 4: Professional Component

Students learn the fundamentals of the design of water quality systems and the interrelationships between processes in series. The class includes open-ended design problems as a routine part in the design of all unit operations and processes, as well as significant operational approaches.

Relationship to Program Outcomes

		Program Outcome						
Course No.	Title	1	2	3	4	5	6	7
CEE 4310	Water Quality Engineering	X	X	X	X	X	X	X

Person(s) Who Prepared Course Syllabi

Saunders, F. Michael, May 2002

CEE 4320: Hazardous Substance Engineering, CEE Technical Elective

Catalog Description

Credit Hours: 3-0-3; Prerequisites: CEE 3040 and CEE 4300

Technical aspects of hazardous waste management and treatment including legislation, exposure and risk assessment, contaminant fate and transport, waste treatment methods, and remediation technologies.

Textbook(s) and/or Other Required Materials

LaGrega, Buckingham and Evans, Hazardous Waste Management, 2nd Edition, McGraw-Hill, New York, 2001.

Educational Objectives

The course is intended for undergraduate students with interests in groundwater, contaminant fate and transport in the subsurface and remediation technologies. Upon completion of this course, the student will have demonstrated an understanding of:

- (1) distribution of contaminants among solid, liquid (water and/or organic liquid), gas phases;
- (2) principles governing the contaminant transport in water-saturated porous media;
- (3) remediation technologies designed to treat groundwater and subsurface contaminants;
- (4) mathematical models used to predict contaminant transport and attenuation in groundwater systems.

Topics Covered

Subsurface contaminant phase distribution and transport, regulations, site characterization, remediation technology overview, pump-and-treat remediation (plume containment, mass transfer limitations), bioremediation (monitored natural attenuation, aerobic-anaerobic processes), surfactant flushing (solubilization and mobilization), soil vapor extraction (bioventing, air sparging), treatment-barrier walls (zero valent iron, zeolite), mathematical modeling of natural attenuation using BIOSCREEN and BIOPLUME III.

Class/Laboratory Schedule

Three 1.0-hour lecture periods per week. Four homework/problem sets, two in-class exams, optional final exam, and a group design project. A significant portion of the class is devoted to the natural attenuation modeling project, which involves teams of 3-4 students. Each team uses BIOSCREEN and BIOPLUME III to simulate the transport of a tracer (MTBE) and dissolved contaminant (benzene) from a gasoline station located in East Patchogue, Long Island, New York. Approximately 8 class periods are set aside to provide model tutorial instruction and to assist in implementation of the model to the field site. A final written report is required from each team, which includes input parameters, assessment of model fits, and simulation output.

Contribution to Criterion 4: Professional Component

The course is intended to provide students with the skills and experience necessary to remediate hazardous waste sites, which ultimately enhances environmental quality and reduces risk to human health (Objective 1). In particular, the modeling project aims to instill technical skills necessary for site remediation, from conception to implementation (Objective 2). Many of the remediation technologies discussed in the course are interdisciplinary in nature, based on physical, chemical and/or biological principles (Objectives 3). In presenting this material, care is taken to emphasize the fact that technologies are continually being developed or modified based on advances in science and technology (Objectives 4 and 5).

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 4230	Hazardous Substance Engineering		X	X	X	X	X	X

Person(s) Who Prepared Course Syllabi: Kurt D. Pennell, May 2002

CEE 4330: Air Pollution Engineering, CEE Technical Elective**Catalog Description**

Credit Hours: 3-0-3

Prerequisites: CEE 4300 or consent of instructor

Introduction to the physical and chemical processes affecting the dynamics and fate of air pollutants at the local, regional and global scales. Particular emphasis is on tropospheric pollutant chemistry and transport.

Textbook(s) and/or Other Required Materials

Wark, K., Warner, C.F., and Davis, S.T., *Air Pollution: Its Origin and Control*, Addison Wesley

Educational Objectives

Students will gain an understanding of the transport and fate of air pollutants in the atmosphere as well as the formation and control of air pollutants. Air pollution issues at local, regional and global scales will be addressed. Students will have an ability to use different concentration units and employ mass and energy balances to address air pollution problems.

Topics Covered

Composition of atmosphere and effects of air pollutants

Sources

Atmospheric chemistry

Pollutant dispersion

Aerosol dynamics

Design of control strategies and policy

Class/Laboratory Schedule

Three one- hour lectures per week.

Contribution to Criterion 4: Professional Component

Students will learn how to use tools to assess how air pollution problems adversely affect human health and global climate (Program Outcome 1). Students will apply fundamental engineering principles (e.g. mass and energy balances with chemistry) to solve air pollution problems (Program Outcome 2). Students will design control strategies needed to meet health-based regulations, with consideration of cost (Program Outcome 3). Students will be encouraged to debate current topics in air pollution, such as proposed strategies for meeting urban air quality standards (Program Outcome 7).

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 4330	Air Pollution Engineering	X	X	X				X

Person(s) Who Prepared Course Syllabus

Mulholland, J., May 2002

CEE 4390: Environmental Engineering Facilities Design, CEE Technical Elective

Catalog Description

Credit Hours: 2-3-3

Prerequisites: CEE 4200 and CEE 4210 and CEE 4300 and CEE 4310

Interdisciplinary design course in environmental engineering and water resources including process design, hydraulic design, reservoir operations and analysis, cost estimates, plans and specifications.

Textbook(s) and/or Other Required Materials

Kawamura, S., (1991), *Integrated Design of Water Treatment Facilities*, John Wiley & Sons; *Recommended Standards for Water Works* (Ten State Standards), 1992; Linsley, R.K., Franzini, J.B., Freyburg, D.L., and Tchobanoglous, G., (1992), *Water-Resources Engineering*, 4th Edition, McGraw-Hill, New York.

Educational Objectives

Exposure of students to engineered water and wastewater treatment systems with field visits. Educate students to design the major elements of a water supply system including pumping stations, distribution systems and distribution reservoirs; and the analysis and design of sewerage systems. The focus of the course is on hydraulic design of these facilities.

Topics Covered

Lecture A

Engineering Reports, SOQs and RFPs
Drinking Water Regulations
Probabilistic Estimation of high and Low flows in streams
Intake and Pumping Station Design
Design of Water Treatment Plants
And Field Visits to Plants
Design of Sedimentation Tanks
Design of Hydraulic Conduits and P&ID Diagrams
Design of filters
Cost of Estimating

Lecture B

Water Resources Planning
Water Supply Design: Sources, Demand
Hydrologic data, Water yield, Mass curves, Operations studies
Hydropower Design: Turbine characteristics, Peaking power,
Design of Rapid Mixing and Flocculation Units allocation,
and field visit
Dependable Power, Storage
Water Quality Evaluation: Lake temperature, DO, Sediment,
Minimum releases
Flood Damage Mitigation: Frequency, Storage, Spillways,
Benefit-cost Analysis
Recreation user days and evaluation, Tradeoff analysis
Engineering Reports, SOQs and RFPs

Class/Laboratory Schedule

Two one-hour lecture/discussion classes and one three-hour design laboratory per week.
Lectures A and B are offered in alternating years.

Contribution to Criterion 4: Professional Component

Students learn to design the major elements of a water supply system.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 4390	Environmental Engineering Facilities Design	X		X	X	X		

Person(s) Who Prepared Course Syllabus

A. Amirtharajah, May 2002

CEE 4400: Geosystems Engineering, CEE Breadth Elective**Catalog Description**

Introduction to engineering behavior of soils; mechanical, chemical, electrical and thermal properties; continuum design principles including theory of elasticity and limiting equilibrium applied to particulate soils. Credit hours: 3-0-3. Prerequisites: EAS 2601, and CEE 3030.

Textbook(s) and/or Other Required Materials

Craig, R.F. (1992). *Soil Mechanics*, 5th Ed., Chapman & Hall, London, 427 pp.

Educational Objectives

The course is intended to introduce undergraduates to the concepts of geosystems engineering with an emphasis on the engineering behavior of particulate soils. Students will demonstrate an ability to apply concepts learned in earth science and mechanics of materials to solve problems in geosystems engineering.

Topics Covered

Soil Formation
 Characterization of Particulate Media
 Principle of Effective Stress
 Steady State Conduction in Porous Media
 Time-Dependent Behavior-Diffusion
 Mechanics of Continuous Media Applied to Soils
 In Situ and Induced Stresses
 Mechanics of Particulate Media
 Plasticity and Limiting Equilibrium
 Overview of Site Characterization
 Geosynthetics
 Ground Modification
 Soil-structure Interaction
 Laboratory Demonstrations and Experiments

Class/Laboratory Schedule

Three 1 hour lectures (or two 1.5 hour lectures).

Contribution to Criterion 4: Professional Component

This class provides an introduction to a fundamental area of civil engineering, geosystems engineering. CEE 4400 allows a student to integrate knowledge learned in engineering mechanics and science classes to set up and solve civil engineering problems.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 4400	Geosystems Engineering	X	X	X	X			

Person(s) Who Prepared Course Syllabi

David Frost and Laurence Jacobs, June 2002

CEE 4410: Geosystems Engineering Design, CEE Technical Elective

Catalog Description

Analysis and design in geosystems engineering projects, including the evaluation of pile foundations, slope stability, earth retaining structures, and embankments. Credit hours: 3-0-3. Prerequisites: CEE 4400.

Textbook(s) and/or Other Required Materials

Lancellotta, R., (1995), *Geotechnical Engineering*, Balkema, Rotterdam.

Educational Objectives

The course is intended to introduce undergraduates to the concepts of geosystems engineering design. Students will demonstrate an ability to apply concepts learned in geosystems engineering to design foundation systems, earth retention systems and obtain an understanding of slope stability.

Topics Covered

Static Equilibrium Methods
 Limit Equilibrium Approach
 Theorems of Plasticity
 Applications to Bearing Capacity and Stability Analyses]
 Foundation Systems
 Stresses Beneath Shallow Foundations and Footings
 Elasticity Solutions
 Settlement Calculations
 Capacity of Axial Pile Foundations
 Pile Foundation Settlements
 Earth Retention Systems
 Earth Pressure Theory
 Gravity Retaining Walls
 Slope Stability and Landslides
 Fellenius Ordinary Method of Slices
 Limit Equilibrium – Bishop Method
 Embankment Stability

Class/Laboratory Schedule

Three 1 hour lectures (or two 1.5 hour lectures).

Contribution to Criterion 4: Professional Component

This class provides an introduction to a fundamental area of civil engineering design. CEE 4410 allows a student to integrate knowledge learned in earlier classes to set up and solve engineering design problems.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 4410	Geosystems Engineering Design	X	X	X		X	X	

Person(s) Who Prepared Course Syllabi

David Frost and Laurence Jacobs, June 2002

CEE 4420: Subsurface Characterization, CEE Technical Elective**Catalog Description**

Introduction to field and laboratory methods for characterizing subsurface geological, hydrological, geotechnical, and contaminant conditions. Credit hours: 2-3-3. Prerequisites: CEE 4400.

Textbook(s) and/or Other Required Materials

Instructor provided notes.

Educational Objectives

The course is intended to introduce undergraduates to the concepts of subsurface characterization. Students will demonstrate an ability to set up and solve problems in surface and subsurface testing and sampling.

Topics Covered

Surface and Borehole Geophysical Testing Techniques
 Seismic Methods and Magnetic Surveying
 Electromagnetic Conductivity Test
 Soil Resistivity Test
 Ground Penetrating Radar Test and Geophysical Logging Tests
 Subsurface Frilling and Sampling Techniques
 Augering, Rotary Drilling, and Coring of Soil and Rock
 Standard Penetration and Hydropunch Tests
 Undisturbed Soil Sampling
 Monitoring Well Installation and Design and Groundwater Sampling
 Penetration Techniques
 Cone, Piezocone, and Environmental Cone Penetrometers
 Geoprobe for Soil, Groundwater, and Vapor Sampling
 Lateral Stress Blades and Pressuremeters
 Laboratory Testing Techniques
 Classification and Index Tests
 Proctor Compaction Tests
 Hydraulic Conductivity Tests
 One-Dimensional Soil Deformation Tests
 Triaxial and Direct Shear Tests and Interface Shear Tests

Class/Laboratory Schedule

Two 1 hour lectures and one 3 hour laboratory.

Contribution to Criterion 4: Professional Component

This class provides an introduction to subsurface characterization. CEE 4420 allows a student to integrate knowledge learned in earlier classes to develop an understanding of field and laboratory testing, including data analysis and interpretation.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 4420	Subsurface Characterization	X	X	X	X	X	X	

Person(s) Who Prepared Course Syllabi

David Frost and Laurence Jacobs, June 2002

CEE 4510: Structural Steel Design, CEE Technical Elective**Catalog Description**

Principles of behavior of tension and compression members, beams, and connections with application to the design of elementary structures. Credit hours: 3-0-3.

Textbook(s) and/or Other Required Materials

AISC LRFD Manual, 2001 and C.G. Salmon and J.E. Johnson. Steel Structures - Design and Behavior, Fourth Ed. 1996.

Educational Objectives

To prepare students to analyze and design elementary steel structural members. Emphasis is on behavioral aspects and failure modes (yield, fracture, local and global buckling) of individual beams, columns and beam-columns. Limited coverage of connection behavior and design, composite floor design, and frame effects is also given.

Topics Covered

Introduction: Material properties, product availability, design applications.

Specifications, loads, and philosophies of design

Tension Members: Net areas, effective net area, failure modes (yielding, fracture, block shear and fatigue) for members

and connections in tension

Compression Members : Euler elastic buckling, effective length, inelastic buckling, design of doubly and singly-symmetric sections, local buckling, design of members with slender elements

Beams : Elastic behavior of flexural members, flange and web local buckling, lateral torsional buckling, shear

design, deflections, and local effects (web yielding, web crippling,)

Beam-Columns: Interaction equations, first order vs. second order analysis of elastic structures, moment magnification.

Connections: Types of bolts and welds, design criteria for simple connections, eccentric shear connections.

Class/Laboratory Schedule

Three hours total per week, usually divided into three 50 minute or two 75 minute periods.

Contribution to Criterion 4: Professional Component

This class provides the students with the opportunity to explore both technical and professional issues. Classes often include visits to steel construction sites or fabrication shops, as well as invited lectures by practitioners to give a better feel for real design constraints. Ethical issues are discussed as part of the course, using examples such as the Kansas City Hyatt, Quebec and Tacoma Narrows bridge collapses.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 4090	Capstone Design		X	X			X	X

Person(s) Who Prepared Course Syllabi

Roberto T. Leon, May 2002

CEE 4520: Reinforced Concrete Design, CEE Technical Elective

Catalog Description

Principles of behavior of reinforced concrete beams, short columns, and slabs, with applications to the design of elementary concrete structures, foundation and earth retaining structures. Credit hours: 3-0-3. Prerequisites: CEE 3055.

Textbook(s) and/or Other Required Materials

Textbook: J. MacGregor. "Reinforced Concrete: Mechanics and Design," Prentice Hall, 2001.

Educational Objectives

The course is intended to introduce concepts of mechanics of materials, with emphasis on problem identification, formulation and solution. Students will apply skills learned in statics and mathematics to solve mechanics of solids problems. Students will demonstrate an ability to set up and solve strength of materials problems such as beam bending and stress transformation.

Topics Covered

History, design, and material properties of concrete
 Flexural analysis and design of rectangular beams
 Analysis and design of T-beams
 Shear design of beams
 Behavior and design of short columns
 Serviceability requirements for reinforced concrete structures
 Cracking of concrete
 Development of reinforcement
 On-way slab design
 Introduction to seismic resistant design of reinforced concrete structures

Class/Laboratory Schedule

Three 1 hour lectures (or two 1.5 hour lectures) per week.

Contribution to Criterion 4: Professional Component

This class provides the fundamental background needed to design and analyze reinforced concrete members and structural systems, according the standard code provisions. Students are systematically introduced to the concepts of engineering problem solving, with an emphasis on the synthesis and application fundamental engineering concepts.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 4520	Reinforced Concrete Design		X	X		X		X

Person(s) Who Prepared Course Syllabi

Reginald DesRoches, May 2002

CEE 4530: Timber and Masonry Design, CEE Technical Elective**Catalog Description**

Stress and LRFD based design of tension, compression and flexural members, design of building systems, unreinforced and reinforced walls using timber and masonry construction.

Textbook(s) and/or Other Required Materials

LRFD Manual for Engineered Wood Construction with AF&PA/ASCE16-96 Specification, plus “Supplements”, American Forest and Paper Association, American Wood Council, 1966

Building Code Requirements for Masonry Structures (ACI 530-99/TMS402-99), The Masonry Society, Boulder, Colorado, 1999

Tek Notes, 2-1A, 3-13, 5-7, 14-1, 14-3A, and 14-18, National Concrete Masonry Association, McLean, VA

Educational Objectives

The course is intended to introduce concepts of structural timber and masonry design. Students will apply skills learned in structural analysis and materials to design building structures. Students will demonstrate an ability to set up and solve structural design problems and to building design.

Topics Covered**TIMBER DESIGN**

Timber Material Characteristics
 Loads and Load Paths
 Design of Flexural Members, Bending and Shear Stress
 Compression and Tension Members
 Connections
 Plywood Walls and Roof Diaphragms

MASONRY DESIGN

Masonry Construction - Materials & Techniques
 Building Systems
 Unreinforced Walls
 Reinforced Walls
 One Story Building Design

Class/Laboratory Schedule

Three 1 hour lectures (or two 1.5 hour lectures) per week.

Contribution to Criterion 4: Professional Component

Students individually design building components and in teams design an entire one-story building.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 4530	Timber and Masonry Design	X	X	X		X	X	X

Person(s) Who Prepared Course Syllabi

Lawrence F. Kahn, May 2002

CEE 4550: Structural Analysis II, CEE Technical Elective**Catalog Description**

Analysis of two- and three-dimensional statically indeterminate structures by classical and matrix methods of solution. Flexibility and stiffness techniques, influence lines, approximate analysis, and nonlinear analysis. Credit hours: 3-0-3. Prerequisite: CEE 3055

Textbook(s) and/or Other Required Materials

Textbook: K. M. Leet and C.M. Uang. "Fundamentals of Structural Analysis", McGraw Hill, 2002.

Educational Objectives

The course is intended to teach undergraduates and first year graduate students the fundamentals of structural analysis for indeterminate structures using classical and matrix methods of solution. This course builds on material presented in the first structural analysis course. Students will demonstrate an ability to solve two- and three-dimensional trusses and frames using a variety of solution methods including computer solutions. Students will also design, build, and demonstrate an experiment which demonstrates structural behavior using a model.

Topics Covered

Review of the Flexibility (Superposition) Method and Extension to 3D Structures
Review of the Unit Load (Virtual Work) Method including combined axial, bending, shear, and torsional effects

Slope Deflection & Moment Distribution Methods
Influence Lines for Determinate and Indeterminate Beams & Frames
Discussion of different structural systems and load paths
Introduction to the Stiffness Method
The Direct Stiffness Procedure
Member Stiffness Matrices for Trusses, Beam, and Frames
Coordinate System Transformations
Equivalent Member Loads - Member Fixed End Forces
Assembling and Solving Equilibrium Equations
Computation of Forces and Reactions
Introduction to Nonlinear Analysis
Compression-only/Tension-only & Gap Analysis
Large Sag Cable Analysis
Behavior of Beam-Columns: Interaction of axial and transverse loads

Experimental Project – Design an experiment to demonstrate structural behavior using models and present the experiment to the class

Class/Laboratory Schedule

Three 1 hour lectures (or two 1.5 hour lectures) per week.

Contribution to Criterion 4: Professional Component

This class provides the student with the background needed to solve structural analysis problems using classical and matrix solution methods. Students are systematically introduced to the concepts of structural analysis problem solving, with an emphasis on the application of mathematics, statics, strength of materials, and material from a first course in structural analysis. The role and importance of structural analysis in the process of structural behavior and design are regularly discussed.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 4550	Structural Analysis II		X	X	X			X

Person(s) Who Prepared Course Syllabi

Kenneth M. Will, June 2002

CEE 4600: Transportation Planning, Operations and Design, CEE Breadth Elective**Catalog Description**

Introduction to transportation engineering with specific emphasis on the planning, design, and operation of transportation facilities. Credit hours: 2-3-3. Prerequisites: CEE 3000 and CEE 2010.

Textbook(s) and/or Other Required Materials

Textbook: P. H. Wright. "Highway Engineering," Wiley, 1996.

Educational Objectives

The course is intended to introduce concepts of transportation engineering to a level where students understand the engineering process necessary to successfully complete a transportation project. As a result, objectives of the class are to provide students with an overview of planning, design, and construction techniques for streets and highways. Laboratory exercises provide direct application of design principles introduced in the classroom to a realistic transportation design project. The students have an opportunity to demonstrate problem solving skills. They are also required to write a project report and give an oral presentation.

Topics Covered

General Traffic Engineering Terms (Level of Service, Capacity, and Demand)
 Optimal Improvement Corridor Selection
 Basic Roadway Elements and Alignment Issues
 Stopping and Passing Sight Distance, Intersection Sight Distance
 Horizontal Geometry Design (Circular Curves, Spirals, Stationing, etc.)
 Superelevation
 Vertical Curvature Design
 Roadside Design
 Cross-Section Design
 Earthwork Computations & Estimates
 Roadway / Roadside Drainage Design
 Traffic Operations
 Traffic Control Devices
 Safe Intersection Design
 Traffic Conflicts
 Pavement Design
 ITS Overview

Class/Laboratory Schedule

Two one-hour lectures per week and one three-hour lab per week.

Contribution to Criterion 4: Professional Component

This class focuses on fundamental design components necessary to understand how to develop a complex transportation infrastructure. Students must incorporate engineering problem solving, they must work as a team to complete a term design project, they must provide incremental submittals (consistent with professional requirements), and they must prepare and provide both a written and oral presentation of their work.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 4600	Transportation Planning, Operations, and Design	X	X	X		X		X

Person(s) Who Prepared Course Syllabi

Karen K. Dixon, May 2002

CEE 4610: Multimodal Transportation Planning, Design, and Operations, CEE Technical Elective**Catalog Description**

Planning, design, and operation of systems of air, rail, water, and highway facilities, including those for bicycles and pedestrians. Credit hours: 3-0-3. Prerequisites: CEE 4600

Textbook(s) and/or Other Required Materials

Textbook: Paul H. Wright & Norman J. Ashford. "Transportation Engineering, 4th Edition." Wiley, 1998.

Educational Objectives

The course is intended to provide an overview of available transportation systems and introduce planning and design issues for each unique system.

Topics Covered

Bicycle & Pedestrian Safety

Bicycle & Pedestrian Design & Operations

Transportation Planning Overview (4-step method, Assessments, etc.)

Transit (Queuing estimation, station issues, corridor selection)

Airports – Airside Design (Runways, Taxiways, Aprons, Instrument Landing Systems)

Airports – Landside Design (Parking facilities, access to terminals and circulation, terminal design)

Traffic Engineering (General Focus is Safety applications traffic engineering)

Docks, Ports, & Harbors Design & Operation

Class/Laboratory Schedule

Three one-hour lectures per week

Contribution to Criterion 4: Professional Component

This class focuses on fundamental design issues for all modes of transportation with particular emphasis in interaction of the modes and connectivity issues between the modes. Basic design and operational analysis must be performed by the students on an individual basis.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 4610	Multimodal Transportation Planning, Design, and Operations	X	X	X				X

Person(s) Who Prepared Course Syllabi

Karen K. Dixon, May 2002

CEE 4620: Environmental Impact Assessment, CEE Technical Elective

Catalog Description

Key policy, planning, and methodological issues in the environmental impact assessment of engineering systems including the regulatory framework and analytical techniques. Credit hours: 3-0-3.

Textbook(s) and/or Other Required Materials

Undetermined at this time.

Educational Objectives

The course is intended to introduce the complex process required to assure that infrastructure improvements compliment the environment and minimize adverse impacts on the environment.

Topics Covered

Finding of No Significant Impact
Environmental Assessment Reports
United States policy issues
Governmental regulation and procedures
Corridor assessment and evaluation
Mitigation of environmental impacts

Class/Laboratory Schedule

Three one-hour lectures per week.

Contribution to Criterion 4: Professional Component

This class focuses on critical issues essential to understand the ethical responsibilities of the engineer in assuring safe infrastructure improvements complimenting the natural environment.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 4620	Environmental Impact Assessment	X	X	X		X	X	X

Person(s) Who Prepared Course Syllabi

Karen K. Dixon, June 2002

CEE 4630: Computer-Aided Site and Roadway Design, CEE Technical Elective**Catalog Description**

Site development principles and application to a comprehensive design project using computer-based digital terrain model software tools. Credit hours: 2-3-3. Prerequisites: CEE 4600 and CEE 1770 (or comparable)

Textbook(s) and/or Other Required Materials

No textbook for this class. Students are required to download course pack notes from class web site.

Educational Objectives

The course is intended to introduce general design and layout of sites, intersections, and highways; apply government regulations similar to those in use by county agencies; and develop strong computer-aided skills in coordinate geometry.

Topics Covered

Initiating a Design Process
 Basic project customization
 Commercial Site Development Fundamentals
 Residential Site Development Fundamentals
 Roadway Design for Local Roads
 Digital Terrain Modeling
 Setbacks, Easements, Lots, and Plats
 Cross Sections, pipe networks for sanitary sewer systems
 Design storm sewer systems including the concept of street spread
 Consultant versus County/City representative's perspective

Class/Laboratory Schedule

One two-hour lecture per week, one three-hour lab per week.

Contribution to Criterion 4: Professional Component

This class focuses on fundamental design issues for site development with an emphasis on computer applications to these problems and manual verification of computer generated solutions. Students will perform a comprehensive design project individually.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 4630	Computer-Aided Site and Roadway Design	X	X	X			X	X

Person(s) Who Prepared Course Syllabi

Karen K. Dixon, June 2002

CEE 4795: Groundwater Hydrology, CEE Technical Elective

Catalog Description

Credit Hours: 3-0-3

Prerequisites: MATH 2403, PHYS 2212, EAS 3602 or CEE 3040

Dynamics of water flow and solute transport in the subsurface environment, including case studies, laboratory demonstrations and field trips.

Textbook(s) and/or Other Required Materials

Fetter, C.W. Applied Hydrogeology; 4th Edition, 2001, Prentice-Hall, Inc., New Jersey.

Educational Objectives

The course is designed to provide a theoretical and practical understanding of groundwater hydrology. The course introduces theoretical equations of water flow and solute transport in the vadose and saturated zones, with emphasis on the coupling of flow and transport phenomena. The practical component of the course focuses on hydrologic measurements, including trips to well-instrumented field sites. Students will examine linkages between terms that appear in equations and practical constraints of these measurements in the real-life settings. The coupling of theory, laboratory demonstrations and field measurements is intended to provide students with a comprehensive knowledge of groundwater hydrology and an appreciation for multi-scale heterogeneity.

Topics Covered

Occurrence and Use of Groundwater: Hydrologic cycle, Role and use of groundwater, fundamental parameters, lithology and geologic controls, practical applications (case studies).

Flow Dynamics: Hydraulic head, Darcy's Law, Specific discharge, permeability, scaling, measurement, one-dimensional flow, two-dimensional flow, three-dimensional flow, unsaturated flow.

Flow Analysis and Modeling: Water storage, Theis equation, pump test analysis, phreatic aquifers, boundary conditions, numerical simulation, groundwater modeling.

Contaminant Transport: Water quality, dispersion, sorption processes, convective models, saline intrusion, transport models, tracer tests, field-scale dispersivity, groundwater sampling and analysis.

Class/Laboratory Schedule

Three 1-hour lectures (or two 1.5-hour lectures) per week. Six homework/problem sets, two in-class exams, and a final exam. In-class laboratory demonstrations of measurement techniques used for groundwater parameters: porosity, specific yield, hydraulic conductivity, and dispersion. Mathematical modeling of water flow equations and optimized monitoring well network using MODFLOW. Required field trip to USGS Lawrenceville site and optional field trip to Sapelo Island.

Contribution to Criterion 4: Professional Component

The course is intended to provide students with a fundamental understanding of groundwater flow and contaminant transport in subsurface environments, which can be used to provide safe drinking water sources, preserve environmental quality, and reduce risks to human health (Objective 1). The measurement and mathematical modeling components of the course instill technical skills necessary to characterize and simulate groundwater flow and contaminant transport (Objective 2). Many of the processes presented are multi-disciplinary, founded on physical, chemical and biological principles (Objective 3). In presenting the course material, emphasis is placed on historical development and current scientific advances in measurement techniques and mathematical modeling (Objectives 4 and 5).

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7

CEE 4795	Groundwater Hydrology		X	X	X	X	X	X
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Person(s) Who Prepared Course Syllabi

Kurt D. Pennell, June 2002

CEE 4900: Undergraduate Honors Research Project, CEE Technical Elective

Catalog Description

Individual research projects conducted in conjunction with and under the direction of a CEE faculty member. Participation by invitation and agreement with individual faculty members. Project culminates in a thesis and presentation. Credit hours: To be arranged

Textbook(s) and/or Other Required Materials

None.

Educational Objectives

The course is intended to introduce undergraduates to an independent research or design experience. The class allows the flexibility to work on a wide variety of topics under faculty direction.

Topics Covered

To be arranged.

Class/Laboratory Schedule

To be arranged.

Contribution to Criterion 4: Professional Component

This class allows a student to work independently, providing the opportunity to integrate a wide variety of skills.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 4900	Undergraduate Honors Research Project	X	X	X	X	X	X	X

Person(s) Who Prepared Course Syllabi

Laurence J. Jacobs, May 2002

CEE 4901: Special Problems, CEE Technical Elective

Catalog Description

None. Credit hours: To be arranged

Textbook(s) and/or Other Required Materials

None.

Educational Objectives

The course is intended to introduce undergraduates to an independent research or design experience. The class allows the flexibility to work on a wide variety of topics under faculty direction. Participation by invitation and agreement with individual faculty members.

Topics Covered

To be arranged.

Class/Laboratory Schedule

To be arranged.

Contribution to Criterion 4: Professional Component

This class allows a student to work independently, providing the opportunity to integrate a wide variety of skills.

Relationship to Program Outcomes

Course No.	Title	Program Outcome						
		1	2	3	4	5	6	7
CEE 4901	Special Problems	X	X	X	X	X	X	X

Person(s) Who Prepared Course Syllabi

Laurence J. Jacobs, May 2002