

**UNIVERSITY OF MARYLAND
DEPARTMENT OF
CIVIL AND ENVIRONMENTAL
ENGINEERING
UNDERGRADUATE
CURRICULUM
EFFECTIVE FALL 2003
www.civil.umd.edu**

Introduction

The Department of Civil and Environmental Engineering has approved a new undergraduate curriculum that is described in this document. The new curriculum takes effect beginning Fall 2003 for the incoming Freshmen. The curriculum, which requires the same number of credits as the previous curriculum, has three tracks. The first two years in all tracks are the same. In the junior year, the students will choose one of the three tracks. These include Infrastructure Engineering, Environmental and Water Resources Engineering, and Transportation Systems and Project Management. The current and the proposed curricula are outlined in the links provided below. In the proposed curriculum, the courses titles that are boldfaced represent new courses. For each course in the proposed curriculum an outline of course content is provided.

The courses in the new curriculum are listed in Table 1. Table 1 indicates the tracks in which the courses are part of the track requirement and also the tracks in which they can be taken as electives. The major differences between the existing and the proposed curricula are listed under the proposed schedule for each year. In what follows the courses that fundamentally remain the same are listed in green color. The new courses that are common to all tracks are listed in blue color with *. The new courses that are common to some but not all tracks are listed in pink color with **. Finally the new courses that are only specific to a single track are listed in red color with ***.

Dr. Ali Haghani
Professor and Chair

Table 1
Proposed Curriculum Course Summary

Course Number	Credits Hours	Infrastructure Engineering	Water Resources/ Environmental Engineering	Transportation Engineering/ Project Management
MATH 140	4	R	R	R
MATH 141	4	R	R	R
MATH 241	4	R	R	R
MATH 246	3	R	R	R
PHYS 161	3	R	R	R
PHYS 262	4	R	R	R
CHEM 135	3	R	R	R
ENGL 101	3	R	R	R
ENGL 393	3	R	R	R
CORE	21	R	R	R
BSCI 105	4	-	R	-
ENES 100	3	R	R	R
ENES 102	3	R	R	R
ENES 220	3	R	R	R
ENES 221	3	R	-	-
ENCE 100	1	R	R	R
ENCE 200	3	R	R	R
ENCE 201	3	R	R	R
ENCE 215	3	R	R	R
ENCE 300	3	R	R	R
ENCE 301	3	R	R	R
ENCE 302	3	R	R	R
ENCE 305	3	R	R	R
ENCE 310	3	E	R	E
ENCE 320	3	R	E	R
ENCE 340	3	R	E	E

Table 1 (Continued)
Proposed Curriculum Course Summary

Course Number	Credits Hours	Infrastructure Engineering	Water Resources/ Environmental Engineering	Transportation Engineering/ Project Management
ENCE 353	3	R	E	E
ENCE 355	3	R	E	E
ENCE 360	3	E	E	R
ENCE 361	3	E*	R	R
ENCE 370	3	E	E	R
ENCE 402	3	E	R	R
ENCE 411	3	E	R	E
ENCE 412	3	E	R	E
ENCE 420	3	E	E	E
ENCE 421	3	E	E	E
ENCE 422	3	E	R	R
ENCE 423	3	E	E	R
ENCE 425	3	E	E	E
ENCE 431	3	E	R	E
ENCE 432	3	E	R	E
ENCE 441	3	R	E	E
ENCE 444	3	E*	E	E
ENCE 447	3	E	E	E
ENCE 453	3	E*	E	E
ENCE 454	3	E	E	E
ENCE 455	3	E	E	E
ENCE 456	3	E	E	E
ENCE 466	3	R	R	R
ENCE 470	3	E	E	R
ENCE 472	3	E	E	R
ENCE 488	3	E	E	E
ENCE 489	3	E	E	E
ENCE Electives	9	R	R	R

R Required for the track
E Elective for the track
E* Restricted Elective for the track (see page 12)

CEE CURRICULUM

FRESHMAN All Civil Engineering

SEMESTER I		SEMESTER II	
<u>Course</u>	<u>Credit</u>	<u>Course</u>	<u>Credit</u>
MATH 140	4	MATH 141	4
CHEM 135	3	PHYS 161	3
ENES 100	3	ENES 102	3
ENGL 101	3	CORE	6
	<hr/>		<hr/>
Total	13		16
Total credits for the year		29	
Total cumulative credits	29		
Total core credits for the year		6	
Total cumulative core credits		6	

**SOPHOMORE
All Civil Engineering**

SEMESTER I		SEMESTER II	
<u>Course</u>	<u>Credit</u>	<u>Course</u>	<u>Credit</u>
MATH 241	4	MATH 246	3
PHYS 262	4	ENCE 201*	3
ENES 220	3	ENCE 305*	3
ENCE 200*	3	ENCE 100*	1
ENCE 215*	3	CORE	6
Total	17		16

Total credits for the year	33
Total cumulative credits	62
Total core credits for the year	6
Total cumulative core credits	12

**JUNIOR
Infrastructure Engineering**

SEMESTER I

SEMESTER II

<u>Course</u>	<u>Credit</u>	<u>Course</u>	<u>Credit</u>
ENCE 301*	3	ENCE 302	3
ENCE 353***	3	ENGL 393	3
ENCE Electives	3	ENCE 340***	3
ENCE 300	3	ENCE 355***	3
ENES 221	3	CORE	3
Total	15		15

Total credits for the year	30
Total cumulative credits	92
Total core credits for the year	3
Total cumulative core credits	15

JUNIOR
Transportation Systems and Engineering Management

SEMESTER I

SEMESTER II

<u>Course</u>	<u>Credit</u>	<u>Course</u>	<u>Credit</u>
ENCE 301*	3	ENCE 302	3
ENCE 320**	3	ENCE 360**	3
ENCE 300	3	ENGL 393	3
ENCE 370***	3	ENCE 472***	3
ENCE 361*	3	CORE	3
Total	15		15

Total credits for the year	30
Total cumulative credits	92
Total core credits for the year	3
Total cumulative core credits	15

JUNIOR
Environmental and Water Resources Engineering

SEMESTER I

SEMESTER II

<u>Course</u>	<u>Credit</u>	<u>Course</u>	<u>Credit</u>
ENCE 301*	3	ENGL 393	3
BSCI 105***	4	ENCE 431***	3
ENCE 361*	3	ENCE 402**	3
ENCE 302	3	ENCE 300	3
CORE	3	ENCE 310***	3
Total	16		15

Total credits for the year	31
Total cumulative credits	93
Total core credits for the year	3
Total cumulative core credits	15

**SENIOR
Infrastructure Engineering**

SEMESTER I		SEMESTER II	
<u>Course</u>	<u>Credit</u>	<u>Course</u>	<u>Credit</u>
ENCE 320**	3	ENCE 466*	3
ENCE Electives	3	ENCE Electives	6
ENCE Restricted Electives	3	ENCE Restricted Electives	3
ENCE 441***	3		
CORE	3	CORE	3
Total	15		15

Total credits for the year	30
Total cumulative credits	122
Total core credits for the year	6
Total cumulative core credits	21

ENCE Restricted Electives to be taken from the following list:

- ENCE 361
- ENCE 444
- ENCE 453

SENIOR
Transportation Systems and Engineering Management

SEMESTER I

SEMESTER II

<u>Course</u>	<u>Credit</u>	<u>Course</u>	<u>Credit</u>
ENCE 423***	3	ENCE 466*	3
ENCE Electives	6	ENCE 422**	3
ENCE 470***	3	ENCE Electives	3
CORE	3	ENCE 402**	3
	-----	CORE	3
Total	15		15

Total credits for the year	30
Total cumulative credits	122
Total core credits for the year	6
Total cumulative core credits	21

SENIOR
Environmental and Water Resources Engineering

SEMESTER I

SEMESTER II

<u>Course</u>	<u>Credit</u>	<u>Course</u>	<u>Credit</u>
ENCE 411***	3	ENCE 466*	3
ENCE 432***	3	ENCE 422**	3
ENCE Electives	6	ENCE Electives	3
CORE	3	ENCE 412***	3
	3	CORE	3
Total		Total	
	15		15

Total credits for the year	30
Total cumulative credits	123
Total core credits for the year	6
Total cumulative core credits	21

**PROPOSED COURSE OUTLINES
FOR THE NEW COURSES**

ENCE 100

Introduction to Civil Engineering (1 Credit)

1 hour lecture

Prerequisites

Admission to Undergraduate Engineering

Course Description

The roles of civil and environmental engineers in meeting the goals of society are introduced. Specialties within civil and environmental engineering are detailed, including curricular alternatives.

Course Topics

- Engineering Project Management
- Environmental Engineering
- Geotechnical Engineering
- Structural Engineering
- Transportation Engineering
- Water Resources Engineering
- Civil and Environmental Engineering Curriculum Tracks

ENCE 200

Engineering Information Processing I (3 Credits)

3 hours lecture

Prerequisites

MATH 141; ENES 100; ENES 102

Course Description

Spreadsheet and computational / symbolic processing packages are introduced in the context of solving engineering problems, including systems of linear equations. Computer architecture, networks, Boolean algebra, databases, and introductory programming skills.

Course Topics

- Introduction to computing
- Operating systems and languages – compiled vs. interpreted
- Networks and the World Wide Web
- File types – ASCII, binary, etc.
- Retrieving information from the web (search engines, plug-ins, FTP, etc.)
- HTML, text editors, and web page builders
- Spreadsheet calculations – stress advanced functions and capabilities
- Pseudo-code, flowcharts
- How to write, compile, and execute simple programs in a relatively “modern” language – examples are Matlab, Java, C, Visual Basic
- Boolean algebra, logical operators, program flow
- Integration of web and other applications
- Introduction to databases

ENCE 201

Engineering Information Processing II (3 Credits)

3 hours lecture

Prerequisites

ENCE 200

Course Description

Matrix algebra and numerical computing. Includes computing accuracy, solutions of systems of linear equations, root-finding, function approximation, and numerical integration. Additional computing material including data types and structures, object-based programming, event-based programming, and client-server computing. Numerical and computing techniques are taught in the context of solving engineering problems.

Course Topics

- Basic matrix theory and operations
- Systems of linear equations, graphical interpretation, direct solution methods, ill-conditioning, Gauss elimination
- Data types – strings, characters, Boolean, various numeric formats
- Data structures – lists, structures, arrays
- Numerical computing – computer representation of integer and floating point numbers, accuracy and precision, roundoff error, catastrophic roundoff, conditioning
- Function approximation – Taylor series, error terms, convergence
- Root-finding – bisection method, false-position method, Newton-Raphson
- Numerical integration – trapezoidal and Simpson's rules
- Object-based programming – objects, pointers, memory allocation, encapsulation, inheritance
- Event-based programming – models of event handling, event masking
- Client-server computing – basic database concepts, distributed computing, application programming interfaces (APIs)

ENCE 215
Applied Engineering Sciences (3 Credits)
3 hours lecture

Prerequisites

CHEM 135

Course Description

Examination of fundamental and applied aspects of chemistry, biology, and geochemistry. Fundamental principles will be coupled with analytical and computational skills essential for addressing crucial processes on human impact on the environment and urban infrastructure. Applications to the development of new materials and technologies will be covered in case studies. Students should come out with an appreciation of how understanding the fundamental concepts could facilitate the development of technologies to mitigate human impact on the environment.

Course Topics

- Introduction
- Stoichiometry
- Thermodynamics
- Mass and Energy Balances
- Chemical Reactions
 - Acid-base Reactions
 - Precipitation-Dissolution Reactions
 - Redox Reactions
- Phase transfer processes
- Soil composition and geo-chemical processes
- Air composition and air pollution
- Chemical kinetics
- Applications to risk analysis
- Case Studies

ENCE 301

Geo-Metrics and GIS in Civil Engineering (3 credits)

3 hours lecture

Prerequisites

ENCE 200; ENCE 201

Course Description

The purpose of this course is to have students develop skills in using GIS technology to solve a range of problems in Civil and Environmental Engineering. The course begins with a rigorous unit on the basics of database organization and use. The course then presents GIS concepts emphasizing the linkage between a standard relational database and the spatially-referenced database underlying the GIS. Both raster and vector data models are presented and used in a variety of natural applications to Civil and Environmental Engineering. Students are also exposed to scripting which aids in the development of more elaborate analyses and reinforces object-oriented programming concepts learned in ENCE 200/201.

Course Topics

- Database Fundamentals
 - What is a database?
 - Building a simple database
 - Boolean Algebra
 - Performing Searches – Standard Query Language
- GIS Fundamentals
 - What is a Geographic Information System?
 - Projections, Coordinate Systems, and Datums
 - Data Types in GIS – raster and vector data models
 - Creating/Modifying GIS Data
 - Obtaining/Interpreting GIS data from the Web
 - Performing Spatial Queries
 - Multi-Layer Computations and Masking
- Geo-Metric Fundamentals
 - What are Geo-Metrics?
 - The Global Positioning System (GPS)
 - Distances
 - Areas
 - Volumes

ENCE 305

Fundamentals of Engineering Fluids (3 credits)

3 hours lecture

Prerequisites

ENES 220; PHYS 262

Course Description

The theoretical bases for fluid statics and dynamics, including the conservation of mass, energy, and momentum. Modeling of hydraulic systems are introduced. Emphasis on pipe flow and open-channel hydraulics, with real-world applications.

Course Topics

- Properties of Fluids
- Fluid Statics
- Energy Considerations – Bernoulli's Equation
- Forces and Momentum in Fluid Flow
- Steady Incompressible Flow in Pressure Conduits
- Dimensional Analysis and Similitude
- Flow in Open Channels

ENCE 310

Introduction to Environmental Engineering (3 credits)

3 hours lecture

Prerequisites

PHYS 262; ENCE 215

Course Description

Introduction to the physical, chemical, and biological systems relating to the quality of water, land and air environments. Fundamental principles will be emphasized, current environmental pollution problems will be examined and methods of pollution abatement discussed.

Course Topics:

- Introduction
- Scientific Fundamentals
 - Environmental Chemistry
 - Environmental Microbiology
- Engineering Fundamentals
 - Engineering Decisions
 - Material Balances and Separations
 - Reactions and Reactor Engineering
- The Environment and Current Environmental Problems
 - Hydrosphere
 - Atmosphere
 - Biosphere
- Environmental Engineering Applications for Pollution Abatement
 - Water Supply and Treatment
 - Stream Response to Waste Discharges
 - Wastewater Treatment
 - Air Pollution Control
 - Solid Wastes
 - Hazardous Wastes
 - Waste Minimization; Pollution Prevention

ENCE 360***Analysis of Civil Engineering Systems (3 Credits)***

3 hours lecture

Prerequisites

ENCE 200; ENCE 201

Course Description

Introduction to systems approach and systems analysis in civil and environmental engineering. Introduction to systems analysis tools that facilitate engineering management decision making including optimization and computer simulation. Introduction to linear and nonlinear mathematical optimization including linear and integer programming, elementary nonlinear programming and dynamic programming.

Course Topics

- Systems Approach and Systems Analysis
- Deterministic Modeling and Optimization
- Linear Programming Formulation and Solution
- Network Problems
- Integer Programming, Formulation and Solution
- Dynamic Programming
- Introduction to Nonlinear Programming
- Computer Simulation

ENCE 361

Applied Numerical Techniques (3 Credits)

3 hours lecture

Prerequisites

MATH 140; ENCE 201

Course Description

Finalize the preparation of our students to do numeric computing on their own in later courses. Linear algebra and numerical methods, curve fitting, interpolation, and systems of nonlinear equations, ordinary and partial differential equations and their applications to civil engineering problems.

Course Topics

- Review of derivatives and integrals
- Linear algebra – Gauss- Jordan elimination, pivoting, conditioning, L/U decomposition, Gauss-Seidel, convergence criteria.
- Root-finding – convergence/ divergence, secant method
- Numerical integration – Riemann sums, Gauss-Legendre quadrature.
- Numeric differentiation, finite difference equations.
- Curve –fitting – least squares regression (matrix form)
- Interpolation–linear, polynomial, cubic splines, Fourier series, Bezier curves.
- Systems of nonlinear equations, fixed point iteration, Newton’s methods.
- Review of differential equations
- Ordinary differential equations – Euler’s method, Runge-Kutta methods
- Partial differential equations – finite difference schemes and Runge-Kutta
- Eigenvalues and eigenvectors.

ENCE 402

Simulation and Design of Experiments for Engineers (3 Credits)

3 hours lecture

Prerequisites

ENCE 302

Course Description

Review of statistics and hypothesis testing, sample design and design of experiments, generation of discrete and continuous distributions and their application. Introduction of simulation languages and simulation of discrete and continuous engineering systems. Output analysis, model validation and sensitivity and reliability analysis.

Course Topics

- Fundamental Statistics (e.g., Hypothesis Testing, Confidence Interval)
- Design and Formulation of Experimental Hypotheses
- Design of Sampling Strategies (Random, Stratified, Systematic, and Cluster Sampling Methods)
- Estimation of Sample Size and Sampling Errors
- Analysis of Experimental Results (Parametric and Non-parametric Analyses)
- Generation of Discrete and Continuous Distributions
- Introduction of Simulation Languages
- Simulation of Discrete Engineering Systems (e.g., Monte Carlo Method)
- Simulation of Continuous Engineering Systems (e.g., Using Differential or Difference Equations)
- Simulation Output Analysis
- Simulation Model Validation and Variance Reduction Methods
- Sensitivity and Reliability Analysis

ENCE 411

Environmental Engineering Science (3 credits)

2 hours lecture, 3 hours lab

Prerequisite

ENCE 310

Course Description

The basic physical, chemical, and biological processes that occur in engineered and natural environmental systems will be discussed. Included will be presentation of parameters used to describe the quality of water, air, and land. Measurement techniques will be discussed. A weekly lab will provide hands-on experience with environmental quality measurements and treatment techniques.

Course Topics

- Introduction to Environmental Engineering Science
- Physical Aspects
 - Water, wastewater, and air analysis-TSS, TDS, FOG, PM
 - Beer Lambert, color, and turbidity
 - Colloids and particles
- Chemical Aspects
 - Chemical equilibria and stoichiometry, THOD, COD
 - Acid-Base
 - Alkalinity
 - Liquid/Solid Equilibria (Precipitation and Solubility)
 - Liquid/Liquid and Liquid/Gas Equilibria
 - Redox Chemistry
 - Advanced instrumentation and trace analyses
- Biological Aspects
 - Microbiology
 - Population Dynamics
 - Microbial growth and Yield
 - Pathogens and Pathogen destruction, disinfection
 - BOD, toxicity
- Risk and Risk Assessment

ENCE 412

Environmental Engineering Unit Operations (3 Credits)

3 hours lecture

Prerequisite

ENCE 305, ENCE 310

Course Description

Examination of unit operations and processes encountered in environmental engineering field. Fundamental principles learned from previous classes will be applied into the design and operation of unit operations/processes, particularly in the area of water and wastewater treatment. Similar processes will be applied to air pollution control, solid waste disposal and hazardous waste treatment.

Course Topics

- Introduction
- Engineering Fundamentals
- Unit Processes and Operations
 - Coagulation
 - Separation (flotation, sedimentation and membrane)
 - Adsorption/Ion Exchange
 - Absorption/Extraction
 - Oxidation/Reduction
 - Biological Systems
- Engineering Applications

ENCE 444

Laboratory Characterization of Geomaterials (3 Credits)

1 hour lecture and 4 hours lab

Prerequisite

ENCE 340

Course Description

Review of major soil tests and their interpretation for engineering purposes. Engineering classification tests (Atterberg limits and grain size distribution), permeability, in-situ and lab density-moisture test, soil strength (CBR, unconfined compression, direct shear test and triaxial) and compressibility characteristics.

Course Topics

- Atterberg limits
- Compaction
- Relative Density
- Field Density
- CBR
- Unconfined Compression
- Direct Shear
- Triaxial Testing
- Consolidation
- Soil Permeability

ENCE 447

Pavement Engineering (3 Credits)

3 hours lecture

Prerequisite

ENCE 340

Course Description

Fundamental principles underlying the design, construction, maintenance and repair, and management of highway and airfield pavement systems. Pavement performance (functional/structural; evaluation); pavement mechanics (multi-layered elastic theory; slab theory); pavement materials (properties and characterization); environmental effects; current rigid and flexible design methods (new/rehabilitation); construction (new construction; maintenance/repair; rehabilitation); economic evaluation; pavement management.

Course Topics

- Introduction; Pavement Infrastructure
- Overview of Pavement Design
- Pavement performance
- Pavement mechanics: flexible pavements
- Pavement mechanics: rigid pavements
- Pavement materials
- Pavement design
- Rehabilitation
- Construction
- Pavement management

ENCE 456

Intermediate Strength of Materials (3 Credits)

3 hours lecture

Prerequisites

ENCE 353

Course Description

The small deflection engineering theory of long, straight beams with arbitrary but compact cross-sections. Beam bending and extension via the Bernoulli-Euler approximation. Beam torsion from the theory of elasticity and the membrane analogy. Beam shearing stresses.

Course Topics

- The six stresses, and the beam stress resultant in terms of those stresses
- The Bernoulli-Euler approximation leading to the axial stress in terms of the axial force and bending moments, and temperature changes
- Calculation of beam cross-sectional properties and equivalent thermal loads
- The non-linear beam equilibrium equations and the resulting beam bending and extension boundary value problems
- Elastic foundations, the Dirac delta function for concentrated loads
- Euler buckling including imperfections
- Uniform torsion via Prandtl's theory of elasticity solution
- The membrane analogy and its use of exact solutions to approximate open and closed beam cross-section solutions for uniform torsion
- Non-uniform torsion
- Beam shearing stresses in thin walled, open and closed beam cross-sections

**PROPOSED COURSE OUTLINES
FOR THE REVISED COURSES**

ENCE 300***Fundamentals of Engineering Materials (3 Credits)***

2 hours lecture, 2 hours lab

Prerequisites

ENES 220

Course Description

Behavior, physical, mechanical, and chemical properties, design and performance of civil engineering materials, including aggregates, cement, concrete, asphalt binders and mixtures, plastics and geosynthetics, timber, metals and alloys. Modified and advanced highway materials (polymer and rubber modified mixtures, high performance concrete, composites, smart materials). Laboratory testing with hands-on experience on aggregates, Portland cement concrete, asphalt mixtures, timber, and metals as per SUPERPAVE, ACI design methods, and ASTM standards and specifications.

Course Topics

- Cost and Availability of Materials
- Material Behavior and Constitutive Models
- Aggregate Characteristics
- Concrete/Cement-based Materials
- Asphalt Binders and Mixtures (SUPERPAVE)
- Timber
- Metals and Alloys
- Plastics & Geosynthetics
- Reclaimed/Recycled Waste Products and Environmental Impact
- Modified and Improved Highway Materials (polymer and rubber modified mixtures, high performance concrete, composites, smart materials)

ENCE 302

Probability and Statistics for Civil & Environmental Engineers (3 Credits)

3 hours lecture

Prerequisites

ENCE 201; MATH 246

Course Description

Statistics is the science of data. Civil Engineers must often make decisions based on incomplete, variable, or uncertain information. In addition, modern methods of design and analysis need to account for variability in natural, engineered, and human systems. After successful completion of this class, a student should have facility and familiarity with established basic techniques for managing data, modeling variability and uncertainty, communicating about data and decisions, and supporting or defending a decision or judgment based on uncertain or incomplete data.

Course Topics

- Database Fundamentals
- Introduction: Why Stats? Why Probability? Uncertainty in engineering
- Data Description and Treatment
 - Graphical methods
 - Summary statistics
 - Obtaining (downloading) and manipulating digital data sets
- Fundamentals of Probability
 - Uncertainty and Events
 - Mathematics of Probability
 - The concept of a random variable and moments
- Discrete Random Variables
- Continuous Random Variables
 - The Normal Distribution and its importance
- Multiple Random Variables
 - Correlation
- Sampling and Simulation
- Fundamentals of Statistical Analysis
 - Estimation and Confidence Intervals
 - Hypothesis Testing
 - Sample Size Determination
- Least Squares Principle
- Linear Regression
- Multiple Regression

- Nonlinear Regression

ENCE 320

Engineering Project Management (3 Credits)

3 hours lecture

Prerequisites

Permission of Department

Course Description

This course presents the principles and techniques of managing engineering and construction projects from the conceptual phase, through design and construction, to completion and close out. Students will develop the analytical skills and awareness necessary on the management side of engineering projects. Topics include project initiation, estimating, budgeting, developing work plans, scheduling, tracking work, design coordination, construction coordination, quality management, managing teams and close out.

Course Topics

- Principles and techniques of managing engineering and construction
- Project initiation
- Estimating
- Budgeting
- Developing work plans
- Scheduling
- Tracking work
- Design coordination
- Construction coordination
- Quality management
- Managing teams
- Close-out

ENCE 340

Fundamentals of Geotechnical Engineering (3 Credits)

3 hours lecture

Prerequisites

ENES 220; ENCE 210

Course Description

Introductory study of soils in civil engineering. Soil origin, phase relationships and classification schemes. Soil hydraulics: capillary, effective stress, permeability and seepage considerations. Basic stress distribution theories and soil consolidation-settlement analysis. Integration of shear strength evaluation with slope stability analysis. If time permits, topics such as applications in geoenvironmental engineering will be covered.

Course Topics:

- Soil Genesis, Soil Composition and Classification
- Flow of Water in Soils
- Effective Stress, Basic Stress Distribution Theories
- Compressibility and Settlement
- Shear Strength
- Geoenvironmental Engineering

ENCE 353

Introduction to Structural Analysis (3 credits)

3 hours lecture

Prerequisites

ENCE 220, MATH 246

Course Description

The basic tools of structural analysis and design. Design loads. Equilibrium of external and internal forces. Shear and moment diagrams in beams and frames. Truss analysis. Influence line diagrams. The slope-deflection method and method of consistent deformation. Matrix stiffness methods for beams, frames and trusses.

Course Topics

- Origins and descriptions of loads acting upon civil engineering structures
- Review static determinacy, stability, and the calculation of support reactions
- Review of bar forces in determinate, pin jointed trusses
- Review shear and bending moment diagrams for beams and planar trusses
- Influence line diagrams
- The slope deflection method and method of consistent deformation
- Review of the origins and uses of the second order beam bending differential equation
- Generalized coordinates for beam segments, and shear forces and bending moments in terms of those lateral deflections and bending slopes
- Parallel derivation of the beam bending stiffness matrix using the principle of virtual work, and the brief derivation of stiffness matrices for beam extension and twisting
- Matrix methods of analysis for structures composed of beam, bar, and spring finite elements
- Matrix methods of analysis for planar trusses using rotated bar elements

ENCE 355

Introduction to Structural Design (3 Credits)

3 hours lecture

Prerequisites

ENES 220; ENCE 300

Course Description

Design of structural members for buildings and bridges subjected to tensions, compression, shear and bending. Materials: structural steel and reinforced concrete. Design of welded and bolted connections. Placement of reinforcing bars in concrete members.

Course Topics

- Loads and load combinations
- Concepts of limit state and allowable stress design
- Design of concrete members for shear, bending and axial force
- Reinforcement details
- Design of steel members for shear, bending and axial force
- Design of connections

ENCE 370

Introduction to Transportation Engineering and Planning (3 Credits)

3 hours lecture

Prerequisites

ENCE 201; PHYS 262

Course Description

Engineering problems of transportation by highways, airways, pipelines, waterways, and railways. Transportation modes and technologies, vehicle dynamics, basic facility design, traffic stream models, capacity analysis, transportation planning, evaluation and choice, and network analysis.

Course Topics:

- Transportation modes & technology
 - Characteristics
 - Physics of vehicle motion
- Geometric design
 - Roads, railways, airport runways
- Vehicular flow models
- Capacity analysis
 - Basic freeway segments
 - Signalized intersections
- Transportation planning
 - Trip generation
 - Trip distribution
 - Mode choice
 - Assignment
- Evaluation and choice
- Transportation network analysis

ENCE 420

Construction Equipment and Methods (3 Credits)

3 hours lecture

Prerequisite

ENCE 320 or equivalent

Course Description

Evaluation and selection of equipment and methods for construction of projects, including earthmoving, paving, steel and concrete construction, formwork, trenching, cofferdams, rock excavation, tunneling, site preparation and organization. Design of formwork, trench supports, and cofferdams.

Course Topics

- Construction economics and contracts
- Planning process for equipment and methods
- Equipment cost
- Engineering fundamentals of moving earth
- Tractors, scrapers, and cranes
- Excavating equipment
- Trucks and wagons
- Compaction and soil stabilization
- Belt-conveyer systems
- Compressed air
- Drilling rock and earth
- Blasting rock
- Piles and pile-driving equipment
- Pumping equipment
- The production of crushed-stone aggregate
- Concrete
- Asphalt mix production and placement.

ENCE 421

Engineering Contracts (3 Credits)

3 hours lecture

Prerequisite

ENCE 320 or equivalent

Course Description

This course presents what constitutes a contract; the different types and variations of basic contracts such as fixed price, cost reimbursable, time & materials, design-build, design-bid-build, CM at risk; the differences between a GMP, lump sum and cost plus type contracts; the differences between government contracts (key FAR clauses), and industry models such as AIA, AGC, DBIA's etc.; discussion on conflict management strategies, resolving disputes, claim notification, and purchase orders; the types of scopes of work; special conditions; terms & conditions; solicitation planning; procurement documents; source selection; negotiation; letters of intent; non-competitive forms of procurement; contract administration; and the essentials of employment law as it affects individuals, performance appraisals, diversity in the workplace, and interview protocols.

Course Topics

- Basic Contract Types
- Contract Organization by Type
- Standard Clauses
- Key Attributes
- Roles of the Parties
- Contract Administration
- Change Orders
- Requests for Information
- Vendor Submittals
- Subcontracts
- Employment Law Basics
- Diversity
- Performance Appraisals
- Interview Protocols

ENCE 422***Project Cost Accounting & Economics (3 Credits)***

3 hours lecture

Prerequisites

ENCE 201 or equivalent; ENCE 320 or equivalent

Course Description

Effective project managers have complete command of their project costs. This course: reviews the fundamentals of accounting; examines project cost accounting principles, applications, and impact on profitability; examines the principles of activity based costing; covers the elements involved in cash management; introduces the framework for project performance measurement, net present value, depreciation, taxes, and earned value analysis.

Course Topics

- Fundamentals of accounting
- Project cost accounting
- Reading financial statements
- Profitability
- Activity based Costing
- Cash management
- Earned value analysis
- Performance measurements such as Cost Performance Index
- Cash flow analysis
- Net Present Value analysis
- Time value of money and interest rate
- Depreciation and taxes
- Pricing options

ENCE 423***Project Planning, Scheduling & Control (3 Credits)***

3 hours lecture

Prerequisites

ENCE 302 or equivalent; ENCE 320 or equivalent

Course Description

Students will learn the basics of project planning and scope development; developing implementation plans; creating work breakdown structures; scheduling fundamentals and the different methods of scheduling; when to schedule, why network schedules and the network diagram; scheduling calculations and the critical path; managing project risk; and the fundamentals of project control including basic control theory and how to control project cost, schedule, and resources.

Course Topics

- Project screening and selection
- Multiple criteria methods for project evaluation
- Project scheduling via CPM and PERT
- Learning effects in project scheduling
- Project budgeting
- Managing budget via activity crashing
- Resource management including resource leveling
- Life-cycle costing
- Earned Value analysis
- Project control techniques

ENCE 425

Decision Analysis for Engineering (3 Credits)

3 hours lecture

Prerequisites

ENCE 302 or equivalent; MATH 141 or equivalent

Course Description

Probability basics, subjective probability, using data, introduction to decision analysis, elements of decision problems, structuring decisions, making choices, sensitivity analysis, creativity and decision-making, Monte Carlo simulation, value of information, risk-based decision making, multi-criteria ranking.

Course Topics

- Probability basics
- Subjective probability
- Time value of money (net present value)
- Theoretical probability models
- Using data
- Introduction to decision analysis
- Elements of decision problems
- Structuring decisions
- Decision Trees
- Influence diagrams
- Sensitivity analysis
- Monte Carlo simulation
- Value of information
- Risk attitudes
- Stochastic dynamic programming

ENCE 431

Hydrologic Engineering (3 Credits)

3 hours lecture

Prerequisite

ENCE 305

Course Description

An introduction to basic principles of hydrologic science including the hydrologic cycle, rainfall, surface runoff, and stream flow. Special emphasis is placed on hydrologic engineering design of stormwater management and flood control facilities. Design projects are used to illustrate design practices.

Course Topics

- The Hydrologic Cycle
- Flood Frequency Analysis
- Watershed Characteristics
- Rainfall
- Peak Discharge Estimation
- Drainage Design
- Stormwater Management
- Hydrograph Analysis
- Channel and Reservoir Routing
- Surface Erosion

ENCE 432

Ground Water Hydrology (3 Credits)

3 hours lecture

Prerequisite

ENCE 305

Course Description

Concepts related to the development of the ground water resources, hydrology, hydrodynamics of flow through porous media, hydraulics of wells, and basin-wide ground water development. Fundamentals of ground water pollution are introduced.

Course Topics

- Physical properties of porous media
- Ground Water Movement in Confined and Unconfined Aquifers
- Steady and Transient Flow Equations
- Flow to Wells and Aquifer Testing
- Introduction to Contaminant Transport
- Elements of soil and aquifer remediation

ENCE 441

Foundation Design (3 Credits)

3 hours lecture

Prerequisite

ENCE 340

Course Description

Critical review of classical lateral earth pressure theories, analysis of retaining walls and reinforced earth walls, subsurface explorations, bearing capacity and settlement of shallow foundations, design of deep foundations that includes both pile foundations and drilled shafts.

Course Topics

- Geotechnical Properties of Soil
- Lateral Earth Pressure
- Retaining Walls
- Reinforced Earth Structures
- Subsurface Exploration
- Bearing Capacity
- Foundation Settlement
- Soil Improvement
- Pile Foundation Capacity
- Pile Group Action
- Drilled Shaft Capacity
- Drilled Shaft Settlement

ENCE 466
Design of Civil Engineering Systems (3 Credits)
3 hours lecture

Prerequisites

Permission of Department

Course Description

A major civil engineering design experience that emphasizes development of student creativity, development and use of design methodologies, evaluation of alternate solutions, feasibility considerations, and detailed system descriptions. Realistic design constraints including economic factors, safety, aesthetics, and reliability will be imposed. Students will work in design project groups and be required to exercise oral and written communication skills.

ENCE 470

Highway Engineering (3 Credits)

2 hours lecture, 2 hours lab

Prerequisites

ENCE 302; ENCE 370

Course Description

Highway location and design, highway engineering economics, traffic engineering, traffic measurement devices and technologies. Includes discussion of technological advances in traffic flow and capacity, such as signal systems, corridor control, automatic driver information, incident detection, and autonomous vehicle operation.

Course Topics

- Highway geometric design
 - Route selection
 - Horizontal alignment design – circular arcs, clothoid spirals
 - Vertical alignment design
 - Earthwork
 - Sight distance and clear zone
- Economics
 - Cost and benefit estimation
 - Decision-making
- Traffic engineering
 - Traffic stream variables and measurement
 - HCM – two-lane highways, unsignalized intersections, weaving sections
 - Actuated traffic signals
- Measurement devices
 - Inductive loop detectors
 - Radar, microwave, lidar
 - Video imaging
 - Area-wide surveillance
- ITS flow and capacity improvements
 - Signal systems
 - Corridor control
 - Driver information dissemination
 - Incident detection and response
 - Autonomous vehicle operation
 - Vehicle-highway automation

ENCE 472

Transportation Engineering (3 Credits)

3 hours lecture

Prerequisites

ENCE 302; ENCE 370

Course Description

Transportation engineering concepts including transportation systems analysis, airport systems, airline and airport operations, marine transportation, and urban public transportation systems.

Course Topics

- Transportation Systems Analysis
- Urban Public Transportation Systems
- Railroad Engineering and Operation
- Air Transportation
- Airport Engineering
- Marine Transportation
- Port Engineering
- Inland Waterway Transportation

**COURSE OUTLINES FOR THE
EXISTING COURSES**

(Information Only)

ENCE 453

Computer Aided Structural Analysis (3 Credits)

3 hours lecture

Prerequisites

ENCE 353

Course Description

Computer-aided analysis of structural systems. Unified matrix formulation of stiffness and flexibility methods. Slope deflection method. Evaluation of truss, frame, and grid systems. Non-prismatic and curved elements. Error analysis and determination of ill-conditions. Introduction to finite element methods; formulation of simple two-dimensional elements. In laboratory, use and development of CAD software. Restricted to students in the College of Engineering.

Course Topics

- Introduction to flexibility and stiffness methods
- The direct stiffness method: beams, frames, trusses and grids
- Application topics: support settlement, temperature & prestrain, constraint equations, symmetry/antisymmetry/asymmetry, substructuring, and other topics
- Numerical and coding aspects
- Introduction to 2D finite elements: direct method, energy methods, plane stress and plane strain
- Qualitative isoparametric formulation
- Qualitative nonlinear finite elements

ENCE 454

Design of Concrete Structures (3 Credits)

3 hours lecture

Prerequisites

ENCE 353; ENCE 355

Course Description

Combined bending and compression, development and anchorage of reinforcement, deflections, design of slabs including one-way and two-way, design of footings, retaining walls, introduction to pre-stressed concrete, design of multi-story buildings.

Course Topics

- Introduction
- Combined Bending and Compression
- Development Length
- Deflection
- Design of Two-way Slabs
- Design of Footings
- Introduction to Pre-stressed Concrete
- Design of Multistory Buildings

ENCE 455

Design of Steel Structures (3 Credits)

3 hours lecture

Prerequisites

ENCE 353; ENCE 355

Course Description

Behavior and design of members subjected to fatigue, and combined bending and compression; plate girders, composite beams, open-web joists and connections. Methods of allowable stress design, and load and resistance factor design. Elements of plastic analysis and design. Framing systems and loads for industrial buildings and bridges.

Course Topics

- Introduction
- Behavior and Design of Members Subject to Fatigue
- Combined Bending and Compression
- Plate Girders, Composite Beams, Open-web Joists, and Connections
- Methods of Allowable Stress Design
- Load and Resistance Factor Design
- Elements of Plastic Analysis and Design
- Framing Systems and Loads for Industrial Buildings and Bridges

ENCE 488
Senior Thesis (3 Credits)

Prerequisites

Permission of Department and Designation of a Faculty Supervisor

Course Description

Advanced study in civil engineering problems with special emphasis on mathematical modeling and experimental methods.

ENCE 489

Special Problems in Civil and Environmental Engineering (1-4 Credits)

Prerequisites

Permission of Department and Designation of a Faculty Supervisor

Course Description

A course arranged to meet the needs of exceptionally well prepared students for study in a particular field of civil engineering.