COURSE PROFILE

Degree Program: **Bachelor of Science in Engineering, Civil Engineering** Date: **April 2011**

Prepared by: CoE – Civil & Environmental Engineering

COURSE #: CEE 200	**COURSE TITLE:** Introduction to Civil & Environmental Engineering
TERMS OFFERED: Winter	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: None	**PREREQUISITES:** None
INSTRUCTOR(S): Love, Hryciw	**COGNIZANT FACULTY:** Love
CoE BULLETIN DESCRIPTION: An introduction to the nature and scope of the civil and environmental engineering discipline and specialty programs. Includes case studies from practice and information about academic and professional opportunities for CEE students.	**COURSE TOPICS:** 1. An Introduction to Civil and Environmental Engineering 2. Construction Engineering and Management 3. Environmental Engineering 4. Geotechnical Engineering 5. Materials Engineering 6. Structural Engineering 7. Water Resources Engineering 8. Transportation Engineering 9. Career Opportunities – private consulting, public jobs, government, academia 10. Professional Licensing and What Is ABET? 11. Professional organizations, student organizations, student team opportunities, and undergraduate research 12. Scholarships, advising, student services and career planning 13. Case study focused on licensure and ethics
COURSE STRUCTURE/SCHEDULE: Seminar: 1 per week @ 1 hour.	

COURSE OBJECTIVES	To provide students with an introduction to different civil engineering and professional issues; provide a formal orientation to various Civil Engineering subdisciplines and facilitate students' choice of the degree path.
COURSE OUTCOMES For <u>each</u> course outcome, links to the Program Outcomes are identified.	1. Describe at least seven sub-disciplines within the CEE discipline. 2. List the wide range of job options for students who obtain degrees in Civil Engineering and describe each of those options. 3. Explain the process of becoming a licensed professional engineer and the purpose of licensing. 4. List the professional organizations that civil engineers participate in, and describe the disciplinary and professional focus of each of those organizations. 5. State the four fundamental principles and seven fundamental canons of the American Society of Civil Engineers Code of Ethics.
ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcomes are identified.	Attendance In-Class participation Out-of-Class participation (5 forum group replies) Feature article posts (9 Posts) Professionalism in class and on CTools forum group

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** April 2011

Prepared by: CoE – Civil & Environmental Engineering

COURSE #: CEE 211	**COURSE TITLE:** Statics and Dynamics
TERMS OFFERED: Fall, Winter	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: *Engineering Mechanics: Statics and Dynamics*, Hibbeler, 10th ed, Prentice-Hall	**PREREQUISITES:** Physics I or equivalent
INSTRUCTOR(S): Michalowski; El-Tawil, Hanson, McCormick	**COGNIZANT FACULTY:** El-Tawil
CoE BULLETIN DESCRIPTION: Statics: review of vector mathematics; moment and force resultants; static equilibrium in two and three dimensions; centroids; center of gravity; distributed loadings. Dynamics: review of concepts of velocity and acceleration; dynamics of particles and rigid bodies; concepts of work, energy, momentum; introduction to vibrations. Four lectures per week.	**COURSE TOPICS:** See catalog description.
COURSE STRUCTURE/SCHEDULE Lecture: 4 per week @ 1 hour; Recitation: 1 per week @ 1 or 2 hours	

COURSE OBJECTIVES	1. To build upon the basic concepts of statics and dynamics introduced in earlier physics classes. 2. To provide additional guidance and practice in sketching free-body diagrams. 3. To convey to students how the fundamental principles of statics and dynamics can be applied in everyday engineering design situations. 4. To train students to prepare legible, well-organized, neat assignments. 5. To further develop problem-solving skills. 6. To emphasize the importance of units and unit conversions.
COURSE OUTCOMES	1. Given some information in one set of units, convert the information into another set of units. 2. Given a formula, verify the units of the final answer. 3. Given a rigid body (in two or three dimensions) at rest, formulate the equations of static equilibrium.

For <u>each</u> course outcome, links to the Program Outcom are identified.	4. Given a distributed loading acting on a body, calculate the resultant force or moment acting on the body and the location of the resultant. 5. Given a cross-section geometry, calculate the moment of inertia of the cross-section about a defined axis. 6. Given a problem assignment, prepare a neat, well-organized, handwritten solution for review by others. 7. Given a function describing displacement, determine the velocity and acceleration. 8. Given the properties of a single-degree-of-freedom oscillator, formulate and solve the governing differential equation. 9. Given a simple problem involving the motion of an object idealized as a particle, be able to apply concepts of force and acceleration, work and energy, impulse and momentum principles as appropriate. 10. Given a simple problem involving the motion of an object idealized as a planar rigid body, be able to apply concepts of force and acceleration, work and energy, impulse and momentum principles as appropriate.
ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcome are identified.	1. Two in-class exams (1 hour each), closed book with equation sheets provided (to demonstrate mastery of basic material covered in class) 2. Weekly homework assignments (for practice and learning) 3. A two-hour final exam

COURSE PROFILE

Degree Program: Bachelor of Science, Civil Engineering **Date:** April 2011

Prepared by: CoE – Civil & Environmental Engineering

COURSE #: CEE 212	**COURSE TITLE:** Solid and Structural Mechanics
TERMS OFFERED: Winter	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: *Mechanics of Materials*, Hibbeler, 6^{th} edition, Prentice-Hall	**PREREQUISITES:** CEE 211 (Statics and Dynamics) or equivalent
INSTRUCTOR(S): Parra-Montesinos; Michalowski	**COGNIZANT FACULTY:** Parra-Montesinos
CoE BULLETIN DESCRIPTION: Fundamental principles of solid and structural mechanics and their application in engineering disciplines. Covered: concepts of stress and strain, stress and strain transformations, axial, torsion, bending and combined loading, elastic deformations, energy concepts, and strength design principles. Lectures and laboratory.	**COURSE TOPICS:** 1. Stress and Strain 2. Mechanical Properties of Materials 3. Axial Loads and Deformations 4. Saint Venant's Principle 5. Torsion 6. Bending of Beams 7. Combined Beam Loading 8. Transformation of Stress and Strain 9. Elastic Deformations of Statically Determinate Beams 10. Energy Methods 11. Design Concept
COURSE STRUCTURE/SCHEDULE Lecture: 3 per week @ 1 hour; Recitation: 1 per week @ 2 hours	

COURSE OBJECTIVES	1. To build upon the basis concepts of statics and dynamics. 2. To teach students the fundamental concepts of stress and strain. 3. To teach students how to analyze statically determinate structural elements under axial, torsion, bending and combined loads. 4. To introduce the basic concepts of energy methods in solid mechanics and prepare for the course in structural analysis. 5. To introduce the basic concepts of structural design and prepare for the courses in structural design. 6. To further develop engineering problem-solving skills.

COURSE OUTCOMES For <u>each</u> course outcome, links to the Program Outcom are identified.	1. Given a loaded elastic body, explain what are the normal and the shear stresses and strains. 2. Given an elastic material, explain the relation between stresses and strains. 3. Given an elastic material, compute stress from strain and/or strain from stress. 4. Given an elastic material, recognize the limit of elastic behavior. 5. Given a state of stress or strain, transform it into an equivalent state of principal stresses or strains using Mohr's circle. 6. Given an axially loaded structural element (rod), compute axial force, axial stress, axial strain and axial deformation. 7. Given a solid rod under torque, compute the shear stress, the shear flow and the angle of twist. 8. Given a solid beam in pure bending, compute the axial stress, strain and curvature of a cross-section. 9. Given a solid beam under transverse loads, compute the axial and shear stress, strain, curvature and shear deformation of a cross-section. 10. Given a solid beam under transverse loads, compute the deflection and the slope at any point of the beam using the integration method or the moment-area method. 11. Given an elastic solid structural element under combined axial and bending loads, compute the state of stress and strain in a cross-section using the principle of superposition. 12. Given a loaded elastic body, explain the sources of external and the internal work. 13. Given a loaded elastic body, compute the internal forces using the principle of equal internal and external work. 14. Given an elastic solid structural element, combine the knowledge about the internal forces and the knowledge about the limits of elastic behavior to understand the basic concept of design for strength.
ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcome are identified.	1. Weekly homework assignments for practice and learning. Allow work in small teams. 2. Two in-class exams (1 hour each) to demonstrate individual's mastery of the material covered in class. Exams are closed-book with 3. equation sheets provided. 4. One two-hour final exam, to demonstrate achievement of the anticipated course outcomes.

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** April 2011

Prepared by: CoE – Civil & Environmental Engineering

COURSE #: 230	**COURSE TITLE:** Energy & Environment
TERMS OFFERED: Fall	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: *Thermodynamics: An Engineering Approach*,Cengel, Mc Graw-Hill	**PREREQUISITES:** Chem 125 & 130 or Chem 210 & 211; Math 116
INSTRUCTOR(S): Lastoskie	**COGNIZANT FACULTY:** Lastoskie
CoE BULLETIN DESCRIPTION: The laws of thermodynamics are presented and applied to energy technologies used for electric power generation, transportation, heating, and cooling. Physical properties of fuels and materials used in energy production are discussed. The environmental impacts, resource constraints, and economic factors governing conventional and alternative energy technologies are considered.	**COURSE TOPICS:** (number of hours in parentheses) 1. First law and energy balances (5) 2. Equations of state (4) 3. Second law and entropy balances (5) 4. Enthalpy and heat capacity (6) 5. Pure-component phase equilibria (5) 6. Multicomponent phase equilibria (5) 7. Chemical reaction equilibria (8) 8. Thermodynamic cycles (4)
COURSE STRUCTURE/SCHEDULE Lectures: 3 per week @ 1 hour.	

COURSE OBJECTIVES	1. To explain how to formulate mass and energy conservation equations and entropy balances for the solution of engineering problems involving both flow and nonflow systems. 2. To show how to apply knowledge of the physical properties and phase behavior of pure substances to solve engineering problems. 3. To give instruction on how to perform design calculations for engineering processes that are used in civil infrastructure systems including power generation, regrigeration, and indoor air conditioning. 4. To introduce property relationships for fluid mixtures and concepts and terminology associated with chemical reactions and combustion systems. 5. To demonstrate how to determine the composition of reacting fluid mixtures using chemical reaction equilibrium calculations.
COURSE OUTCOMES For each course outcome, links to the Program Outcomes are identified.	1. Construct and solve energy and entropy balances for calculation of heat requirements and work inputs/outputs of physical processes. 2. Use equations of state and/or thermodynamic charts and tables to determine the physical properties of substances. 3. Determine the compositions of gas and liquid mixtures using activity relationships, Raoult's and Henry's laws. 4. Calculate the compositions of reactive aqueous solutions from chemical equilibrium equations. 5. Analyze combustion processes and chemical/biological reaction systems using elemental mass balances. 6. Combine conservation equations and thermophysical property data to solve design problems in civil and environmental engineering.
ASSESSMENT TOOLS For each assessment tool, links to the course outcomes are identified.	1. Weekly homework problem sets. 2. Two midterm examinations and one final examination. 3. Lecture and office-hour discussions and student course evaluations.

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** April 2011

Prepared by: CoE – Civil & Environmental Engineering

COURSE #: 260	**COURSE TITLE:** Introduction to Environmental and Sustainable Engineering
TERMS OFFERED: Fall, Winter	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: *Environmental Engineering Science,* Nazaroff, 2001, Wiley; *Introduction to Engineering and the Environment,* Rubin, 1st ed, McGraw-Hill	**PREREQUISITES:** Chem 130; Math 116
INSTRUCTOR(S): Hayes	**COGNIZANT FACULTY:** Hayes
CoE BULLETIN DESCRIPTION: Introduction to environmental and sustainable engineering systems. Topics covered include: environmental laws, regulations, and sustainability issues; economics incentives, inhibitors and financial calculations in sustainable engineering; life cycle assessment; hazard and risk assessment of pollutants; emissions/discharges and material and energy balances; modeling pollutant fate and transport; environmental remediation and design for the environment.	**COURSE TOPICS:** 1. Environmental laws, regulation, and sustainability issues 2. Economic incentives, inhibitors, and financial calculations 3. Life cycle assessment in engineering systems 4. Pollutant standards and risk assessment 5. Emissions/discharges and material and energy balances 6. Chemical properties and pollutant partitioning in air, land, and water 7. Modeling pollutant fate and transport 8. Environmental remediation 9. Design for the environment
COURSE STRUCTURE/SCHEDULE Lecture: 2 per week @ 1 hour; Discussion: 1 per week @ 2 hours	

COURSE OBJECTIVES	1. Given emissions and resource consumption data for an engineering system such as a power plant or vehicle, be able to identify possible environmental impact and sustainability issues. 2. Given an exposure pathway for a chemical, be able to compute the acceptable exposure level. 3. Given the rate of reaction and mass flow rate, or partitioning information be able to compute the concentration of a pollutant

	in air, water, or soil. 4. Given life cycle assessment information for two engineering systems, be able to use the information to demonstrate which option is likely to have less significant emissions to air, water, and land. 5. Given information on cash flows related to two pollution prevention or environmental remediation options, use net present value concepts ot identify the one with least life cycle cost. 6. Given an environmental quality issue related to pollution, be able to identify possible approaches for mitigating impact.
COURSE OUTCOMES For <u>each</u> course outcome, links to the Program Outcom are identified.	1. Given the governmental, economic, and socio-political climate surrounding a particular engineering issue, be able to articulate the need for sustainable systems engineering. 2. Given information on cash flows and the time value of money, be able to perform financial calculations in the context of environmental and economic decision-making related to engineering design. 3. Given the exposure pathway, students will be able to compute the acceptable levels of exposure for a particular chemical. 4. Given the rate of reaction and the flow rate, students will be able to compute pollutant environmental concentrations. 5. Given the characteristics of a chemical, be able to estimate where it will impact the environment. 6. Given life cycle assessment data and engineering design options, be able to choose the option most likely to minimize live cycle environmental impact. 7. Given an environmental quality issue, be able to identify possible approaches for mitigating impact.
ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcome are identified.	1. Two in class closed book exams and an open book final exam will test outcomes #1-7. 2. Weekly problem sets will test outcomes #1-7.

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** April 2011

Prepared by: CoE – Civil & Environmental Engineering

COURSE #: CEE 270	**COURSE TITLE:** Statistical Methods for Data Analysis and Uncertainty Modeling
TERMS OFFERED: Fall	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: Devore, J.L. (2008) Probability and Statistics for Engineering and the Sciences. Thomson Brooks/Cole. Seventh edition.	**PREREQUISITES:** Engineering 101, Math 116
INSTRUCTOR(S): Michalak, Huntzinger	**COGNIZANT FACULTY:** Michalak
CoE BULLETIN DESCRIPTION: Introductory probability and statistics with emphasis on data analysis and uncertainty modeling for engineering and environmental systems. Descriptive statistics, graphical representation of data, linear regression, correlation, discrete and continuous probability distributions, conditional probability, estimation, statistical inference, hypothesis testing, sampling design, load factors, extreme events, reliability analysis. Lecture, recitation and computation.	**COURSE TOPICS:** 1. Representation of data and basic descriptive statistics 2. Conditional probability & independence; Bayesian analysis 3. Discrete and continuous random variables and distributions 4. Testing hypotheses 5. Linear regression and correlation analysis
COURSE STRUCTURE/SCHEDULE Lecture: 2 per week @ 1.5 hours; Laboratory: 1 per week @ 3 hours	

COURSE OBJECTIVES	1. To teach students to discuss a dataset using basic descriptive statistics and graphical representations of data [a,b,k] 2. To teach students to use rules of probability, and discrete and continuous probability distributions to calculate probabilities of events [a,b,e] 3. To teach students to select the appropriate discrete or continuous probability distribution to model a given experiment or dataset [a,b,e] 4. To teach students to estimate sample statistics based on known population probability distributions, and estimate parameters

	of probability distributions based on sample data. [a,b,k] 5. To teach students procedures for hypothesis testing, including calculating probabilities of type I and type II errors. [a,c,k]
COURSE OUTCOMES For <u>each</u> course outcome, links to the Program Outcom are identified.	1. Given a sample dataset, students will be able to describe it in statistical terminology and prepare appropriate graphical representations of the data 2. Students will be able to calculate probabilities of events using the axioms and rules of probability, as well as probability distributions of discrete and continuous variables 3. Students will be able to select appropriate discrete and continuous probability distributions to be used to model a given experiment or dataset 4. Students will be able to estimate sample statistics based on known population probability distributions, and estimate parameters of probability distributions based on sample data. 5. Students will be able to perform hypothesis testing and quantify the probabilities of type I and type II errors.
ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcomes are identified.	1. Two in-class closed book midterms test outcomes 1-5 2. Weekly problem sets test outcomes 1-5 **3.** Weekly workshops involving computer applications of the presented concepts or additional worked examples test outcomes 1-5

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** April 2011

Prepared by: CoE – Civil & Environmental Engineering

COURSE #: CEE 303 / ENG 303	**COURSE TITLE:** Computational Methods for Engineers and Scientists
TERMS OFFERED: Winter	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: *Numerical Methods for Engineers*, Chapra, 4th ed, McGraw-Hill	**PREREQUISITES:** Engineering 101, Math 216
INSTRUCTOR(S): Katopodes	**COGNIZANT FACULTY:** Katopodes
CoE BULLETIN DESCRIPTION: Applications of numerical methods to infrastructure and environmental problems. Development of mathematical models and computer programs using a compiled language (FORTRAN). Formulation and solution of initial and boundary value problems with emphasis on structural analysis, fluid flow, and transport of contaminants. Lecture, recitation and computation.	**COURSE TOPICS:** 6. Fundamentals of computational modeling and programming. 7. Initial-value problems of ordinary differential equations. 8. Euler and Runge-Kutta methods; Adaptive step-size control. 9. Systems of ordinary differential equations; Stiff systems. 10. Finite-difference approximation of two-point boundary-value problems. 11. Solution of tri-diagonal systems of linear equations. 12. Newton-Raphson solution of nonlinear systems. 13. Numerical integration techniques. 14. Initial and boundary-value problems of partial differential equations. 15. Finite-difference approximation of equilibrium problems. 16. Gauss-Seidel method and successive over-relaxation. 17. Finite-difference approximation of propagation problems. 18. Accuracy, stability and consistency of approximations.
COURSE STRUCTURE/SCHEDULE Lecture: 2 per week @ 1.5 hours; Laboratory: 1 per week @ 3 hours	

COURSE OBJECTIVES	6. To teach students the fundamental concepts of mathematical modeling and FORTRAN programming. [a,b,e,i,j,k] 7. To teach students how to set up initial and boundary - value problems. [a,e,k] 8. To teach students how to solve numerically ordinary and partial differential equations. [a,b,c,e,g,i,j,k]

	9. To teach students how to solve large systems of equations. [a,c,e,g,i,j,k] 10. To teach students how to design a computer program to solve an engineering problem. [a,b,c,e,g,k] 11. To teach students how to perform a sensitivity and uncertainty analysis due to variable data and parameters. [a,b,c,e,i,j,k]
COURSE OUTCOMES For each course outcome, links to the Program Outcom are identified.	6. Given an initial or boundary value problem, design a numerical model. 7. Given a large system of linear algebraic equations, design a computer code, obtain the solution, and perform an error analysis. 8. Given an equilibrium problem, design a model using successive over-relaxation for its solution. 9. Given a propagation problem, design a time-dependent finite-difference model for its solution. 10. Given a set of input parameters that are subject to error, determine the uncertainty of the computed results.
ASSESSMENT TOOLS For each assessment tool, links to the course outcome are identified.	4. In-class closed book exams test outcomes #1-5 for individual students. 5. Weekly problem sets test outcomes #1-5 under less time pressure. 6. Seven computer program assignments test outcomes #1-5. 7. Laboratory performance and reports test outcomes #1-5.

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** April 2011

Prepared by: CoE – Civil & Environmental Engineering

COURSE #: CEE 312	**COURSE TITLE:** Structural Engineering
TERMS OFFERED: Fall	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: *Structural Analysis*, Hibbeler, 6th edition, Prentice-Hall	**PREREQUISITES:** CEE 212 or equivalent
INSTRUCTOR(S): Wight, El-Tawil, Jeffers	**COGNIZANT FACULTY:** El-Tawil
CoE BULLETIN DESCRIPTION: Introduction to the field of structural engineering. Discussion of structural analysis techniques and concepts such as virtual work, flexibility method, stiffness method, and influence lines. Training in AutoCAD and exposure to commonly used structural analysis computer program(s). Discussion of basic design concepts and principles. Lecture and laboratory.	**COURSE TOPICS:** 1. Structural form and structural modeling 2. Loads and load combinations 3. Concept of load path 4. Concept of static determinacy / indeterminacy 5. Analysis of determinate and indeterminate structures using virtual work 6. Introduction to stiffness and flexibility methods 7. Influence lines 8. Introduction to design concepts (materials, design for strength and serviceability, structural systems.)
COURSE STRUCTURE/SCHEDULE Lecture: 3 per week @ 1 hour; Laboratory: 1 per week @ 3 hours	

COURSE OBJECTIVES	1. To introduce the field of structural engineering to all CEE students. 2. To discuss some of the simplifying assumptions and idealizations used in structural analysis and design. 3. To introduce some methods of determinate and indeterminate structural analysis. 4. To compare output from structural analysis software with results from "hand calculation" methods. 5. To provide a lead-in to more advanced courses in structural analysis and design.
COURSE OUTCOMES	1. Given adequate information, construct the bending moment, shear, and axial force diagrams for a typical element of a framed structure. 2. Given a two-dimensional structure, evaluate whether the structure is determinate or indeterminate and assess its stability.

For <u>each</u> course outcome, links to the Program Outcom are identified.	3. Given a simple determinate structure, be able to analyze the structure. (Analysis includes calculation of reactions, internal forces and moments, deflections at key points.) 4. Given a simple indeterminate structure, be able to analyze the structure using flexibility methods, stiffness methods and virtual work methods. 5. Ability to identify different types of structural systems. 6. For a simple determinate structure, construct the influence line for some response quantity of interest. 7. Given an influence line, understand how to interpret it and use it for positioning live loads. 8. Given a two-dimensional structure, be able to create a computer model of the structure. (This involves understanding boundary conditions, element releases, specification of loads, and specification of member properties.) 9. Given a distributed floor or wall loading, use tributary load and load path concepts to evaluate how the load is resisted by the structure.
ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcome are identified.	1. Two mid-term exams 2. Weekly homework assignments (for practice and learning) 3. A two-hour final exam 4. Lab submissions 5. Course evaluations

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** 3/30/2011

Prepared by: CoE – Civil & Environmental Engineering

COURSE #: CEE 325	**COURSE TITLE:**
TERMS OFFERED: Fall, Winter	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: *Engineering Fluid Mechanics*, Crowe, Roberson, Elger, 9th ed. Wiley	**PREREQUISITES:** CEE 211 E
INSTRUCTOR(S): Cotel, Demond	**COGNIZANT FACULTY:** Wright
CoE BULLETIN DESCRIPTION: Principles of mechanics applied to real and ideal fluids. Fluid properties and stati continuity, energy, and momentum equations by control volume analysis; differe equations of motion for laminar and turbulent flow; dimensional analysis and sin boundary layers, drag, and lift; incompressible flow in pipes; fluid measurement turbomachinery. Lectures and laboratory.	**COURSE TOPICS:** 1. Fluid pressure, hydrostatic pressure variation including constant acceleration 2. Forces and moments on plane and curved surfaces 3. Buoyancy 4. Reynolds transport theorem applied to control volume formulations of continuity, momentum, and energy 5. Multidimensional flow equations applied to ideal fluids 6. Solutions to laminar flow problems with simple geometries 7. Turbulent flows 8. Dimensional analysis and similitude considerations 9. Lift and drag 10. Laminar and turbulent flow in pipes
COURSE STRUCTURE/SCHEDULE (i.e., Lecture: 3 per week @ 50 minutes; Laboratory: 1 per week @ 2 hours)**:**	

COURSE OBJECTIVES	1. To teach students the concepts of pressure variations in non-accelerating fluids and in fluids with specified accelerations; to use these principles to compute forces and moments due to fluid pressure. [a,e] 2. To teach students the basic control volume approach of describing flow in fluid systems; to use this to develop solution techniques utilizing fluid continuity, momentum and energy.[a,e,k]

	3. To teach students the basic techniques of dimensional analysis applied to fluid flow phenomena. [a,b,e,k] 4. To teach students the basics of flow in piping systems. [a,e] 5. To teach students the principles of laboratory data error analysis. [a,b,d,e,g] 6. To develop communication skills in experimental measurement, data analysis and communication of results. [a.b]
COURSE OUTCOMES For <u>each</u> course outcome, links to the Program Outcom are identified.	1. Given a fluid with zero or specified acceleration, be able to compute pressures at arbitrary points within the fluid, use this to analyze fluid manometers. 2. Given a solid surface exposed to fluid pressure, be able to compute the force and/or moment on that surface. 3. Given a submerged or partially submerged object, be able to analyze the buoyant forces acting on that object. 4. Given a fluid flow problem statement, be able to apply the control volume equations of continuity, momentum and energy as required to meet the objectives of the analysis. 5. Utilize boundary layer descriptions of fluid flow to compute skin friction resistance for both laminar and turbulent flows. 6. Given a statement of relevant system variables, be able to perform a formal dimensional analysis to describe the phenomenon by a reduced set of dimensionless variables. 7. Given a hydraulic modeling problem, be able to formulate the requirements for dynamic similarity and to be able to determine the necessary laboratory conditions to achieve dynamic similarity and the scaling of laboratory measurements to a prototype problem. 8. To be able to estimate lift and drag forces on bluff bodies. 9. To be able to compute resistance losses in laminar and turbulent pipe flow. 10. Given a laboratory setup, be able to identify the sources of measurement error and methods for the estimation of the uncertainty in both bias and precision uncertainty. 11. Given estimates of measurement uncertainty, be able to propagate the uncertainty errors through results derived from laboratory data.
ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcome are identified.	1. Weekly problem assignments, test outcomes 1-9 2. In-class exams, test outcomes 1-9 3. Laboratory measurement and analysis projects, test outcomes 10-11 explicitly and 1,4,6-9 implicitly 4. Laboratory demonstrations, test outcomes 1-9

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** April 2011

Prepared by: CoE – Civil & Environmental Engineering

COURSE #: CEE 345	**COURSE TITLE:** GEOTECHNICAL ENGINEERING
TERMS OFFERED: Fall, Winter	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: *Coduto, D. P., Yeung, M-C. R., Kitch, W. A. (2011), Geotechnical Engineering, Principles and Practices, 2nd edition, Prentice Hall.*	**PREREQUISITES:** CEE 212
INSTRUCTOR(S): Athanasopoulos-Zekkos, Hryciw, Zekkos	**COGNIZANT FACULTY:** Hryciw
CoE BULLETIN DESCRIPTION: Soil classification and index properties; soil structures and moisture, seepage, compressibility and consolidation; stress and settlement analysis; shear strength; applications to foundations, retaining structures, slopes and landfills. Lectures, problems, laboratory, report writing.	**COURSE TOPICS:** 1. Origin of soils and soil constituents. 2. Grain size distribution, index properties and classification. 3. Phase relationships. 4. Soil compaction. 5. Permeability, seepage, flow nets, seepage forces. 6. Stresses in soils. 7. Consolidation and settlement. 8. Soil strength. 9. Introduction to foundation engineering and retaining structures. 10. Slope Stability. 11. Soil and Site improvement 12. Soil sampling and laboratory testing. 13. In-situ testing.
COURSE STRUCTURE/SCHEDULE Lecture: 3 per week @ 1 hour; Laboratory: 1 per week @ 3 hours):	

COURSE OBJECTIVES	1. To teach students the fundamental engineering properties of soils and geotechnical engineering principles, so students are prepared to apply these concepts to the analysis and design of geotechnical engineering problems. 2. To teach students to work in teams in order to plan, conduct and effectively communicate the results of common geotechnical laboratory tests. 3. To teach students how to classify a soil. 4. To teach students how to estimate seepage quantities and seepage forces. 5. To teach students to compute stresses in soils due to both soil weight and imposed surface loading. 6. To teach students how to predict foundation settlements based on determined soil properties and applied stresses. 7. To introduce the students to the concepts on how to design a shallow foundation based on determined soil strengths and compressibility characteristics. 8. To introduce the students to the concepts on how to estimate slope stability based on determined soil strength 9. To introduce students to the concepts of lateral earth pressures and how to design a retaining structure 10. To introduce students to the concepts of soil and site improvement, site investigation and field testing
COURSE OUTCOMES For <u>each</u> course outcome, links to the Program Outcom are identified.	1. Given the grain size distribution and index properties, to be able to classify a soil. 2. Given a soil classification, to be able to qualitatively predict the soil's engineering behavior. 3. Given raw laboratory and, or field data, to be able to compute a soil's water content, void ratio, degree of saturation and unit weight. 4. Given a site stratigraphy, the site's hydraulic conductivity and water levels in a reservoir, to construct a flow net and compute seepage losses and uplift pressures beneath a dam. 5. Given a site's soil unit weights and groundwater conditions, to be able to compute the variation of total stress, pore water pressure and effective stress with depth. 6. Given an imposed surface load, to be able to compute increases in subsurface stress. 7. Given a soil's compressibility properties, to be able to estimate ground settlements due to an imposed surface load. 8. Given the results of laboratory direct shear, triaxial or unconfined compression tests, to be able to determine the soil's friction angle and cohesion. 9. Given a structural load, the soil's strength and groundwater conditions, to be able to size a footing for safe load transfer using bearing capacity equations. 10. Given a slope geometry and soil strength properties, to be able to estimate the stability of a slope. 11. Given laboratory instructions, to be able to conduct, in a team setting, laboratory tests for collection of various engineering soil properties. 12. Having collected geotechnical laboratory data, to be able to reduce, analyze and formally report the results.
ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcome are identified.	1. One in-class closed book midterm exam (1 hour) to test outcomes #1-10. 2. One, closed book final exam (2 hours) to test outcomes #1-10. 3. Homework problem sets to test outcomes #1-10. 4. Weekly laboratory assignments and reports test outcomes #1, #3, #4, #7, #8, #11 and #12.

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** April 2011

Prepared by: CoE – Civil & Environmental Engineering

COURSE #: CEE 351	**COURSE TITLE:** Civil Engineering Materials
TERMS OFFERED: Fall, Winter	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: *Concrete,* Mindess, 2nd ed., Prentice Hall	**PREREQUISITES:** CEE 212
INSTRUCTOR(S): Hansen, Li	**COGNIZANT FACULTY:** Hansen
CoE BULLETIN DESCRIPTION: Discussion of basic mechanical and physical properties of a variety of civil engineering materials such as concrete, asphalt, wood and fiber composites. Evaluation and design for properties, load-time deformation characteristics, response to typical service environments. Lecture and laboratory.	**COURSE TOPICS:** 1. Introduction to civil engineering materials. 2. Aggregates for concrete: Evaluation of mechanical and physical properties. 3. Portland Cements: Types, physical and chemical composition and hydration kinetics. 4. Fundamentals of Portland cement concrete mix design. 5. Fresh concrete properties: workability and temperature control. 6. Development of mechanical and physical properties of concrete. 7. Durability issues: Freeze-Thaw, chemically induced deterioration, ASR, corrosion of reinforcement. 8. Time effects: creep, shrinkage and fatigue. 9. Bituminous concrete: Marshall mix design. 10. Plastics and Polymers: Mechanical properties, time-temperature effects. 11. Wood and timber: Anisotropy, mechanical and physical properties. 12. Steel: Mechanical properties pertaining to civil engineering applications. 13. NDTM – Non Destructive Testing Methods
COURSE STRUCTURE/SCHEDULE Lecture: 2 per week @ 1.5 hours; Laboratory: 1 per week @ 3 hours	

COURSE OBJECTIVES	1. To teach students the fundamental concepts of mechanical, physical, and time-dependent properties (shrinkage & creep) of civil

	engineering construction materials. 2. To teach students how to conduct laboratory experiments according to ASTM standards, critically evaluate and analyze data collected. 3. To teach students how to write technical reports based on data collected from experiments. 4. To teach students how to design portland cement concretes to meet certain design requirements. 5. To teach students how to understand and interpret the mechanical properties and their significance in design. 6. To teach students the relationships between construction materials and environmental concerns.
COURSE OUTCOMES For <u>each</u> course outcome, links to the Program Outcom are identified.	1. Given laboratory collected data, evaluate properties for acceptance by specifications and ASTM standards. 2. Given the strength requirements for structural design for concrete and environmental conditions, be able to incorporate effects of material strength variability and severity of environment to arrive at economical mix design meeting the strength and durability requirements. 3. Given the seasonal temperature conditions, calculate fresh concrete placement, be able to suggest proper precautions to minimize adverse effects of placement temperature. 4. Given typical time dependent properties of creep and shrinkage, be able to evaluate their effects on long-term load and deformation. 5. Given traffic category, design optimum bituminous mixture to meet these requirements. 6. Given the data from a stress relaxation test for plastics and polymers, be able to predict creep deformation over time.
ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcome are identified.	1. In-class closed book exams test outcomes #1-6. 2. Bi-weekly problem sets test outcomes #1-6 without the time constraints. 3. Individual laboratory reports test outcomes #1-6.

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** April 2011

Prepared by: CoE – Civil & Environmental Engineering

COURSE #: CEE 360	**COURSE TITLE:** Environmental Process Engineering
TERMS OFFERED: Winter	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: *Wastewater Engineering: Treatment and Reuse,,*Metcalf, 4th ed., McGraw-Hill	**PREREQUISITES:** CEE 260 (E); CEE 325 (E)
INSTRUCTOR(S): Lastoskie, Semrau, Raskin, Olson	**COGNIZANT FACULTY:** Semrau
CoE BULLETIN DESCRIPTION: An introduction to the analysis, characterization, and modeling of environmental processes; physical, chemical, and biological processes and reactor configurations commonly used for water quality control; applications to the development and design of specific water and wastewater treatment operations; discussion of economic and legislative constraints and requirements.	**COURSE TOPICS:** 1. Characterization of pollution (BOD, COD, TSS, etc). 2. Ideal reactor analysis and mass balances. 3. Discrete, flocculent, and hindered settling of particles. 4. Modeling and measurement of biological activity (aerobic vs. anaerobic, attached vs. suspended growth). 5. Alkalinity, solubility. 6. Filtration and disinfection 7. Membrane Processes 8. Adsorption
COURSE STRUCTURE/SCHEDULE Lecture: 2 per week @ 1.5 hours; Laboratory: 7 per term @ 3 hours + plant visits)**:**	

COURSE OBJECTIVES	1. To teach students mass balances for a variety of reactor configurations. [a,c,e,k] 2. To teach students physical processes used in waste treatment including screening, equalization, and sedimentation. [a,b,c,d,e,g] 3. To teach students biological processes used in waste treatment including microbial kinetics and products of biodegradation. [a,b,c,d,e,g,k] 4. To teach students chemical processes in waste treatment, including reduction/oxidation reactions, adsorption, coagulation, precipitation, and disinfection. [a,b,c,d,e,g,k] 5. To teach students the legislative factors involved in treatment design. [i,j]
	1. Students will be able to construct and solve mass balances for a variety of reactor configurations.

COURSE OUTCOMES For <u>each</u> course outcome, links to the Program Outcom are identified.	2. Students will be able to analyze and design units utilizing physical separation such as clarifiers, grit chambers, and filtration. 3. Students will understand the fundamentals of microbial activity, and will be able to analyze and design units utilizing such activity for waste removal. 4. Students will learn how attached vs. suspended growth of microorganisms can be utilized for biodegradation of municipal and industrial wastes. 5. Students will be able to apply fundamental concepts of chemistry including equilibrium and solubility for waste removal. 6. Students will be able to determine what processes are dominating or limiting remediation and construct steps to circumvent such limitation given operational parameters such as pH, temperature, substrate concentrations, and redox conditions. 7. Students will be able to evaluate proposed solutions in terms of removal efficiency and societal concerns to differentiate between alternatives to select the optimal solution. 8. Students will be able to effectively present their work with written reports.
ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcome are identified.	1. Two to three closed-book mid-term exams test outcomes #1-8 for individual students. 2. One closed-book comprehensive final examination will test outcomes #1-8 for individual students. 3. Weekly problem assignments to test outcomes #1-8. 4. Laboratory assignments to assess understanding of outcomes 2, 3 & 5.

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** April 2011

Prepared by: CoE – Civil & Environmental Engineering

COURSE #: CEE 402	**COURSE TITLE:** Professional Issues & Design
TERMS OFFERED: Winter	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: no textbook required	**PREREQUISITES:** Graduating senior (E)
INSTRUCTOR(S): Wight and Wright	**COGNIZANT FACULTY:** Wight and Wright
CoE BULLETIN DESCRIPTION: Multidisciplinary team design experience including consideration of codes, regulations, alternate solutions, economic factors, sustainability, constructability, reliability, and aesthetics in the solution of a civil or environmental engineering problem. Professionalism and ethics in the practice of engineering.	**COURSE TOPICS:** 1. Proposal presentation 2. Elements of project design and report preparation 3. Economic analysis of projects 4. State, County and Federal Regulations 5. Professional licensure 6. Professional code of ethics 7. Ethical Decision making and whistle blowing
COURSE STRUCTURE/SCHEDULE Lecture: 2 per week @ 2 hours	

COURSE OBJECTIVES	1. To provide an exposure to project design. [a,c,d,e] 2. To provide an exposure to proposal writing and final report preparation. [d,g] 3. To provide exposure to economic analysis of engineering projects. [a,c,e,k] 4. To provide exposure to regulatory issues. [h,i] 5. To provide an exposure to engineering ethics and the role of professional code of ethics in decision making. [f,m]
COURSE OUTCOMES	1. Given a request for proposal, to prepare a written proposal and oral presentation to obtain engineering work. 2. Integrate the various elements of civil engineering analysis into a final project design. 3. Given the complete elements of a project design, be capable of integrating these into written report and oral presentation~~s~~ to the client. 4. Know where to find information ~~in order~~ required to estimate project costs.

For each course outcome, links to the Program Outcom are identified.	5. Know how to analyze capital and operating costs in order to determine the most economic and sustainable project design. 6. Given and ethical dilemma, understand the processes for decision making, including professional codes of ethics.
ASSESSMENT TOOLS For each assessment tool, links to the course outcomes are identified.	1. Written reports for 1-5, oral presentation for 1-3. 2. Written paper on proper handling of an ethical dilemma in engineering practice (for item 6).

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** May 2011

Prepared by: CoE – Civil & Environmental Engineering

<table>
<tr><td>COURSE #: CEE 413</td><td>COURSE TITLE: DESIGN OF METAL STRUCTURES</td></tr>
<tr><td>TERMS OFFERED: Fall</td><td>For each prerequisite below, “E” denotes Enforced and “A” denotes Advised.</td></tr>
<tr><td>TEXTBOOKS/REQUIRED MATERIAL: Segui, W.T. (2007) <u>Steel Design,</u>
Stamford, CT: Cengage Learning.</td><td>PREREQUISITES: CEE 312 (A)</td></tr>
<tr><td>INSTRUCTOR(S): El-Tawil and McCormick</td><td>COGNIZANT FACULTY: McCormick</td></tr>
<tr><td>CoE BULLETIN DESCRIPTION:

Design of metal members and connections, and their use in buildings and bridges.

Application of relevant design specifications with emphasis on structural steel.

Lectures, problems, and laboratory.</td><td>COURSE TOPICS:

14. Steel as a structural material - advantages and disadvantages.
15. Specifications, Loads, and Methods of Design.
16. Overview of application of influence lines.
17. Analysis and design of tension members.
18. Analysis and design of compression members - concept of effective length, flexural-torsional buckling, stiffness reduction factor. Design of built-up members.
19. Design of beams for moments - concepts of elastic buckling, inelastic buckling, and plastic buckling. Compact and non-compact sections. Design of continuous beams.
20. Design of beams for shear.
21. Calculation of deflection.
22. Failure modes and design of beams in areas under concentrated loads.
23. Analysis and design of beam-columns - members under combined bending and axial forces: First-order and second-order moments, Magnification factors.
24. Introduction to bolted and welded connections.</td></tr>
<tr><td colspan="2">COURSE STRUCTURE/SCHEDULE Lecture: 2 per week @ 50 minutes; Laboratory: 1 per week @ 3 hours</td></tr>
</table>

COURSE OBJECTIVES	1. To expose students to latest code specifications on the design of metal members. 2. To teach students how to analyze and design tension members. 3. To teach students how to analyze and design compression members. 4. To teach students how to analyze and design flexural members by using elastic analysis methods. 5. To teach students how to analyze and design beam-columns and understand the difference between 1st order and 2nd order analysis. 6. To teach students how to design simple bolted and welded connections under normal loading conditions. 7. To develop competency in students as structural steel designers and instill an intuition in regards to the design and analysis of steel systems.
COURSE OUTCOMES For <u>each</u> course outcome, links to the Program Outcom are identified.	7. Given different loads on a structure, be able to calculate the most appropriate load combinations to be used in design. [a,e,f,g,k] 8. Given the loading conditions on the member, be able to use appropriate sections from the Code for analysis and design. [c,d,e,f,i,k,m] 9. Given the size and material properties of a member and the size of bolt/weld, be able to calculate the design strength of the member under tension. [a,c,e,k] 10. Given the applied load, be able to design the member under tension. [a,c,e,k] 11. Given the size and strength of the member and the boundary conditions, be able to calculate the design strength of the member under axial load. [a,c,e,k] 12. Given the applied load, be able to design the individual and build-up members under axial load. [a,c,e,k] 13. Given the applied load, be able to design the compression members under side-sway condition. [a,c,e,k] 14. Given the axial load, size and strength of the metal column. [a,c,e,k] 15. Given the size and strength of the beam, be able to calculate the design strength of the beam by using elastic methods. [a,c,e,k] 16. Given a concentrated load, be able to design the base plate, pedestal, and stiffners for the beam member. [a,c,e,k] 17. Given the applied load, be able to select suitable size for the beam by using elastic methods. [a,c,e,k] 18. Given the size of the beam, be able to calculate its shear strength and maximum deflection. [a,c,e,k] 19. Given the size and strength of the beam-column under a given axial load and moment, be able to check whether the member is satisfactory or not. [a,c,e,k] 20. Given the applied axial load and moment, be able to design the beam-column by using the code provisions. [a,c,e,k] 21. Given the applied axial load and moment, be able to modify first order methods to account for second order effects. [a,c,e,k] 22. Given the size and strength of bolts/welds, be able to calculate the design strength of connections. [a,c,e,k]
ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcome are identified.	4. Problem sets on calculating factor loads under various loading conditions, analysis and design of tension members, analysis and design of compression members, analysis and design of beam members, analysis and design of beam-columns members, and analysis and design of connections. 5. Two laboratory assignments involving the calculation of the design strength of tension and compression members and a written comparison of the calculated results versus those obtained during testing. 6. Two in-class problem based open AISC Manual exams (2 hours each) focusing on outcomes #1-16. **Two in-class open book exams (2 hours each) test outcomes #1-14.**

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** April 2011

Prepared by: CoE – Civil & Environmental Engineering

COURSE #: CEE 415	**COURSE TITLE:** Design of Reinforced Concrete Structures
TERMS OFFERED: Winter	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: *Reinf. Conc. Mech. & Design, Fifth Edition, Wight and MacGregor*	**PREREQUISITES:** CEE 312
INSTRUCTOR(S): Wight and Parra	**COGNIZANT FACULTY:** Wight
CoE BULLETIN DESCRIPTION: Design of reinforced concrete members and slabs, and their use in buildings and bridges. Application of relevant design specifications. Lectures, problems and design laboratory.	**COURSE TOPICS:** 1. Material Properties 2. Flexural Behavior and Strength of R/C Sections 3. Flexural Design of R/C Beams 4. Analysis and Design of Continuous Floor Systems 5. Analysis and Design for Shear in R/C Beams 6. Reinforcement Development Lengths and Continuity Details 7. Analysis for Elastic Deflections 8. Analysis of Column Sections 9. Design of "Short" Columns for Axial load and Bending 10. Analysis and Design of Column Sections for Biaxial Bending 11. Laboratory Testing of Beams and Columns
COURSE STRUCTURE/SCHEDULE Lecture: 2 per week @ 1 hour; Laboratory: 1 per week @ 3 hours	

COURSE OBJECTIVES	1. To understand flexural behavior of RC beam sections through full range of loading. 2. To determine nominal moment capacity of any beam section and develop flexural design procedure for singly and double reinforced sections. 3. To understand behavior of beams subjected to shear and develop design procedure.

	4. To analyze complete one-way floor systems for bending, and shear, and develop section designs and reinforcement detailing requirements for all elements of the system. 5. To analyze nominal strength of column sections subjected to axial load and bending moments, and develop section design procedures for uniaxial and biaxial bending with axial load.
COURSE OUTCOMES For <u>each</u> course outcome, links to the Program Outcom are identified.	1. Given any beam section, be able to calculate its cracking moment, uncracked and cracked stiffnesses. 2. Given any beam section, be able to calculate its flexural strength and check reinforcement limits. 3. Given loading and support conditions, be able to design singly or doubly reinforced beam sections at points of maximum positive and negative moment. 4. Given a beam subjected to bending, and shear, be able to design cross sections and provide appropriate reinforcement details along the entire length of the member. 5. Given a complete floor system, be able to determine the flow of gravity loads from slabs, to floor beams, to girders, to columns. 6. Given a complete floor system, be able to find maximum moments, and shears in all members. 7. Given any beam loading and support conditions, be able to calculate short-term and long-term deflections and check them against code limitations. 8. Given any column section, be able to determine points on the axial load vs. uniaxial bending moment strength envelope. 9. Given any column section, be able to use approximate methods to determine its nominal strength under axial load and biaxial bending. 10. Given any set of axial loads and bending moments, be able to use design charts to design a column section to resist those loads.
ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcome are identified.	1. Weekly homework sets to apply analysis and design procedures developed during lectures. Work in small groups is strongly encouraged. 2. Two in-class exams (90 mins.) to evaluate student's mastery of analysis and design skills. Exams are closed book with help sheets permitted. 3. Two-hour comprehensive final exam to evaluate student's overall mastery of course material. Open book and ACI Code.

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** April 2011

Prepared by: CoE – Civil & Environmental Engineering

COURSE #: 421	**COURSE TITLE:** Hydrology And Floodplain Hydraulics
TERMS OFFERED: Fall	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: *Hydrology and Floodplain Analysis,* Bedient, 4th ed., Prentice Hall	**PREREQUISITES:** CEE 303, CEE 325
INSTRUCTOR(S): Katopodes, Ivanov	**COGNIZANT FACULTY:** Katopodes, Ivanov
CoE BULLETIN DESCRIPTION: Fundamentals of surface-water hydrology, flow in open channels, and flood hazard mitigation. Rainfall-runoff relations. Unit hydrograph method. Uniform and non-uniform flow in open channels. Measurement and control of river flow. Flood waves in rivers, floodplains, and reservoirs. Design of storage basins, storm channels. Lecture, laboratory and computation.	**COURSE TOPICS:** 1. The hydrologic cycle: Precipitation, evaporation, and infiltration. 2. Watershed concept, overland flow and the Rational method. 3. Unit hydrograph method; Convolution and base conversion. 4. Synthetic hydrographs; Basin properties and runoff characteristics. 5. Frequency analysis of storms. Intensity-duration-frequency curves. 6. Uniform flow in open channels; Channel conveyance. 7. Energy conservation, transitions and critical depth of flow. 8. Momentum conservation, energy dissipation and the hydraulic jump. 9. Measurement and control of river flow; Critical constrictions. 10. Gradually-varied flow. 11. Computation of flood waves in rivers, floodplains, and reservoirs. 12. Design of storm sewers and flood detention basins.
COURSE STRUCTURE/SCHEDULE Lecture: 2 per week @ 1.5 hours; Laboratory: 1 per week @ 2 hours)**:**	

COURSE OBJECTIVES	1. To teach students the fundamental concepts of surface-water hydrology and open-channel hydraulics, so students are prepared to apply these concepts to the analysis and design of methods predicting or mitigating floods. [a,b,c,d,e,h,i,j,k] 2. To teach students how to process information regarding rainfall data, river streamflow, and soil properties, so students can compute the net rainfall into a drainage basin and the resulting runoff hydrograph. [a,b,d,e,g,h,i,j,k]

	3. To teach students how to determine the depth and flow rate in a stream and its floodplain under uniform and non-uniform flow conditions. [a,b,c,d,e,g,j,k] 4. To teach students how to predict the time of travel, magnitude, growth and subsidence of flood waves. [a,e,i,j,k] 5. To teach students how to design a storm detention system to mitigate a flood of a given return period. [a,c,d,e,g,h,j,k]
COURSE OUTCOMES For <u>each</u> course outcome, links to the Program Outcom are identified.	1. Given radar or rain gauge data, climatological information, and soil properties, be able to compute area precipitation and infiltration rates for a drainage basin. 2. Given the cross-sectional geometry of a stream, be able to design and perform velocity measurements, and compute the flow rate. 3. Given intensity-duration-frequency data for a location, compute the time of concentration and the equilibrium runoff from a drainage basin. 4. Given the net rainfall hyetograph and runoff hydrograph of a watershed, be able to separate the base flow and compute the unit hydrograph. 5. Given the D-hour unit hydrograph, compute unit hydrographs of a different duration, and analyze complex storms of arbitrary duration. 6. Given a watershed with no runoff data, construct a synthetic hydrograph and compute the runoff from an arbitrary storm. 7. Given a time series of streamflow, be able to perform a frequency analysis, fit a distribution, and make a graphical presentation of the data. 8. Given a flow rate, be able to approximate open channel characteristics that can deliver it under conditions of uniform flow. 9. Given the geometric characteristics of a channel transition, be able to compute alternate and conjugate depths of flow. 10. Given the geometry of a channel, be able to identify and use critical sections for the measurement and control of the flow rate. 11. Given channel geometry and resistance, be able to compute the gradually-varied flow profiles for sub- and supercritical flow. 12. Given a depth-storage relation for a reservoir, and the inflow hydrograph, be able to compute the outflow hydrograph. Equivalently, be able to design a detention pond. 13. Given the properties of a river reach, predict the time of propagation and attenuation of a flood wave. 14. Given topographic and climatological data, be able to perform a complete design of surface drainage structures that can prevent flood hazards for the desired return period of a storm.
ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcome are identified.	1. In-class closed book exams test outcomes #1-11 for individual students. 2. Weekly laboratory exercises outcomes #1-11 under less time pressure. 3. Three computer program assignments test outcomes #11-14. 4. Laboratory performance and reports test outcomes #9-12 explicitly and # 2, 13, 14. 5. Team design project tests ability to work in a team, collect real topographic, climatological and streamflow data, apply methods of analysis, design an original hydraulic structure, and present the output (outcomes #1-8, 13-15).

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** March 2011

Prepared by: CoE – Civil & Environmental Engineering

COURSE #: CEE 428	**COURSE TITLE:** Introduction to Groundwater Hydrology
TERMS OFFERED: Fall	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: *Applied Hydrogeology,* Fetter, Prentice-Hall, 4th edition.	**PREREQUISITES:** CEE 260 (A) and CEE 325 (E) or equivalent
INSTRUCTOR(S): Demond	**COGNIZANT FACULTY:** Demond
CoE BULLETIN DESCRIPTION: Basic principles which govern the flow of water in the subsurface. Development and solution of groundwater flow and contaminant transport equations, in presence and absence of pumping wells, for both confined and phreatic aquifers. Measurement and estimation of parameters governing flow and transport, including methods such as pump tests and moment analysis. Remediation of contaminated groundwater.	**COURSE TOPICS:** 1. Groundwater environment 2. Water budgets 3. Darcy's Law 4. Aquifer properties 5. Flow equations for confined and phreatic aquifers 6. Flow equations for confined and phreatic aquifers including wells 7. Pump tests 8. Groundwater composition 9. Solute transport 10. Remediation of groundwater
COURSE STRUCTURE/SCHEDULE Lecture: 2 per week @ 1.5 hours; Laboratory: 1 per 2 weeks @ 2 hours	

COURSE OBJECTIVES	1. To teach students the basic principles of flow in confined and phreatic aquifers. [a] 2. To teach students how to estimate drawdown in situations with both single and multiple wells, boundaries and variable pumping rates. [c,e,i,j] 3. To show students how to estimate aquifer properties using pump tests. [a,e] 4. To prepare students to use software such as MODFLOW to solve practical groundwater problems. [c,h,k] 5. To introduce students to the basics of contaminant transport in aquifers. [a,b,e,k]

	6. To provide students with techniques for estimating parameters for both the flow and transport equations. [d,g]
COURSE OUTCOMES For <u>each</u> course outcome, links to the Program Outcom are identified.	1. Students will be able to calculate the head distribution and flow rates in a variety of aquifer types both analytically and numerically. 2. Students will be able to calculate drawdown in a variety of aquifer types both analytically and numerically. 3. Students will be able to calculate aquifer parameters from pump tests. 4. Students will be able to calculate breakthrough curves for both conservative and non conservative contaminants. 5. Students will be able to estimate parameters necessary for determination of contaminant transport. 6. Students will be able to collect appropriate hydrologic and climatologic information and develop a numerical aquifer model for a site, using state-of-the-art software.
ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcome are identified.	1. Problem Sets #1and 2 and Midterm #1 will test outcome #1. 2. Problem Set #3 and Midterm #2 will test outcome #2. 3. Problem Set #4 and Midterm #2 will test outcome #3. 4. Problem Set #5 and Midterm #2 will test outcomes #4 and 5. 5. Project and labs (#1-#6) will test outcomes #1, 2 and 6.

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** **25 March 2011**

Prepared by: SangHyun Lee and Vineet R. Kamat

COURSE #: CEE 431	**COURSE TITLE:** Construction Contracting
TERMS OFFERED: Fall, Winter	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: *Construction Contracting,* Clough et al., 7th ed., Wiley	**PREREQUISITES:** Junior standing
INSTRUCTOR(S): Lee, Kamat	**COGNIZANT FACULTY:** Lee
CoE BULLETIN DESCRIPTION: Construction contracting for contractors, architects, owners. (1) Organization and administration; industry structure; construction contracts, bonds, insurance. (2) Planning and estimating; quantity takeoff and pricing; labor and equipment estimates; estimating excavation and concrete; proposal preparation; scheduling; cost accounting. Students use contract documents to prepare detailed estimate.	**COURSE TOPICS:** 1. Structure of industry, project delivery methods 2. Design and construction contracts: contract types, agreements, general conditions 3. Construction documents: drawings, specifications, changes, submittals 4. Estimating, bidding, and awarding construction contracts 5. Project planning and scheduling 6. Cost accounting 7. Insurance and bonds 8. Dispute resolution 9. Ownership of design and construction businesses, management of construction firms
COURSE STRUCTURE/SCHEDULE Lecture: 2 per week @ 1.5 hour, Laboratory: 1 per week @ 1 hour	

COURSE OBJECTIVES	1. To understand project and construction vocabulary, entities, relationships, ethics. 2. To produce, read, and understand design and construction contracts and construction documents. 3. To learn basic construction detailed estimating, cost accounting and control, planning and scheduling processes. 4. To understand the relationships and responsibilities among owners, architects, engineers, construction managers, prime contractors, subcontractors, and vendors.

	5. To understand construction insurance, bonds, bidding, licensing, business formation and ownership.
COURSE OUTCOMES For <u>each</u> course outcome, links to the Program Outcom are identified.	1. Be able to understand construction terms and to use them appropriately in design and construction documents and other communications. 2. Given a list of requirements to be specified, be able to write a technical specification. 3. Given characteristics of a project, be able to select appropriate method of procuring design and construction services. 4. Given a list of project requirements, be able to write a contract for architectural or engineering services. 5. Given project name, location, price(s), construction time, owner, architect/engineer, contractor, liquidated damages, and other contract documents, be able to write a lump sum, unit price, or reimbursable cost agreement for construction. 6. Given the appropriate information to include, be able to write appropriate contract and construction documents such as subcontract agreement, bid bond or other guarantee, performance bond, payment bond, notice of award, letter of intent, application for payment, schedule of values. 7. Given working drawing and specification for a component, be able to perform quantity takeoff and estimate the cost of its construction, as an individual and as a team. 8. Given ones own construction costs and subcontractors' bids for segments of project; be able to produce a recap sheet and a bid for project individually and as a team. 9. Given construction activities and durations, be able to produce activity on node and activity on arrow network of required sequences individually and as a team. 10. Given a network of activities, be able to calculate earliest and latest start and finish times and floats for activities and project. 11. Given a list of cost accounts, daily hours worked per cost account, wages or equipment cost per hour, and construction output, be able to produce a weekly labor or equipment cost report. 12. Given weekly cost account reports and estimated costs, be able to calculate labor and equipment cost variances. 13. Given a particular personal injury or property damage exposure, be able to identify the party that is responsible and the appropriate insurance coverage. 14. Given a particular contract or construction document or method, be able to identify the role or responsibility of each entity for producing, reviewing, and approving it. 15. Given a project scenario, be able to describe capabilities and contract, business, construction, communication, and ethics responsibilities of construction entities.
ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcome are identified.	1. In class closed book midterm exam test outcomes #1-15 for individual students. 2. Laboratory projects and individual assignments test outcomes #1-2, 4-10 in more depth and under less time pressure. 3. Team laboratory projects test ability outcomes #7-9. 4. Two-hour closed book comprehensive final exam evaluates student's overall mastery of course materials.

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** **20 May 2011**

Prepared by: Terese Olson

COURSE #: CEE 460	**COURSE TITLE:** Design of Environmental Engineering Systems
TERMS OFFERED: Fall	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: Water Treatment: Principles and Design	**PREREQUISITES:** CEE 360 (A)
INSTRUCTOR(S): Olson	**COGNIZANT FACULTY:** Olson
CoE BULLETIN DESCRIPTION: Design and theoretical understanding of environmental processes; biological, physical, and chemical processes, and reactor configurations commonly used for water quality control; applications to the design of specific water and wastewater treatment operations; discussion of pollution prevention and green engineering options.	**COURSE TOPICS:** 1. Ideal and non-ideal reactor models 2. Reaction rate analysis 3. Equilibrium phase distributions 4. Mass transfer analysis 5. Pollution prevention and water conservation 6. Example process design applications for water quality control a) oxidation processes b) membrane processes c) adsorption processes d) air stripping processes e) chemical and physical disinfection f) coagulation processes g) particle filtration processes 7. Case study examples

COURSE STRUCTURE/SCHEDULE Lecture: 2 per week @ 1.5 hours; Optional Discussion: 1 per week @ 1 hour

COURSE OBJECTIVES	1. To teach students to apply mass balances to environmental processes 2. To teach students criteria for selecting process reactor types and considerations of process scale-up 3. To teach students how to incorporate chemical equilibrium relationships in multiphase environmental processes 4. To teach students principles of chemical kinetics and mass transfer rate analysis 5. To examine the conceptual design process for examples of water quality processes and incorporate economic and environmental impact evaluations of engineering alternatives 6. To hone students' technical writing skills 7. To provide students an appreciation of the historical context for current practice and emerging technological challenges through case studies
COURSE OUTCOMES For each course outcome, links to the Program Outcom are identified.	1. Ability to apply material conservation relationships to environmental processes. [a,c,e] 2. Ability to apply selection criteria for process reactor types and process scale-up principles.[c,e] 3. Ability to apply equilibrium relationships for component distributions in multiphase systems. [a] 4. An understanding of the physical and chemical rate limiting factors for environmental processes and an ability to estimate mass transfer rates in homogeneous and heterogeneous systems. [a,e] 5. Ability to apply the modeling principles of outcomes 1-4 to the conceptual design of engineered treatment processes, incorporating economic analysis into the selection of design alternatives. [a,c,e,j,k] 6. Improve professional and technical writing skills in design assignments. [g,m] 7. Ability to incorporate principles of pollution prevention in water quality process selection. [e,f,h,j] 8. Awareness of historical context for current practice, important future directions in environmental engineering, and the need for lifelong learning. [f,h,i,j,m]
ASSESSMENT TOOLS For each assessment tool, links to the course outcome are identified.	1. Three in-class exams designed to test outcomes 1-5 and 7-8 for individual students. 2. Eight sets of homework assignments that contain quantitative closed solution problems and open-ended design problems to assess outcomes 1-8. In at least 3 homework assignments, the design problems additionally focus on technical written communication skills.

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** **March 25, 2011**

Prepared by: **Lidia P. Kostyniuk**

<table>
<tr><td>COURSE #: CEE 470</td><td>COURSE TITLE: Introduction to Transportation Engineering</td></tr>
<tr><td>TERMS OFFERED: Winter 2011</td><td>For each prerequisite below, “E” denotes Enforced and “A” denotes Advised.</td></tr>
<tr><td>TEXTBOOKS/REQUIRED MATERIAL: Mannering, F.L., Washburn, S.S., Kilarski, W.P. Principles of Highway Engineering and Traffic Analysis, Fourth Edition, John Wiley & Sons, 2009.</td><td>PREREQUISITES: Math 116 (A) or permission of instructor</td></tr>
<tr><td>INSTRUCTOR(S): Lidia P. Kostyniuk</td><td>COGNIZANT FACULTY:</td></tr>
<tr><td>CoE BULLETIN DESCRIPTION:

This course introduces students to the fundamentals of planning, design, and operation of highway transportation facilities. Topics covered include driver and vehicle performance characteristics, highway geometric design principles, basics of traffic analysis, and transportation planning.</td><td>COURSE TOPICS:

1. The fields of transportation engineering
    Economic, social, political role of transportation
    Role of civil engineering in transportation
2. Vehicle and driver
    Road vehicle performance
    Driver performance
3. Geometric design of highways
    Sight distance requirements
    Superelevations
    Horizontal and vertical alignments
4. Fundamentals of traffic flow and queuing theory
    Queuing theory
    Applied queuing models
    Traffic delay computations
5. Highway Capacity and Level of Service
    Level of service concept
    Basic Freeway Segments
    Multilane and two lane highways
6. Traffic control and analysis at signalized intersections</td></tr>
</table>

	Probabilistic arrivals Traffic signal timing 7. Travel demand and traffic forecasting Traveler decisions Travel demand model system 8. Evaluation Environmental and sustainability Issues Safety
COURSE STRUCTURE/SCHEDULE Lecture: 3 per week @ 50 minutes;	

COURSE OBJECTIVES	The purpose of this course is to provide students with a solid introduction to the principles of transportation engineering with a focus on highway engineering and traffic analysis. The material learned will provide the basic skill set that will allow students to solve commonly-encount problems in design, operation, and planning of highway transportation.
COURSE OUTCOMES For <u>each</u> course outcome, links to the Program Outcom are identified.	A student completing this course should: 1. be able to start thinking critically about fundamental issues in transportation. 2. have basic understanding of the performance characteristics associated with modern road vehicles. 3. have basic understanding of elements involved in geometric design of roads including the safety concerns that motivate vertical and horizontal curve design. Student should be able to begin a basic road design. 4. have very basic understanding of queuing theory and familiarity with deterministic and probabilistic assumptions made for analysis of arrivals and departures in traffic flow analysis. 5. be able to conduct level of service analysis and gain the background needed to use the Highway Capacity Manual (HCM) level of service software. 6. be familiar with the elements of signal timing, terminology, and basic signal timing theory. 7. have basic understanding of the various modeling approaches for determining and forecasting travel demand. 8. have basic understanding of the elements and modeling approaches used in evaluating highway projects, (energy use, noise, emissions, safety)
ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcome are identified.	1. Six problem-oriented homework assignments. The objective of these assignments is to assist in the learning of the course material, so discussion among students is encouraged, but each student hands in his/her own homework. (course outcomes 2-8) 2. Each student is required to complete a group project. The project can deal with any transportation-oriented problem and can be completed individually or in groups of up to three students. Each group submits a written report (10-15 pages) and makes an informal presentation to the class. (course outcome 1) **3.** Exams - An in-class one-hour mid-term exam and a two-hour final exam to demonstrate student's mastery of material presented in class. Both are open book. (course outcomes 2-8)

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** May 27, 2011

Prepared by: Gustavo J. Parra-Montesinos

COURSE #: CEE-512	**COURSE TITLE:** THEORY OF STRUCTURES
TERMS OFFERED: Fall	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: None; various textbooks recommended, in addition to course handouts	**PREREQUISITES:** CEE-312 or equivalent (A)
INSTRUCTOR(S): Gustavo J. Parra-Montesinos	**COGNIZANT FACULTY:** Gustavo J. Parra-Montesinos
CoE BULLETIN DESCRIPTION: Presentation of the direct stiffness method of analysis for two-dimensional and three-dimensional structures. Overview of analysis techniques for arch and cable-supported structures. Brief introduction to the theory of plates and shells. Lecture.	**COURSE TOPICS:** **1. Overview of Stiffness Method** a. Kinematic indeterminacy b. Review of relationship between member end displacements and actions (truss elements; beam-column elements) c. Member loads and equivalent joint loads d. Construction of structure (joint) stiffness matrix e. Determination of joint displacements, member end actions, and reactions **2. Direct Stiffness Method (applied to frame and truss structures)** a. Global versus local axes b. Rotation of axes c. Member stiffness matrix (includes application of energy methods, member stiffness matrix from flexibility matrix) d. Determination of joint stiffness matrix e. Joint and member loads, support displacements f. Determination of joint displacements, member end actions, and reactions g. Other topics: elastic supports, flexible connections, member releases, incorporation of shear deformations in framed elements, member offsets **3. Energy concepts** a. Stress and strain components b. Strain energy

	c. Principle of stationary potential energy (applications) d. Virtual work/complementary virtual work (applications) **4. Introduction to Nonlinear Analysis** a. Sources of nonlinearity b. First versus second-order analysis; elastic versus inelastic analysis c. Inelastic models for framed elements d. P-Δ effects
COURSE STRUCTURE/SCHEDULE (i.e., Lecture: 3 per week @ 50 minutes; Laboratory: 1 per week @ 2 hours)**:** 3 per week @ 50 minutes	

COURSE OBJECTIVES	To identify degrees of freedom and assemble stiffness matrix for 2D truss and framed structures. To determine equivalent joint loads due to member loads, changes in temperature, and prestrains. To determine joint displacements, reactions and member internal actions in indeterminate structures using the stiffness method. To apply computer programming in order to analyze structures using the direct stiffness method. To learn the concepts of virtual work and its application for determination of equivalent joint loads and member stiffness matrix. To learn basic concepts of second-order and inelastic structural analysis.
COURSE OUTCOMES For each course outcome, links to the Program Outcomes are identified.	For a given truss or frame member at an arbitrary orientation, construct the member stiffness matrix based on global axes. For a given truss or frame structure subjected to joint loads, identify the structure degrees of freedom, construct the structure stiffness matrix, and determine joint displacements, reactions and member end forces. Determine equivalent joint loads for a given member subjected to a set of external loads, changes in temperature, and/or prestrains. For a given frame member, determine its stiffness matrix accounting for shear deformations, as well as for the presence of flexible connections and end rigid zones. Using the concept of rotation of axes, convert stiffness matrix and load and displacement vectors from/to local axes to/from global axes (2D). Using the direct stiffness method and applying computer programming, determine joint displacements, reactions, and member internal forces in 2D structures. Using the principle of virtual work, determine the stiffness matrix for any arbitrary frame member. Using the principle of virtual work, determine equivalent loads for a member subjected to external loads, changes in temperature, and/or prestrains.
ASSESSMENT TOOLS For each assessment tool, links to the course outcomes are identified.	Weekly or bi-weekly homework assignments for practice and learning. Allow work in small teams. One in-class mid-term exam (2 hours) to demonstrate individual's mastery of the material covered in class. Exams are closed-book, but students are allowed to bring one equation sheet. One two-hour final exam to demonstrate achievement of the anticipated course outcomes. Students are allowed to bring two equation sheets, one being that used during the mid-term examination.

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** 3/27/2011

Prepared by: CoE – Civil & Environmental Engineering

COURSE #: CEE 521	**COURSE TITLE:** FLOW IN OPEN CHANNELS
TERMS OFFERED: Fall	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: Free Surface Flow (e-book)	**PREREQUISITES:** CEE 325
INSTRUCTOR(S): Katopodes	**COGNIZANT FACULTY:** Nik Katopodes
CoE BULLETIN DESCRIPTION: Conservation laws for transient flow in open channels; shallow-water approxima the method of characteristics; simple waves and hydraulic jumps; nonreflective boundary conditions; dam-break analysis; overland flow; prediction and mitigatio flood waves.	**COURSE TOPICS:** 1. One-dimensional approximation of flow problems; Pressure and velocity distribution in an open channel. 2. Steady Flow principles; Uniform Flow; Rapidly-varied and gradually-varied fl 3. Transition Flow; Flow over a bottom ridge and through a constriction; Alternate depths; Occurrence of critical flow; Flow controls. 4. Specific energy and specific force diagrams; Design of energy dissipators. 5. Flow Resistance; Surface and form resistance. 6. Uniform flow; Channel conveyance and design of best channel section. 7. Non-uniform flow; mild and steep slopes; 8. Classification of gradually-varied flow profiles; 9. Overland Flow - Kinematic-wave theory. 10. Dynamic-wave characteristics; Domain of dependence and region of influence. 11. Elevation waves and spontaneous shock formation; 12. Dam-Break Analysis – Dry channel. 13. Partial opening and closing of sluice gates. 14. Flood Prediction and Mitigation; Sustainable channel design; 15. Control of open-channel flow; Adjoint equations and sensitivity waves.
COURSE STRUCTURE/SCHEDULE Lecture: 3 per week @ 50 minutes	

COURSE OBJECTIVES	1. To teach students the fundamental concepts of channel flow. [a,b,e,i,j,k] 2. To teach students how to design channels for a desired capacity. [a,e,k] 3. To teach students how to determine numerically backwater profiles. [a,b,c,e,g,i,j,k] 4. To teach students transient control operation in open channels. [a,c,e,g,i,j,k] 5. To teach students how to design a channel to prevent flooding. [a,b,c,e,g,k]
COURSE OUTCOMES For <u>each</u> course outcome, links to the Program Outcom are identified.	1. Given a desired flow, design a channel that can deliver it. 2. Given a system of lakes, design the interconnecting channels for flood mitigation. 3. Given a dam, determine alert methods and potential flood inundation maps. **4.** Given a system of channel gates, determine their optimal operation for navigation, irrigation, etc.
ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcomes are identified.	1. In-class closed book exams test outcomes #1-5 for individual students. 2. Weekly problem sets test outcomes #1-5 under less time pressure.

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** March 2011

Prepared by: CoE – Civil & Environmental Engineering

COURSE #: CEE 526	**COURSE TITLE:** Design of Hydraulic Systems
TERMS OFFERED: Winter	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: *Hydraulics of Pipelines,* Tullis, 1st ed., Wiley	**PREREQUISITES:** CEE 325 or equivalent
INSTRUCTOR(S): Wright	**COGNIZANT FACULTY:** Wright
CoE BULLETIN DESCRIPTION: Hydraulic design of piping systems including pumps and networks; pump system design including variable speed operation, cavitation, and wet well design; waterhammer and other transient phenomena; control valves and flow metering considerations; hydraulic control structures.	**COURSE TOPICS:** 1. Design of Branching Pipe Systems 2. Piping Systems with Pumps 3. Turbomachinery 4. Pipe Networks 5. Control Valves, metering and other design 6. Cavitation in Pumps and Valves 7. Economic Analysis of Pipe Systems 8. Pump Sump Design 9. Unsteady flow, classification and analysis procedures 10. Trapped Air in Pipelines
COURSE STRUCTURE/SCHEDULE Recitation: 3 per week @ 1 hour	

COURSE OBJECTIVES	1. To teach students how to analyze general piping systems including series, parallel, and branching systems and pipe networks. [a,c,e,k] 2. To teach students how to analyze piping systems with pumps including series and parallel pump systems. [a,e,k] 3. To teach students how to select control valves, pumps and other system elements to avoid cavitation, minimize costs, achieve metering objectives, and other system detail. [a,c,e,k]

	4. To teach students the basics of pump sump design. [a,j,k] 5. To teach students the basics of unsteady flow analyses. [a,j,k] 6. To provide methodology for analyzing water distribution networks as well as the issues associated with distribution system design. [c,d,e,g,j,k]
COURSE OUTCOMES For <u>each</u> course outcome, links to the Program Outcom are identified.	1. Given a simple series or parallel piping system, be able to compute the flow rate. 2. Given a branching pipe system or a pipe network, be able to compute the flow distribution and system pressures. 3. Given a piping system with a pump, be able to analyze the flow through the system. 4. Given a piping system with multiple pumps in series or parallel, be able to analyze the system flow. 5. Given a specified turbomachine, be able to predict its performance under different rotational speeds and impeller sizes. 6. Be able to select a control valve for purposes of regulating flow in pipelines. 7. Be able to analyze a system for the potential of cavitation in valves, pumps, etc. 8. Be able to select a flow meter for a piping system to meet specific metering objectives such as minimizing head loss, attaining meter accuracy, etc. 9. Be able to estimate the capital and operating costs of a piping system to determine the most economical design. 10. Given a pumping system with required wet well, be able to develop a preliminary design on wet well geometry. 11. Given an unsteady flow application, to be able to select the appropriate analysis techniques. 12. Given a system description, to formulate and solve equations for rigid column analysis. 13. To understand the basics of waterhammer analysis, circumstances that lead to severe water hammer and methods for waterhammer control.
ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcome are identified.	1. Design project and assignments, test outcomes 1-13. 2. Final Examination, test outcomes 1-12

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** April 2011

Prepared by: CoE – Civil & Environmental Engineering

COURSE #: CEE 534	**COURSE TITLE:** Construction Engineering, Equipment, and Methods
TERMS OFFERED: Winter	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: *Construction Methods & Management,* Nunnally, 8th ed., Prentice Hall	**PREREQUISITES:** Junior Standing (A)
INSTRUCTOR(S): Everett	**COGNIZANT FACULTY:** Everett
CoE BULLETIN DESCRIPTION: Major construction equipment and concrete construction. Selection of scrapers, dozers, cranes, etc., based on applications, methods, and production requirements. Power generation, transmission, and output capacity of equipment engines. Calculation of transport cycle times. Concrete methods include mixing, delivery, and placement. Design of forms for concrete walls and support slabs.	**COURSE TOPICS:** 1. Site clearing and erosion control measures 2. Earthmoving materials and equipment fundamentals 3. Excavation methods and stability of excavations 4. Loading, hauling, cycle times, and equipment production 5. Rock excavation and blasting 6. Cranes and lifting 7. Construction equipment economics 8. Production of aggregates and concrete 9. Concrete characteristics, problems, and admixtures 10. Conveying, placing, curing, hot weather and cold weather concreting. 11. Concrete form design
COURSE STRUCTURE/SCHEDULE Lecture: 2 per week @ 1.5 hour	

COURSE OBJECTIVES	1. To teach students the planning and sequencing of safe site development, earthwork, and rock excavation operations. 2. To teach students the characteristics and applications of major types of construction heavy equipment. 3. To teach students to design and optimize a spread of multiple types of equipment to perform specific earthmoving operations under schedule and cost constraints. 4. To teach students the procedures and equipment for batching, mixing, transporting, placing, finishing and curing of concrete.

	5. To teach students how to design concrete forms.
COURSE OUTCOMES For <u>each</u> course outcome, links to the Program Outcom are identified.	1. Given a required excavation and soil characteristics, determine loose volumes, compacted volumes, and spoil pile sizes and configurations. [a,c,e,f,k,l] 2. Given manufacturers rated horsepower, determine available power, rimpull and drawbar pull at different altitudes and temperatures. [a,c,e,i,k] 3. Given haul road configurations, calculate grade resistance, rolling resistance, required pull, and useable pull for a given piece of equipment. [a,c,e,k,l] 4. Given equipment manufacturer's data and job site conditions, compute equipment cycle times and production rates. [a,c,e,k,l] 5. Given site conditions and equipment manufacturer's data, design appropriate multi-equipment combinations to meet production requirements. Determine the number of pieces of each type of equipment to optimize production and cost. [a,c,e,f,k,l] 6. Given seismic velocities of rock and equipment manufacturer's data, determine the production output of rock excavation equipment. [a,c,e,k,l] 7. Given bench height, specific gravities of rock and explosives, and available drilling equipment: design a blast pattern including; burden, hole spacing, and delays. [a,c,e,k,l] 8. Given lift charts, loads and site constraints, design heavy lifts including; crane selection, location, and lift sequence. [a,c,e,f,k,l] 9. For a given piece of equipment, calculate ownership and operating costs as an hourly rate. [a,c,e,f,k,l] 10. Given concrete slab self weight, construction loads, shoring and reshoring weights, determine maximum slab loads for a multi-story cast-in-place concrete building. [a,c,e,f,k,l] 11. Given a set of plans, design formwork and shoring for a structural concrete slab. [a,c,e,f,k,l] 12. Given a set of plans, design formwork for a concrete wall. [a,c,e,f,k,l]
ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcomes are identified.	5. Weekly homework assignments to provide practice and stimulate questions. 6. Open-book exams to test the students' ability to apply the concepts learned in class to realistic situations.

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** **March 25, 2011**

Prepared by: CoE – Civil & Environmental Engineering

COURSE #: CEE 536	**COURSE TITLE:** Critical Path Methods
TERMS OFFERED: Fall, Spring	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: *Precedence & Arrow Networking Techniques for Construction,* Harris, 1978, Wiley; CRSPK Eng-Civ.636	**PREREQUISITES:** Senior or graduate standing
INSTRUCTOR(S): Lee	**COGNIZANT FACULTY:** Lee
CoE BULLETIN DESCRIPTION: Basic critical path planning and scheduling with arrow and precedence networks; project control; basic overlapping networks; introduction to resource leveling and least cost scheduling; fundamental PERT systems.	**COURSE TOPICS:** 1. Arrow Networks 2. Precedence Networks 3. Activity Durations 4. Arrow Network Computations 5. Precedence Network Computations 6. Project Reporting and Control 7. PERT 8. Time-Cost Tradeoff 9. Limited Resource Allocation 10. Unlimited Resource Leveling 11. Overlapping Networks 12. Repetitive Scheduling Method
COURSE STRUCTURE/SCHEDULE Lecture: 2 per week @ 1.5 hours	

COURSE OBJECTIVES	1. To understand the principles, steps, and techniques involved in planning, scheduling, and control of construction projects. 2. To learn and apply the basics of CPM and PERT scheduling using activity-on-arrow and activity-on-node networks. 3. To be able to perform project planning, scheduling, and control of construction projects, develop target schedules and communicate the results.

	4. To understand and solve resource-driven problems such as time-cost tradeoff, limited resource allocation, and resource leveling. 5. To learn the basics of advanced project scheduling, overlapping precedence networks, and repetitive project scheduling (RSM).
COURSE OUTCOMES For <u>each</u> course outcome, links to the Program Outcom are identified.	1. Given the description of a project create an activity list and identify precedence relationships. 2. Given an activity list estimate activity durations based on construction methods used and resources applied. 3. Given an activity list and precedence relationships construct the correct plan using an activity-on-arrow network, an activity-on-node (precedence) network, or an overlapping precedence network. 4. Perform scheduling calculations for activity-on-arrow networks, activity-on-node networks, and overlapping precedence networks to determine the early and late start and finish times for activities, the early and late times for event occurrence, and the total, free, interfering, and independent floats for each activity. (Several schedule calculation methods and software could be used for each type of network). 5. Construct and communicate the schedule using tables, barcharts, networks, and time-scaled networks. 6. Understand work breakdown structure (WBS), organizational breakdown structure (OBS) and their function in project control. 7. Be able to construct target time-cost S curves (Budgeted Cost of Work Scheduled), and evaluate work progress using Actual Cost of Work Performed (ACWP) and Budgeted Cost of Work Performed (BCWP) using the concepts of Cost and Schedule Variances. 8. Given past activity performance and estimated duration and precedence for remaining activities construct an updated project schedule. 9. Given time-cost curves for the activities of a project, determine the minimum direct-cost curve as a function of project duration and identify the activity and project duration that minimize total project cost (using the Fondahl algorithm, or by using linear programming software). 10. Given daily resource requirements for project activities, find the minimum project duration subject to limited resource availability using the Wiest algorithm. 11. Given activity daily resource requirements, schedule the work to minimize daily resource fluctuations without extending project duration using the Minimum Moment algorithm or the PACK algorithm (by hand or by using CPMLevel software). 12. Master basic concepts relating to beta and normally distributed random variables, subjective estimation of moments using PERT and Perry & Greig approximations, the use of normal probability tables, and the implications of the central limit theorem in network scheduling. 13. Perform probabilistic analysis (including the treatment of merge event bias) for PERT networks using the traditional PERT approach, the PNET method, as well as numerical simulation methods using ProbShed software. 14. Given a CPM network describing the work in a unit of a multi-unit project, use the repetitive scheduling method (RSM) to schedule the work in each unit so as to minimize project duration and achieve continuity in resource utilization (the work of crews from unit to unit). 15. Given a project determine which elements may be best scheduled using CPM and which using RSM and integrate the two methods to schedule the work.
ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcomes are identified.	1. 10 problem sets address most of the above desired outcomes. Homework becomes the basis for testing in exams. Some homework assignments require the use of general purpose or specialized software as appropriate. 2. Term project: Students form teams of 3-4 persons and conduct research on the new paradigms, technique, and tools to improve planning and scheduling in construction. Final requirement is presentation and a final report. Term project addresses how course outcomes can be improved with new techniques and allows students to see state-of-the art planning and scheduling. 3. In-class closed book midterm exam test outcomes #1-15 for individual students. 4. Two-hour closed book comprehensive final exam evaluates student’s overall mastery of course material.

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** February 2011

Prepared by: CoE – Civil & Environmental Engineering

COURSE #: CEE 537	**COURSE TITLE:** Construction of Buildings
TERMS OFFERED: Fall	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: *Fundamentals of Building Construction: Materials and Methods,* Allen, 5th ed., Wiley, 2009. Course notes.	**PREREQUISITES:** CEE 351
INSTRUCTOR(S): Everett	**COGNIZANT FACULTY:** Everett
CoE BULLETIN DESCRIPTION: Material selection, construction details, manufacture, fabrication, and erection of building structures using steel, light wood, timber, cast-in-place concrete, precast concrete, and masonry; and of building materials for roof, floor, and wall surfaces. Field trips to fabrication plants and construction sites.	**COURSE TOPICS:** 1. Zoning, building codes, permits, inspection 2. Excavations, earth retention 3. Foundations 4. Concrete 5. Masonry 6. Steel 7. Wood 8. Interior construction 9. Roofing 10. Mechanical 11. Electrical
COURSE STRUCTURE/SCHEDULE Lecture: 2 per week @ 1.5 hours	

COURSE OBJECTIVES	1. Generally, to show and teach students how the systems they learned to design in other courses are actually put together in the field, including terminology, means and methods, safety considerations, and productivity and cost considerations. [a,f,g,h,i,j,k,l,m] 2. To teach students about the professional and legal issues regarding zoning, building codes, permits, and inspection. [f,g,h,i,j,k,l,m]

	3. To teach students how earth retention systems and foundation systems are constructed. [a,c,e,l] 4. To teach students how building structural systems (concrete, masonry, steel, and wood) are constructed. [a,c,e,l] 5. To teach students how building interior systems (light gauge steel framing and drywall) are constructed. [a,c,e,f,l,m] 6. To teach students how roofing systems are constructed. [a,l] 7. To introduce students to major pieces of mechanical equipment. [a,c,e,j,l] 8. To introduce students to major pieces of electrical equipment. [a,c,e,j,l]
COURSE OUTCOMES For each course outcome, links to the Program Outcom are identified.	1. Given plans, specifications, cost, size, and location of a building, prepare documents to apply for zoning variance and building permit. 2. Given type of foundation or structural system, define terminology and sketch construction and connection details. 3. Given a list of building components, be able to visit a construction site and locate the components.
ASSESSMENT TOOLS For each assessment tool, links to the course outcome are identified.	1. Weekly problem sets address most of the above desired outcomes. Homework becomes the basis for testing in exams. Some homework assignments require the use of general purpose software as appropriate. 2. Closed book midterm exams evaluate the students' test preparation effort and allow testing most outcomes in detail.

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** **25 March 2011**

Prepared by: **Vineet R. Kamat**

COURSE #: 539	**COURSE TITLE:** CONSTRUCTION MANAGEMENT INFORMATION SYS
TERMS OFFERED: Winter	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised**
TEXTBOOKS/REQUIRED MATERIAL:	**PREREQUISITES:** Senior or graduate standing
INSTRUCTOR(S): Kamat	**COGNIZANT FACULTY:** Kamat
CoE BULLETIN DESCRIPTION: Automation of construction engineering and management functions using modern analysis, design, and productivity tools. Modeling and graphical 3D visualization of construction processes and products. Mobile computing and information systems to support field engineering tasks. Students apply computerized systems to solve construction problems and case studies.	**COURSE TOPICS:** 1. Operations design 2. Randomness and uncertainty 3. Activity cycle diagrams 4. Probability distributions 5. Discrete event simulation 6. Data collection and goodness of fit analysis 7. Statistical interpretation of simulation results 8. Visualization of simulated operations 9. Verification, validation and accreditation 10. Mobile computing applications
COURSE STRUCTURE/SCHEDULE Lecture: 1 per week @ 3 hours	

COURSE OBJECTIVES	1. To understand the principles, steps, and techniques involved in designing and optimizing construction field operations. 2. To learn and apply the basics of activity cycle diagrams to create models that appropriately represent construction operations. 3. To be able to perform computer simulation on construction operation models using appropriately designed experiments, and analyze interpret simulation results. 4. To understand the implications of uncertainty in the context of construction operations, and determine the best distribution and parar to use to represent each uncertain aspect of a proposed operation design. 5.To learn how to verify, validate, and communicate simulated construction operations using dynamic 3d visualization.

COURSE OUTCOMES For <u>each</u> course outcome, links to the Program Outcom are identified.	1. Given the description of a construction operation, identify the processes and tasks involved, and the resources required. 2. Given a list of processes comprising an operation and their resource requirements, identify the process interrelationships and competition for scarce resources. 3. Given a list of processes and resources and their interrelationships, conceive and construct an operation plan using Activity Cycle diagrams. 4. Master basic concepts relating to uniform, exponential, beta, lognormal, and normally distributed random variables, subjective estimation of activity or inter-arrival times, and their implications in estimating durations of planned tasks or processes in an operation. 5. For an existing operation, measure time durations for various tasks, conduct Chi-Square, Kolmogorov-Smirnov (KS), and Anderson Darling (AD) goodness-of-fit analysis on the measured durations, and estimate the best probability distributions to describe the observed task durations. 6. Perform discrete-event simulation analysis using EZStrobe and Stroboscope simulation software 7. Master basic concepts related to the interpretation of probabilistic simulation results, and the implication of multiple simulation replications in achieving a desired confidence interval for a dependent variable. 8. Understand the processes of model verification, validation, and accreditation (VVA) and their function in simulation analysis and construction operations design. 9. Be able to graphically visualize simulated operations in 3D for VVA using Vitascope visualization software.
ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcomes are identified.	1. Weekly problem sets address most of the above desired outcomes. Homework becomes the basis for testing in exams. All homework assignments require the use of general purpose or specialized software as appropriate**.** 2. Term project: Students form teams of 3-4 persons acting as construction planning and operations design consultants to produce a professional report for planning and designing an actual engineering operation using simulation analysis and state of the art modeling (Stroboscope) and visualization (Vitascope) software**.** 3. Two take-home midterm exams evaluate students' understanding of course material and allow testing most outcomes in detail 4. Two-hour closed book comprehensive final exam evaluates student's overall mastery of course material.

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** April 2011

Prepared by: CoE – Civil & Environmental Engineering

COURSE #: CEE 540	**COURSE TITLE:** Advanced Soil Mechanics
TERMS OFFERED: Fall	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: Soil Behavior and Critical State Soil Mechanics. D.M. Wood, Cambridge	**PREREQUISITES:** CEE 345
INSTRUCTOR(S): Michalowski	**COGNIZANT FACULTY:** Michalowski
CoE BULLETIN DESCRIPTION: Deformation and strength of soils; total and effective stress; drained and undrained behavior. Constitutive description: elastic-plastic, hardening/softening, Cam clay model, critical states. Stress paths, and testing of soils. Modeling of reinforced soil: multi-component model and homogenization approach; fiber-reinforced soil. Theorems of limit analysis; applications in stability assessment.	**COURSE TOPICS:** 1. Deformation and strength of soils 2. Total and effective stress 3. Drained and undrained behavior 4. Constitutive description of soils (elastic-plastic, hardening/softening, Cam clay model, critical states) 5. Stress paths, and testing of soils 6. Reinforced soil 7. Theorems of limit analysis 8. Applications
COURSE STRUCTURE/SCHEDULE Lecture: 2 per week @ 1.5 hours	

COURSE OBJECTIVES	1. To develop knowledge of the fundamental concepts of elastic and plastic behavior of soils, and their mathematical description consistent with the rules of continuum mechanics. 2. To develop understanding of drained and undrained behavior of soils and interpretation of triaxial test results for both drained and undrained stress paths. 3. To became familiar with the elasto-plastic modeling of soils, and Cam clay model in particular, and develop understanding of critical states. 4. To understand the notion of stability and the concepts of the yield condition and the flow rule in the context of limit analysis.

	5. To develop understanding of reinforcement interaction with soil, and to use this skill in both the analysis and design. 6. To develop the skill to construct statically admissible stress fields and kinematically admissible failure mechanisms with hodographs. 7. To develop the ability to apply the theorems of limit analysis to stability problems in geotechnical engineering.
COURSE OUTCOMES	1. Given the stress and strain state in deforming continuum, represent those states using index notation; show ability to perform operations on tensors. 2. Given the reversible/irreversible response of soil, characterize the soil in terms of its elastic, plastic and rate-dependent properties; develop an appropriate framework for mathematical description of the behavior (constitutive law). 3. Given information from drained or undrained deformation process of soil, interpret this behavior in terms of generated and dissipated pore water pressure, and characterize the soil plastic properties. 4. Given loads on geotechnical structures, introduce parameters that are appropriate to express loss of stability. 5. Demonstrate geotechnical engineering cases where the kinematic approach of limit analysis yields an upper bound to the limit load, and when it yields the lower bound; provide explanation. 6. Given soil strength parameters (c, ϕ) calculate an upper bound to critical height of the slope, for slopes of any inclination; demonstrate the ability to include the presence of water in the soil, and also seismic excitation. 7. Demonstrate the ability to apply the theorems of limit analysis in any geotechnical engineering stability problem.
ASSESSMENT TOOLS For each assessment tool, links to the course outcomes are identified.	1. Take-home assignments [1-6]. 2. Midterm test [1-3] 3. Final exam [1-7] 4. In-class question-and-answer sessions [4,5,7] 5. End-of-semester survey for students' evaluation of course outcomes [1-7].

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** May 2011

Prepared by: CoE – Civil & Environmental Engineering

COURSE #: CEE 545	**COURSE TITLE:** Foundation Engineering
TERMS OFFERED: Fall	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: *Foundation Design,* Coduto, 2nd ed., Prentice Hall	**PREREQUISITES:** CEE 345
INSTRUCTOR(S): Hryciw	**COGNIZANT FACULTY:** Hryciw
CoE BULLETIN DESCRIPTION: Application of principles of soil mechanics to: determination of bearing capacity and settlement of spread footings, mats, single piles and pile groups; site investigation, evaluation of data from field and laboratory tests; estimation of stresses in soil masses; soil structure interaction.	**COURSE TOPICS:** 1. Engineering properties of soils (a review). 2. Drained and undrained soil strength. 3. Soil exploration and sampling 4. In-situ testing 5. Bearing capacity of shallow foundations. 6. Stresses in soils. 7. Immediate settlement and consolidation settlement 8. Spread footings, combined footings and mats 9. Soil-structure interaction, beam on elastic foundation. 10. Single piles, load transfer to soils, tip bearing and side friction. 11. Pile driving formulas, wave equation. 12. Pile load tests. 13. Pile groups 14. Lateral Loading on piles 15. Drilled shafts, auger cast piles and rammed aggregate
COURSE STRUCTURE/SCHEDULE Lecture: 2 per week @ 1.5 hours	

COURSE OBJECTIVES	1. To review with students basic soil properties including phase relationships, index properties, classification, seepage and effective stress. 2. To teach students how drained and undrained soil strengths are determined and when each should be used in design. 3. To teach students how to plan and conduct a site investigation program, including in-situ tests. 4. To teach students to understand and use bearing capacity equations for shallow foundation design. 5. To teach students to compute stresses in soils due to imposed surface loading. 6. To teach students how to predict immediate and consolidation settlements. 7. To teach students how to determine stresses and deformations of mat foundations. 8. To teach students to understand the load transfer mechanisms between deep foundations and soil. 9. To teach students how to predict capacities of piles by static analysis, pile driving formulas and load tests. 10. To teach students how to predict bearing capacities and settlements of shallow foundations based on in-situ tests 11. To teach students how to predict load carrying capacities of deep foundations based on in-situ tests. 12. To teach students how to construct spread footings, pile foundations and drilled shafts.
COURSE OUTCOMES For <u>each</u> course outcome, links to the Program Outcom are identified.	1. Given a site's soil unit weights and groundwater conditions, to be able to compute the variation of total stress, pore water pressure and effective stress with depth. 2. Given a site description and expected construction time frame, be able to determine whether drained or undrained soil strengths should be used for foundation design. 3. Given a site plan, be able to recommend a site investigation program including spacing and depth of borings and in-situ tests. 4. Given geotechnical site conditions, soil properties and structural loads, to be able to size a spread footing to achieve a desired factor of safety against failure. 5. Given an imposed surface load, to be able to compute increases in subsurface stress. 6. Given a soil's compressibility properties, to be able to estimate ground settlements due to the imposed surface load. 7. Given mat foundation dimensions and soil subgrade modulus distribution, to be able to predict by numerical techniques the mat deformations. 8. Given that a shallow foundation is unfeasible, be able to design a deep foundation alternative. 9. Given a soil boring log or CPT result, be able to describe the expected load transfer from piles over depth. 10. Given the results of a pile load test, be able to estimate the ultimate load carrying capacity of the pile. 11. Given SPT and, or CPT data, be able to estimate bearing capacities and settlements for shallow foundations and load carrying capacities for deep foundations. 12. Given the dimensions of a pile group, be able to predict the group efficiency.
ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcome are identified.	1. Two in-class closed book exams (2 hours each) test outcomes #1-12. 2. Weekly homework problem sets test outcomes #1-12. 3. Group projects to test outcomes #5 and #11

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** **March, 2011**

Prepared by: CoE – Civil & Environmental Engineering

COURSE #: 546	**COURSE TITLE:** SLOPES, DAMS AND RETAINING STRUCTURES
TERMS OFFERED: Winter	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: no textbook required – in class handouts	**PREREQUISITES:** CEE 345 (E)
INSTRUCTOR(S): Athanasopoulos-Zekkos	**COGNIZANT FACULTY:** Athanasopoulos-Zekkos
CoE BULLETIN DESCRIPTION: Slope stability analyses, seepage through soils, settlements and horizontal move in embankments, earthen embankment design, landslide and embankment stabilization, earth pressures and retaining structure design.	COURSE TOPICS: I. Introduction II. Slope Stability -Methods for Static Slope Stability Analyses -Effects of Water on Slope Stability -Analyses for Rapid Drawdown -Slope Stability Charts -Computer Programs for Slope Stability -Dynamic Slope Stability (briefly) -Factors of Safety and Reliability -Slope Stabilization and Repair -Special Topics III. Dam Engineering -Geology and Site Investigation Issues -Embankment types and Zoning -Design and Construction of Filters -Dam Foundations -Seepage, Internal Erosion and Piping -Analyses of Stability and Deformations -Seismic Design of Dams (briefly) IV. Earth Retaining Structures -Lateral Earth Pressure Theory -"Rigid" and Flexible Retaining Walls

	-Mechanically Stabilized Earth Walls -Excavation Bracing -Slurry Walls -Seismic Lateral Earth Pressures (briefly)
COURSE STRUCTURE/SCHEDULE (i.e., Lecture: 3 per week @ 50 minutes; Laboratory: 1 per week @ 2 hours)**: Lecture: 2 per week @ 1.5 hours**	

COURSE OBJECTIVES	1. To develop understanding of the factors contributing to stability of earth slopes, including the influence of the presence of water, and to familiarize students with different methods of slope stability analyses. 2. To familiarize students with a slope stability software and use it to analyze slope stability problems. 3. To teach students mitigation techniques for slope repair and slope monitoring. 4. To teach students theories of earth pressure, and methods to determine lateral earth loads against retaining structures. 5. To teach students to design and perform stability analyses for gravity, cantilever retaining walls, sheet-pile walls, mechanically stabilized earth (MSE) walls and braced excavations. 6. To develop understanding of the factors contributing to the design and stability of earthen dams, including influence of foundation conditions, geologic environment, climate, construction methods and material availability.
COURSE OUTCOMES For each course outcome, links to the Program Outcom are identified.	1. Given the soil density and shear strength parameters of the backfill determine the lateral stress distribution and resultant lateral load against a vertical retaining wall with an horizontal, unsurcharged backfill 2. Given the same information in (1) above determine the influence of wall yielding (extension or compression) and wall friction on the lateral stress distribution and resultant lateral force 3. Given the density, friction angle, and cohesion of a soil determine the critical height of vertical, unsupported cut. 4. Given the wall characteristics (height, density, and cross section), foundation soil and backfill properties determine the external stability against overturning, sliding, and bearing capacity failure. 5. Given the wall characteristics & backfill properties analyze the influence of different backfill loading conditions, wall inclinations, and backfill slope angle on the resultant lateral force. 6. Given a particular gravity retaining wall geometry and backfill properties determine the influence of different water/drainage conditions on the resultant lateral force against the wall 7. Given the backfill properties, wall height and inclination determine the factor of safety of an articulated, block wall against overturning and local shear failure. 8. Given the wall height, backfill and tensile inclusion (reinforcement) properties determine the factor of safety against tensile failure and pullout respectively of the reinforcements 9. Given a simple slope with cohesion and friction, show how the assumption of a plane vs. rotational (circ arc) failure surface affects the calculated factor of safety as the slope angle decreases from vertical. 10. Calculate the stability of an earth dam (with an internal phreatic surface and external free water surface) using both the conventional and modified method of slices. 11. Calculate factor of safety of the stability of earth slopes using a computer program 12. Given data from slope instrumentation (i.e. inclinometers, piezometers and surface monuments) interpret state of slope and suggest possible problems and solutions. 13. Given site geologic conditions, soil properties, foundation conditions, climate, time determine type of dam for best design.

ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcomes are identified.	1. In-class closed-notes exams test outcomes # 1-12 for individual students 2. Bi-Weekly problem sets test outcomes #1-12 under less time pressure. 3. Two computer program assignments test outcomes # 11 4. A group project on a case-study on the performance of an earthen slope, retaining structure or earth dam for which the teams collect available information on the purpose/use of this engineered structure, any potential problems that came up during or post-construction, any mitigation measures taken to improve performance and the final product. This project tests ability to work as a team and present findings in an oral presentation and a written report prepared by the design team.

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** 5/24/2011

Prepared by: COE – Civil and Environmental Engineering

COURSE #: CEE 549	**COURSE TITLE:** GEOENVIRONMENTAL ENGINEERING
TERMS OFFERED: Fall or Winter	**For each prerequisite below, “E” denotes Enforced and “A” denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: Sharma & Reddy “Geoenvironmental Eng.”	**PREREQUISITES:** CEE345 (A)
INSTRUCTOR(S): D. Zekkos	**COGNIZANT FACULTY:** Michalowski
CoE BULLETIN DESCRIPTION: Waste generation/disposal; waste types; waste facilities regulations; geoenvironmental site characterization; soil-water-contaminant interactions; design and construction of base and cover containment systems; geosynthetic materials in geoenvironmental applications; landfill settlement and stability; introduction to bioreactor landfills and emerging technologies for waste disposal; technologies for site restoration and clean up.	**COURSE TOPICS:** • Waste Containment • Waste generation and disposal; • Types and characterization of wastes; • Regulations and siting of waste facilities; • Anatomy of a waste containment facility – design issues • Principles, design, and construction of containment and leachate collection systems; • Use of earth and geosynthetic materials in waste containment applications; • Engineering soil and waste properties; • Fundamentals of landfill settlement and stability; • Contaminated Site Remediation • Contaminated Site characterization; • Risk assessment and remedial strategies; • Soil remediation technologies: (soil vapor extraction; soil washing; stabilization; electrokinetic remediation; thermal desorption; vitrification; bioremediation; phytoremediation; soil fracturing); c) Emerging Technologies • Beneficial use of waste materials; • Fundamentals of bioreactor landfills; • End uses of closed landfills; • In-situ capping;
COURSE STRUCTURE/SCHEDULE 3 1-hr lectures per week	

COURSE OBJECTIVES	1. To familiarize students with the issues associated with solid waste management, such as the waste generation rates, waste management alternatives, solid waste characterization and solid waste regulations, and landfill siting. 2. To explain the fundamentals of soil mineralogy and clay behavior. 3. To understand the behavior of compacted clayey soils. 4. To teach the factors that affect the hydraulic conductivity of soils and how it is measured in the field and the laboratory. 5. To teach students how to design using geosynthetics in waste containment facilities. 6. To explain the issues related to construction using geosynthetics 7. To explain the behavior of Municipal Solid Waste in terms of compressibility, strength, dynamic properties, hydraulic conductivity. 8. To present the issues related with stability of landfills both shallow (cover instability) and deep-seated (global). 9. To present the various methods used for environmental site investigation/characterization. 10. To understand the fundamentals of risk assessment. 11. To familiarize students with the various soil remediation techniques and develop the skills to select the appropriate scheme.
COURSE OUTCOMES For <u>each</u> course outcome, links to the Program Outcom are identified.	a) For a given population and waste generation rate, identify the needed landfill total capacity as well as the cell sizes to manage waste in the next years. b) For a given clay with specific mineralogy, identify the CEC, and SSA and their relationship to Atterberg Limits c) For given compaction data and project requirements, develop the appropriate compaction "window" considering, strength, hydraulic conductivity and swelling potential. d) For given containment system, identify the leakage rates with and without geosynthetics and with and without clay. e) For given geosynthetic installation identify common construction errors. f) Understand the differences between Municipal Solid Waste behavior and the behavior of clayey and sandy soils g) For given cover system and slope geometry, evaluate the stability of the cover under static and seismic conditions h) For given soil conditions and contaminant information, identify the most appropriate remediation technique, its strengths and its weaknesses.
ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcome are identified.	1. In-class closed book mid-term exam and final to test outcomes # a-h for individual students 2. Weekly to bi-weekly problem sets test outcomes #a-h under less time pressure. 3. Two-person student project to test outcomes #h.

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** March 2011

Prepared by: CoE – Civil & Environmental Engineering

COURSE #: CEE 554/MFG 551	**COURSE TITLE:** Materials in Engineering Design
TERMS OFFERED: Winter	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: *Materials Selection in Mechanical Design*, Ashby, 3rd ed., Elsevier	**PREREQUISITES:** CEE 351 or permission of instructor
INSTRUCTOR(S): Li	**COGNIZANT FACULTY:** Li
CoE BULLETIN DESCRIPTION: Integrated study of materials properties, processing, performance, structure, cost and mechanics, as related to engineering design and material selection. Topics include design process, material properties and selection, ecological considerations, elementary linear elastic fracture mechanics, scaling, materials database, processing and design, and optimization. Examples will be drawn from cement and ceramics, metals, polymers and composites.	**COURSE TOPICS:** The Design Process; Engineering Materials and Their Properties; Materials Selection Charts; Materials Selection Without Shapes; Case Studies: Materials Selection Without Shapes; Selection of Material and Shape; Case Studies: Selection of Material and Shape; Materials Processing and Design; Case Studies: Selection of Process; Sources of Material Property Data; Case Studies: Use of Material Data Sources; Forces for Change; Environmentally Informed Materials Selection
COURSE STRUCTURE/SCHEDULE Lecture: 2 per week @ 1.5 hours	

COURSE OBJECTIVES	1. Introduce student to broad range of engineering materials. 2. Introduce student to methodology to systematically select materials to meet design function. 3. Introduce student to elementary linear elastic fracture mechanics. 4. Introduce student to modern material databases. 5. Introduce student to ecological basis in material selection for engineering design.
COURSE OUTCOMES	1. Optimize engineering design without limitation to traditional materials. 2. (a) Maximize efficiency of material usage in achieving design goals; (b) Minimize probability of accidental failure

For <u>each</u> course outcome, links to the Program Outcom are identified.	3. (a) Deeper appreciation of why certain materials behave the way they do; (b) Beginning knowledge of materials engineering 4. Acquisition of knowledge of materials database and familiarity in the use of such in engineering design.
ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcomes are identified.	1. Mid term 2. Homeworks (approximately weekly) 3. Term project – approximately 10-15 pages paper documenting a specific engineering design case study. Analysis on objective functions, constraints, identification of performance index, application of materials charts and materials database, and conclusion on optimal material and shape selection. 4. Oral presentation of term project.

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** April 2011

Prepared by: CoE – Civil & Environmental Engineering

COURSE #: CEE 581	**COURSE TITLE: A**quatic Chemistry
TERMS OFFERED: Winter	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: *Principles & Applications of Aquatic Chemistry,* Morel, 1993, Wiley; *Water Chemistry,* Benjamin, 2002, McGraw-Hill; *Aquatic Chemistry,* Stumm, 1996, Wiley	**PREREQUISITES:** Chem. 130
INSTRUCTOR(S): Hayes	**COGNIZANT FACULTY:** Hayes
CoE BULLETIN DESCRIPTION: Chemical principles applicable to the analysis of the chemical composition of natural waters and engineered water systems; chemistry of water purification technology and water pollution control; chemical processes which control the movement and fate of trace contaminants in aquatic environments including precipitation-dissolution, oxidation-reduction, adsorption-desorption, and complexation.	**COURSE TOPICS:** 1. Chemical equilibrium constants and Gibbs free energy. 2. Standard amd reference state conditions; corrections to the equilibrium contant. 3. Components, stoichiometry, and stoichiometric coefficient matrices. 4. Solving chemical equilibrium problems; setting up the the Tableau. 5. Acid-base reactions: open and closed systems. 6. Titration, alkalinity and buffer capacity. 7. Precipitation-dissolution reactions. 8. Complexation reaction. 9. Oxidation-reduction reactions. 10. Graphical chemical equilibrium solution techniques. 11. Computer chemical equilibrium solution techniques. 12. Design of a water treatment system using computer speciation model.
COURSE STRUCTURE/SCHEDULE Lecture: 3 per week @ 1 hour; Laboratory: 1 per week @ 2 hours	

COURSE OBJECTIVES	1. To teach students the fundamentals of chemical equilibrium and aquatic chemistry so that students are prepared to apply these concepts in the analysis of chemical speciation in water.

	2. To teach students how to estimate chemical equilibrium constants and corrections to it as a function of temperature, pressure, and ionic strength using thermodynamic and empirical relationships. 3. To teach students how to solve chemical equilibrium problems using the analytical, graphical, and computer solution methods. 4. To teach students specific strategies to set up and solve chemical speciation problems involving acid-base, precipitation-dissolution, complexation, and oxidation-reduction reactions. 5. 5. To teach students how to use a computer chemical speciation model to design, analyze, and optimize a chemical water treatment process**.**
COURSE OUTCOMES For <u>each</u> course outcome, links to the Program Outcom are identified.	1. Given information about the chemical compounds present in an aquatic system, students will be able to compute the chemical equilibrium concentration of the species in water. 2. Given thermodynamic data, and information on temperature, pressure and ionic strength, students will be able to provide needed corrections to equilibrium constants. 3. Given a chemical compound recipe, students will be able to solve for the concentration distribution of each species using analytical, graphical and computer solution techniques. 4. Given chemical information about a natural or engineered water system, students will be able to evaluate the impact of changing environmental conditions on chemical speciation and water quality. 5. Given a goal of removing an inorganic pollutant from a given aquatic environment, students will be able to design a set of chemical conditions t be optimal for its removal using a computer equilibrium model.
ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcome are identified.	1. In class closed book exams, test outcomes #1-4. 2. Weekly problem sets, test outcomes #1-4. 3. Weekly computer workshops, assigned in-class and take home problem sets, and a computer term project tests computer portion of outcome #3. 4. A computer term project tests outcome #5.

COURSE PROFILE

Degree Program: Bachelor of Science in Engineering, Civil Engineering **Date:** April 2011

Prepared by: CoE – Civil & Environmental Engineering

COURSE #: CEE 582	**COURSE TITLE:** Environmental Microbiology
TERMS OFFERED: Fall	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: Brock biology of microorganisms, Madigan, 12th ed, Pearson, 2009.	**PREREQUISITES:** Chem 130
INSTRUCTOR(S): Raskin, Semrau	**COGNIZANT FACULTY:** Raskin
CoE BULLETIN DESCRIPTION: Discussion of basic microbial metabolic processes, thermodynamics of growth and energy generation, and genetic and metabolic diversity. Emphasis is placed on the application of these concepts to biogeochemical cycling, subsurface microbiology, wastewater microbiology, pollutant degradation, and microbial ecology.	**COURSE TOPICS:** 1. Redox chemistry and biogeochemical cycling 2. The microbial cell: Evolution, morphology, and classification 3. Microbial metabolism 4. Microbial kinetics 5. Microbial ecology and diversity 6. Methods and applications in microbial ecology
COURSE STRUCTURE/SCHEDULE Lecture: 2 per week @ 1.5 hours.	

COURSE OBJECTIVES	1. Understanding the role and diversity of microorganisms among all life forms. [a] 2. Understanding the role of microbial interactions in effecting changes in environmental chemistry. [a,e] 3. To understand the significance of microbial activities in natural and anthropogenic organic and inorganic matter transformations. [h,j] 4. To quantify the energetics and kinetics of microbial transformation/growth reactions. [a,b,e,k] 5. To evaluate and quantify the potential use of microorganisms in natural and engineered systems. [a,b,c,e] 6. To hone the students' presentation skills and ability to work together on a team-based laboratory project. [d,g]
COURSE OUTCOMES For <u>each</u> course outcome, links to the Program Outcomes are identified.	1. The students will be able to recognize and classify microorganisms, and understand microbial dynamics in response to environmental changes. 2. Based on the basics of redox chemistry and thermodynamics, the student will be able to grasp the interaction between microbial and chemical processes. 3. Examples in class and homework serve to demonstrate the microbial impact on contaminant remediation. 4. The student will be able to evaluate and calculate the likelihood of given microbial reactions and the rate at which they occur under various environmental conditions. 5. The student will learn to quantify and design microbial strategies to address environmental problems such as groundwater and sediment contamination.
ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcomes are identified.	1. In class closed book exams, test outcomes 1-5. 2. Biweekly quantitative problem sets, test outcomes 2, 4, and 5. 3. Weekly guided laboratory exercise during first half of term, test outcomes 1 and 2. 4. Team-based "independent" laboratory project during second half of term, test outcomes 3 and 5. 5. Team-based term paper on independent project to describe observations and quantify processes, test outcomes 4 and 5.