1. Course Title:

CEGE 1101: Introduction to Civil Engineering

2. Credit and Contact Hours

1 credit hours
1 contact hours per week (lecture)

3. Instructors:

Dr. Mihai Marasteanu, PE

4. Textbook:

No required textbook

   a. Other supplemental materials

      None

5. Specific Course Information:

   a. Brief description of the content of the course (catalog description)

      Introduction to Department of Civil Engineering and civil engineering practice. Presented by faculty members and professional engineers.

   b. Prerequisites or co-requisites

      None

   c. Required, elective, or selected elective

      Selected elective

6. Specific Goals for the Course

   a. Specific outcomes of instruction

      • To inform students of the vital role that civil engineers and geoengineers play in modern society
      • To inform students of the types of projects performed by civil engineers and geoengineers

   b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
(i) a recognition of the need for, and an ability to engage in, life-long learning
(j) a knowledge of contemporary issues

7. Brief list of topics to be covered.

- General description of civil engineering
- General description of geoengineering, geomechanics, and geotechnical engineering
- General description of environmental engineering
- General description of structural engineering
- General description of water resources engineering
- General description of transportation engineering
- Personal experiences of a handful of practicing engineers
1. Course Title:

CEGE 3101: *Computer Applications in Civil Engineering I*

2. Credit and Contact Hours

3 credit hours
3 contact hours per week

3. Instructors:

Dr. Randal Barnes
Dr. Stefano Gonella

4. Textbook:

*Numerical Methods for Engineers and Scientists*, A. Gilat and V. Subramaniam, 2011.

   a. Other supplemental materials

   Websites and other freely available material

5. Specific Course Information:

   a. Brief description of the content of the course (catalog description)


   b. Prerequisites or co-requisites

   Math 1271/Math 1371 (or equivalent)
   Math 1272/Math 1372 (or equivalent)
   Phys 1301 (or equivalent)

   c. Required, elective, or selected elective

   Required

6. Specific Goals for the Course

   a. Specific outcomes of instruction

   - Introduce the fundamental techniques for the numerical solution of mathematical problems that are encountered across the disciplines in engineering and science
• Introduce the fundamental concepts of numerical analysis: convergence, accuracy, stability
• Learn how to Implement and use numerical solution techniques in Matlab
• Acquire or perfect the art of coding. Overcome any anxiety generated by coding. Develop an appreciation for the problem solving skills associated with technical computing.
• Develop a personal library of Matlab computer codes for present and future use in academic and professional life

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering
(d) an ability to function on multi-disciplinary teams
(g) an ability to communicate effectively
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

7. Brief list of topics to be covered.

Solving nonlinear equations
Iterative methods, algorithms, and convergence
Data representations, computer math, and an introduction to error analysis
Solving systems of nonlinear equations
Regression, curve fitting, and parameter estimation
Interpolation, function approximation, and optimization
Visual Basic Macros
Engineering model fitting
Programming, including debugging, using MATLAB
Numerical integration
Computational precision
Solving systems of linear equations
Specific and iterative methods
Numerical solution of first-order ordinary differential equations
Numerical solution to higher-order differential equations
Systems of linear equations (invertible, over-determined, and under-determined)
Numerical solution to partial differential equations
Presentation software and presentation graphics
Introduction to HTML
1. Course Title:

CEGE 3102: Uncertainty and Decision Analysis

2. Credit and Contact Hours

3 credit hours
2 contact hours per week (lecture)
1 contact hour per week (recitation)

3. Instructors:

Dr. Randal Barnes
Dr. Gary Davis

4. Textbook:


a. Other supplemental materials

None

5. Specific Course Information:

a. Brief description of the content of the course (catalog description)

Stochastic models, their usefulness in reasoning about uncertainty in civil engineering. Techniques for identifying, fitting, and validating models using data samples. Testing hypotheses about, and bounding uncertainty attached to, engineering parameters. Applications to branches of civil engineering.

b. Prerequisites or co-requisites

Math 1371/Math 1372

c. Required, elective, or selected elective

Required

6. Specific Goals for the Course

a. Specific outcomes of instruction

- Use probability theory to deduce probability statements from given information
- Derive a plausible probability model from first principles
- Use Monte Carlo simulation to compute desired probabilities
• Estimate a population quantity from a sample, determine the associated confidence interval
• Determine the minimum sample size needed to achieve a desired precision.
• Identify a plausible probability model for a data set, and assess its goodness-of-fit
• Test a hypothesis about a population quantity using a data sample

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering
(e) an ability to identify, formulate, and solve engineering problems
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

7. Brief list of topics to be covered.

Descriptive Statistics
Probability Theory
Random Variables
Discrete Probability Modes
Continuous Random Variables
Lognormal Random Variables
Functions of Random Variables
Estimation and Hypothesis Testing
Simulation/Numerical Methods
Goodness of Fit/Model Selection
Regression Analysis
1. Course Title:

CEGE 3111: CADD for Civil Engineers

2. Credit and Contact Hours

2 credit hours
4 contact hours per week (combination of lab and lecture)

3. Instructors:

Ms. Ann Johnson, P.E.

4. Textbook:

Harnessing AutoCAD 2013, G.V. Krishnan, 2013.

   a. Other supplemental materials

   Course packet provided by instructor

5. Specific Course Information:

   a. Brief description of the content of the course (catalog description)

   Introduction to AutoCAD and Civil 3D software. Students complete all tasks to design two-lane roadways and subdivision using civil engineering design software, including topography, plan/profile, contours, cross sections, and quantity calculations.

   b. Prerequisites or co-requisites

   CEGE 3201

   c. Required, elective, or selected elective

   Selected elective

6. Specific Goals for the Course

   a. Specific outcomes of instruction

   • Understand and describe how AutoCAD and other computer aided drafting programs work
   • Execute basic autocad drawing commands
   • Execute basic autocad modification commands
   • Dimension a drawing according to industry standards
   • Read an autocad drawing and describe its elements
• Develop a plan for efficiently completing an autocad drawing given dimensions and criteria
• Transfer hand-measured dimensions to an autocad drawing
• Understand and use drawing limits and drafting settings
• Understand blocks and how they are used, developed and modified
• Plot an autocad drawing to scale
• Describe how Civil 3D works to model civil engineering projects
• Import surveying data into a Civil 3D drawing
• Create a topographic map using survey data points along with photos from Google earth, and the MnGEO website

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(g) an ability to communicate effectively
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

7. Brief list of topics to be covered.

Autocad Skills
Beginning Drawing, Coordinate Systems, Modify Objects
Drawing Tools, Layers
Moving, Rotating, Copying and Modifying
Constructing Geometric Figures
Advanced Drawing Commands
Dimensioning
Hatching and Boundaries
Blocks and Attributes
Plotting
Civil 3D Skills
Creating a Project
Importing Points/Description Keys
Creating Topographic Maps
Digital Terrain Modeling and Contours
Horizontal Geometry
Vertical Geometry
Assemblies, Subassemblies and Cross-sections
Transitions
Intersections
Plotting Plan Sheets
1. Course Title:

CEGE 3201: Transportation Engineering

2. Credit and Contact Hours

3 credit hours
2 contact hours per week (lecture)
1 contact hour per week (recitation)

3. Instructors:

Dr. Gary Davis

4. Textbook:


   a. Other supplemental materials

      None

5. Specific Course Information:

   a. Brief description of the content of the course (catalog description)

      Applying laws of motion to vehicle performance, determining constraints for highway designs. Traffic flow principles, their relation to capacity and level of service. Geometric design, pavement design, transportation planning.

   b. Prerequisites or co-requisites

      CEGE 3101, CEGE 3102, Phys 1301

   c. Required, elective, or selected elective

      Required

6. Specific Goals for the Course

   a. Specific outcomes of instruction

      • Obtain a basic understanding of the fundamental issues in transportation
      • Obtain a basic understanding of the factors influencing road vehicle performance
      • Learn basic principles of highway geometric design and be able to apply these principles to solve simple problems
• Obtain a basic understanding of traffic flow and queuing theory
• Lean basic procedures for highway capacity and level of service analysis
• Obtain a basic understanding of traffic signal theory and elements of traffic signal operation
• Lean basic procedures for traffic signal design
• Obtain a basic understanding of travel demand and traffic forecasting

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global and societal context
(j) a knowledge of contemporary issues

7. Brief list of topics to be covered

Vehicle Performance/Human Factors
Geometric Design
Traffic Flow
Traffic Signals
Freeway Capacity and LOS
Pavement Design
Travel Demand/Forecasting
1. Course Title:

CEGE 3202: Surveying and Mapping

2. Credit and Contact Hours

2 credit hours
1.25 contact hours (lecture)
3 contact hours (lab; first six weeks of the term)

3. Instructors:

Ms. Ann Johnson, P.E.

4. Textbook:


a. Other supplemental materials

None

5. Specific Course Information:

a. Brief description of the content of the course (catalog description)

Theory of precision measurements of distance, elevation, angle, and direction of points/lines above, on, or beneath earth's surface. Establishing such points/lines. Elements of coordinate systems, datum planes, and maps.

b. Prerequisites or co-requisites

Math 1271/Math 1272

c. Required, elective, or selected elective

Selected elective

6. Specific Goals for the Course

a. Specific outcomes of instruction

- operate a differential level
- operate a total station
- reduce level notes
- correct angle measurements for use in traverse computations
- compute latitude and departure of a line
• compute coordinate values
• use coordinate geometry to compute distances and angles
• understand the direction of lines as described by azimuth and bearing
• draw, read and interpret contours
• describe how GPS works
• describe the use of GPS in construction staking and operations
• use and engineering scale to plot survey data
• develop a map from survey data
• sketch locations of objects in the field
• accurately determine horizontal distances by pacing

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering
(e) an ability to identify, formulate, and solve engineering problems
(g) an ability to communicate effectively
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

7. Brief list of topics to be covered.

Lab:
Differential leveling
Traversing with total station
Topographic mapping with a Total Station
Introduction to GPS

Lecture:
Surveying terms and precision
Field notes, distance measurements and angles
Traversing and traverse corrections
Angle measurement and correction
Azimuths and bearings
Topographic mapping and drafting
Map reading
Public Land Survey origin and implications
Coordinate geometry
Contours
Civil plan elements: plan, profiles, sections, and plan components
Introduction to GPS
1. Course Title:

CEGE 3301: Soil Mechanics I

2. Credit and Contact Hours

3 credit hours
3 contact hours per week

3. Instructors:

Dr. Bojan Guzina
Dr. Emmanuel Detournay

4. Textbook:


a. Other supplemental materials

CE 3301 Lab Manual, Department of Civil Engineering

5. Specific Course Information:

a. Brief description of the content of the course (catalog description)


b. Prerequisites or co-requisites

AEM 3031

c. Required, elective, or selected elective

Required

6. Specific Goals for the Course

a. Specific outcomes of instruction

• Understand the nature and multi-phase composition of soils
• Understand the basics of one-dimensional and two-dimensional groundwater flow
• Reinforce the concepts of stress and stain; introduce the principle of effective stress
• Develop an ability to compute the geostatic stress and pore pressure in a soil mass
• Develop an ability to solve 2D engineering problems (in particular groundwater flow) via contemporary computer tools such as the finite difference method
• Understand the compressibility and consolidation of soils.
• Understand the principles and importance of soil compaction.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(b) An ability to design and conduct experiments, as well as to analyze and interpret data
(e) An ability to identify, formulate, and solve engineering problems
(g) An ability to communicate effectively
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

7. Brief list of topics to be covered.

Mineral composition
Grain-size distribution; soil classification
Phase composition (particles, water & air); phase relationships
Soil consistency (cohesive and granular soils)
1D Groundwater flow; Darcy’s law
Determination of hydraulic conductivity
Permeability of layered soils
2D groundwater flow; continuity equation
Seepage problems; flow nets
Finite difference method; numerical simulation of seepage
Effective stress principle
Geostatic stresses in layered soils; capillary action
Boussinesq solution; stresses under a rectangularly loaded area
Consolidation of soils; 1D consolidation settlement
Settlement due to non-monotonic loading; oedometer test
Consolidation equation; consolidation parameters
Coefficient of consolidation; time rate of consolidation
Soil compaction; cut and fill
1. Course Title:
CEGE 3401: Linear Structural Analysis

2. Credit and Contact Hours
3 credit hours
3 contact hours per week (lecture)

3. Instructors:
Dr. Henryk Stolarski

4. Textbook:

   a. Other supplemental materials

      None

5. Specific Course Information:
   a. Brief description of the content of the course (catalog description)

      Analysis of determinate/indeterminate trusses and frames, and of deformation by virtual work. Application of energy, slope-deflection, and moment distribution methods to indeterminate structures. Influence lines. Design.

   b. Prerequisites or co-requisites

      AEM 3031

   c. Required, elective, or selected elective

      Required

6. Specific Goals for the Course
   a. Specific outcomes of instruction

      • Familiarity with basic structural systems and their load carrying mechanisms.
      • Understanding of basic principles and analysis methods in structural analysis.
      • Ability to evaluate internal forces in determinate structures and their deformations.
      • Understanding of the force-based and displacement-based approaches to analysis of indeterminate structures.
• Ability to select an appropriate method of analysis for a given structure.
• Familiarity with selecting design-critical loading scenarios based on the influence lines.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering
(e) an ability to identify, formulate and solve engineering problems
(k) an ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

7. Brief list of topics to be covered.

Systems of forces and corresponding equilibrium conditions;
Stability and statical determinacy (indeterminacy) of structures:
Evaluation of internal forces in statically determinate frames and trusses:
Development of the principle of virtual work and its use in analysis of deformation;
Analysis of deformations using moment-area method;
Influence lines;
Force-based method of analysis of statically indeterminate structures;
Displacement-based method of analysis of statically indeterminate structures;
Brief introduction to matrix (computer) analysis of structures.
1. Course Title:

CEGE 3402W: Civil Engineering Materials

2. Credit and Contact Hours

3 credit hours
4 contact hours per week (3 per week in lecture and 1 per week in laboratory)

3. Instructors:

Dr. Roberto Ballarini, P.E.
Dr. Lev Khazanovich
Dr. Mihai Marasteanu, P.E.

4. Textbook:


a. Other supplemental materials

Standards for materials testing on reserve in School of Engineering library.

5. Specific Course Information:

a. Brief description of the content of the course (catalog description)

Concepts and modeling of behavior mechanisms for civil engineering materials such as concrete, metals, asphalt, plastics, and wood. Standard specifications for material properties. Techniques for testing.

b. Prerequisites or co-requisites

AEM 3031

c. Required, elective, or selected elective

Required

6. Specific Goals for the Course

a. Specific outcomes of instruction

- Understand the qualitative behavior of materials used in civil engineering construction, including concrete, metals, composites, asphalt and masonry.
• Remember the values of basic mechanical properties of materials used in civil engineering construction, including modulus of elasticity, yield strength, ultimate strength, endurance limit, fracture toughness, Charpy impact energy.
• Use mechanics to formulate elasticity, plasticity and viscoelasticity models of the mechanical behavior of materials used in civil engineering construction.
• Conduct experiments to measure the mechanical and physical properties of materials, interpret data and prepare laboratory reports.
• Write two technical papers on assigned topics within the spirit of writing across the curriculum.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(e) an ability to identify, formulate, and solve engineering problems
(g) an ability to communicate effectively

7. Brief list of topics to be covered.

Stress/strain/deformation, mechanical properties.
Structural elements made of linear and nonlinear materials; tension, compression and flexure of elastic, elastic-plastic and composite elements.
Review of stress and strain transformations.
Performance indices and material selection charts.
Metals; properties, fatigue, fracture, corrosion.
Brittle materials: concretes, rocks, and ceramics.
Weibull model of strength and element reliability.
Aggregates, Portland cement, Portland cement concrete.
Three-dimensional elasticity; Tresca and Mohr-Coulomb yielding criteria.
Linear systems; series and parallel arrangements.
Applications to elastic, thermal and electrical systems
Composite materials: wood, masonry, and composites.
Viscoelasticity.
Asphalt cement, asphalt concrete.
Bioinspired materials and structures.
1. Course Title:

CEGE 3501: Environmental Engineering

2. Credit and Contact Hours

3 credit hours
3 contact hours per week (lecture)

3. Instructors:

Dr. Paige Novak, P.E.
Dr. Julian Marshall

4. Textbook:

Introduction to Environmental Engineering and Science, Masters and Ela, 2008.

a. Other supplemental materials

None

5. Specific Course Information:

a. Brief description of the content of the course (catalog description)

Introduction to environmental engineering. Quantitative approach to environmental problems. Scientific background for understanding roles of engineers and scientists.

b. Prerequisites or co-requisites

Chem 1022
Phys 1302

c. Required, elective, or selected elective

Required

6. Specific Goals for the Course

a. Specific outcomes of instruction

- Develop a broad understanding of challenges and current technologies in environmental engineering
- Understand the scientific principles behind global climate change
- Identify key water pollutants
- Understand the chemistry and microbiology principles behind water and wastewater treatment
- Identify key air pollutants and removal technologies
- Understand how air pollutants are dispersed in the environment
- Understand treatment of solid and hazardous wastes

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(f) an understanding of professional and ethical responsibility  
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and social context  
(i) a recognition of the need for, and an ability to engage in, life-long learning  
(j) a knowledge of contemporary issues

7. Brief list of topics to be covered.

Mass and energy balances  
Global climate change  
Equilibrium chemistry: pH, solubility, carbonate system  
Microbiology and nutrient cycling  
Water resources  
Water pollutants  
Drinking water treatment  
Wastewater treatment  
Air pollutants  
Treatment of air pollution  
Solid waste treatment  
Hazardous waste treatment  
Ethics
1. Course Title:

CEGE 3502: Fluid Mechanics

2. Credit and Contact Hours

4 credit hours
3 contact hours per week (lecture)
2 contact hours per week (lab)

3. Instructors:

Dr. Michele Guala
Dr. Kimberly Hill

4. Textbook:

Engineering fluid mechanics, Elger et al., Wiley 2012.

a. Other supplemental materials

Laboratory manual (e-copy)

5. Specific Course Information:

a. Brief description of the content of the course (catalog description)


b. Prerequisites or co-requisites

AEM 2012 or AEM 3031, Math 2372

c. Required, elective, or selected elective

Required

6. Specific Goals for the Course

a. Specific outcomes of instruction

- Measure fluid properties and understand how different fluids can be used for different purposes
- Estimates the forces acting on submerged or partially submerged objects of different shape
• Understand the difference between the laminar and turbulent regimes (in the equations and in laboratory experiments)
• Understand how to apply the Control Volume approach for energy and momentum equation
• Understand how to design a laboratory experiments (similitude and flow measurements)
• Understand how to design simple components of hydraulic systems (pumps, pipe systems)

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, analyze and interpret data.
(c) an ability to design a system, component, or process to meet desired needs.
(d) an ability to identify, formulate, and solve engineering problems

7. Brief list of topics to be covered.

Fluid properties
Fluid statics
Bernoulli equation and pressure variation
Control volume approach and continuity equation
Momentum equation
Energy equation
Dimensional analysis and similitude
Shear force and boundary layer
Flow in conduits
Drag and lift
Flow and fluid properties measurements
Turbomachinery
1. **Course Title:**

CEGE 4000H: Honors Research Seminar

2. **Credit and Contact Hours**

1 credit hours
1 contact hours per week (lecture)

3. **Instructors:**

Dr. Randal Barnes

4. **Textbook:**

No required textbook

   a. **Other supplemental materials**

      None

5. **Specific Course Information:**

   a. **Brief description of the content of the course (catalog description)**

      Attend twelve (12) research seminars in civil and geological engineering given by faculty members and visiting scholars. Write and submit a summary of each attended seminar. Explicitly interact with four or more of the speakers.

   b. **Prerequisites or co-requisites**

      Enrolled in the honors program, or instructor approval. Typically, the instructor approval requires upper division standing in the Department of Civil Engineering.

   c. **Required, elective, or selected elective**

      Selected elective

6. **Specific Goals for the Course**

   a. **Specific outcomes of instruction**

      - To inform students of the vital role that civil and geo-engineers play in modern society.
      - To inform students of the future of civil and geo-engineering by exposing them to current state-of-the-art research.
• To develop students’ ability to listen to, and process, the presentation of highly technical information. A seminar is not a class lecture, and the necessary listening skills are somewhat different.
• To learn more about how to, and how not to, present highly technical information. This learning is accomplished extensionally. The pros and cons of various presentations are a regular topic of discussion for the class.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(g) an ability to communicate effectively
(i) a recognition of the need for, and an ability to engage in, life-long learning
(j) a knowledge of contemporary issues

7. Brief list of topics to be covered.
• Civil engineering infrastructure and associated public policy
• Environmental engineering
• Geomechanics
• Structural engineering
• Transportation engineering
• Water resources engineering
1. Course Title:

CEGE 4102W: Capstone Design

2. Credit and Contact Hours

4 credit hours
3 contact hours per week (lecture)

3. Instructors:

Dr. Mihai Marasteanu, P.E.
Mr. Dennis Martenson, P.E., Pres.06.ASCE
Dr. Henry Mott, P.E.

4. Textbook:

None

   a. Other supplemental materials

      None

5. Specific Course Information:
   a. Brief description of the content of the course (catalog description)

      Teams formulate/solve civil engineering or geoengineering problems. From conceptual stage through preliminary planning, public hearings, design, environmental impact statements, final plans/specifications, and award of contracts.

   b. Prerequisites or co-requisites

      Completed all other required CEGE 4000-level courses.

   c. Required, elective, or selected elective

      Required

6. Specific Goals for the Course

   a. Specific outcomes of instruction

      • Solve a real-world design problem
      • Establish a consultant-client relationship
      • Synthesize knowledge from various courses
      • Interact with team members, peers, and consultants
• Understand various management strategies for completing civil engineering and geoengineering projects
• Discuss basic concepts in business, public policy, and leadership
• Present and analyze case histories on ethical dilemmas
• Write a professional report
• Make oral presentations

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(c) an ability to design a system, component, or process to meet desired needs
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(i) a recognition of the need for, and an ability to engage in life-long learning

7. Brief list of topics to be covered.

Design process: presentations by instructors and practicing engineers
Design process: in-person and remote discussions between mentor/instructor and team members
Practical work of a civil/geo- engineer: business, contracts, and construction industry procedures
Ethical dilemmas in civil/geo- engineering practice
Professional licensure and continuing education
Writing technical documents
Oral presentations
1. Course Title:
CEGE 4121: Computer Applications in Civil Engineering II

2. Credit and Contact Hours
3 credit hours
3 contact hours per week (lecture)

3. Instructors:
Dr. Randal Barnes
Dr. Bojan Guzina

4. Textbook:
All of the “textbooks” for the class are available online as freeware. There are NO required textbooks to be purchased for this course.

a. Other supplemental materials
Digital course notes.

5. Specific Course Information:
   a. Brief description of the content of the course (catalog description)
   Advanced application of computer tools/methods in solving ordinary/partial differential equations from civil and geo-engineering problems. Spreadsheet, MatLab programming. Methods may include finite differences, boundary element, finite element, and control volume finite element.

b. Prerequisites or co-requisites
   CEGE 3101, Math 2243, Math 2263

c. Required, elective, or selected elective
   Selected elective

6. Specific Goals for the Course
   a. Specific outcomes of instruction
   • an enhanced ability to recognize when a computer-based solution or model is appropriate for the civil engineering problem at hand
• a recognition and understanding of basic data structures and common algorithms appropriate for civil and geo-engineering problems
• an understanding of computer computations; specifically, understanding and controlling round-off and truncation errors
• an ability to implement a “test-first” design for engineering programs
• an enhanced computational toolbox
• the development of anti-bugging practices; an enhanced ability at software debugging
• training in team design, implementation, and execution of engineering software

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering
(c) an ability to design a system, component, or process to meet desired needs
(e) an ability to identify, formulate, and solve engineering problems
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

7. Brief list of topics to be covered.

• Spatial interpolation of irregularly spaced data over irregular polygons (e.g. interpolating rainfall data over a watershed). Multiquadritic interpolation. Bilinear interpolation. Solving large systems of linear equations.
• Shortest route problem and dynamic programming (e.g. for on-board navigation with intelligent vehicle systems). Dijkstra’s shortest route algorithm.
• Constrained least squares (e.g. adjustment of traffic network surveys). Network-based models and data structures: node-arc incidence matrices.
• Computer computations, understanding IEEE 754-2008 floating point numbers. Dealing with truncation and round-off by choosing wisely, and a bit of math. Series expansions, Horner’s rule, computational efficiency (e.g. stress singularities).
• Computational geometry, numerical integration over irregular shapes (e.g. average rainfall over a watershed). Point-in-polygon algorithms.
• Linear optimization (e.g. mixing and blending).
• Nonlinear optimization (e.g. model selection using genetic algorithms).
• Nonlinear systems of equations (e.g. large pipe networks).
• Monte Carlo simulation and queueing theory (e.g. ramp monitoring).
• Deterministic simulation using mechanics (e.g. distinct element modeling).
• Solving complex systems of ordinary differential equations.
• Solving partial differential equations, finite difference formulations (e.g. the heat equation for modeling thermal stress in pavements).
• Large-scale, complex system optimization (e.g. optimizing a truss).
• Stochastic simulation of complex systems (e.g. cell dynamics).
1. Course Title:

CEGE 4201: Highway Design

2. Credit and Contact Hours

3 credit hours
3 contact hours per week (lecture)

3. Instructors:

Ms. Ann Johnson, P.E.

4. Textbooks:

A Policy on the Geometric Design of Highways and Streets, AASHTO 2011
MnDOT Road Design Manual, 2012

a. Other supplemental materials

None

5. Specific Course Information:

a. Brief description of the content of the course (catalog description)

Vertical and horizontal alignment, earthwork computations, highway capacity, forecast of traffic volume demand, impact of vehicle type on geometric design, intersection design.

b. Prerequisites or co-requisites

CEGE 3201

c. Required, elective, or selected elective

Selected elective

6. Specific Goals for the Course

a. Specific outcomes of instruction

- Describe how the planning phase of highway design proceeds
- Describe an Environmental Assessment Worksheet
- List the functional classifications of roadways
- Describe the 13 critical design criteria and how they are applied to a highway design
- Prepare a preliminary and final horizontal alignment
- Prepare a preliminary and final vertical alignment
• Calculate the azimuth or bearing of a line
• Calculate state plane coordinates of points along a horizontal alignment, including those points on both tangent and curve
• Define design speed and describe how it applies to highway design
• Design the superelevation transition grading plan for a horizontal curve
• Describe “lateral clearance to obstruction”
• Calculate safe speeds for stopping, passing and decision sight distance
• Calculate elevations along a vertical alignment
• Calculate cut and fill on a roadway project
• Create a mass balance diagram for a 2-lane roadway alignment
• Calculate an estimate of grading costs on a 2-lane roadway alignment
• Describe a “typical section” and how it is selected and determined
• Create simple cross-sections for a 2-lane roadway using contours and typical section

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(e) an ability to identify, formulate, and solve engineering problems
(g) an ability to communicate effectively
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

7. Brief list of topics to be covered.

Autocad Skills
Beginning Drawing, Coordinate Systems, Modify Objects
Drawing Tools, Layers
Moving, Rotating, Copying and Modifying
Constructing Geometric Figures
Advanced Drawing Commands
Dimensioning
Hatching and Boundaries
Blocks and Attributes
Plotting
Civil 3D Skills
Creating a Project
Importing Points/Description Keys
Creating Topographic Maps
Digital Terrain Modeling and Contours
Horizontal Geometry
Vertical Geometry
Assemblies, Subassemblies and Cross-sections
Transitions
Intersections
Plotting Plan Sheets
1. Course Title:

CEGE 4211: Traffic Engineering

2. Credit and Contact Hours

3 credit hours
3 contact hours per week (lecture)

3. Instructors:

Dr. John Hourdos

4. Textbook:

Traffic Engineering, Roess, Prassas, and McShane, 2011.

   a. Other supplemental materials

      MN Manual of Uniform Traffic Control Devices
      Highway Capacity Manual 2010

5. Specific Course Information:
   a. Brief description of the content of the course (catalog description)

      Principles of vehicle/driver performance as they apply to safe/efficient operation of
      highways. Design/use of traffic control devices. Capacity/level of service. Trip
      generation, traffic impact analysis. Safety/traffic studies.

   b. Prerequisites or co-requisites

      CEGE 3201, CEGE 3102

   c. Required, elective, or selected elective

      Selected elective

6. Specific Goals for the Course

   a. Specific outcomes of instruction

      • Obtain an understanding of the fundamentals of traffic engineering
      • Learn both quantitative and computerized techniques for solving basic traffic
        engineering problems
      • Apply the principles of traffic engineering to evaluate, analyze, and design timing
        plans for signalized intersections
• Demonstrate the capability to write a technical report and communicate the results of their solution approach to other engineering professionals

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering
(c) an ability to design a system, component, or process to meet desired needs
(e) an ability to identify, formulate, and solve engineering problems
(j) a knowledge of contemporary issues

7. Brief list of topics to be covered.

Vehicle/Driver Performance
Highway Sight distance
Intersection Sight Distance
Probability and Statistics Review
Traffic Flow Theory
Freeway Operations
Freeway Level-of-Service
Traffic Control Devices
Un-signalized Intersection Capacity
Signalized Intersection Control
Signalized Intersection Capacity and LOS
Actuated Signals
Introduction to Roundabout design and control
Traffic Analysis Tools
HCM and Synchro methodologies Introduction
Safety Improvement Programming
Analysis of Individual Accidents
1. Course Title:

CEGE 4251: Pavement Analysis, Design, and Rehabilitation

2. Credit and Contact Hours

4 credit hours
4 hours per week (lecture)

3. Instructor:

Dr. Lev Khazanovich

4. Textbook:

Pavement Guide Interactive, Washington DOT


a. Other supplemental materials

Pavement Analysis and Design, Huang, 2004

5. Specific Course Information:

a. Brief description of the content of the course (catalog description)

Concepts/principles in rigid/flexible pavement design. Traffic loads, soil considerations, material characteristics for highway/airfield pavement design. Rehabilitating flexible/rigid pavement systems.

b. Prerequisites or co-requisites

CEGE 3201, CEGE 3301, CEGE 3402W

c. Required, elective, or selected elective

Selected elective

6. Specific Goals for the Course

a. Specific outcomes of instruction
- Analyze flexible pavements with layered elastic analysis program (MnLAYER).
- Calculate rigid pavement stresses and deflections using finite element analysis program (ISLAB2000).
- Explain sensitivity of structural responses to key pavement geometry and material properties.
- Estimate the number of total truck axle loadings that a pavement structure for a given traffic lane may experience over a design life.
- Derive the elastic property inputs (modulus, Poisson’s ratio) for each material type used in a pavement based on laboratory and field test data.
- Explain how key pavement geometry and material properties affect pavement distresses.
- Design and analyze pavement performance using the M-EPDG design software, MnPAVE, and AASHTO-93 design procedure.
- Design rigid and flexible overlays using AASHTO-93 and M-EPDG methods.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering,
(b) an ability to design a system, component, or process to meet desired needs,
(e) an ability to identify, formulate, and solve engineering problems,
(k) an ability to use the techniques, skills, and engineering tools necessary for engineering practice.

7. Brief list of topics to be covered.

Types of pavements; pavement performance metrics and distress types
Stresses and deflections in flexible pavements, rigid pavements
Elements of a pavement structure
Traffic characterization
Subgrade characterization
Asphalt/concrete characterization
AASHTO-93 design procedure for flexible pavements
MnPAVE design procedure
MEPDG design procedure for flexible pavements
Asphalt pavement performance
AASHTO-93 design procedure for rigid pavements
MEPDG design procedure for rigid pavements
Rigid pavement performance
Block pavements
Pavement evaluation and rehabilitation
AASHTO-93 overlay design procedure for rigid and flexible pavements
1. Course Title:

CEGE 4253: Pavement Engineering and Management

2. Credit and Contact Hours

3 credit hours
3 contact hours per week (lecture)

3. Instructors:

Dr. Mihai Marasteanu, PE

4. Textbook:

No required textbook

  a. Other supplemental materials

    None

5. Specific Course Information:

  a. Brief description of the content of the course (catalog description)


  b. Prerequisites or co-requisites

    CEGE 3201, CEGE 3301, CEGE 3402

  c. Required, elective, or selected elective

    Selected elective

6. Specific Goals for the Course

  a. Specific outcomes of instruction

    • Understand the pavement design and construction issues that significantly affect the performance and durability of pavements
    • Learn how to identify these issues and how to design construction process to prevent them from taking place
    • Understand the main concepts in pavement management and how to measure and asses road conditions
• Learn about the maintenance and rehabilitation techniques available
• Understand pavement performance models, life cycle analysis, and how they are used to design pavement management systems
• Evaluate case studies in pavement management

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering
(c) an ability to design a system, component, or process to meet desired needs
(e) an ability to identify, formulate, and solve engineering problems
(g) an ability to communicate effectively,
(k) an ability to use the techniques, skills, and engineering tools necessary for engineering practice.

7. Brief list of topics to be covered.

Introduction, pavement history, pavement types, traffic
Flexible and rigid pavements structure, subgrade materials testing, resilient modulus
Shrinking, swelling, frost heave, thaw weakening, mitigating frost action
Soil stabilization – full depth reclamation & rubblization, stabilization methods in MN
Aggregate sources and production, mineral properties
Chemical, physical, and other aggregate properties
PCC pavements, Portland cement and concrete review
Plant operations, transport, steel placement, general construction procedure
Fixed form and slip form paving, joints
Rigid pavements distresses, maintenance, and rehabilitation
Asphalt pavements, asphalt binder and asphalt mixtures review
Surface preparation, asphalt mixture production and transport
Asphalt mixture placement and compaction
Asphalt mixture construction problems
Flexible pavements distresses, maintenance, and rehabilitation
Use of recycled materials, warm mix asphalt
Introduction to Pavement Management, condition assessment data
Roughness, surface friction, deflection measurements, surface distresses
Pavement Condition Index (PCI), predicting deterioration
Rehabilitation and maintenance strategies
Needs analysis, selection when funds are constrained
Needs analysis, selection when funds are constrained
Time value of money, LCCA
Life cycle cost analysis, FHWA – LCCA in Pavement Design
Environmental effects and LCA
MnDOT pavement management system
1. Course Title:

CEGE 4301: Soil Mechanics II

2. Credit and Contact Hours

3 credit hours
3 contact hours per week (lecture) + laboratory

3. Instructors:

Dr. Joseph Labuz, P.E.
Dr. Stefano Gonella

4. Textbook:


a. Other supplemental materials


5. Specific Course Information:
   a. Brief description of the content of the course (catalog description)


   b. Prerequisites or co-requisites

   CEGE 3301

   c. Required, elective, or selected elective

   Required

6. Specific Goals for the Course

   a. Specific outcomes of instruction

   • Use principles of solid mechanics to describe Mohr-Coulomb failure criterion
   • Measure mechanical behavior, evaluate data, and write reports
   • Apply earth pressure theory to design rigid and flexible retaining walls
• Apply limit equilibrium to evaluate stability of slopes
• Apply bearing capacity theory to design a shallow foundation
• Analyze various options for design of a geotechnical structure

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(b) An ability to design and conduct experiments, as well as to analyze and interpret data
(c) An ability to design a system, component, or process to meet desired needs
(e) An ability to identify, formulate, and solve engineering problems
(g) An ability to communicate effectively

7. Brief list of topics to be covered.

Subsurface exploration
State of stress; normal and shear stresses
Mohr’s circle; concept of the pole
Shear strength: Mohr-Coulomb failure criterion
Direct shear test
Triaxial compression test
Undrained (uniaxial) compression test
Lateral earth pressure—Rankine theory
Rigid retaining walls
Sheet pile walls
Limit equilibrium—Coulomb theory
Slope stability
Shallow foundations
Bearing capacity
Deep foundations
1. Course Title:

CEGE 4311: Rock Mechanics

2. Credit and Contact Hours

4 credit hours
4 contact hours per week (lecture) + laboratory

3. Instructors:

Dr. Joseph Labuz, P.E.

4. Textbook:


a. Other supplemental materials


5. Specific Course Information:

a. Brief description of the content of the course (catalog description)


b. Prerequisites or co-requisites

CEGE 3301

c. Required, elective, or selected elective

Selected elective for CivE; Required for GeoE

6. Specific Goals for the Course

a. Specific outcomes of instruction

- Use the basic principles of elasticity and plasticity to describe mechanical behavior
• Measure index properties, evaluate experimental data, and write a report
• Apply vector analysis to 3D slope problems and design support for a slope
• Obtain experience in using numerical modeling to analyze excavations
• Apply numerical modeling to a tunnel problem and evaluate support conditions

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(b) An ability to design and conduct experiments, as well as to analyze and interpret data
(h) The broad education necessary to understand the impact of engineering
(j) A knowledge of contemporary issues
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

7. Brief list of topics to be covered.

Stress vector and stress state; Mohr’s circle
Planes of weakness; Coulomb friction
Shear strength of joints and rock; Mohr-Coulomb failure
Mechanical response of rock; index properties
Uniaxial and triaxial compression tests; elasto-plastic behavior
Sampling rock (RQD); geological data (strike and dip)
Stereographic projections; limit equilibrium of blocks
Stereonets and DIPS
Kinematic analysis of blocks
Vector operations; cone of friction
3D stability of blocks; generalized cone of friction
Bolt force; water pressure
Block size and SWEDGE
Tunneling: methods, equipment and support systems
Lamé solution, Kirsch solution
Elasto-plastic analysis of Lamé problem
Numerical modeling of excavation, PHASE2
Support systems
Ground reaction and support characteristic curves
Convergence-confinement method; stress analysis of support
Shallow tunnel
Rock mass classification systems
1. **Course Title:**

CEGE 4351: Groundwater Mechanics

2. **Credit and Contact Hours**

3 credit hours
3 contact hours per week (lecture)

3. **Instructors:**

Dr. Otto Strack

4. **Textbook:**

*Applied Groundwater Mechanics*, Otto Strack (draft); provided in pdf form to the students

   a. **Other supplemental materials**

   Class notes are all written on an iPad, are projected on screen during class time and are e-mailed to the students in pdf form

5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**


   b. **Prerequisites or co-requisites**

   CEGE 3502

   c. **Required, elective, or selected elective**

   Selected elective

6. **Specific Goals for the Course**

   a. **Specific outcomes of instruction**

   - Understand the basic equations and principles that govern groundwater flow
   - Learn about the natural occurrences of groundwater and the types of flow that occur in aquifer systems
   - Learn how to estimate aquifer properties from field observations
   - Solve groundwater flow problems involving rivers and well fields
• Solve problems of transient groundwater flow, involving rivers and well fields
• Solve groundwater flow problems involving leakage from surface water bodies into aquifers
• Complete one groundwater modeling project taken from consulting practice and report the findings in a formal report

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering
(c) an ability to design a system, component, or process to meet desired needs
(e) an ability to identify, formulate, and solve engineering problems

7. Brief list of topics to be covered.

Introduction into groundwater flow; illustration by practical observations stressing the importance of groundwater as a resource and explanation of the term “groundwater mining”
Definition of piezometric head, pressure, specific discharge; Darcy’s law and mass balance
The governing partial differential equation
Shallow confined flow
Discharge potential for uniform flow and wells
Shallow unconfined flow
Combined confined/unconfined flow
Infiltration from rainfall
Infiltration through the bottoms of circular and linear surface water bodies
Application of elementary solutions to problems involving wells and rivers
Capture zones of wells
Semi-confined flow; flow underneath dams
Flow to well fields near rivers for semi-confined flow
Derivation of the equations governing the interaction between rivers and aquifers
Transient flow with wells
Principles of groundwater modeling
1. Course Title:
CEGE 4352: Groundwater Modeling

2. Credit and Contact Hours
3 credit hours
3 contact hours per week (lecture)

3. Instructors:
Dr. Otto Strack

4. Textbook:
Applied Groundwater Mechanics, Strack, (draft); provided in pdf form to the students

   a. Other supplemental materials

       Class notes are all written on an iPad, are projected on screen during class time and are e-
       mailed to the students in pdf form

5. Specific Course Information:
   a. Brief description of the content of the course (catalog description)

       Analytic element method. Mathematical/computer modeling of single/multiple aquifer
       systems. Groundwater recovery. Field problems. Theory/application of simple
       contaminant transport models, including capture zone analysis.

   b. Prerequisites or co-requisites (required)

       CEGE 4351

   c. Required, elective, or selected elective

       Selected elective

6. Specific Goals for the Course

   a. Specific outcomes of instruction

       • Learn how to create a conceptual model for a groundwater flow problem
       • Learn how to use solutions presented in the text to solve practical problems by
         implementing them in Matlab®
       • Learn how to solve contaminant removal problems using wells
• Learn how to gather data necessary for the modeling of regional single-layer aquifers involving rivers, lakes and wells
• Learn how to calibrate a groundwater model using field data; learn what field data are necessary for this purpose
• Learn how to model the effect of inhomogeneities on flow in aquifers, understand their role and learn to decide to create the simplest model possible that will be useful for answering the stated question(s)
• Understand the contemporary issues associated with groundwater management and groundwater as a resource, e.g. for agriculture

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering
(c) an ability to design a system, component, or process to meet desired needs
(e) an ability to identify, formulate, and solve engineering problems
(j) a knowledge of contemporary issues

7. Brief list of topics to be covered.

Modeling groundwater flow analytically using programs to be written by the students in Matlab®
Formulation of two-dimensional groundwater flow in terms of complex variables
The complex potential, the potential and the stream function
Modeling project: determining capture zones for wells operating in a problem of contaminant removal
Capture zone analysis and contaminant capture
Modeling and understanding the effect of inhomogeneities, in particular their effect on the pumping rates of wells
Line-sinks and their application to model aquifers with rivers and lakes
Complex functions suitable for modeling infiltration in areas bounded by polygons; implement in Matlab®
Waste isolation in aquifers
Modeling project: modeling a regional aquifer systems with wells, lakes, rivers and infiltration using the analytic method, implemented by the students in Matlab®. Present the results in an oral 15 minute presentation, which counts as the final examination.
1. Course Title:

CEGE 4401: Steel and Reinforced Concrete Design

2. Credit and Contact Hours

4 credit hours
4 contact hours per week (lecture)
2 additional contract hours per week (recitation)

3. Instructors:

Dr. Catherine French, PE
Dr. Carol Shield, PE

4. Textbook:

Building Code Requirements for Structural Concrete (318-11) and Commentary (318R-11),
American Concrete Institute, 2011.

   a. Other supplemental materials

      Reinforced Concrete – Mechanics and Design, James Wight and James MacGregor,
      2011.

5. Specific Course Information:
   a. Brief description of the content of the course (catalog description)

      Limit-states design. Steel: tension, compression, flexure, combined compression/flexure,
      connections. Concrete: beams in flexure/shear, one-way slabs, T-beams, development
      length, serviceability.

   b. Prerequisites or co-requisites

      CEGE 3401
      CEGE 3402 (co-
      requisite)

   c. Required, elective, or selected elective

      Required

6. Specific Goals for the Course

   a. Specific outcomes of instruction
• Identify critical load combinations required for member design
• Design steel tension members
• Determine capacities of steel flexural members
• Determine capacities of steel columns
• Design singly reinforced concrete beams for flexure
• Determine shear capacities of reinforced concrete beams

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering
(c) an ability to design a system, components, or process to meet desired needs
(e) an ability to identify, formulate, and solve engineering problems

7. Brief list of topics to be covered.

Introduction, Loads
Steel: Tension Members
Steel: Connections
Steel: Compression Members
Steel: Beams
Steel: Beam-Columns and Frames
Concrete: Materials
Concrete: Flexure
Concrete: Serviceability
Concrete: Shear
Concrete: Development length
Concrete: Short Columns
1. Course Title:

CEGE 4411: Matrix Structural Analysis

2. Credit and Contact Hours

3 credit hours
3 contact hours per week (lecture)

3. Instructors:

Dr. Steven Wojtkiewicz

4. Textbook:


   a. Other supplemental materials

      None

5. Specific Course Information:

   a. Brief description of the content of the course (catalog description)

      Analysis of linear structural systems by matrix methods, stiffness, and flexibility methods. Introduction to computerized structural analysis of trusses/frames, including coding in Matlab.

   b. Prerequisites or co-requisites

      CEGE 3101, CEGE 3401

   c. Required, elective, or selected elective

      Selected elective

6. Specific Goals for the Course

   a. Specific outcomes of instruction

      • Distinguish between energy-based flexibility approaches and matrix-based stiffness approaches to structural analysis.
      • Determine deflections and forces in statically determinate and indeterminate structures using the matrix stiffness method.
      • Understand the physical interpretation of stiffness matrices and use this interpretation to assemble the stiffness matrix by hand.
Compute deflections and rotations, internal forces and moments, and reactions in trusses, beams and frames.
Develop and use computer programs which implement the direct stiffness method to analyze and design simple structural systems.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering
(e) an ability to identify, formulate, and solve engineering problems
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

7. Brief list of topics to be covered.

• Overview of Matrix Structural Analysis
• Matrix Algebra
• Plane Trusses
• Computer Program for Plane Trusses
• Beams
• Computer Program for Beams
• Plane Frames
• Computer Program for Frames
• Member Releases and Secondary Effects
• Three-dimensional structures (space trusses, grids, and space frames)
1. Course Title:

CEGE 4412: Reinforced Concrete II

2. Credit and Contact Hours

3 credit hours
3 contact hours per week (lecture)

3. Instructors:

Dr. Arturo Schultz

4. Textbook:


a. Other supplemental materials

Building Code Requirements for Structural Concrete (ACI 318-11), American Concrete Institute, 2011.

5. Specific Course Information:

a. Brief description of the content of the course (catalog description)

Advanced design of reinforced concrete structures: footings, retaining walls, columns with slenderness effects and biaxial loading, torsion, continuous systems, two-way floor systems.

b. Prerequisites or co-requisites

CEGE 4401

c. Required, elective, or selected elective

Selected elective

6. Specific Goals for the Course

a. Specific outcomes of instruction

- Understand at a qualitative level the complete flow of forces from gravity loads in reinforced concrete buildings
- Analyze and design continuous one-way floor systems including slab-beam-girder floors and concrete joist floors
• Analyze and design two-way concrete floor systems using the Direct Design and Equivalent Frame Methods, as well as modern computer software (e.g., SAP2000)
• Understand the mechanics of torsion in reinforced concrete beams and apply contemporary principles for their design
• Analyze and design concrete columns under compression and biaxial loading
• Analyze and design slender concrete columns, both sway and non-sway, using contemporary methods

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering
(c) an ability to design a system, component, or process to meet desired needs
(e) an ability to identify, formulate, and solve engineering problems
(k) an ability to use the techniques, skills, and engineering tools necessary for engineering practice.

7. Brief list of topics to be covered.

Introduction, design process
Continuous beams and one-way slabs
Modeling and analysis of concrete buildings
Continuous slab-beam-girder floor system
Joist floor systems
Two-way floor systems-Direct Design Method
Two-way floor systems-Equivalent Frame Method
Shear strength of two-way floor systems
Unbalanced moment transfer in two-way floor systems
Biaxially-loaded columns
Slender columns
Torsion in beams
Spread footings
Retaining walls
1. Course Title:

CEGE 4413: Steel Design II

2. Credit and Contact Hours

3 credit hours
3 contact hours per week (lecture)

3. Instructors:

Dr. Jialiang Le

4. Textbook:

Steel Structures Design and Behavior, Salmon, Johnson, and Malhas, 2009.

a. Other supplemental materials

None

5. Specific Course Information:

a. Brief description of the content of the course (catalog description)

Design of steel and composite steel/concrete structures, including composite beams, plate girders, beam-columns, connections and multi-story frames.

b. Prerequisites or co-requisites

CEGE 4401

c. Required, elective, or selected elective

Selected elective

6. Specific Goals for the Course

a. Specific outcomes of instruction

- Understand the AISC Steel Construction Manual from the fundamental principles of mechanics.
- Design individual structural members and components, which include composite beams, plate girders, beam columns, and connections.
- Design multi-story steel structures by using computer structural analysis software.
- Model simplification for the design of large-scale steel structures.
• Understand the iterative design process to reach an optimum design solution.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering
(c) an ability to design a system, component, or process to meet desired needs
(e) an ability to identify, formulate, and solve engineering problems
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

7. Brief list of topics to be covered.
   Design of composite beams
   Buckling analysis
   Design of plate girders
   Second-order analysis
   Design of multi-story frames
   Design of shear connections
   Design of moment connections
1. Course Title:

CEGE 4501: Hydrologic Design

2. Credit and Contact Hours

4 credit hours
3.0 contact hours per week - lecture
1.5 contact hours per week - recitation

3. Instructors:

Dr. Vaughan Voller
Dr. John Gulliver, PE
Dr. Omid Mohseni, PE

4. Textbook:

Water Resources Engineering, L.W. Mays, 2010

a. Other supplemental materials

Moodle website

5. Specific Course Information:

a. Brief description of the content of the course (catalog description)


b. Prerequisites or co-requisites

CEGE 3502

c. Required, elective, or selected elective

Required

6. Specific Goals for the Course

a. Specific outcomes of instruction

- Understand the hydrologic cycle and its primary components
- Develop the ability to quantitatively estimate the magnitude of hydrologic processes
- Determine hydrologic design events using probability and statistics
- Acquire a basic understanding of open channel hydraulics, uniform flow, critical depth and gradually varied flow.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering
(c) an ability to design a system, component, or process to meet desired needs
(e) an ability to identify, formulate, and solve engineering problems

7. Brief list of topics to be covered.

Introduction to the Course and Course Policies
Hydrologic Cycle and Water budget
Precipitation
Evaporation and Transpiration
Infiltration
Measurement of surface runoff
Surface runoff and stream-flow
Unit hydrographs
Synthetic UH
Hydrologic routing and river routing
Probability and statistics in hydrology
Frequency analyses
Design storm and design flow
Hydrologic simulation, HEC-HMS
Principles of open channel hydraulics
Critical depth
Uniform flow
Canal Design
Canal design
Gradually varied flow
Culvert design
1. Course Title:

CEGE 4502: Water and Wastewater Treatment

2. Credit and Contact Hours

3 credit hours
3 contact hours per week (lecture)

3. Instructors:

Dr. Timothy LaPara, P.E.
Mr. Dennis Martenson, P.E.

4. Textbook:


   a. Other supplemental materials

      None

5. Specific Course Information:
   a. Brief description of the content of the course (catalog description)


   b. Prerequisites or co-requisites

      CEGE 3501

   c. Required, elective, or selected elective

      Required

6. Specific Goals for the Course

   a. Specific outcomes of instruction

      • Understand the characteristics of surface water, groundwater, and municipal wastewater and how these impact the design of water and wastewater treatment facilities
      • Estimate the expected flow requirements for water/wastewater utilities and how to estimate population growth
Design individual unit operations for the purpose of providing potable and palatable drinking water
Design individual unit operations for the purpose of proving wastewater treatment for the purpose of minimizing the impact on surface water quality
Design an integrated wastewater treatment process, incorporating an iterative design approach that accounts for internal recycle streams
Understand the contemporary issues associated with municipal wastewater solids and their ultimate disposal

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering
(c) an ability to design a system, component, or process to meet desired needs
(e) an ability to identify, formulate, and solve engineering problems
(j) a knowledge of contemporary issues

7. Brief list of topics to be covered.

Introduction to the Course and Course Policies;
Chemical Kinetics and Reactor Theory
Reactor Theory; Water Use and Wastewater Generation
Water Quality
Preliminary Water Treatment Unit Operations
Coagulation Theory
Rapid Mixing and Coagulation
Slow Mixing and Flocculation
Lime-Soda Water Softening
Sedimentation
Filtration
Disinfection
Wastewater Characteristics
Water Quality Modeling
Preliminary Wastewater Treatment Unit Operations
Activated Sludge
Nutrient Removal; Trickling Filters
Secondary Clarifier Design
Wastewater Disinfection; Solids Handling
Sludge Regulations
Sludge Stabilization
Ultimate Disposal
1. Course Title:

CEGE 4511: Hydraulic Structures

2. Credit and Contact Hours

3 credit hours
3 contact hours per week (lecture)

3. Instructors:

Dr. Omid Mohseni, PE

4. Textbook:

Hydraulic Structures, Novak et al., 2007.

   a. Other supplemental materials

      Open Channel Hydraulics, Van Te Chow, 1959
      Design of Small Dams, US Bureau of Reclamation
      Dam Hydraulics, D. L. Vischer, 1998
      US Army Corps of Engineers Engineering Manuals

5. Specific Course Information:
   a. Brief description of the content of the course (catalog description)

      Hydraulic design procedures for culverts, dams, spillways, outlet works, and river control
      works. Drop structures, water intakes, bridge crossings.

   b. Prerequisites or co-requisites

      CEGE 4501

   c. Required, elective, or selected elective

      Selected elective

6. Specific Goals for the Course

   a. Specific outcomes of instruction
      • Apply conservation of mass, momentum and energy principles to open channel flow
        and closed conduit problems
      • Understand hydrologic and hydraulic design aspects of earthen and concrete dams
      • Design and analyze outlet structures (spillways), energy dissipaters (stilling basins)
        and control structures (gates)
• Design and analyze intakes and diversion systems using the concepts of pipe flow and gradually varied flow conditions
• Understand the principles of physical model studies

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering
(c) an ability to design a system, component, or process to meet desired needs
(e) an ability to identify, formulate, and solve engineering problems
(j) a knowledge of contemporary issues

7. Brief list of topics to be covered.

Review of open channel flow
Flow analysis in closed conduits and culverts, and culvert design
Introduction to earthen and concrete dams and levees
Probable maximum precipitation (PMP), PMF, SPF and IDF
Hydraulic design and analysis of ogee spillways, and other spillways such as morning glory, siphon spillways, stepped spillways, side channels and labyrinth spillways
Hydraulic analysis of stilling basins and drop structures
Drop shafts
Intakes and bottom outlets
Gates and hydraulic analysis of vertical and tainter gates
Cavitation and aeration
Diversion systems
Fish passage
Scour analysis downstream of hydraulic structures
Waves
Estimating freeboard
Riprap protection and bioengineering techniques
Physical model studies
1. Course Title:

CEGE 4512: Open Channel Hydraulics

2. Credit and Contact Hours

4 credit hours
4 contact hours per week (lecture)

3. Instructors:

Dr. Michele Guala
Dr. Omid Mohseni, PE

4. Textbook:


a. Other supplemental materials

None

5. Specific Course Information:

a. Brief description of the content of the course (catalog description)

Theories of flow in open channels, including gradually varied and rapidly varied flows, steady and unsteady flows. Computational methods for unsteady open channel flows, applications to flood routing. Introduction to moveable bed mechanics.

b. Prerequisites or co-requisites

CEGE 3502

c. Required, elective, or selected elective

Selected elective

6. Specific Goals for the Course

a. Specific outcomes of instruction

- Understand the characteristics of natural and built open channel hydraulic systems
- Understand how different structures are designed for controlling water surface profile along a channel
- Understand how to apply energy and momentum equation to model specific flow conditions typical of open channel hydraulics.
• Design a set of hydraulic structures in a real river at a given discharge using HecRas
• Understand the contemporary issues associated with sediment transport and morphodynamic stability of a river

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering
(c) an ability to design a hydraulic system or component to meet desired needs
(e) an ability to identify, formulate, and solve engineering problems

7. Brief list of topics to be covered.

Basic principles
Specific energy and critical depth
Momentum (hydraulic jumps, stilling basin, surges and bridge piers)
Uniform flows
Turbulence and flow resistance
Friction coefficient
Gravity sewer
Compound channels
Gradually varying flow
Water surface profile (classification and computation)
Hydraulic structures
Spillways, culverts, bridges
Governing equation of unsteady flow
HecRas modeling in gradually varying flows
Simplified methods of flow routing
Flow in alluvial channels
Basics of sediment transport
1. **Course Title:**

CEGE 4561: *Solids and Hazardous Wastes*

2. **Credit and Contact Hours**

3 credit hours
3 contact hours per week (lecture)

3. **Instructors:**

Dr. Paige Novak, P.E.

4. **Textbook:**


   a. Other supplemental materials

   Handouts

5. **Specific Course Information:**

   a. Brief description of the content of the course (catalog description)

   Solid and hazardous waste characterization; regulatory legislation; waste minimization; resource recovery; chemical, physical, and biological treatment; thermal processes; disposal practices. Analysis and design of systems for treatment and disposal.

   b. Prerequisites or co-requisites

   CEGE 3501

   c. Required, elective, or selected elective

   Selected elective

6. **Specific Goals for the Course**

   a. Specific outcomes of instruction

   - Understand the regulatory framework of solid and hazardous waste management
   - Know the management hierarchy for solid and hazardous waste management
   - Understand the principles of pollution prevention and life cycle assessment; recognize opportunities in pollution prevention
   - Understand the characteristics of solid waste
   - Determine how to treat or manage solid waste based on its characteristics
• Predict products and residuals from solid waste treatment (methane generation, energy production, air pollutant generation, solid residual mass)
• Design individual unit operations for the purpose of treating hazardous waste based on waste characteristics
• Design treatment trains for hazardous waste treatment

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science and engineering  
(c) an ability to design a hydraulic system or component to meet desired needs 
(e) an ability to identify, formulate, and solve engineering problems 
(g) an ability to communicate effectively 
(j) a knowledge of contemporary issues

7. Brief list of topics to be covered.
Definitions of solid and hazardous wastes, regulatory framework for solid and hazardous waste management  
Pollution prevention and life-cycle assessment  
Introduction to solid waste properties  
Solid waste recycling  
Solid waste incineration and air pollution control technologies  
Landfilling  
Solid waste composting  
Hazardous waste treatment, precipitation  
Hazardous waste treatment, chemical oxidation/reduction  
Hazardous waste treatment, ion exchange  
Biological hazardous waste treatment (oxidation/reduction)  
The policy of pollution prevention/LCA 
Designing a treatment train for hazardous waste
1. Course Title:

CEGE 5212: Transportation Policy, Planning, and Deployment

2. Credit and Contact Hours

4 credit hours
4 contact hours per week

3. Instructors:

Dr. David Levinson

4. Textbook:


a. Other supplemental materials

None

5. Specific Course Information:

a. Brief description of the content of the course (catalog description)


b. Prerequisites or co-requisites

CEGE 3201

c. Required, elective, or selected elective

Selected elective

6. Specific Goals for the Course

a. Specific outcomes of instruction

Students should be able to:

- Illustrate how technologies are innovated and identify the policy environments conducive to innovation.
- Explain the lifecycle model of technology diffusion (birth, growth, maturity) and its implications for current policy and investment.
• Demonstrate the consequences of positive and negative feedback processes on transportation systems.
• Compare and contrast models and simulations of network growth with historical experience.
• Estimate statistical functions of the rate of deployment of transportation technologies.
• Prepare, present, and lead discussion of a case study of a contemporary transportation issue, situating the discussion’s context in the history of transportation and the local geography.
• Develop and test original hypotheses with original data about transportation systems.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(b) An ability to design and conduct experiments, analyze and interpret data.
(c) An ability to design a system, component, or process to meet desired needs
(d) An ability to function on multi-disciplinary teams
(f) An understanding of professional and ethical responsibility
(h) The broad education necessary to understand the impact of engineering solutions in a global and societal context.

7. Brief list of topics to be covered.

Transportation history
Innovation processes
Lifecycle theory
Transportation policy
Transportation planning
1. Course Title:

CEGE 5213: Transit Planning and Management

2. Credit and Contact Hours

3 credit hours
3 contact hours per week

3. Instructors:

Dr. Jason Cao

4. Textbook:


a. Other supplemental materials

TCRP 102: *Transit-Oriented Development in the United States--Experiences, Challenges, and Prospects*
TCRP 128: *Effects of TOD on Housing, Parking, and Travel*
TCRP 135: *Controlling System Costs: Basic and Advanced Scheduling Manuals and Contemporary Issues in Transit Scheduling*
TCRP 100: *Transit Capacity and Quality of Service Manual*

5. Specific Course Information:

a. Brief description of the content of the course (catalog description)


b. Prerequisites or co-requisites

None

c. Required, elective, or selected elective

Selected elective

6. Specific Goals for the Course
a. Specific outcomes of instruction

Students should be able to:

Understand and address the issues related to:
- transit services in the Twin Cities, in the US, and around the world
- transit management techniques including design standard, capacity analysis, and route scheduling
- transit agency organization, economics, and politics
- the linkage between transit and land use planning

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(d) an ability to function on multi-disciplinary teams
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(j) a knowledge of contemporary issues

7. Brief list of topics to be covered.

History of public transportation
Transit policy in the USA and worldwide
Land use and transit integration
Transit management techniques
Politics of transit
1. Course Title:

CEGE 5214: *Transportation Systems Analysis*

2. Credit and Contact Hours

4 credit hours
4 contact hours per week

3. Instructors:

Dr. Henry Liu

4. Textbook:


a. Other supplemental materials

None

5. Specific Course Information:

a. Brief description of the content of the course (catalog description)

Systems approach to decision-making in transportation systems engineering and planning. Linear programming, integer programming, multi-objective optimization, and non-linear optimization. Transportation system analysis and design. Intelligent transportation systems. Prediction of traffic flows and level of service. Equilibrium assignment, decision analysis, multidimensional evaluation of transportation projects.

b. Prerequisites or co-requisites

CEGE 3201

c. Required, elective, or selected elective

Selected elective

6. Specific Goals for the Course

a. Specific outcomes of instruction

- Apply the systems-level approach to the analysis and design of transportation infrastructure.
- Formulate linear models of applications in transportation engineering systems
- Solve linear models of applications in transportation engineering systems
• Systematically evaluate design options involving competing objectives
• Apply a variety of approaches toward solving non-linear models of applications in transportation engineering systems

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering
(c) an ability to design a system, component, or process to meet desired needs
(e) an ability to identify, formulate, and solve engineering problems
(j) a knowledge of contemporary issues

7. Brief list of topics to be covered.

Basic Systems Concepts
Formulation of a Linear Program
The Simplex Algorithm for Solving Linear Programs
Analysis and Design under Competing/Conflicting Objectives
Intelligent Transportation System Examples
Models with Integer Solutions
Transportation Network Models
Shortest Path Search and its Application to Vehicle Navigation
Non-linear Program and First-Order Conditions
Solution Algorithms for Nonlinear Programs
1. Course Title:

CEGE 5253: Asphalt and Portland Cement Concrete Materials

2. Credit and Contact Hours

4 credit hours
4 contact hours per week (lecture)

3. Instructors:

Dr. Lev Khazanovich: Part 1, Portland Cement Concrete, weeks 1 through 8
Dr. Mihai Marasteanu, PE: Part 2, Asphalt Materials, weeks 9 through 16

4. Textbook:

No required textbook

   a. Other supplemental materials

   Concrete, Sidney Mindess, J. Francis Young, and David Darwin, 2003.

5. Specific Course Information:
   a. Brief description of the content of the course (catalog description)


   b. Prerequisites or co-requisites

   CEGE 3402W Civil Engineering Materials Prerequisite
c. Required, elective, or selected elective

Selected elective

6. Specific Goals for the Course

a. Specific outcomes of instruction

- To develop a fundamental understanding of the microstructure of concrete
- To illustrate the relationship between the microstructure and the key material properties and the behavior of portland cement concrete.
- To develop understanding how construction practices and weather impact concrete strength and durability
- To develop a fundamental understanding of the concepts used in the development of the Superpave asphalt binder and mixture specifications
- To illustrate the relationship between the components of the composite asphalt mixture and the key material properties that affect mechanical behavior
- To develop understanding of how construction practices and weather impact asphalt pavements performance and durability

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering,
(b) an ability to design and conduct experiments, as well as to analyze and interpret data,
(h) the education to understand the impact of engineering solutions in a global and societal context,
(j) a knowledge of contemporary issues

7. Brief list of topics to be covered.

Portland cement production and composition
Portland cement hydration
Supplementary cementitious materials
Aggregates
Chemical admixtures
Properties of fresh and hardened concrete
Specialty concretes and high performance concrete
Asphalt binder production and characterization
Asphalt emulsions
Asphalt mixtures design and characterization
Asphalt mixture production, transport, placement, and compaction
Warm mix asphalt
Recycling of asphalt materials
1. Course Title:
CEGE 5311: Experimental Geomechanics

2. Credit and Contact Hours
3 credit hours
3 contact hours per week (lecture) + laboratory

3. Instructors:
Dr. Joseph Labuz, P.E.

4. Textbook:
Experimental Solid Mechanics, Shukla and Dally, 2010.

   a. Other supplemental materials

      Experimental Stress Analysis, Dally and Riley, 2001.

5. Specific Course Information:
   a. Brief description of the content of the course (catalog description)


   b. Prerequisites or co-requisites

      CEGE 4301 or consent of instructor

   c. Required, elective, or selected elective

      Elective

6. Specific Goals for the Course
   a. Specific outcomes of instruction

      • Use principles of solid mechanics to describe deformation
      • Measure mechanical behavior and evaluate data
      • Apply appropriate constitutive model to explain behavior
      • Analyze data from electrical and optical methods
b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) An ability to apply knowledge of mathematics, science, and engineering
(b) An ability to design and conduct experiments, as well as to analyze and interpret data
(g) An ability to communicate effectively

7. Brief list of topics to be covered.

Material behavior; force and displacement
Closed-loop, servo-hydraulic load frame
System versus material response
Error and statistics of data
Displacement and small strain
Measurement of deformation: electrical devices
Velocity and acceleration gauges; acoustic emission
Measurement of deformation: optical methods
 Constitutive behavior: direct and indirect testing
 Uniaxial tension and compression tests: orthotropic elasticity
 Brazilian (splitting) test: elastic parameters from an indirect test
 Flexure test: microcracked solid
 Fracture test: linear fracture mechanics
1. Course Title:

CEGE 5341: Wave Methods for Nondestructive Testing

2. Credit and Contact Hours

4 credit hours
3 contact hours per week (lecture)

3. Instructors:

Dr. Stefano Gonella

4. Textbook:

No textbook is required

   a. Other supplemental materials

   Wave Propagation in Elastic Solids, Achenbach, 1973
   Ultrasonic Waves in Solid Media, Rose, 1999
   Structural Health Monitoring with Piezoelectric Wafer Active Sensors, Giurgiutiu, 2008

5. Specific Course Information:
   a. Brief description of the content of the course (catalog description)

   Introduction to contemporary methods for nondestructive characterization of objects of
civil infrastructure (e.g., highways, bridges, geotechnical sites). Imaging technologies
based on propagation of elastic waves such as ultrasonic/resonant frequency methods,
seismic surveys, and acoustic emission monitoring. Lecture, lab.

   b. Prerequisites or co-requisites

   AEM 3031

   c. Required, elective, or selected elective

   Selected elective

6. Specific Goals for the Course

   a. Specific outcomes of instruction

   • Understand elastic wave propagation in structural systems, and its use for non-
destructive evaluation (NDE) and structural health monitoring (SHM).
   • Understand the generation of guided waves by means of piezoelectric actuators
• Understand the principles of wave steering using phased array systems
• Learn the fundamentals of signal processing required for wave based damage detection and triangulation
• Conduct individual research on a contemporary problem related to wave methods for nondestructive testing

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering
(c) an ability to design a system, component, or process to meet desired needs
(e) an ability to identify, formulate, and solve engineering problems
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

7. Brief list of topics to be covered.

The wave equation and its properties
Dispersive and non-dispersive media. Phase and group velocity
Waves in one-dimensional structures: rods, shafts and beams
Plane waves in two-dimensional domains
Flexural and Lamb waves in plates
Waves in layered media
Actuation and sensing
Piezoelectric wafer active sensors (PWAS)
Tuned guided waves. Triangulation techniques
Wave beaming and beam steering: Phased array ultrasonics
Wavefield reconstruction via laser interferometry
Signal processing and filtering techniques for SHM data
1. Course Title:

CEGE 5351: Advanced Mathematics for Civil Engineers

2. Credit and Contact Hours

3 credit hours
3 contact hours per week (lecture)

3. Instructors:

Dr. Otto Strack

4. Textbook:

Application of Vector Analysis to Engineering Problems (draft), by Otto D.L. Strack, provided to the students in electronic form

a. Other supplemental materials

Class notes are all written on an iPad, are projected on screen during class time and are e-mailed to the students in pdf form

5. Specific Course Information:

a. Brief description of the content of the course (catalog description)

Emphasizes skills relevant for civil engineers. Mathematical principles explained in an engineering setting. Applications from various areas in civil engineering.

b. Prerequisites or co-requisites

Math 2263, Math 2374

c. Required, elective, or selected elective

Selected elective

6. Specific Goals for the Course

a. Specific outcomes of instruction

• Learn basic mathematical skills in the context of civil engineering problems
• Learn mathematical expressions relevant in engineering and their meaning, in particular properties of vector fields such as curl and divergence
• Learn the definitions of the material-time derivative, its application to expressions for velocity and acceleration, and application of these concepts to fluid mechanics
• Derive and understand mathematical expressions for stresses and strains in the context of coordinate transformations
• Learn how to use complex variables (Wirtinger calculus) to formulate and solve general two-dimensional problems
• Create a model for open-channel flow involving a series of impermeable cylindrical obstructions as the final class project
• Learn to distinguish between the three fundamental types of partial differential equations, and learn the approach for solving these equations

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering
(e) an ability to identify, formulate, and solve engineering problems

7. Brief list of topics to be covered.

Vectors in three-dimensional space
Vector fields
Fundamental equations for fluid mechanics
Irrotational and divergence-free flow
Coordinate transformations; definitions of vectors and tensors; application to linear elasticity
Partial differential equations of the first order
Partial differential equations of the second order
The elliptical case; complex characteristics; general complex variables; fluid mechanics and groundwater flow
The parabolic case; heat flow and diffusion
The hyperbolic case; longitudinal vibration in a bar
1. Course Title:

CEGE 5411: Applied Structural Mechanics

2. Credit and Contact Hours

3 credit hours
3 contact hours per week

3. Instructors:

Dr. Roberto Ballarini, P.E.

4. Textbook:

None

   a. Other supplemental materials

      Instructor’s notes provided on an as needed basis.

5. Specific Course Information:
   a. Brief description of the content of the course (catalog description)

      Principal stresses and failure criteria in 3 dimensions. Introduction to plane elasticity, energy methods, torsion of beams, and bending of unsymmetrical beams.

   b. Prerequisites or co-requisites

      A course in mechanics of materials (also referred to as strength of materials)

   c. Required, elective, or selected elective

      Selected elective

6. Specific Goals for the Course

   a. Specific outcomes of instruction

      • Understand the fundamental constitutive responses of elastic, plastic and creeping materials.
      • Understand the behavior of structural elements comprised of materials with various constitutive behaviors as determined by engineering theories.
      • Understand the equations of elasticity and their application to simple boundary value problems.
• Understand the different failure mechanisms of structural components, including plastic collapse, high cycle fatigue, crack propagation, static fatigue, and buckling.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering
(e) an ability to identify, formulate, and solve engineering problems

7. Brief list of topics to be covered.

Exact solutions vs. approximate solutions
Constitutive models for elastic, elastic-plastic, and creeping solids
Review of element behavior (tension, torsion, flexure, pressure vessels) for linear elastic and elastic-plastic materials
Linear elasticity (stress, strain, displacement, compatibility, equilibrium, Hooke’s Law for isotropic and transversely isotropic materials, strain energy and complementary energy, plane stress and planes strain)
Strength theories: criteria for pressure independent and pressure dependent ductile and brittle materials
High cycle fatigue
Fracture mechanics
Plates
Energy methods
Finite element method
Stability
1. Course Title:

CEGE 5414: Prestressed Concrete Design

2. Credit and Contact Hours

3 credit hours
3 contact hours per week

3. Instructors:

Dr. Carol Shield, P. E.
Dr. Catherine French, P. E.

4. Textbook:

Design of Prestressed Concrete Structures, Lin & Burns, 1981.
ACI 318-11 Building Code Requirements for Reinforced Concrete
PCI Handbook

a. Other supplemental materials

5. Specific Course Information:
   a. Brief description of the content of the course (catalog description)

   Design of prestressed concrete structures. Time dependent effects, behavior, flexure, shear, torsion, deflections, continuous systems.

b. Prerequisites or co-requisites

   CEGE 4401

c. Required, elective, or selected elective

   Selected elective

6. Specific Goals for the Course

   a. Specific outcomes of instruction
     • Understand the concepts of pretensioning and posttensioning
     • Determine short and long term prestress losses.
     • Design prestressed beam for flexure including consideration of service stresses and strength
     • Understand the effects of prestress and strand area on the moment-curvature response
     • Design prestressed beam for shear and torsion
• Determination of camber and deflections
• Design composite section

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering
(c) an ability to design a system, component, or process to meet desired needs
(e) an ability to identify, formulate, and solve engineering problems

7. Brief list of topics to be covered.

Introduction; technology and materials; prestressing systems
Prestress losses; relaxation, creep and shrinkage
Flexural design; general principles; allowable stresses
Flexural behavior, moment-curvature relationships
Design for shear and torsion
Serviceability: camber, deflection and cracking
Composite beams
1. Course Title:

CEGE 5415: Masonry Structures

2. Credit and Contact Hours

3 credit hours
3 contact hours per week

3. Instructors:

Dr. Arturo Schultz

4. Textbook:


a. Other supplemental materials

Building Code Requirements for Masonry Structures (TMS 402/ACI 530/ASCE 5), 2011.

5. Specific Course Information:

a. Brief description of the content of the course (catalog description)


b. Prerequisites or co-requisites

CEGE 3401

c. Required, elective, or selected elective

Selected elective

6. Specific Goals for the Course

a. Specific outcomes of instruction

- Understand the methods of production of masonry materials, their physical composition and the corresponding materials properties
- Understand the mechanics of masonry assemblages that are loaded in compression, flexure, tension, or shear
- Understand the methods of construction and structural forms used for contemporary masonry
• Understand the Allowable Stress Design (ASD) and Strength Design (SD) philosophies and the corresponding building code design criteria
• Analyze and design masonry members (beams, walls, columns and pilasters) under gravity loads using modern principles
• Analyze and design masonry buildings and components subjected to lateral loads (wind and seismic)

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering
(c) an ability to design a system, component, or process to meet desired needs
(e) an ability to identify, formulate, and solve engineering problems
(g) an ability to communicate effectively
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

7. Brief list of topics to be covered.

Introduction / History of Masonry / Contemporary Masonry
Building Systems / Design Methods
Materials – Clay Masonry Units, Concrete Masonry Units
Materials – Concrete Masonry Units, Mortar Grout and Reinforcement
Masonry Assemblages in Compression, Tension and Shear
Masonry Beams in Flexure (ASD & SD)
Masonry Beams in Shear (ASD & SD)
Anchorage and Development Length in Masonry Beams
Serviceability and Load Distribution in Masonry Beams
Unreinforced Masonry (URM) Walls in Flexure
Reinforced Masonry (RM) Walls in Flexure
Loadbearing Walls in Compression and Out-of-Plane Flexure
Characteristics and Design of Cavity Walls
Masonry Columns and Pilasters
Masonry Shear Walls
Connectors
Movement Joints
Introduction to Prestressed Masonry
1. Course Title:

CEGE 5511: Urban Hydrology and Land Development

2. Credit and Contact Hours

4 credit hours
4 contact hours per week (lecture)

3. Instructors:

Dr. John Gulliver, PE

4. Textbook:

None

   a. Other supplemental materials

      Handouts, reports, articles

5. Specific Course Information:

   a. Brief description of the content of the course (catalog description)

      Urban hydrology for small watersheds and the management of storm water quality and quantity.

   b. Prerequisites or co-requisites

      CEGE 4501

   c. Required, elective, or selected elective

      Selected elective

6. Specific Goals for the Course

   a. Specific outcomes of instruction

      • Understand the characteristics of urban runoff that are important to predicting and improving upon runoff quantity and quality.
      • Work with the Green-Ampt assumptions to develop infiltration rates for various applications.
      • Redesign a known urban pipe-shed to relieve flooding with given cost constraints.
      • Develop alternatives and test feasibility of stormwater features on projects in conjunction with a local city.
b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering
(c) an ability to design a system, component, or process to meet desired needs
(e) an ability to identify, formulate, and solve engineering problems
(j) a knowledge of contemporary issues

7. Brief list of topics to be covered.

Introduction to Course and Projects
Quality of Urban Runoff
Stormwater Detention and Sedimentation of Pollutants
Volume Control through Infiltration
Advanced Stormwater Treatment
Assessment and Maintenance of Stormwater Practices
1. Course Title:

CEGE 5541: Environmental Water Chemistry

2. Credit and Contact Hours

3 credit hours
3 contact hours per week (lecture)

3. Instructors:

Dr. William Arnold, P.E.

4. Textbook:


    a. Other supplemental materials

        None

5. Specific Course Information:

    a. Brief description of the content of the course (catalog description)

        Introduction to water chemistry. Physical chemical principles, geochemical processes controlling chemical composition of waters, behavior of contaminants that affect the suitability of water for beneficial uses.

    b. Prerequisites or co-requisites

        CEGE 3501

    c. Required, elective, or selected elective

        Selected elective

6. Specific Goals for the Course

    a. Specific outcomes of instruction

        • Develop an understanding of the dissolved and solid species that affect the chemistry of aquatic systems
        • Perform equilibrium calculations graphically, algebraically, and using computer software
• Be able to perform calculations related to acids and bases, titrations, complexation, solubility, and oxidation-reduction reactions
• Evaluate expressions for chemical kinetics and perform kinetic simulation calculations
• Develop an understanding of how chemical processes affect natural and engineered aquatic systems.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) An ability to design to apply knowledge of mathematics, science, and engineering
(e) An ability to identify, formulate, and solve engineering problems
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

7. Brief list of topics to be covered.

Introduction to the Course and Course Policies; concentration units
Thermodynamics and equilibrium
Activity and activity coefficients
Principals of chemical kinetics
pH, introduction to acids and bases, and displaying chemical equilibrium
Solution of chemical equilibrium problems, acid-base chemistry and calculations
Titration, pH calculation, pH buffers, ionization fraction
Composition of natural waters, carbonate system
Metal-ion complexation
Solubility, water softening
Solubility of metal (hydr)oxides and carbonates
Principles of redox equilibria
Chlorine chemistry
Sorption processes
Fate of organic pollutants
Natural organic matter
1. Course Title:

CEGE 5542: *Experimental Methods in Environmental Engineering*

2. Credit and Contact Hours

3 credit hours
4.25 contact hours per week (1.25 hour lecture, 3 hours laboratory)

3. Instructors:

Dr. William Arnold, P.E.

4. Textbook:


   a. Other supplemental materials

   US Geological Survey Manuals for collection and analysis of environmental samples (available online)

5. Specific Course Information:

   a. Brief description of the content of the course (catalog description)

   Tools necessary to conduct research in environmental engineering and chemistry. Theory of operation of analytical equipment. Sampling and data handling methods, statistical analyses, experimental design, laboratory safety. Lecture, laboratory.

   b. Prerequisites or co-requisites

   CEGE 3501, (CEGE 5541 recommended)

   c. Required, elective, or selected elective

   Selected elective

6. Specific Goals for the Course

   a. Specific outcomes of instruction

   - Understand and use proper statistical tools for data analysis
   - Understand the basics of instrument function and operation
   - Conduct routine water quality analyses
   - Design and conduct an independent experimental investigation
   - Develop technical writing and oral presentation skills
b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

7. Brief list of topics to be covered.

Lab safety and role of environmental measurements  
Volumetric and gravimetric measurements  
pH measurement, Alkalinity, and Specific conductance  
Reactor Kinetics  
UV/Visible Spectroscopy  
Atomic absorption spectrometry  
Ion chromatography, Organic carbon analysis  
Dissolved oxygen, Temperature, Ion-specific electrodes, Turbidity.  
Gas chromatography  
Liquid chromatography  
Surface characterization and Microscopy techniques  
Field sampling and preservation  
Capillary electrophoreses
1. Course Title:

CEGE 5543: Introductory Environmental Fluid Mechanics

2. Credit and Contact Hours

4 credit hours
4 contact hours per week (lecture)

3. Instructors:

Dr. Miki Hondzo

4. Textbook:

No required textbook

    a. Other supplemental materials


5. Specific Course Information:

    a. Brief description of the content of the course (catalog description)

        Divergence theorem, Convective flux, Mass conservation, Biological reactions, Random
        walk and diffusive flux, Receptors and channels, Momentum conservation, Navier-Stokes
        equations, Boundary layer, Chemotaxis, Phototaxis, Shear dispersion, Turbulent flows.

    b. Prerequisites or co-requisites

        CEGE 3502 or AEM 4201 or ChEN 3005

    c. Required, elective, or selected elective

        Selected elective

6. Specific Goals for the Course

    a. Specific outcomes of instruction
• Understand key concepts and fundamental principles pertaining to conservation of mass and momentum of fluid and substance in the environment.
• Develop analytical skills for quantification of fluid transport in biogeochemical environments.
• Develop the ability to design and scale up laboratory experiments of natural and engineered systems involving fluid flow and biogeochemical environments.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
(a) an ability to apply knowledge of mathematics, science, and engineering. 
(c) an ability to design a system, component, or processes to meet desired needs. 
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

7. Brief list of topics to be covered.

Scalars, vectors, tensors
Divergence theorem, pressure, Archimedes principle
Convective flux, fluid mass conservation
Introduction to biological reactions
Random walk and diffusive flux
Receptors and channels
Momentum conservation
Constitutive relation for Newtonian fluid
Navier-Stokes equations
Boundary layer approximations of the Navier-Stokes equations
Laminar flows with microorganisms (chemotaxis, phototaxis)
Shear dispersion
Introduction to turbulent flows
Laboratory experiments (laminar and turbulent flows, dispersion)
Nutrient fluxes to microorganisms in a turbulent flow
1. Course Title:

CEGE 5551: Environmental Microbiology

2. Credit and Contact Hours

3 credit hours
3 contact hours per week

3. Instructors:

Dr. Paige Novak, P.E.

4. Textbook:


   a. Other supplemental materials

   None

5. Specific Course Information:
   a. Brief description of the content of the course (catalog description)

   Role of microorganisms in environmental bioremediation, pollution control, water/wastewater treatment, biogeochemistry, and human health.

   b. Prerequisites or co-requisites

   None

   c. Required, elective, or selected elective

   Selected elective

6. Specific Goals for the Course

   a. Specific outcomes of instruction

   - Understand the physiology of prokaryotes
   - Understand the basics of metabolism, including heterotrophic metabolism, chemolithotrophic metabolism, and phototrophic metabolism
   - Understand the basics of respiration and electron flow in an organism, including concepts from aerobic respiration and anaerobic respiration
   - Understand the essentials of genetics, including replication, transcription, and translation
• Understand regulation with respect to transcription and translation
• Understand microbial ecology with respect to microbial interactions, succession, and community development
• Understand how different metabolic capabilities result in biogeochemical cycling
• Understand the fundamental kinetic expressions of enzyme activity, microbial growth, and substrate utilization
• Be capable of applying fundamental principles of microbiology to wastewater treatment
• Be capable of applying fundamental principles of microbiology to the degradation of contaminants
• Understand the contemporary issues associated with environmental microbiology

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply knowledge of mathematics, science, and engineering
(e) an ability to identify, formulate, and solve engineering problems
(j) a knowledge of contemporary issues

7. Brief list of topics to be covered.

Introduction to the Course and Course Policies
Cell chemistry
Cell physiology
Introduction to metabolism
Heterotrophs
Respiration
Photoautotrophs
Chemolithotrophs
Genetics
Introduction to ecology
Microbial interactions
Biogeochemical cycling
Communities and ecosystems
Kinetics
Wastewater microbiology
Degradation of xenobiotics
1. Course Title:

CEGE 5552: Environmental Microbiology Laboratory

2. Credit and Contact Hours

1 credit hour
2.5 contact hours per week

3. Instructors:

Dr. Paige Novak, P.E.

4. Textbook:

None.

   a. Other supplemental materials

   Course packet containing laboratory exercises and background information, the book

5. Specific Course Information:
   a. Brief description of the content of the course (catalog description)

   Basic microbiological techniques: media making, staining, visualization, plating,
   isolation, identification/enumeration of bacteria, quantification using quantitative
   polymerase chain reaction (molecular technique). Individual laboratory project. Lab.

   b. Prerequisites or co-requisites

   None

   c. Required, elective, or selected elective

   Selected elective

6. Specific Goals for the Course

   a. Specific outcomes of instruction

   • Practice basic cultivation-based microbiology techniques
   • Practice basic cultivation-independent microbiology techniques
   • Use microscopy to visualize bacteria
   • Understand when different techniques are appropriate for use and the information that
     can be obtained through their use
• Develop an independent hypothesis-based laboratory project that utilizes the techniques learned in class to explore a question related to environmental microbiology
• Gain practice in presenting information to the class

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(a) an ability to apply mathematics, science and engineering principles.
(b) an ability to design and conduct experiments, analyze and interpret data.
(g) an ability to communicate effectively.

7. Brief list of topics to be covered.

Introduction to various microbiology laboratory techniques (cultivation and cultivation-independent)
Media preparation
Introduction to the microscope and staining
Plating, transferring, and isolating organisms
Enumeration of organisms
Extraction of DNA
Quantitative polymerase chain reaction (PCR)
Development, presentation, and execution of an independent laboratory project with feedback from the instructor and classmates
1. Course Title:
CEGE 5561: Air Quality Engineering

2. Credit and Contact Hours
3 credit hours
3 contact hours per week

3. Instructors:
Dr. Julian Marshall

4. Textbook:

  a. Other supplemental materials

5. Specific Course Information:
  a. Brief description of the content of the course (catalog description)

    Introduction to air pollution problems/solutions, local to global. Quantitative analysis of chemistry and physics of atmospheric pollutants. Sources, sinks, and controls; atmospheric transport and transformation; air quality management and regulation; health impacts; global issues.

  b. Prerequisites or co-requisites

      None

  c. Required, elective, or selected elective

      Selected elective

6. Specific Goals for the Course

  a. Specific outcomes of instruction

    • Carry out mass and energy balance calculations related to air pollution.
    • Use and apply concepts of exposure assessment and environmental health as related to air pollution, for example, intake fraction and relative risk.
    • Carry out basic statistical analyses such as determining whether a dataset is log-normally distributed.
    • Describe main approaches to air quality modeling.
Describe key concepts in the chemistry and physics of air pollution formation and removal.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(g) An ability to communicate effectively,
(h) The broad education necessary to understand the impact of engineering solutions in a global and societal context,
(j) A knowledge of contemporary issues, and
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

7. Brief list of topics to be covered.

1. Introduction: air pollution problems from local to global
2. Health effects of air pollution
3. Combustion sources: emissions and controls
4. Particulate matter
5. Atmospheric chemistry: ozone
6. Air pollution modeling
7. Air pollutant measurement
8. Global warming
1. Course Title:

CEGE 5570: *Design for Sustainable Development: Discovery*

2. Credit and Contact Hours

3 credit hours
3 contact hours per week

3. Instructors:

Dr. Julian Marshall
Dr. John Gulliver
Mr. Fred Rose
Mr. Brian Bell

4. Textbook:

*Poor Economics*, Banerjee and Duflo, 2012.
*Beyond the Beautiful Forevers*, Boo, 2012.

a. Other supplemental materials

None

5. Specific Course Information:

a. Brief description of the content of the course (catalog description)

Intensive, experiential learning opportunity on infrastructure, development, environment issues in Delhi, India.

b. Prerequisites or co-requisites

Advanced standing and permission of instructor.

c. Required, elective, or selected elective

Selected elective

6. Specific Goals for the Course

a. Specific outcomes of instruction

- Understanding of strengths and limitations of technical solutions for issues of development
• Understanding of global grand challenges
• Develop a local, sustainable solution to a global grand challenge

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(d) ability to function on multidisciplinary teams
(h) understand the impact of engineering solutions in a global, economic, environmental, and societal context
(j) knowledge of contemporary issues

7. Brief list of topics to be covered.

Design thinking
Global grand challenges
Appropriate technologies
Environmental engineering and water resources engineering for Developing Countries
1. Course Title:

CEGE 5571: Design for Sustainable Development: Innovate

2. Credit and Contact Hours

4 credit hours
4 contact hours per week

3. Instructors:

Dr. Julian Marshall
Dr. John Gulliver, PE
Mr. Fred Rose
Mr. Brian Bell

4. Textbook:

Poor Economics, Banerjee and Duflo, 2012.
Beyond the Beautiful Forevers, Boo, 2012.

a. Other supplemental materials

None

5. Specific Course Information:

a. Brief description of the content of the course (catalog description)

Hands-on training evaluating technologies to improve health/quality of life in developing countries. Students work in teams/students in India to select technology or service. Design business serving low-income community in India.

b. Prerequisites or co-requisites

Advanced standing and permission of instructor.

c. Required, elective, or selected elective

Selected elective

6. Specific Goals for the Course

a. Specific outcomes of instruction
- Understanding of strengths and limitations of technical solutions for issues of development.
- Understanding of global grand challenges.
- Develop a local, sustainable solution to a global grand challenge

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(d) ability to function on multidisciplinary teams
(h) understand the impact of engineering solutions in a global, economic, environmental, and societal context
(j) knowledge of contemporary issues

7. Brief list of topics to be covered.

Design thinking
Global grand challenges
Appropriate technologies
Environmental engineering and water resources engineering for Developing Countries
1. Course Title:

CEGE 5572: Design for Sustainable Development: Create I

2. Credit and Contact Hours

2 credit hours
2 contact hours per week

3. Instructors:

Dr. Julian Marshall
Dr. John Gulliver, PE
Mr. Fred Rose
Mr. Brian Bell

4. Textbook:

Poor Economics, Banerjee and Duflo, 2012.
Beyond the Beautiful Forevers, Boo, 2012.

a. Other supplemental materials

None

5. Specific Course Information:
   a. Brief description of the content of the course (catalog description)

      Hands-on experience regarding entrepreneurship/social entrepreneurship.

   b. Prerequisites or co-requisites

      Advanced standing and permission of instructor.

   c. Required, elective, or selected elective

      Selected elective

6. Specific Goals for the Course

   a. Specific outcomes of instruction

      • Understanding of strengths and limitations of technical solutions for issues of development.
      • Understanding of global grand challenges.
- Develop a local, sustainable solution to a global grand challenge

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(d) ability to function on multidisciplinary teams
(h) understand the impact of engineering solutions in a global, economic, environmental, and societal context
(j) knowledge of contemporary issues

7. Brief list of topics to be covered.

Design thinking
Global grand challenges
Appropriate technologies
Environmental engineering and water resources engineering for Developing Countries
1. Course Title:

CEGE 5573: Design for Sustainable Development: Create II

2. Credit and Contact Hours

1 credit hours
1 contact hours per week

3. Instructors:

Dr. Julian Marshall
Dr. John Gulliver, PE
Mr. Fred Rose
Mr. Brian Bell

4. Textbook:

Poor Economics, Banerjee and Duflo, 2012.
Beyond the Beautiful Forevers, Boo, 2012.

a. Other supplemental materials

None

5. Specific Course Information:
   a. Brief description of the content of the course (catalog description)

   Weekly discussion on social or environmental venture.

   b. Prerequisites or co-requisites

   Advanced standing and permission of instructor.

   c. Required, elective, or selected elective

   Selected elective

6. Specific Goals for the Course

   a. Specific outcomes of instruction

   • Understanding of strengths and limitations of technical solutions for issues of development
   • Understanding of global grand challenges
• Develop a local, sustainable solution to a global grand challenge

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(d) ability to function on multidisciplinary teams
(h) understand the impact of engineering solutions in a global, economic, environmental, and societal context
(j) knowledge of contemporary issues

7. Brief list of topics to be covered.

Design thinking
Global grand challenges
Appropriate technologies
Environmental engineering and water resources engineering for Developing Countries