C E-CIVIL ENGINEERING

C E 109. Computer Drafting Fundamentals
3 Credits (2+2P)
Introduction to principles and fundamentals of drafting using both manual drawing techniques and computer-aided drafting (CAD) applications. Crosslisted with: DRFT 109 and E T 109. May be repeated up to 3 credits.
Learning Outcomes
1. Describe related career options/pathways.
2. Explain and apply common drafting terms, concepts, and conventions.
3. Utilize various AutoCAD commands and Coordinate Entry methods to produce accurate and precise Two-Dimensional drawings.
4. Setup AutoCAD working environment, drawings, styles, and applicable settings.
5. Navigate the AutoCAD user interface efficiently.
6. Apply different drafting methods, strategies, and processes.
7. Utilize AutoCAD to produce basic 2D CAD working drawings.
8. Measure utilizing scales accurately.
9. Create drawings with different scales and units. 1
10. Plot drawings produced in AutoCAD at various scales and on various sheet sizes. 1
11. Utilize the two Drawing Environments: Paper Space and Model Space. 1
12. Manage AutoCAD drawing files.

C E 151. Introduction to Civil Engineering
3 Credits (3)
Problem solving and use of computer software for civil engineering applications. May be repeated up to 3 credits.
Prerequisite(s)/Corequisite(s): MATH 1220G.

C E 198. Special Topics
1-3 Credits
May be repeated for a maximum of 6 credits.
Prerequisite: consent of department head.

C E 233. Mechanics-Statics
3 Credits (3)
Engineering mechanics using vector methods. May be repeated up to 3 credits.
Prerequisite: C- or better grade in MATH 1521G or MATH 1521H, C- or better grade in PHYS 1310G and cumulative GPA of 2.0.
Learning Outcomes
1. Student will be able to apply concepts of equilibrium.

C E 234. Mechanics-Dynamics
3 Credits (3)
Kinematics and dynamic behavior of solid bodies utilizing vector methods. May be repeated up to 3 credits.
Prerequisite: A grade of C- or better grade in the following: C E 233 and PHYS 1310G and MATH 1521G or MATH 1521H.
Learning Outcomes
1. Student will be able to apply concepts of kinematics and accelerated motion.

C E 256. Environmental Engineering and Science
3 Credits (3)
Principles in environmental engineering and science: physical chemical systems and biological processes as applied to pollution control. Crosslisted with: ENVS 2111
Prerequisite: CHEM 1215G and MATH 1511G or ENGR 190.
Learning Outcomes
1. To understand the nature of water quality parameters in the context of Civil Engineering and Environmental Science (Water Treatment/Wastewater Treatment/Environmental Science)
2. To learn to apply engineering and scientific solutions to water quality problems
3. To understand environmental regulations and their consequences on the design of pollution control systems

C E 256 L. Environmental Science Laboratory
1 Credit (1P)
Laboratory experiments associated with the material presented in C E 256. Same as ENVS 2111L.
Corequisite(s): C E 256.

C E 298. Special Topics
1-3 Credits
May be repeated for a maximum of 6 credits.
Prerequisite: consent of department head.

C E 301. Mechanics of Materials
3 Credits (3)
Stress, strain, and elasticity of materials. May be repeated up to 3 credits.
Prerequisite: C- or better grade in ENGR 233.
Learning Outcomes
1. Calculate deformations, stresses, and strains of various types of members under loading.
2. Calculate principal stresses and strains.
3. Perform two-dimensional stress and strain transformation.
4. Analyze statically indeterminate structures using the method of consistent deformations.
5. Construct shear and moment diagrams for beam type structures.
6. Calculate beam deflections and rotations using various methods.
7. Determine buckling loads for elastic columns.

C E 311. Civil Engineering Materials
3 Credits (2+3P)
Introduction to the structure, physical properties, testing and mechanical behavior of civil engineering materials and components made from these materials. May be repeated up to 3 credits.
Prerequisite: C- or better grade in C E 301.
Learning Outcomes
1. Students will understand the structure, properties, and roles of materials in civil engineering.

C E 315. Structural Analysis
4 Credits (3+3P)
Classical analysis of determinate and indeterminate structures; introduction to modern methods of structural analysis using computer programs. May be repeated up to 4 credits.
Prerequisite: C- or better grade in C E 301.
Learning Outcomes
1. Students will be able to compute deflections for trusses, beams, and frames.

C E 331. Fluid Mechanics and Hydraulics
3 Credits (3)

Fluid Mechanics and Hydraulics. Fundamentals and theory of fluid mechanics, compressible fluids, flow of incompressible fluids in open and closed conduits.
Prerequisite: C- or better grade in PHYS 1310G, C- or better grade in ENGR 233 or C E 233.
Learning Outcomes
1. Students learn how to read and interpret problem statements related to fluid mechanics and hydraulics, how to work in teams as well as apply critical thinking skills to solve problems.
2. Students develop an understanding of the theories and principles of hydraulics to understand hydraulic engineering components and subsystems.

C E 331 L. Fluid Mechanics and Hydraulics Laboratory
1 Credit (1P)
Fundamentals and Theory of Fluid Mechanic, compressible and incompressible flow of fluids in open and closed conduits.
Prerequisite(s)/Corequisite(s): C E 331. Restricted to: C E majors.

C E 355V. Technology and the Global Environment
3 Credits (3)
A scientific basis for understanding changes in the global environment that result through the complex interactions of natural phenomena and the impacts of the activities of man.
Prerequisites: junior or senior standing, and the general education requirements for math and natural sciences.

C E 356. Fundamentals of Environmental Engineering
3 Credits (3)
Introduction to water treatment and water pollution and the analysis and design of selected treatment processes. May be repeated up to 3 credits.
Prerequisite: C- or better grade in C E 256.
Learning Outcomes
1. Students will understand water treatment processes.
2. Students will understand wastewater treatment processes.

C E 357. Soil Mechanics
3 Credits (2+3P)
Engineering properties of soils, consolidation settlement, compaction, water flow through soils, geostatic stresses, soil shear strength, lateral earth pressure, and soil laboratory testing.
Prerequisite: GEOL 1110G and C E 301.
Learning Outcomes
1. The course covers the basic principles governing the mechanical behavior of soils.
2. Students will develop an understanding of soil mechanics, flow through porous media, and mass-volume relationships, as well as the laboratory methods for measuring the mechanical and index properties of soils.
3. Students will be able to interpret and use the laboratory test results for soil classification and for solving simple geotechnical engineering problems.

C E 382. Hydraulic and Hydrologic Engineering
3 Credits (3)
Analysis and design of hydraulic systems, including pipe networks, open channels, regulating structures, and pumping systems. Surface water and groundwater hydrology, analysis and design. May be repeated up to 3 credits.
Prerequisite: C- or better grade in C E 331, C E 331 L.
Learning Outcomes
1. Student will be analyze hydraulic systems.

C E 398. Special Topics
1-3 Credits
May be repeated for a maximum of 6 credits.
Prerequisite: consent of department head.

C E 435. Technical Communication for Engineers
3 Credits (3)
The course addresses the fundamentals of communicating technical information that is clear, concise, and concrete to a wide variety of stakeholder types.
Learning Outcomes
1. Ability to write in a way that is clear.
2. Ability to write in a way that is concise.
3. Ability to write in a way that is concrete.

C E 444. Elements of Steel Design
3 Credits (3)
Analysis and design of tension members, beams, columns, and bolted and welded connections. May be repeated up to 3 credits.
Prerequisite: C- or better grade in C E 315.
Prerequisite/Corequisite: C E 311.
Learning Outcomes
1. Students will be able to design structural steel elements and connections.

C E 445. Reinforced Concrete Design
3 Credits (3)
Design and mechanics of structural reinforced concrete members. May be repeated up to 3 credits.
Prerequisite: C- or better grade in C E 315.
Prerequisite/Corequisite: C E 311.
Learning Outcomes
1. Students will be able to analyze and design reinforced concrete structural elements subjected to loads.

C E 452. Geohydrology
3-4 Credits (3+1P)
Origin, occurrence, and movement of fluids in porous media and assessment of aquifer characteristics. Development and conservation of ground water resources, design of well fields. Crosslisted with: ENVS 452 and GEOL 452.
Prerequisite(s): Junior or Senior.

C E 454. Wood Design
3 Credits (3)
Theory and design of wood structural members and systems subjected to gravity and lateral loads. Taught every other year, alternates with C E 455, Masonry Design. May be repeated up to 3 credits.
Prerequisite: C- or better grade in C E 315.
Prerequisite/Corequisite: C E 311.
Learning Outcomes
1. Students will be able to design wood structural members and components.

C E 455. Masonry Design
3 Credits (3)
Theory and design of masonry structural members and systems subjected to gravity and lateral loads. Taught every other year, alternates with C E 454.
Prerequisite: C- or better grade in C E 315.
Prerequisite/Corequisite: C E 311.

Learning Outcomes

1. Introduce students to topics in masonry design that are commonly encountered in structural engineering.
2. Provide the background needed to understand the code requirements applicable to problems in masonry design.

C E 457. Foundation Design
3 Credits (2+3P)

Application of principles of classical soil mechanics to the design of shallow and deep foundations, and the fundamentals of geotechnical site investigation. May be repeated up to 3 credits.
Prerequisite: C- or better grade in C E 357.
Learning Outcomes

1. Students will be able to analyze and design shallow and deep foundations.

C E 460. Site Investigation
3 Credits (2+2P)

Investigation and characterization of surficial and subsurface geologic materials and ground water for civil engineering projects. Includes exploration program, drilling and sampling, rock and soil classification and logging, groundwater monitoring, profiles, and preparation of geotechnical reports.
Prerequisite: C- or better grade in C E 357.
Prerequisite/Corequisite: C E 457.
Learning Outcomes

1. Develop approach to scoping and conducting a subsurface investigation.
2. Develop an understanding of geotechnical complexity and how to use the graded approach.
3. Use soil mechanics and foundation design skills to perform geotechnical analyses and develop recommendations needed by the project team to provide client(s) with needed facilities.
4. Understand field and laboratory tools and techniques used to develop suitable data for subsurface analyses and geotechnical report recommendations.
5. Understand the observational approach, how to use it, and how to avoid its misuse.
6. Develop skills needed to prepare geotechnical letter reports and complete geotechnical investigation reports.

C E 469. Structural Systems
3 Credits (3)

Design of structural systems for buildings and bridges. May be repeated up to 3 credits.
Prerequisite: C- or better grade in C E 444 or C E 445.
Learning Outcomes

1. Students will understand the scope of structural design projects.

C E 470. Design of Municipal and Hazardous Waste Landfills
3 Credits (3)

Solid waste and application of geotechnical engineering principles and methods to the site selection and design of municipal and hazardous waste landfills. May be repeated up to 3 credits.
Prerequisite: C- or better grade in C E 357 and C E 452, or consent of instructor.
Learning Outcomes

1. Students will understand the elements of design for municipal and hazardous waste landfills.

C E 471. Transportation Engineering
3 Credits (3)

Highway and traffic design and systems. Students must be in junior or senior standing to enroll. May be repeated up to 3 credits.
Prerequisite: C- or better in MATH 1521G.
Learning Outcomes

1. Provide understanding of the principles of transportation engineering with a focus on highway engineering and traffic analysis.
2. Provide basic skill set that will allow a student to address most of the transportation problems that are likely to appear in professional practice and on the Fundamentals of Engineering exam (FE) and the Principles and Practice of Engineering exam (PE).
3. Provide foundation for future coursework in transportation should a student wish to pursue further coursework in the fields.

C E 477. Engineering Economics and Construction Management
3 Credits (3)

Engineering economics, construction and project management. May be repeated up to 3 credits.
Prerequisite/Corequisite: C- or better grade in C E 357.
Learning Outcomes

1. Understand time value of money and be able to perform economic analyses on engineering problems to determine whether a given project is worthwhile or to prioritize multiple alternatives based on present worth.
2. Understand the mathematical and ethical implications of benefit/cost and internal rate of return analyses
3. Estimate durations and requirements of individual construction tasks.
4. Develop construction schedules using Critical Path Method (CPM) Analysis.
5. Understand the legal and ethical concerns involved in economic analysis and construction engineering.

C E 479. Pavement Analysis and Design
3 Credits (3)

Covers stresses and deflections in pavement layers, material characterization, flexible and rigid pavement design by AASHTO, and rehabilitation concepts. May be repeated up to 3 credits.
Prerequisite: C- or better grade in C E 357.
Learning Outcomes

1. Students will be able to analyze and design flexible and rigid pavements.

C E 481. Civil Engineering Capstone Design
3 Credits (3)

Culminating multidisciplinary project-oriented capstone design. Ethics, professional development, global issues. May be repeated up to 3 credits.
Prerequisite: C- or better grade in C E 356, C- or better grade in C E 382, and a C- or better grade in either C E 444 or C E 445.
Prerequisite/Corequisite: C E 457, C E 471, C E 477.
Learning Outcomes

1. Students will understand the scope of civil engineering design projects.

C E 482. Hydraulic Structures
3 Credits (3)

Engineering design of water-regulating structures. Capstone design course. May be repeated up to 3 credits.
Prerequisite: C- or better grade in C E 382.
Prerequisite/Corequisite: C E 477.
Learning Outcomes

1. Students will understand the scope of interdisciplinary civil engineering design projects.

C E 483. Surface Water Hydrology
3 Credits (3)
Hydrologic cycle and relationships between rainfall and surface water runoff. May be repeated up to 3 credits.
Prerequisite: C- or better grade in C E 331 or consent of instructor.
Learning Outcomes
  1. Students will understand the hydrologic cycle and basic principles of hydrology.

C E 485. Design of Earth Dams
3 Credits (3)
Engineering design applied to site selection, foundation inspection and treatment, hydrology and hydraulics, stability, and seepage analysis. Economic and environmental factors.
Prerequisite: C E 357, C E 382.
Learning Outcomes
  1. Course introduces the students to small earthen dam siting, design and construction based on the knowledge and skills acquired in earlier coursework.
  2. Course incorporates engineering standards and realistic constraints and prepares students for entry-level work.
  3. Students work in teams to design a small earthen dam.

C E 490. Introduction to Artificial Intelligence for Civil Engineers
3 Credits (3)
Introduces various machine learning methods for solving various civil engineering problems. Topics include: supervised & unsupervised machine learning; classification and linear regressions; K-nearest neighbor; decision tree, bagging, & boosting; random forest; and support-vector machines.
Prerequisite: C- or better grade in STAT 371.
Learning Outcomes
  1. Identify appropriate data analysis methods for various civil engineering problems.
  2. Perform various Machine Learning (ML) analyses to solve civil engineering problems.
  3. Evaluate various forms of Machine Learning (ML) analysis results.

C E 497. Senior Seminar
1 Credit (1)
Selected topics on the civil engineering profession and orientation for professional practice. Preparation for the FE exam. Students must be able to submit their application for degree while enrolled in this course.
Learning Outcomes
  1. Prepare students for professional and ethical aspects of employment or graduate studies.

C E 498. Special Topics
1-3 Credits
May be repeated for a maximum of 9 credits.
Prerequisite: consent of department head.

C E 501. Advanced Mechanics of Materials
3 Credits (3)
Study of stress and strain in two and three dimensions, theories of failure, stress concentrations, unsymmetrical bending, curved beams, beams on elastic foundations, column theories, torsion, thick-wall cylinders. Same as M E 501.
Prerequisites: C E 301, MATH 392.

C E 502. Advanced Mechanics of Steel Structures
3 Credits (3)
Advanced structural mechanics applicable to steel structures. Includes inelastic behavior, plastic analysis, column and frame stability and torsion.
Prerequisite: C E 444.
Learning Outcomes
  1. Introduce students to advanced topics in structural mechanics of steel structures that are commonly encountered in structural engineering
  2. Provide the background needed to understand the code requirements applicable to problems in plastic design of steel structures

C E 503. Special Design and Analysis Program
3-6 Credits
Design and analysis covering subject matter of an approved 450 undergraduate departmental course plus an additional report or project. Course may be subtitled in the Schedule of Classes. May be repeated once for a total of 6 credits.
Prerequisite: consent of instructor/committee.

C E 504. Advanced Engineering Design
3 Credits (3)
Advanced engineering design covering subject matter of a selected capstone undergraduate design course plus an additional report or project. May be subtitled.
Prerequisite: consent of instructor/committee.

C E 507. Design of Earth Retaining Structures
3 Credits (3)
Lateral earth pressure theory, soil-reinforcement interaction, and analysis and design of rigid and flexible earth retaining structures for support of fills and excavations, including retaining walls, mechanically stabilized earth (MSE) walls, sheet pile walls, anchored walls, tiebacks and soil nailing.
Prerequisite(s): C E 357.
Prerequisite(s)/Corequisite(s): C E 457.

C E 508. Advanced Soil Behavior
3 Credits (3)
The course covers particle-scale phenomena that govern the macro-scale behavior of soils. Topics covered in the class include classical concepts as well as contemporary advances in soil mechanics. The students will develop a fundamental understanding of soil-water interaction, theories of contact level deformation, and mass and energy transport through granular media. Consent of Instructor required.
Prerequisite(s): C E 357 or Instructor Consent.

C E 509. Deep Foundations
3 Credits (3)
Behavior, analysis and design of pile and pier foundations subjected to axial and lateral loads.
Prerequisite: C E 457 or consent of instructor.

C E 510. Introduction to Nondestructive Testing
3 Credits (3)
This course explores the application of different Nondestructive Testing (NDT) methods in material characterization and product qualification.
Prerequisite(s): C E 311 or CHME 361 or Consent of Instructor.

C E 514. Numerical Methods in Civil Engineering
3 Credits (3)
Mathematical, numerical, and programming foundations of applied numerical methods with a focus on Civil and Environmental Engineering applications using MATLAB.

Learning Outcomes
1. To provide necessary background and skills to use MATLAB as a programing language for engineering problem solving.
2. To introduce classical and some modern methods for civil engineering numerical problem solving.
3. Develop numerical algorithms and programs for solving civil engineering problems involving: (1) multi-dimensional integration, (2) multivariate differentiation, (3) ordinary differential equations, (4) partial differential equations, (5) optimization (6) parameter estimation methods such as linear and nonlinear least square methods.

C E 515. Finite Element Methods
3 Credits (3)
Introduces the finite element method. Topics may include beam, frame, plane stress, plane strain, axisymmetric, and 3-D stress elements. Includes static and dynamic analysis. Uses readily available finite-element software.
Prerequisite: graduate standing or consent of instructor.

C E 531. Open Channel Hydraulics
3 Credits (3)
Theoretical and applied hydraulics of open channels, with emphasis on nonuniform flow, rapidly varied flow, and wave formation.
Prerequisite: C E 382 or consent of instructor.

C E 535. Technical Communication for Engineers
3 Credits (3)
The course addresses the fundamentals of communicating technical information that is clear, concise, and concrete to a wide variety of stakeholder types. Same as C E 435 with differentiated assignments for graduate students.
Learning Outcomes
1. Ability to write in a way that is clear
2. Ability to write in a way that is concise
3. Ability to write in a way that is concrete

C E 544. Advanced Design of Steel Structures
3 Credits (3)
Connection design; beam-column analysis and design; composite construction; and plate girder design.
Prerequisite: C E 444.
Learning Outcomes
1. Introduce students to advanced topics in steel design that are commonly encountered in structural engineering
2. Provide the background needed to practice structural steel design
3. Provide the background needed to understand the code requirements applicable to difficult problems in structural steel design

C E 545. Advanced Concrete Design
3 Credits (3)
Advanced topics in ultimate strength design of reinforced concrete that include: concrete footings, retaining structures, short and long columns, torsion members, deep beams and shear walls, two-way slabs, and shear and moment transfer at slab-column connections.
Prerequisites: C E 445.
Learning Outcomes
1. Introduce students to advanced topics in reinforced concrete design that are commonly encountered in structural engineering
2. Provide the background needed to practice structural concrete design

3. Provide the background needed to understand the code requirements applicable to difficult problems in structural concrete design

C E 547. Bridge Engineering
3 Credits (3)
Topics related to prestressed concrete, reinforced concrete and steel bridge design according to the AASHTO specifications; bridge analysis and evaluation.
Prerequisite: C E 444 or C E 445.
Learning Outcomes
1. Introduce students to topics in bridge design that are commonly encountered in structural engineering
2. Provide the background needed to understand the code requirements applicable to problems in bridge design

C E 554. Wood Design
3 Credits (3)
Theory and design of wood structural members and systems subjected to gravity and lateral loads. Design project required. Taught every other year, alternates with C E 555 - Masonry Design.

C E 555. Masonry Design
3 Credits (3)
Theory and design of masonry structural members and systems subject to gravity and lateral loads. Design project required. Taught every other year, alternates with C E 554.
Learning Outcomes
1. Introduce students to advanced topics in masonry design that are commonly encountered in structural engineering.
2. Provide the background needed to practice masonry design.
3. Provide the background needed to understand the code requirements applicable to difficult problems in masonry design.

C E 557. Water Resources Development
3 Credits (3)
Students function as members of a consulting panel and prepare reports on major water resources development problems. Political, financial, and social aspects of water resources development are considered as well as scientific and technical details.

C E 571. Structural Dynamics
3 Credits (3)
Response of elastic structure to dynamic loading. Moving load, earthquake and blast loading.
Prerequisite: ENGR 234 and C E 315.
Learning Outcomes
1. Introduce students to topics in structural dynamics that are commonly encountered in structural engineering
2. Provide the background needed to understand the code requirements applicable to problems in seismic and blast-resistant design

C E 579. Ground Improvement
3 Credits (3)
The objective of this course is to introduce common ground improvement techniques, including mechanical (compaction, soil reinforcement, preloading and accelerated consolidation) and chemical (cementing, ion-replacement, polymer bonding) stabilization methods, as well as seepage and dewatering. Emphasis will be placed on developing an understanding of the underlying physical and chemical processes involved in each case.
Prerequisite(s): C E 357.

C E 581. Ground Water Hydrology
3 Credits (3)

Mathematical treatment of water flow in porous media. Emphasis on hydraulics of water movement, including pumping and recharge wells, drainage, and water quality.
Prerequisites: MATH 392, G EN 452, and C E 382, or consent of instructor.

C E 582. Statistical Hydrology
3 Credits (3)
Application of statistical techniques to hydrologic data, including distributions, hypothesis testing, linear models, non-parametrics, and time-series and stochastic models. May be repeated up to 3 credits.

C E 585. Slope Stability Analysis and Design
3 Credits (3)
Design of earth slopes, causes of instability, limit equilibrium methods, slope reinforcement (geosynthetics soil nailing, tiebacks), seismic analysis, rock slope stability. Consent of instructor required.
Learning Outcomes
1. Be familiar with the implications of drainage conditions and pore water pressure in the soil as they relate to soil shear strength and slope stability.
2. Be able to recognize the differences between short-term and long-term analyses (total versus effective stress analyses) applied to slope stability.
3. Be able to perform hand calculations of slope stability for very simple cases.
4. Be familiar with the set of input data usually required to perform stability analyses using software.
5. Be able to design soil slopes with various soil profiles and geometry and reinforcement using slope stability software.
6. Recognize and understand the effects of geologic and groundwater conditions on the stability of soil slopes.
7. Understand the mechanisms by which the most common methods of slope stabilization work (tie-backs, soil nailing, geosynthetics).

C E 590. Advanced Artificial Intelligence for Civil Engineers
3 Credits (3)
Deep learning methods for solving civil engineering problems. Topics include: introduction, backpropagation, training, regulations, and techniques of Neural Networks (NN); image processing using Convolutional Neural Networks (CNN); time-series data analysis using Recurrent Neural Networks (RNN); Gated Recurrent Units; and introduction to Transfer Learning.
Prerequisite: STAT 371 and MATH 392.
Learning Outcomes
1. Identify appropriate data analysis methods and utilize mathematical formulations of Deep Learning (DL) for various civil engineering problems.
2. Perform various Deep Learning (DL) analyses to solve civil engineering problems.
3. Evaluate various forms of Deep Learning (DL) analysis results.

C E 596. Special Topics
1-3 Credits
May be repeated for a maximum of 6 credits.
Prerequisite: consent of department head.

C E 598. Special Research Programs
1-3 Credits
Individual investigations either analytical or experimental. May be subtitled. Maximum of 3 credits per semester.

C E 599. Master's Thesis
1-15 Credits
Thesis.

C E 600. Doctoral Research
1-15 Credits
Research.

C E 604. Advanced Engineering Topics
3 Credits (3)
In depth study of a topic at the forefront of environmental engineering & science. Journal papers will be critically reviewed and students will be asked to write an analysis of the topic and present their thoughts orally.

C E 614. Advanced Numerical Methods in Civil Engineering
3 Credits (3)
Advanced mathematical, numerical, and programming for applied numerical methods with a focus on Civil and Environmental Engineering applications using MATLAB. Same as C E 514 with differentiated material and assignments for C E 614 students.
Learning Outcomes
1. To provide necessary background and skills to use MATLAB as a programing language for engineering problem solving.
2. To introduce classical and some modern methods for civil engineering numerical problem solving.
3. Develop numerical algorithms and programs for solving civil engineering problems involving: (1) multi-dimensional integration, (2) multivariate differentiation, (3) ordinary differential equations, (4) partial differential equations, (5) optimization (6) parameter estimation methods such as linear and nonlinear least square methods, and (7) time series analysis such as Fourier transform, wavelet, and basic filtering.

C E 682. Topics in Hydrodynamics II
3 Credits (3)
Selected topics in hydrometeorology, including the transfer of water and energy between the land surface and the lower atmosphere.
Learning Outcomes
1. This course helps lay the foundation for theoretical concepts useful in measurement, analysis and estimation of evaporation/evapotranspiration. Students learn some of the theoretical concepts and relationships useful in the phenomenon of evaporation as well as gain some field experience on measurement of evapotranspiration and open water evaporation.

C E 698. Special Research Programs
1-3 Credits
May be subtitled. May be repeated for a maximum of 9 credits.

C E 700. Doctoral Dissertation
1-15 Credits
Dissertation.