

# Civil & Environmental Engineering

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Rominder Suri, Ph.D., P.E., Chair of Civil and Environmental Engineering  
Room 514, Engineering Building  
215-204-2378  
rominder.suri@temple.edu

Robert Brooks, Ph.D., Undergraduate Coordinator of Civil Engineering  
Room 523, Engineering Building  
215-204-6348  
robert.brooks@temple.edu

Evelyn Walters, Ph.D., Undergraduate Coordinator of Environmental Engineering  
Room 912, Engineering Building  
215-204-4815  
e.walters@temple.edu

Denise Guiteras, Administrative Specialist of Civil and Environmental Engineering Department  
Room 513, Engineering Building  
215-204-7814  
denise.guiteras@temple.edu

<https://engineering.temple.edu/academics/departments/civil-environmental-engineering-department>

The Civil Engineering Program is accredited by the Engineering Accreditation Commission (EAC) of ABET, <http://www.abet.org>.

## Goals, Objectives & Design Integration

Graduates will be employed in industries, academia or state and federal government agencies or enter into or complete graduate or professional degree programs. Graduates will use modern engineering techniques, skills, and tools to identify, formulate, and solve civil engineering problems; or design structures or systems considering functionality, safety and cost effectiveness; or evaluate the impact of civil engineering solutions in a global, societal, and environmental context consistent with the principles of sustainable development. Graduates will engage in the professional practice in civil engineering or closely related fields. Graduates will demonstrate an understanding of ethical, societal, and professional responsibility; engage in life-long learning opportunities; and demonstrate effective communication and interpersonal skills within multidisciplinary teams.

## Programs

- Bachelor of Science in Civil Engineering (<http://bulletin.temple.edu/undergraduate/engineering/civil-environmental-engineering/bs-civil-engineering>)
- Bachelor of Science in Civil Engineering - Environmental Engineering Concentration (<http://bulletin.temple.edu/undergraduate/engineering/civil-environmental-engineering/bs-civil-engineering-environmental-engineering-concentration>)
- Bachelor of Science in Civil Engineering - Environmental Engineering Concentration with Co-op (<http://bulletin.temple.edu/undergraduate/engineering/civil-environmental-engineering/bs-civil-engineering-environmental-engineering-concentration-cooperative-education>)
- Bachelor of Science in Civil Engineering with Co-op (<http://bulletin.temple.edu/undergraduate/engineering/civil-environmental-engineering/bs-civil-engineering-cooperative-education>)
- Bachelor of Science in Environmental Engineering (<http://bulletin.temple.edu/undergraduate/engineering/civil-environmental-engineering/bs-environmental-engineering>)
- Minor in Environmental Engineering (<http://bulletin.temple.edu/undergraduate/engineering/civil-environmental-engineering/environmental-engineering-minor>)

## Courses

### **CEE 0845. The Environment. 3 Credit Hours.**

In today's world characterized by rapid and global environmental changes, it is crucial that citizens have an understanding of the key concepts in environmental science. This course provides students with an introduction to the science behind critical environmental debates and breaks down the requirements for creating and maintaining sustainable ecosystems. A major focus of the course is to develop critical thinking skills and apply them to assess relevant questions such as: How do we predict trends in the growth of populations or climate change? How do human activities impact the nitrogen and phosphorus cycles and how does this in turn affect the environment? How can we quantify and value biodiversity? Should we eat lower on the food chain or are genetically modified crops a sustainable solution? What were the key outcomes of the 2015 U.N. Climate Change Conference in Paris and how will various countries carry out their commitments to protect the environment? This course will enhance awareness of the impacts that our everyday decisions have on the environment and will provide students with strategies to become better environmental stewards. NOTE: This course fulfills a Science & Technology (GS) requirement for students under GenEd and Science & Technology Second Level (SB) for students under Core. Students cannot receive credit for this course if they have successfully completed CEE 0945, CEE 1051, ENVT 0845, ENVT 0945, or ENVT 1051.

**Course Attributes:** GS

**Repeatability:** This course may not be repeated for additional credits.

### **CEE 0945. Honors: The Environment. 3 Credit Hours.**

In today's world characterized by rapid and global environmental changes, it is crucial that citizens have an understanding of the key concepts in environmental science. This course provides students with an introduction to the science behind critical environmental debates and breaks down the requirements for creating and maintaining sustainable ecosystems. A major focus of the course is to develop critical thinking skills and apply them to assess relevant questions such as: How do we predict trends in the growth of populations or climate change? How do human activities impact the nitrogen and phosphorus cycles and how does this in turn affect the environment? How can we quantify and value biodiversity? Should we eat lower on the food chain or are genetically modified crops a sustainable solution? What were the key outcomes of the 2015 U.N. Climate Change Conference in Paris and how will various countries carry out their commitments to protect the environment? This course will enhance awareness of the impacts that our everyday decisions have on the environment and will provide students with strategies to become better environmental stewards. (This is an Honors course.) NOTE: This course fulfills a Science & Technology (GS) requirement for students under GenEd and Science & Technology Second Level (SB) for students under Core. Students cannot receive credit for this course if they have successfully completed CEE 0845, CEE 1051, ENVT 0845 or ENVT 0945.

**Cohort Restrictions:** Must be enrolled in one of the following Cohorts: SCHONORS, UHONORS, UHONORSTR.

**Course Attributes:** GS, HO

**Repeatability:** This course may not be repeated for additional credits.

### **CEE 1001. Introduction to Civil Engineering. 3 Credit Hours.**

This course provides an understanding of the study and practice associated with Civil Engineering. It stresses the importance of good communications and teamwork skills in a successful engineering career. Students will understand the basics of problem solving and design. Laboratory included.

**Repeatability:** This course may not be repeated for additional credits.

### **CEE 1051. Introduction to the Environment. 3 Credit Hours.**

Basic environmental issues, systems and change; biogeochemical cycles; human population; ecosystems and their management and restoration; biological diversity, productivity and energy flow; biogeography; environmental health, pollution and toxicology; energy; and global warming. Hands on laboratory exercises are an integral part of the course. The lab exercises are conducted within the class schedule at each campus. NOTE: Students cannot receive credit for this course if they have successfully completed CEE 0845, CEE 0945, ENVT 0845, ENVT 0945 or ENVT 1051.

**Repeatability:** This course may not be repeated for additional credits.

### **CEE 1105. Surveying. 2 Credit Hours.**

Calculating closure and area of a traverse; computing offset angles and chord distances to layout circular and spiral curves; determine elevations to layout vertical curves; computing volumes from terrain cross sections. Field problems using surveying instruments to layout a traverse and a circular curve. Students will work on teams, which will be responsible for performing field work, analytic calculations, and report presentation associated with loop leveling and closed-loop traverse surveys.

**Repeatability:** This course may not be repeated for additional credits.

#### **Pre-requisites:**

MATH 1021 to 4999| Required Courses:1|Minimum Grade of C-|May not be taken concurrently  
 OR MC5 Y|May not be taken concurrently  
 OR MC6 Y|May not be taken concurrently  
 OR MC6A Y|May not be taken concurrently.

**CEE 1115. Surveying Laboratory. 1 Credit Hour.**

Students will work on teams, which will be responsible for performing field work, analytic calculations, and report presentation associated with loop leveling and closed-loop traverse surveys.

**Repeatability:** This course may not be repeated for additional credits.

**CEE 2011. Civil Engineering Materials. 2 Credit Hours.**

Basic laboratory and field tests conducted with aggregate, soil, concrete, steel, masonry, wood and other construction materials.

**Repeatability:** This course may not be repeated for additional credits.

**CEE 2341. Construction Materials Laboratory. 2 Credit Hours.**

Basic laboratory and field tests conducted with aggregate, soil, concrete, steel, masonry, wood and other construction materials. Students are required to submit lab reports on the test results of various materials.

**Repeatability:** This course may not be repeated for additional credits.

**CEE 2711. Environmental Chemistry & Microbiology. 3 Credit Hours.**

This course covers the structure of atoms; chemical bonds and reactions; water, solutions, and colloids; acids, bases, and pH; carbohydrates, lipids, proteins; nucleotides and nucleic acids; commonly occurring organic contaminants; and microorganisms and contamination remediation.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

(CHEM 1031|Minimum Grade of C-|May not be taken concurrently  
OR CHEM 1035|Minimum Grade of C-|May not be taken concurrently)  
AND (CHEM 1033|Minimum Grade of C-|May not be taken concurrently)

**CEE 2712. Introduction to Environmental Engineering. 3 Credit Hours.**

This course will provide an introduction to the sources, effects, and control of pollution in different environmental compartments. Topics include air and water quality (indicator parameters), mass transport, solid and hazardous waste classification, risk assessment, environmental regulations (air, water, solids). Water and wastewater treatment are introduced as well as water resources engineering (rainfall/runoff analysis).

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

(CHEM 1032|Minimum Grade of C-|May not be taken concurrently  
OR CHEM 1952|Minimum Grade of C-|May not be taken concurrently)  
AND (MATH 1042|Minimum Grade of C|May not be taken concurrently  
OR MATH 1942|Minimum Grade of C|May not be taken concurrently)

**CEE 2715. Principles of Sustainable Engineering. 3 Credit Hours.**

Sustainable engineering principles include calculations of environmental emissions and resource consumption. Mass and energy balance calculations in context of pollution generation and prevention, resource recovery and life-cycle assessment. Economic aspects of sustainable engineering decision-making. Social impacts of technology system design decisions including ethical frameworks, government legislation and health risks. Students will gain an awareness of challenges to sustainable water and energy and inter-linkages between these. Energy-water design trade-offs will be investigated for various energy and water processing facilities, e.g. electric power or desalination plants.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

CEE 2712|Minimum Grade of C-|May not be taken concurrently.

**CEE 2811. Sustainable Projects in the Developing World I. 2 Credit Hours.**

This course focuses on multiple aspects of developing and implementing projects in underserved areas of the world following guidelines established by Engineers Without Borders. This course will prepare students for international travel to work on projects currently being undertaken or considered by the EWB Temple University student chapter. The course topics include development of community partnerships, identification of community needs, budgeting, fundraising, communication, and sustainable project design. Topics covered each semester will be dependent on the current project status. The course is open to students across all disciplines with an interest in applying their education to projects in the developing world. This is the first of a two course sequence with CEE 2812.

**Repeatability:** This course may be repeated for additional credit.

**CEE 2812. Sustainable Projects in the Developing World II. 1 Credit Hour.**

This course focuses on multiple aspects of developing and implementing projects in underserved areas of the world following guidelines established by Engineers Without Borders. In this course students will develop a topic related to the service learning trip undertaken as part of CEE 2811 and write an in-depth technical report. Topics may include, but are not limited to, development of community partnerships, identification of community needs, and sustainable engineering design. This course is open to students across all disciplines who have successfully completed CEE 2811 and traveled on an EWB-Temple, or similar, service trip. This is the second of a two course sequence (with CEE 2811).

**Repeatability:** This course may be repeated for additional credit.

**Pre-requisites:**

CEE 2811|Minimum Grade of C-|May not be taken concurrently.

**CEE 3048. Probability, Statistics & Stochastic Methods. 3 Credit Hours.**

A practical course on uncertainty and risk analysis for engineers and scientists, including modern computer algebra software applications. Random variables and probability distributions. Simulations of random systems, analytical models and Monte Carlo simulations. Systems with jointly distributed random variables. Estimation theory in engineering. Fitting probability models to data. Regression analysis. Reliability of engineering systems. Design of engineering experiments. Experiments and tests for two or more random variables. ANOVA. Introduction to stochastic processes, random walk, Brownian motion, white noise, and colored noise processes. Stochastic differential equations, stochastic calculus, differential equations with random initial conditions, random forcing functions, random boundary conditions, random partial differential equations. New techniques for non-linear equations.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

MATH 3041|Minimum Grade of D-|May not be taken concurrently  
OR MATH 3941|Minimum Grade of D-|May not be taken concurrently.

**CEE 3211. Transportation Engineering. 3 Credit Hours.**

The principal modes of transportation including highway, rail, and air; analysis of elements of transport technology; transportation system development, planning, design, construction, and maintenance.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

(CEE 1105|Minimum Grade of D-|May not be taken concurrently  
AND ENGR 2331|Minimum Grade of C-|May not be taken concurrently)

**CEE 3311. Construction Engineering. 3 Credit Hours.**

Contracts, construction contract documents, and construction specifications; estimating construction costs, planning and estimating earthwork, concrete formwork design and estimating; planning and scheduling construction projects, critical path method; project cash flow, funding and cost control; construction equipment: types, ownership and operating costs. Computer applications.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

CEE 2011|Minimum Grade of D-|May not be taken concurrently.

**CEE 3331. Soil Mechanics. 3 Credit Hours.**

Soil as a multiphase material, strength and deformation properties, earth pressure, bearing capacity, stability of slopes, soils laboratory. Written reports and oral presentations required.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

ENGR 2333|Minimum Grade of C-|May not be taken concurrently.

**CEE 3332. Soil Mechanics Laboratory. 1 Credit Hour.**

Students will work on teams, which will be responsible for performing laboratory work, analytic calculations, and report preparation associated with soil classification according to USCS and AASHTO systems and with soil compaction according to ASTM specifications.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

ENGR 2333|Minimum Grade of C-|May not be taken concurrently.

**CEE 3334. Structural Design of Pavements. 3 Credit Hours.**

Basic characteristics of different pavement structures, various modes of failure and design of pavement structures, identification and analysis of stresses, strains and deflections in flexible and rigid pavements, computation of the traffic loading and volume for the structural design of pavements, engineering properties of pavement materials, pavement performance, distress, empirical and mechanistic-empirical approaches.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

CEE 3331|Minimum Grade of D-|May not be taken concurrently.

**CEE 3411. Structural Analysis. 3 Credit Hours.**

Elastic analysis of statically indeterminate structures using force and deformation methods. Introduction to numerical methods and computer techniques. The analysis includes determination of stresses and deflections using stiffness method, force method, and moment-distribution methods.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

ENGR 2333|Minimum Grade of C-|May not be taken concurrently.

**CEE 3412. Structural Analysis Laboratory. 1 Credit Hour.**

Introduction to the basic theory and concepts of the Stiffness Method and the Finite Element Method. Students will gain experience in analyzing structural systems and structural mechanics by general-purpose finite element programs such as STAAD PRO and ANSYS.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

ENGR 2333|Minimum Grade of C-|May not be taken concurrently.

**CEE 3421. Steel Design. 3 Credit Hours.**

Loadings on structures. Design criteria and procedures for steel members subjected to axial forces, bending and shear. Buckling of columns. Plastic design and load and resistances factor theories. Computer-based design methods are included.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

CEE 3411|Minimum Grade of D-|May not be taken concurrently.

**CEE 3431. Concrete Design. 3 Credit Hours.**

Load and strength factor design methods for plain and reinforced concrete elements of structural systems. Serviceability checks at service loads. Manual and computer-based design methods are included.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

CEE 3411|Minimum Grade of D-|May not be taken concurrently.

**CEE 3441. Steel & Concrete Design. 4 Credit Hours.**

The course's design objective is to develop within the student an awareness of the fundamentals that are required to produce safe, functional, and economical steel and reinforced concrete structures, which are in conformance with national building codes and with industry codes, specifications and standards and to formulate applied load criteria and make reasonable assumptions regarding structural behavior. Then through an interactive process, the student will determine the most cost-effective solution.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

CEE 3411|Minimum Grade of D-|May not be taken concurrently.

**CEE 3611. Hydraulic Engineering. 3 Credit Hours.**

The course deals with the design of hydraulic systems based on various flow regimes (laminar and turbulent). Students will learn to design pipe and network systems along with open channels. The design of various hydraulic structures such as, culverts and spillways, will be taught. Widely used software such as MWH Soft and HECRAS (US Army Corps of Engineers) will be taught and used in the class. Field studies will be conducted and students will get to experiment with various instruments used in water systems (e.g., pumps, flowmeters, diffuser, etc). NOTE: Prior to spring 2010, the course title was "Hydrology and Hydraulic Engineering."

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

ENGR 3553|Minimum Grade of C-|May not be taken concurrently.

**CEE 3711. Environmental Engineering. 3 Credit Hours.**

Sources, effect, and control of environmental pollution. Topics include air and water pollution, solid and hazardous waste, noise, radiation and risk assessment. Effects across media, and applications to current concerns such as global warming and ozone depletion are emphasized. Course material and problem solving are reinforced through application of appropriate computer models.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

(CHEM 1031|Minimum Grade of C-|May not be taken concurrently)  
OR CHEM 1035|Minimum Grade of C-|May not be taken concurrently)  
AND (MATH 1042|Minimum Grade of C-|May not be taken concurrently)  
OR MATH 1942|Minimum Grade of C-|May not be taken concurrently)

**CEE 3712. Environmental Fluids and Contaminant Dynamics. 3 Credit Hours.**

Dynamics of fluids in motion; laminar and turbulent flow, Bernoulli's equation, friction in conduits; open-channel flow. Introduction to the processes controlling the migration and fate of chemicals in all phases of the environment, including surface and subsurface water as well as the atmosphere. Boundary layers, turbulence, mixing, convection, stratification and plumes and their impacts on contaminant dynamics will be discussed.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

(CEE 2712|Minimum Grade of C-|May not be taken concurrently)  
AND (MATH 2043|Minimum Grade of C-|May not be taken concurrently)  
OR MATH 2943|Minimum Grade of C-|May not be taken concurrently)  
AND (MATH 3041|Minimum Grade of C-|May not be taken concurrently)  
OR MATH 3941|Minimum Grade of C-|May not be taken concurrently)

**CEE 3715. Microbiological Principles of Environmental Engineering. 3 Credit Hours.**

Introduction to underlying microbiological principles dealing with fate and transport of contaminants in the natural and built environment; reactor configurations for water and air quality control; and contaminant partitioning and contemporary environmental issues. The diverse roles of microorganisms in natural and engineered environments will be discussed.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

CEE 2712|Minimum Grade of C-|May not be taken concurrently.

**CEE 3717. Chemical Principles of Environmental Engineering. 3 Credit Hours.**

Introduction to chemical equilibrium, thermodynamics and kinetics in water, atmosphere, and soils and sediments. The objective of this course is to develop a basis for understanding the behavior of chemical processes in the natural and built environment.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

CEE 2712|Minimum Grade of C-|May not be taken concurrently.

**CEE 3725. Water Quality and Analysis Lab. 1 Credit Hour.**

Environmental lab methods to measure properties and characteristics of dissolved, particulate, and microbiological constituents in water, air, and soil systems.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

(CEE 3715|Minimum Grade of C-|May be taken concurrently)

AND (CEE 3717|Minimum Grade of C-|May be taken concurrently)

**CEE 3727. Environmental Hydrology and Stormwater Management. 3 Credit Hours.**

The course covers the relationship between precipitation and runoff, unit hydrographs, flood routing, and water supply principles and applications. Impacts of improperly controlled runoff on urban streams and how the rate, volume and quality of urban stormwater runoff can be properly controlled through appropriate Best Management Practice (BMP) implementation.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

(MATH 2043|Minimum Grade of C-|May not be taken concurrently)

OR MATH 2943|Minimum Grade of C-|May not be taken concurrently)

AND (CEE 3712|Minimum Grade of C-|May not be taken concurrently)

**CEE 4040. Special Topics. 1 to 3 Credit Hour.**

A course designed to present new and emerging areas of engineering. The course may also be used to present areas not normally taught in the College. Course requirements vary with the topic and instructor. Offered as needed or as appropriate.

**Repeatability:** This course may be repeated for additional credit.

**CEE 4072. Update and Assessment. 3 Credit Hours.**

The course objective is to facilitate the process of Civil Engineering, Senior-Level Students preparing for and taking the NCEES Fundamentals of Engineering (FE) Examination. Students will take in-class examinations on each review topic.

**Class Restrictions:** Must be enrolled in one of the following Classes: Senior 90 to 119 Credits, Senior/Fifth Year 120+ Credits.

**Repeatability:** This course may not be repeated for additional credits.

**CEE 4201. Transportation Systems Management. 3 Credit Hours.**

This course covers cost-effective techniques for the rebuilding of deteriorated transportation systems, pavement management and traffic systems management; extensive use of advanced computer software packages.

**Repeatability:** This course may not be repeated for additional credits.

**CEE 4211. Bridge Engineering. 3 Credit Hours.**

Design criteria, loads, construction techniques, state codes, superstructure components design-modeling and analysis, method, rating, computer software, detailing, new bridge, replacement, widening, rehabilitation, state codes, technical proposal, structural planning, feasibility studies, preliminary and final design, and post design services.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

CEE 3441|Minimum Grade of D-|May not be taken concurrently.

**CEE 4221. Intelligent Transportation Systems. 3 Credit Hours.**

To understand the multidimensional upgrades needed for highway and vehicles to develop intelligent transportation systems. The new system should be able to handle higher traffic safely in lesser time. Several case studies are an integral part of the course.

**Repeatability:** This course may not be repeated for additional credits.

**CEE 4231. Airport Engineering. 3 Credit Hours.**

This course deals with the various aspects of airport engineering, planning, design and development of 21st century airports. The course covers airport master and system planning, airside layout, landside access design, passenger and cargo facilities, terminal design, drainage and pavement design.

**Repeatability:** This course may not be repeated for additional credits.

**CEE 4244. Introduction to Geosynthetics. 3 Credit Hours.**

This course will enhance your critical understanding of Geosynthetic Materials used in civil engineering applications and develop the knowledge and skills required for designing and applying geosynthetic materials in civil engineering and environmental applications. Geosynthetics properties, testing of properties, design of geotextiles, geogrids, geonets, and geomembranes for applications in separation, pavement design, embankment and retaining wall reinforcement, soil stabilization, filtration, drainage and liquid barrier, construction guidelines and case histories. The module will also develop critical understanding of the processes and materials used for the manufacture of geosynthetic materials.

**Repeatability:** This course may not be repeated for additional credits.

**CEE 4301. Construction Administration. 3 Credit Hours.**

The engineering and construction industry; basis of construction contracting; organizational structure and its functions; management structure and its functions, office administration, employment practices and labor relations; organizational financing and accounting; safety practices, risk management, and industrial insurance.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

CEE 3311|Minimum Grade of C-|May not be taken concurrently.

**CEE 4302. Engineering Project Management. 3 Credit Hours.**

Overview of the basic principles underlying all methods of project management, including project estimating, planning and scheduling, budgeting, cost accounting and cost control, project documentation, tracking and resource leveling. Utilization of project management software packages for selected civil engineering projects. Different types of projects, organizing the project management functions, setting up the project team, starting up and managing engineering projects and ensuring the effective completion of the project on time, within budget and meeting specifications.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

CEE 3311|Minimum Grade of C-|May not be taken concurrently.

**CEE 4303. Construction Financial Management. 3 Credit Hours.**

Overview of the basic principles underlying all methods of project management and financial accounting methods, construction cost accounting systems, construction project costing approaches, project budgeting, financial reporting procedure. Computer applications as required.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

CEE 3311|Minimum Grade of C-|May not be taken concurrently.

**CEE 4312. Construction Equipment Management. 3 Credit Hours.**

Concepts and theories of construction equipment operation and ownership costs and their relationship to production systems. Production planning and Productivity Analysis. Analysis of depreciation and fixed costs for equipment pricing on construction projects. Selection and use of construction equipment. Equipment economics and financing.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

CEE 3311|Minimum Grade of C-|May not be taken concurrently.

**CEE 4321. Geotechnical Engineering. 3 Credit Hours.**

Soil testing, site investigation, design of both shallow and deep foundations, bulkheads, soil-structure interaction and advanced topics in soil behavior and stability. Students are required to submit lab reports on the test results of various materials.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

CEE 3331|Minimum Grade of D-|May not be taken concurrently.



**CEE 4421. Structural Dynamics. 3 Credit Hours.**

This course is designed for civil engineering students interested in pursuing careers in Structural Engineering. The course will enable students to explain the dynamic equilibrium of a structural system under dynamic loading; formulate equations of motion for single and multi-degree-of-freedom structures subjected to various dynamic loads; compute responses of structural systems to harmonic, pulse and earthquake loads; use spectral analysis and numerical methods to compute the response of structures to dynamic loading; recognize the basis for building code provisions related to dynamic loading; and use and evaluate modern commercial dynamic analysis software.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

(CEE 3411|Minimum Grade of D-|May not be taken concurrently)  
AND (ENGR 2332|Minimum Grade of D-|May not be taken concurrently)  
AND (MATH 3041|Minimum Grade of D-|May not be taken concurrently)  
OR MATH 3941|Minimum Grade of D-|May not be taken concurrently)

**CEE 4431. Behavior and Design of Steel Structures. 3 Credit Hours.**

Loadings on structures. Design criteria and procedures for steel members subjected to axial forces, bending and shear. Buckling of columns. Design of connections. Plastic design and load factor resistance theories. Computer-based design methods included.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

CEE 3441|Minimum Grade of D-|May not be taken concurrently.

**CEE 4432. Behavior and Design of Reinforced Concrete Structures. 3 Credit Hours.**

Behavior, analysis, and design of advanced reinforced concrete structures and components including columns subjected to flexure in one or two directions, slender columns, floor systems including two-way slabs, and analysis, design application using modern software.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

CEE 3441|Minimum Grade of D-|May not be taken concurrently.

**CEE 4433. Behavior and Design of Masonry Structures. 3 Credit Hours.**

Masonry materials, structural behavior of masonry assemblages, deformational characteristics of brick, block, and natural stone masonry. Performance of load-bearing wall systems, design of unreinforced and reinforced masonry members including beams, columns and pilasters, and walls; special design and construction topics; application of design to low and high-rise masonry buildings.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

CEE 3411|Minimum Grade of D-|May not be taken concurrently.

**CEE 4443. Finite Element Analysis. 3 Credit Hours.**

Covers application of modern, computer-aided graphics techniques and the use of state-of-the-art, computer-aided design/drafting package(s) for finite element modeling. Includes 3-D modeling, solid modeling, shading, and rendering; and file transfer.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

(CEE 3411|Minimum Grade of D-|May not be taken concurrently)  
AND CEE 3412|Minimum Grade of D-|May not be taken concurrently)

**CEE 4445. Earthquake Engineering and Seismic Design. 3 Credit Hours.**

Basic knowledge of and introduction to earthquake engineering, seismic design and analysis methods, and seismic design based on International Building Code (IBS), ASCE 7 - Minimum Design Loads for Buildings and Other Structures, introduction of material specific design requirement.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

CEE 4421|Minimum Grade of D-|May not be taken concurrently.

**CEE 4531. Life Cycle Assessment and Carbon Footprinting. 3 Credit Hours.**

Life Cycle Analysis (LCA) examines the environmental impacts of products, processes and policies beyond their direct production. Cradle to grave analysis in this manner provides the full picture needed to understand the true impact. This course provides an overview of Life Cycle Assessment principles and practice in relation to environmental and energy concerns. Regulatory and economic decision support tools and software analysis packages will be included. The course is structured such that students will start an LCA from the beginning of the course and progress on it as topics are covered.

**Repeatability:** This course may not be repeated for additional credits.

**CEE 4622. Fate Pollutants in Subsurface Environments. 3 Credit Hours.**

This course focuses on integrated chemical, physical, and microbiological principles of contaminant fate and transport processes necessary in the use of engineered approaches toward selecting and implementing subsurface cleanup options. It also covers abiotic processes, biotic processes, empirical models, and vulnerability mapping.

**Repeatability:** This course may not be repeated for additional credits.

**CEE 4623. Contaminant Dynamics in Urban Streams. 3 Credit Hours.**

Contaminant Dynamics in Urban Streams is designed to teach undergraduate students fundamental concepts of solute exchange at the air:water interface and the water:sediment interface. These systems are by definition boundary or edge systems and are therefore exceptionally important to aquatic ecosystem functioning. After briefly discussing the air:water interface in rivers and lakes, the course will focus on the water:sediment interface. It is here that steep gradients in chemical concentration can be found and significant nutrient cycling occurs. In addition, studies have shown that significant ecosystem productivity and respiration occurs within the bed sediments of flowing water. The course will discuss the concept of transient storage and hyporheic exchange; issues surrounding modeling of transient storage and hyporheic exchange; phosphorus and nitrogen biogeochemistry within the hyporheic zone; and biotic/abiotic nutrient cycling.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

(CHEM 1031|Minimum Grade of C-|May not be taken concurrently  
OR CHEM 1035|Minimum Grade of C-|May not be taken concurrently)  
AND (CEE 4631|Minimum Grade of C-|May not be taken concurrently  
OR CEE 4621|Minimum Grade of C-|May not be taken concurrently  
OR CEE 3711|Minimum Grade of C-|May not be taken concurrently)

**CEE 4631. Environmental Hydrology. 3 Credit Hours.**

A study of the physical laws affecting the occurrence, distribution, movement, storage, and contamination of water in watersheds. The physics of surface and subsurface circulation and storage of water and the transport of contaminants in watersheds, soils, aquifers, rivers, the ocean, and the atmosphere. The laws and equations which govern the recharge, flow, storage, and discharge of water in natural environments. The laws and equations governing the occurrence, absorption, propagation and fate of contaminants in natural environments. Hydrologic effects of global climate change. Engineering methods for the sustainable use of water resources. Engineering methods for the containment and treatment of surface and groundwater pollution, and the restoration of aquifers.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

(MATH 3041|Minimum Grade of D-|May not be taken concurrently  
OR MATH 3941|Minimum Grade of D-|May not be taken concurrently)  
AND (ENGR 3553|Minimum Grade of C-|May not be taken concurrently  
OR CEE 3712|Minimum Grade of C-|May not be taken concurrently)

**CEE 4641. Urban Streams and Stormwater Management. 3 Credit Hours.**

Stormwater management has become a significant issue in recent years. In the past, the typical thinking was 'get it out of my town' which resulted in downstream communities suffering the brunt of poor or inadequate management. In fact, only the rate of runoff was addressed, not the volume, nor the quality of that runoff. In urban areas, the volume of runoff increases significantly due to the additional impervious cover (e.g. pavement and rooftops) and urban stormwater runoff causes water quality degradation due to excess amounts of nutrients, metals, bacteria and sediment. This course will address the impacts of improperly controlled runoff on urban streams and how the rate, volume and quality of urban stormwater runoff can be properly controlled through appropriate Best Management Practice (BMP) implementation.

**Field of Study Restrictions:** Must be enrolled in one of the following Majors: Civil Engineering, Electrical Engineering, Environmental Engineering, Mechanical Engineering.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

CEE 3711|Minimum Grade of C-|May be taken concurrently  
OR CEE 4631|Minimum Grade of C-|May be taken concurrently.

**CEE 4711. Air Pollution Control System. 3 Credit Hours.**

Principles of design and operation of the major categories of air pollution control equipment. Theory and principles are presented to reinforce extensive application and design components.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

(PHYS 1062|Minimum Grade of C-|May not be taken concurrently)  
AND (ENGR 3553|Minimum Grade of C-|May not be taken concurrently)  
OR CEE 3712|Minimum Grade of C-|May not be taken concurrently)

**CEE 4721. Water and Wastewater Systems Design. 3 Credit Hours.**

Unit operations in water treatment, design objectives and parameters of water treatment; coagulation and flocculation; filtration plant design; physical unit operations; biological unit processes; design of facilities for biological treatment of waste water.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

(CEE 3711|Minimum Grade of D-|May not be taken concurrently)  
OR CEE 2712|Minimum Grade of D-|May not be taken concurrently)  
AND (ENGR 3553|Minimum Grade of C-|May not be taken concurrently)  
OR CEE 3712|Minimum Grade of C-|May not be taken concurrently)

**CEE 4722. Water/Wastewater Lab. 1 Credit Hour.**

Quantitative laboratory studies of operations such as coagulation/flocculation, adsorption/ion exchange, filtration, disinfection, biological oxidation, advanced oxidation processes, and gas transfer. Laboratory safety and technical writing skills are emphasized. The course will include field trips to water and wastewater treatment plants as well as a solid waste management facility.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

CEE 4721|Minimum Grade of C-|May be taken concurrently.

**CEE 4725. Environmental Systems Design. 3 Credit Hours.**

Systems-based design and integration of various unit operations at treatment plants dealing with potable water, industrial wastewater, municipal wastewater, high purity industrial water, groundwater, and soil remediation.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

(CEE 3712|Minimum Grade of C-|May not be taken concurrently)  
AND (CEE 4721|Minimum Grade of C-|May not be taken concurrently)

**CEE 4731. Solid & Hazardous Waste Management. 3 Credit Hours.**

This course covers the principles of integrated solid waste management. The planning and engineering principles needed to address the growing and increasingly intricate problem of controlling and processing the refuse (solid waste) created by urban societies. Federal regulations and management practices associated with hazardous waste are also covered. Situations dealing with real world settings are covered through worked examples and field trips to solid waste management facilities. NOTE: Prior to spring 2010, the course title was "Solid & Hazardous Waste Engineering."

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

CHEM 1031|Minimum Grade of C-|May not be taken concurrently.

**CEE 4741. Professional Issues I. 1 Credit Hour.**

This environmental engineering seminar series will focus on contemporary environmental topics, innovation, entrepreneurship, and life-long skills.

**Class Restrictions:** Must be enrolled in one of the following Classes: Senior 90 to 119 Credits, Senior/Fifth Year 120+ Credits.

**Repeatability:** This course may not be repeated for additional credits.

**CEE 4742. Professional Issues II. 1 Credit Hour.**

This environmental engineering seminar series will focus on contemporary environmental topics, innovation, entrepreneurship, and life-long skills.

**Class Restrictions:** Must be enrolled in one of the following Classes: Senior 90 to 119 Credits, Senior/Fifth Year 120+ Credits.

**Repeatability:** This course may not be repeated for additional credits.

**CEE 4761. Environmental Chemistry. 3 Credit Hours.**

This is an advanced course focusing on examination of processes that affect the behavior and fate of anthropogenic organic contaminants in aquatic environments. The lectures will begin with intermolecular interactions and thermodynamic principles governing the kinetics of some of the important chemical and physicochemical transformation reactions of organic contaminants. From this class, students will learn to predict chemical properties and to apply the knowledge of chemical properties and transformation reactions to assess the environmental fate of organic contaminants.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

CHEM 2201|Minimum Grade of C-|May not be taken concurrently.

**CEE 4762. Environmental Organic Chemistry. 3 Credit Hours.**

This is an advanced course focusing on examination of processes that affect the behavior and fate of anthropogenic organic contaminants in aquatic environments. The lectures will focus on intermolecular interactions and thermodynamic principles governing the kinetics of some of the important chemical and physicochemical transformation reactions of organic contaminants.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

CHEM 2201|Minimum Grade of C-|May not be taken concurrently.

**CEE 4773. Sustainability Aspects of Water Supply and Wastewater Treatment. 3 Credit Hours.**

Major environmental, economic and social trends are influencing the application of sustainability principles within the engineering profession. This course will examine the sustainability principles that will transform future engineering practice regarding drinking water supply and the treatment of wastewater. The term, wastewater, will be replaced by one more representative of the fact that 'wastewater' is in fact a largely untapped source of raw materials. It is in the areas of energy recovery, small molecule harvesting, and the water energy nexus where the next generation of environmental engineers will have a major impact on meeting societal needs regarding the provision of adequate drinking water as well as industrial requirements for this increasingly scarce resource. The course will introduce the underlying principles of sustainability directly relevant to meeting this need. Case studies will evaluate the above mentioned principles and the applicable areas of energy, chemical intermediates, and reclamation of previously used water, with a focus on dealing with emerging microconstituents in the water environment.

**Repeatability:** This course may not be repeated for additional credits.

**CEE 4811. Advanced Soil Mechanics. 3 Credit Hours.**

Advanced concepts related to behavior of soil as an engineering material. Topics include consolidation magnitude and time rate, evaluation of secondary compression, mitigation of consolidation of settlements, shear strength of soils and other geologic materials, principles of critical state soil mechanics, and normalization of undrained shear strength.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

CEE 3331|Minimum Grade of C-|May not be taken concurrently.

**CEE 4821. Foundation Engineering. 3 Credit Hours.**

Principles of foundation engineering and design. Topics include soil stress distributions, bearing capacity of shallow (footings, mats) and deep foundations (driven piles, drilled shafts), tolerable settlements, construction techniques, and field quality control.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

CEE 3331|Minimum Grade of C-|May not be taken concurrently.

**CEE 4822. Earth Retaining Systems. 3 Credit Hours.**

Principles related to design of earth retaining systems and stability of earth slopes. Topics include lateral earth pressure theory, temporary and permanent retaining structures, in-situ reinforcement, and braced excavations. Shear strength of cohesive and granular soils and slope stability analysis using limited equilibrium, design charts and numerical methods.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

CEE 3331|Minimum Grade of C-|May not be taken concurrently.

**CEE 4823. Geotechnical Earthquake Engineering. 3 Credit Hours.**

An introduction to seismology and earthquake hazards in geotechnical engineering. Topics include plate tectonics and earthquake faulting, strong ground motions, dynamic soil properties, and characterization of design ground motions based on deterministic and probabilistic seismic hazard analysis. Analysis of earthquake-induced ground failures, seismic design of earth retaining systems and slopes, and effects of soil-structure interaction.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:**

CEE 3331|Minimum Grade of C-|May not be taken concurrently.

**CEE 4871. Fundamentals of Engineering in Civil Engineering. 1 Credit Hour.**

Review of subject areas in preparation for the Fundamentals of Engineering examination in Civil Engineering.

**Repeatability:** This course may not be repeated for additional credits.

**CEE 4882. Independent Study in Civil Engineering. 2 to 5 Credit Hours.**

Student may complete a regular course during semester the course is not offered to meet prerequisite or graduation requirements. NOTE: An instructor is assigned to supervise the student.

**Repeatability:** This course may be repeated for additional credit.

**CEE 4883. Directed Study in Civil Engineering. 1 to 4 Credit Hour.**

An opportunity to study specialized topics not covered in currently available courses and providing significant progress towards the technical/professional objectives of the program. An instructor is assigned to define the scope and direct, supervise, and evaluate student progress.

**Repeatability:** This course may be repeated for additional credit.

**CEE 4891. Independent Research in Civil Engineering. 2 to 5 Credit Hours.**

A project assigned with the approval of the department chair and conducted under the supervision of a faculty sponsor.

**Repeatability:** This course may be repeated for additional credit.