

ENCE - ENGINEERING, CIVIL

ENCE100 Introduction to Civil and Environmental Engineering (1 Credit)

An overview of the department of Civil and Environment Engineering. Students are introduced to the undergraduate curriculum and will be exposed to other undergraduate and graduate students at various points in their program. The course blends panel presentations by seniors and graduate students, faculty and practitioners with a project and book review to be performed by the students.

ENCE200 Civil Engineering Graphics for Design and Construction (3 Credits)

Introduction to the basic principles and fundamentals of civil design, plan interpretation, and plan creation. Development of the knowledge and skills to analyze existing sites, environmental features, and characteristics used to develop a site properly. Introduction of the use of Computer-Aided Drafting (CAD) software in the context of civil and environmental engineering design and applications.

Prerequisite: ENES100, MATH141, and ENES102; and permission of ENGR-Civil & Environmental Engineering department.

ENCE201 Engineering Information Processing (3 Credits)

Exploration of algorithms for solving problems in several important areas of numerical computing: roots of equations; matrix algebra and the systems of linear equations; function approximation, numerical differentiation and integration; and ordinary differential equations. Issues of solution accuracy, robustness, and efficiency are also considered. Numerical techniques are presented in the context of engineering applications, and example problems are solved using a variety of computer-based tools (primarily MATLAB).

Prerequisite: ENES220 and MATH241; and permission of ENGR-Civil & Environmental Engineering department.

Corequisite: MATH246.

Credit Only Granted for: ENCE201 or ENCE203.

ENCE204 How Do Cities Work (3 Credits)

Can we improve the way cities work? Are we equitably sharing the benefits and the burdens of living in a city? This course examines how cities work, and importantly, whether they work the same for everyone living in the city. We will explore the ways in which we provide city services and who is included or excluded from these services. We will examine how the city infrastructure serves a neighborhood's residents, with an eye toward how community forms. We will use first person accounts from policymakers, advocates, and community members to learn about the planning process for services and the tensions that can exist around access to healthcare, food and affordable housing. Each week we will study a new facet of the city, drawing on the writings of experts and your own journey through the city to better understand its infrastructure, asking how does it work, how does it connect to other infrastructure and whom does it primarily serve?

ENCE205 Biology for Civil and Environmental Engineers (3 Credits)

Introduction to the functions and interactions of biological systems in civil and environmental engineering systems in the context of societal issues. The course includes an introduction to biotechnological principles from a quantitative perspective, modern experimental techniques in biotechnology and methods of data analysis. Roles for civil and environmental engineers in society seen from a biotechnological perspective, and the role of biotechnology in civil and environmental engineering will be elucidated. The role of biotechnology in other engineering disciplines will also be discussed.

Prerequisite: MATH140 or equivalent.

Restriction: Must be in the Civil Engineering program; or permission of the Civil and Environmental Engineering Department.

Credit Only Granted for: BIOE120 or ENCE205.

ENCE215 Engineering for Sustainability (3 Credits)

Engineers have a key role to play in planning, designing, building, and ensuring a sustainable future. In this class, a problem-based approach is used to examine fundamentally-based analyses and approaches for engineering as sustainable society, with a focus on sustainable use of energy and materials, sustainable infrastructure solutions, atmospheric sustainability and sustainable water supply, and human population growth and resource consumption and its implications for sustainability.

Prerequisite: CHEM135; and permission of ENGR-Civil & Environmental Engineering department.

ENCE300 Fundamentals of Engineering Materials (3 Credits)

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

Prerequisite: ENES220; and permission of ENGR-Civil & Environmental Engineering department.

ENCE302 Probability and Statistics for Civil and Environmental Engineers (3 Credits)

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

Prerequisite: MATH246 and ENCE201; and permission of ENGR-Civil & Environmental Engineering department.

ENCE305 Fundamentals of Engineering Fluids (3 Credits)

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

Prerequisite: ENES220, PHYS260, and PHYS261; and permission of ENGR-Civil & Environmental Engineering department.

Credit Only Granted for: BIOE331, ENCE305, ENFP300, or ENME331.

ENCE310 Introduction to Environmental Engineering (3 Credits)

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

Prerequisite: PHYS260 and ENCE215; and permission of ENGR-Civil & Environmental Engineering department.

ENCE320 Introduction to Project Management (3 Credits)

Principles and techniques of managing engineering projects from the initiation, through planning, execution, monitoring & control, then finally closeout.

Prerequisite: Permission of ENGR-Civil & Environmental Engineering department.

Restriction: Must be in a major in ENGR-A James Clark School of Engineering.

Credit Only Granted for: BMGT485, ENCE320, ENCE325, INST4080 or INST453.

ENCE325 Introduction to Construction Project Management (3 Credits)

Learn the basic topics in sourcing, planning, financing, designing, contracting, constructing and operating buildings and other facilities in the built infrastructure. Topics include construction economics, design constructability reviews, construction process planning, contracts and procurement strategies, project scheduling and resource utilization, site layout planning, project cost and quality controls, temporary structures, environmental sustainability, project handover procedures, facility operation and management, IT-based tools for construction project and resource management.

Restriction: Must be in a major in ENGR-A. James Clark School of Engineering; or must be in a major in ARCH-School of Architecture, Planning, & Preservation; or must be in the Construction Project Management minor. And permission of ENGR-Civil & Environmental Engineering department.

Credit Only Granted for: BMGT485, ENCE320, ENCE325, INST4080 or INST453.

ENCE340 Fundamentals of Geotechnical Engineering (3 Credits)

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

Prerequisite: ENES220; and permission of ENGR-Civil & Environmental Engineering department.

ENCE353 Introduction to Structural Analysis (3 Credits)

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

Prerequisite: Permission of ENGR-Civil & Environmental Engineering department; and (MATH246 and ENES220).

ENCE360 Analysis of Civil Engineering Systems (3 Credits)

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

Prerequisite: ENCE201 and MATH140; and permission of ENGR-Civil & Environmental Engineering department.

ENCE370 Introduction to Transportation Engineering and Planning (3 Credits)

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

Prerequisite: ENCE201, PHYS260, and PHYS261; and permission of ENGR-Civil & Environmental Engineering department.

ENCE386 Experiential Learning (3-6 Credits)

Prerequisite: Learning Proposal approved by the Office of Experiential Learning Programs, faculty sponsor, and student's internship sponsor.

Restriction: Junior standing or higher.

ENCE398 Honors Research Project (1-3 Credits)**ENCE402 Simulation and Design of Experiments for Engineers (3 Credits)**

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

Prerequisite: ENCE302; and permission of ENGR-Civil & Environmental Engineering department.

ENCE411 Environmental Engineering Science (3 Credits)

Introduces the analytical techniques available to assess performance of engineering processes as they relate to water, soil, and air treatment and quality. The basic principles of environmental management, economics of waste treatment, by-product reutilization, and energy cycles are introduced and discussed. Alternative technologies are introduced and evaluated mostly by assessing their potential to reduce waste, minimize energy use, and promote sustainability. Students' activities include, a weekly lab to provide hands-on experience with environmental quality measurements and treatment techniques; on-site visits to regional industries that undertake sustainable practices; and a final research project where experimental design and laboratory techniques are used to assess interactions between technologies and natural systems and their potential for reducing environmental impacts.

Prerequisite: ENCE310; and permission of ENGR-Civil & Environmental Engineering department.

ENCE412 Environmental Engineering Unit Operations (3 Credits)

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

Prerequisite: ENCE305 and ENCE310; and permission of ENGR-Civil & Environmental Engineering department.

ENCE420 Selection and Utilization of Construction Equipment (3 Credits)

Learn to evaluate and select construction equipment with a focus on mechanized equipment for earthwork and building construction. Learn about the parties involved in procurement, operation and maintenance, and how to cost-effectively plan, select, and utilize equipment for earthmoving, paving, formwork, trenching, rock excavation, tunneling, site preparation, and steel and concrete construction. Explore trends in equipment design, construction automation, and robotics.

Prerequisite: Permission of ENGR-Civil & Environmental Engineering department.

Restriction: Must be in a major in ENGR-A. James Clark School of Engineering; or must be in the Construction Project Management minor.

ENCE421 Legal Aspects of Architectural and Engineering Practice (3 Credits)

Learn the basic structure of the US legal system and court procedures and legal principles relevant to architectural and engineering design and construction contracts including principles of ethical, legal and professional conduct of engineers and architects. Topics include: contracts for design and construction, sales and warranties, torts and product liability, business agency and government agencies, professional liability of architects and engineers, labor laws, expert testimony, mediation and arbitration, tangible property including real estate, intellectual property including trademarks, patents and copyrights, insurance and sureties.

Restriction: Must be in a major in ENGR-A. James Clark School of Engineering; or must be in the Construction Project Management minor; or must be in the Project Management Minor. And permission of ENGR-Civil & Environmental Engineering department.

ENCE422 Project Cost Accounting and Economics (3 Credits)

Learn: the fundamentals of accounting; project cost accounting principles as they apply to project management; project cost accounting; and the fundamentals of engineering economics. Topics include: project feasibility analysis; reading and analyzing financial statements; cash management; cash flow analysis; depreciation and taxes; and impact on profitability; the principles of activity based costing; net present value analysis; the framework for project performance measurement, cost performance indices, and earned value analysis.

Prerequisite: Permission of ENGR-Civil & Environmental Engineering department.

Restriction: Must be in a major in ENGR-A. James Clark School of Engineering; or must be in the Construction Project Management Minor; or must be in the Project Management Minor.

ENCE423 Project Planning, Estimating & Scheduling (3 Credits)

Learn the fundamentals of project planning, estimating, and scheduling. Understand the concepts of planning; to reduce uncertainty, improve efficiency of the operation, to set and meet objectives, and to provide a basis for monitoring and controlling the work. Be introduced to: the concepts of resource definition, assignment and management, and; the basics of project estimating (pricing) methods including global pricing strategies, types of estimates, pricing processes, overhead and profit, and project financing. Learn the basics of project scheduling including; bar charts, network-based methodologies, and linear scheduling techniques. Emphasis is placed on Critical Path Method (CPM) scheduling, a network based methodology. Be exposed to the use of scheduling software and will actually develop a CPM schedule for an actual construction project as part of a semester project.

Restriction: Must be in a major in ENGR-A. James Clark School of Engineering; or must be in the Construction Project Management Minor; or must be in the Project Management Minor. And permission of ENGR-Civil & Environmental Engineering department.

ENCE424 Communication for Project Managers (3 Credits)

Learn the fundamentals of communications for project managers. Emphasis is on interpersonal and group communications; through voice, electronic, and written messages; project cycle and reports and presentations during this cycle; and communications for employment.

Prerequisite: Permission of ENGR-Civil & Environmental Engineering department.

Restriction: Must be in a major in ENGR-A. James Clark School of Engineering; or must be in the Construction Project Management minor; or must be in the Project Management minor. Jointly offered with: ENCE614.

Credit Only Granted for: ENCE424 or ENCE614.

ENCE426 Construction Documentation and BIM Applications in Engineering and Construction (3 Credits)

Learn the basics of construction documentation methods, with particular emphasis on Building Information Modeling (BIM). Topics include: the fundamentals of assembly, coordination, and maintenance of construction documents and implementation of BIM techniques in the design and construction processes, and; a review of Autodesk, Revit, and Navisworks and other leading BIM software. Lectures from project management faculty supplemented by guest lecturers from the construction industry.

Prerequisite: Permission of ENGR-Civil & Environmental Engineering department.

Restriction: Must be in a major in ENGR-A. James Clark School of Engineering; or must be in the Construction Project Management Minor; or must be in the Project Management Minor.

ENCE431 Hydrologic Engineering (3 Credits)

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

Prerequisite: ENCE305; and permission of ENGR-Civil & Environmental Engineering department.

ENCE432 Ground Water Hydrology (3 Credits)

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

Prerequisite: ENCE305; and permission of ENGR-Civil & Environmental Engineering department.

ENCE441 Foundation Design (3 Credits)

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

Prerequisite: ENCE340; and permission of ENGR-Civil & Environmental Engineering department.

ENCE444 Experimental Methods in Geotechnical Structural Engineering (3 Credits)

In the geotechnical engineering part of the course, major soils testing and their interpretation including classification, compaction, strength, and compressibility will be undertaken. The structural engineering part of this course covers test planning, loading apparatus, instrumentation, data acquisition and data analysis, as well as basic aspects of structural testing techniques and shake-table test.

Prerequisite: ENCE353 and ENCE340; and permission of ENGR-Civil & Environmental Engineering department.

ENCE447 Pavement Engineering (3 Credits)

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

Prerequisite: ENCE340; and permission of ENGR-Civil & Environmental Engineering department.

ENCE453 Computer-Aided Structural Analysis (3 Credits)

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

Prerequisite: ENCE353; and permission of ENGR-Civil & Environmental Engineering department.

ENCE454 Design of Concrete Structures (3 Credits)

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

Prerequisite: ENCE353; and permission of ENGR-Civil & Environmental Engineering department.

Formerly: ENCE451.

ENCE455 Design of Steel Structures (3 Credits)

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

Prerequisite: ENCE353; and permission of ENGR-Civil & Environmental Engineering department.

ENCE466 Design of Civil Engineering Systems (3 Credits)

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

Prerequisite: Permission of ENGR-Civil & Environmental Engineering department.

Restriction: Senior standing.

Additional Information: Must be taken in the semester in which the student graduates.

ENCE467 Civil and Environmental Engineering Design II (2 Credits)

This experiential course provides structured and unstructured time for groupwork as part of the senior capstone design course sequence. The course builds on skills acquired throughout a student's academic career extending a project defined and scoped in ENCE465. The objective of this course is to provide students with hands on experience similar to the experience encountered by new engineers working in professional engineering and construction practice. The course offers students an opportunity to develop the leadership and coursework skills needed to meet professional expectations.

Prerequisite: ENCE465 .

Restriction: Permission of the ENGR-Civil & Environmental Engineering Department.

ENCE470 Highway Engineering (3 Credits)

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

Prerequisite: ENCE302 and ENCE370; and permission of ENGR-Civil & Environmental Engineering department.

ENCE472 Transportation Engineering (3 Credits)

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

Prerequisite: ENCE302 and ENCE370; and permission of ENGR-Civil & Environmental Engineering department.

ENCE488 Senior Thesis (3 Credits)

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

Prerequisite: Permission of ENGR-Civil & Environmental Engineering department.

Restriction: Senior standing.

ENCE489 Special Problems in Civil Engineering (1-4 Credits)

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

Prerequisite: Permission of ENGR-Civil & Environmental Engineering department.

Restriction: Senior standing.

Repeatable to: 9 credits if content differs.