Civil, Architectural and Environmental Engineering

http://www.cae.miami.edu

Dept. Code: CAE

Mission Statement
The mission of the Department of Civil, Architectural, and Environmental Engineering is to:

• Provide high-quality undergraduate and graduate education in civil, architectural, and environmental engineering that will prepare graduates for professional careers and a lifetime of learning
• Conduct high-quality research that will advance the body of knowledge and improve the quality of human life
• Serve the engineering profession and society through active involvement in professional organizations and contribution of professional expertise

The department offers three undergraduate degrees:

• Bachelor of Science in Civil Engineering,
• Bachelor of Science in Architectural Engineering and
• Bachelor of Science in Environmental Engineering.

Civil Engineering
Civil engineers are leaders in the planning, design, construction, and operation of systems that are essential to modern life. These systems include: buildings, highways, airports, pipelines, bridges, dams, irrigation systems, drainage systems, water-supply and distribution systems, and wastewater collection and treatment works. Civil engineers are employed by government agencies, public utility companies, private consulting firms, construction companies, architectural firms, and universities.

Architectural Engineering
Architectural engineers are leaders in the planning, design, construction, and operation of engineered systems for commercial, industrial, and institutional buildings and other facilities. These engineered systems include electrical, communications and control, lighting, heating, ventilating, air conditioning, fire protection, plumbing, acoustic, and structural components. Architectural engineers are employed by consulting firms, construction companies, facility management companies, HVAC equipment manufacturers, architectural firms, government agencies, and universities.

Environmental Engineering
Environmental engineers are leaders in the application of engineering principles to improve and maintain the environment for the protection of human health, for the protection of nature’s beneficial ecosystems, and for environment-related enhancement of the quality of human life. Environmental engineers are employed by government agencies, consulting firms, and universities.

Educational Objectives
The objectives of the Civil Engineering Program are to have graduates who within the first several years following graduation are either

1. Working as a professional in an area closely related to civil engineering or
2. Pursuing a graduate or professional degree.

The objectives of the Architectural Engineering Program are to have graduates who within the first several years following graduation are either

1. Working as a professional in an area closely related to architectural engineering or
2. Pursuing a graduate or professional degree.

The objectives of the Environmental Engineering Program are to have graduates who within the first several years following graduation are either

1. Working as a professional in an area closely related to the water environment or
2. Pursuing a graduate or professional degree.

Advanced Writing and Communication Skills
Civil, Architectural, and Environmental Engineering students satisfy the University’s Advanced Writing and Communication Skills requirement by completing a set of classroom courses, laboratory courses and design courses where they learn effective oral, graphical and technical writing skills. Civil, Architectural, and Environmental Engineering students acquire Advanced Writing and Communication skills in the following core courses:

• CAE 111 – Introduction to Engineering I- 3 Credits
• CAE 212 – Structures Laboratory (Civil and Architectural Engineering)- 1 Credit
• CAE 345 – Environmental Laboratory (Environmental Engineering)- 3 Credits
• CAE 371 – Geotechnical Laboratory (Civil and Architectural Engineering) – 1 Credit
• CAE 402 – Professional Engineering Practice- 3 Credits
CAE 100. Introduction to Civil, Architectural, and Environmental Engineering. 3 Credit Hours.
This introductory course is designed to expose high school students to a variety of specific disciplines within the civil engineering arena to assist them in making informed decisions about possible college majors. The program is designed for the exemplary high school student interested in applied mathematics and science. All students enrolled in this course will gain experience in problem solving, engineering mechanics, computer simulation, and laboratory activity. The course content changes throughout the 3-week duration and includes topics on civil engineering, environmental engineering, and architectural engineering. The students will be provided with an understanding and some hands-on experience on topics relative to the disciplines of civil, architectural, and environmental engineering. Via an introduction to several case histories, the students will be able to understand the challenges associated with the design and construction and importance of the scientific methods in engineering. The laboratory and field trip experiences will deal with bridge building, material testing, water purification, and building systems.
Components: LEC.
Grading: GRD.
Typically Offered: Summer.

CAE 111. Introduction to Engineering I. 3 Credit Hours.
Use of engineering tools for problem solving. Computer techniques for data acquisition, analysis and presentation, software design, and computer aided drafting are covered. Development of design skills is achieved through several design and building competitions. Introduction to professional ethics and intellectual property rights, MATLAB, AutoCAD, and programming in C++ is also included.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

CAE 112. Introduction to Engineering II. 2 Credit Hours.
Hands-on applications of various surveying instruments for leveling, angles and distance measurements, and other engineering applications. Hands on application of Geographic Information Systems, including ArcView and extensions. Prerequisite: CAE 111.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

CAE 114. Introduction to Engineering II (GIS). 1 Credit Hour.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

CAE 115. Introduction to Engineering II (Surveying). 1 Credit Hour.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

CAE 210. Mechanics of Solids I. 3 Credit Hours.
Vectors, force systems, equilibrium, analysis of frames, machines, trusses for internal forces, friction, centroids, moment of inertia, and shear and bending moment diagrams are discussed. Prerequisites: PHY 205, MTH 151 or MTH 161 or MTH 171, and Non Engineering majors: PHY 101, PHY 103, PHY 160, PHY 201 and MTH 130, MTH 151, MTH 161, MTH 171.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

CAE 211. Mechanics of Solids II. 3 Credit Hours.
Flexural, shear, principal, and torsional stresses are discussed as well as displacements and instability. An introduction to statically indeterminate analysis is also included. Prerequisite: CAE 210.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

CAE 212. Structural Laboratory. 1 Credit Hour.
Laboratory techniques, tests for tension, compression, shear, bending, and torsion are discussed. Models, similitudes, buckling of columns, and review of current research are also included. Laboratory 3 hours. Corequisite: CAE 211.
Prerequisite: IEN 311. Or Corequisites: IEN 311 or CAE 211. Or Requisite: Permission of Instructor.
Components: LAB.
Grading: GRD.

CAE 213. Behavior of Structural Systems I. 3 Credit Hours.
Design and testing of experimental models of qualitative and quantitative prediction of full scale structural behavior. Investigation of single and multi-story rectangular frames, curved structures and longspan buildings. Application of graphical and analytical techniques to determine basic system layout and preliminary dimensioning of key subsystems and members is also included. Prerequisite: ARC 231.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

CAE 240. Environmental Pollution. 3 Credit Hours.
Exploration of contemporary environmental issues. Introduction to engineering approaches for protecting and cleaning up the environment, techniques for assessing the impact of human activity on the environment, strategies for pollution control and implementation of environmental mitigation measures. Requisite: Sophomore Status.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

CAE 310. Structural Analysis. 3 Credit Hours.
Analysis of statically determinate and indeterminate structures for internal forces, external reactions, displacements, including influence lines. Prerequisite: CAE 211.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

CAE 313. Behavior of Structural Systems II. 3 Credit Hours.
Overall analysis of simple and multi-story frame structures. Consideration of flat plates, prestressed concrete flat slabs, slab and beam, joist and girder, waffle and space truss systems, columns, wall and rigid frame subsystems under vertical and horizontal loads. Application of structural model analysis to supplement or supplant mathematical analysis is included. Prerequisite: CAE 213.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.
CAE 320. Concrete Structures. 3 Credit Hours.
Course topics include design of concrete beams, columns, structural systems one-way slabs, and isolated footings by ultimate design methods. Prerequisite: CAE 310. Or Corequisite: CAE 310.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

CAE 321. Steel Structures. 3 Credit Hours.
Design of tension, compression, flexural members, and beam columns using load and resistance factor design are discussed. Introduction to design and detailing of welded and bolted connections is also included. Prerequisite: CAE 310. Or Corequisite: CAE 310.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

CAE 330. Fluid Mechanics. 3 Credit Hours.
Properties of fluids, gas systems, pressure distribution in static fluids, and hydrostatic forces on plane and curved surfaces are discussed. Kinematics and dynamics of fluid motion, dimensional analysis and similitude, flow in closed conduits, pumps, design of water distribution systems, and an introduction to flow in open channels is also included. Prerequisite: CAE 210 and PHY 206.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

CAE 340. Introduction to Environmental Engineering. 3 Credit Hours.
Environmental mass and energy balances, introduction to environmental chemistry, air pollution, water pollution, sustainable solid waste management, risk assessment, and global atmospheric change are discussed. Prerequisite: MTH 162, and CHM 111 or CHM 151.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

CAE 345. Environmental Laboratory And Analysis. 3 Credit Hours.
Laboratory-based course focusing on the analysis of environmental samples including water, wastewater, air, and solids. Basic analytical techniques and quality control are also included as well as an introduction to advanced analytical measurements. Prerequisite: CHM 112 and CAE 340.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

CAE 350. Transportation Engineering I. 3 Credit Hours.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

CAE 370. Geotechnical Engineering I. 3 Credit Hours.
Soil composition and classification, excavation, grading, fill compaction, stress distribution in soils, one-dimensional flow of water through soil, laboratory, and field permeability, effective stress concept, calculation of consolidation, field settlement, bearing capacity, and design and analysis of shallow foundations are discussed. Prerequisite: CAE 211. Corequisite: CAE 371.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

CAE 371. Geotechnical Laboratory. 1 Credit Hour.
Evaluation of physical and mechanical properties of soils, and preparation of reports. Three hours. Prerequisite: ENG 107 and IEN 311. Corequisite: CAE 370.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

CAE 380. Electrical and Illumination Systems for Buildings. 3 Credit Hours.
Typical electrical systems for buildings including electrical circuits, protective devices and code requirements. Illumination and lighting design. Prerequisite: PHY 207.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

CAE 381. Building Mechanical Systems I: Hvac Fundamentals. 3 Credit Hours.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

CAE 395. Undergraduate Research. 1-3 Credit Hours.
Designed for the undergraduate student who wishes to engage in research. Not for graduate credit or for baccalaureate graduation credit. Subject and credit to be arranged with the instructor.
Components: THI.
Grading: GRD.
Typically Offered: Spring.

CAE 399. Internship. 1 Credit Hour.
Practical application of classroom theory through employment with firms offering positions consistent with the student's field of study. Courses may be repeated.
Components: IND.
Grading: SUS.
Typically Offered: Fall, Spring, & Summer.

CAE 400. Preparation for FE Exam. 1 Credit Hour.
Review of material in preparation for the Fundamentals of Engineering (FE) exam statistic. For credit only. Requisite: Senior Status.
Components: LEC.
Grading: CNC.
Typically Offered: Offered by Announcement Only.
CAE 402. Professional Engineering Practice. 3 Credit Hours.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

CAE 403. Senior Design Project I - Civil & Architectural. 1 Credit Hour.
Two-semester comprehensive design project based on the knowledge and skills acquired in earlier coursework and incorporating engineering standards and realistic constraints. The faculty coordinator and several practicing engineers/architects provide consultation, guidance, and recommendations on aspects such as design definition, evaluation of design approaches, design development, and the preparation of construction documents. Prerequisite: CAE 403.
Typically Offered: Fall.

CAE 404. Senior Design Project II - Civil & Architectural. 2 Credit Hours.
Second semester of a two-semester comprehensive design project based on the knowledge and skills acquired in earlier coursework and incorporating engineering standards and realistic constraints. The faculty coordinator and several practicing engineers/architects provide consultation, guidance, and recommendations on aspects such as design definition, evaluation of design approaches, design development and the preparation of construction documents. Prerequisite: CAE 403.
Typically Offered: Spring.

CAE 421. Timber Structural Systems. 3 Credit Hours.
Engineering properties of timber, design of tension, compression, and flexural members are covered. The design and detail of connections and hardware, and the design of timber systems and heavy timber construction is also included. Prerequisite: CAE 310.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

CAE 430. Water-Resources Engineering I. 3 Credit Hours.
Basic principles of open channel flow. Computation of water surface profiles. Design of hydraulic structures, design of lined and unlined open channels, and design of sanitary sewer systems. Introduction to hydrology and analysis of hydrologic data. Rainfall characteristics and peak runoff models. Prerequisite: CAE 330.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

CAE 440. Water Quality Control Systems. 3 Credit Hours.
Principles of domestic wastewater treatment, design of biological and chemical waste treatment processes, design and sizing of small scale treatment units, and design of water treatment processes are discussed. An introduction to industrial waste treatment. Prerequisite: CAE 330 and CAE 340.
Components: LEC.
Grading: GRD.
Typically Offered:Spring.

CAE 450. Transportation Engineering II. 3 Credit Hours.
Transportation system planning and design. Advanced geometric design for highway and railway/transit. Human, vehicle, and environmental factors affecting the design, operation, and safety of transportation systems. Planning and design of both landside/airside aspects of airport facilities. Water port and multi-modal facilities design. Prerequisite: CAE 350.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

CAE 460. Construction Management. 3 Credit Hours.
An introduction to the management of construction projects including legal considerations as well as the techniques of management science applied to construction. The course includes engineering methods of cost and time estimating, and exercises in applications of engineering economics, network planning techniques, including CPM and PERT are introduced. The management principles of time and cost control are also explored. Computer application of project management tools are included. Prerequisite: Senior Status.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

CAE 470. Foundations and Earth Retaining Systems. 3 Credit Hours.
Natural soil deposits and subsoil exploration. Geotechnical analysis and design of shallow and deep foundations. Theories of lateral earth pressure. Design and analysis of earth-filled retaining systems. Prerequisite: CAE 330, CAE 370, and CAE 371.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

CAE 480. Plumbing and Life Safety For Buildings. 3 Credit Hours.
Design of Building environmental systems including domestic cold and hot water systems, sanitary storm and special waste systems, fuel gas systems, building life safety systems and architectural acoustics. Prerequisite: CAE 330.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

CAE 481. Building Mechanical Systems II: HVAC Systems. 3 Credit Hours.
Applies engineering principles to the design of heating, ventilating, and air conditioning (HVAC) systems for buildings. Covers air distribution systems, air handling units, coils and heat exchangers, water distribution systems, and primary systems. Prerequisite: CAE 381.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.
CAE 510. Structural Mechanics. 3 Credit Hours.
Analysis of stress and deformation of solids. Application to systems in the elastic and inelastic range. Topics include beams of special
geometry and support, stress concentrations, stresses in elastic
foundations, torsion, energy method, failure theories, and brittle
fracture.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 511. Advanced Structural Analysis. 3 Credit Hours.
General methods of indeterminate analysis. Elements of energy method
in indeterminate analysis of axially, flexural-torsional, and composite
members. Basic flexural and stiffness methods and matrix development
are also included.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

CAE 520. Advanced Design of Concrete Structures. 3 Credit Hours.
Design of reinforced concrete flat plates, flat slabs, two-way slabs, long
columns, and slab-column connections are discussed. Deflections, cracks
widths, and background of current ACI Building Code are also included.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

CAE 521. Advanced Design of Steel Structures. 3 Credit Hours.
Steel framing systems, design of members and connections of braced
and rigid frames, design for torsion, and design of steel-concrete
composite members are discussed.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

CAE 522. Design of Prestressed Concrete Structures. 3 Credit Hours.
Materials and systems for prestressing. Design of prestressed concrete
members for flexure and shear, camber, deflection, and crack control are
discussed. Design of continuous beams, compression members, two-
way concrete floor systems, and the loss of prestress are also included.
Prequisite: CAE 320.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 523. Design of Masonry Structures. 3 Credit Hours.
Masonry construction. Design of flexural and compression members,
bearing walls, shear walls, diaphragms, and connections of masonry
structures. Arches, vaults, and buttresses are also included.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 525. Timber Structural Systems. 3 Credit Hours.
Engineering properties of timber, design of tension, compression, and
flexural members are covered. The detail and design of connections
and hardware, and the design of timber systems and heavy timber
construction is also included.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 530. Water Resources Engineering II. 3 Credit Hours.
Runoff models, routing models, water-quality models, and
evapotranspiration models. Design of stormwater management systems.
Principles of groundwater flow. Design of wells and wellfields for public
water supply. Legal regulatory, and economic components of water-
resources management systems. Comprehensive design project.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

CAE 531. Surface-Water Hydrology. 3 Credit Hours.
Rainwater characteristics. abstraction processes, surface-runoff, routing,
and water-quality models. Design of stormwater-management systems,
evapotranspiration, and regional water-management is also included as
well as case studies.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 532. Ground-Water Hydrology. 3 Credit Hours.
Governing equations of ground-water flow. Numerical modeling of
ground-water flow. Analytic and semi-analytic solutions to the flow
equations. Principle of superposition and method of images. Saltwater
invasion. Ground-water flow in the unsaturated zone. Engineered
systems. Introduction to contaminant fate and transport in ground water.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 533. Water-Quality Control in Natural Systems. 3 Credit Hours.
Water-quality regulations, fate and transport processes, water-quality
control in rivers, lakes, wetlands, oceans, and ground water.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 540. Environmental Chemistry. 3 Credit Hours.
Kinetics, equilibrium, acid-base, oxidation-reduction, and reaction
chemistry applied to water and wastewater engineering.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 541. Engineering Systems For Disease Control And Bioremediation.
3 Credit Hours.
Classification of microorganisms. Microbial agents of infectious
diseases and modes of disease transmission. Control of pathogens
through water and waste treatment, food protection, and insect control.
Microbial ecology and bioremediation systems. Laboratory exercises in
microbiology.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 542. Solid and Hazardous Waste Engineering. 3 Credit Hours.
Solid-waste characteristics. recycling, incineration, hazardous waste
characteristics. prevention, and physical and chemical treatment are
covered. Design projects are also included.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.
CAE 543. Air Pollution Control Engineering. 3 Credit Hours.
Fundamentals of air pollution and air quality; properties and control of particulates, volatile organic compounds, carbon monoxide, sulfur oxides, and nitrogen oxides; motor vehicle emissions; health and aesthetic effects (acid rain, visibility), laws and regulations, meteorology and pollutant transport in the atmosphere; indoor air pollution.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 553. Transportation Systems Planning and Demand Modeling. 3 Credit Hours.
Transportation demand analysis and forecasting. Sampling techniques, collection and analysis of survey data. Disaggregate and aggregate models. Trip generation, distribution, modal split and assignment. Transportation network equilibrium. Transportation system management.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 560. Sustainable Construction. 3 Credit Hours.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

CAE 561. Computer Aided Architectural Engineering Design. 3 Credit Hours.
The course prepares students to utilize Building Information Modeling (BIM) and Building Performance Analysis (BPA) in a coordinated, integrated and consistent approach in the Architecture, Engineering and Construction (AEC) Industry. The basics of high-quality 5 dimensional BIM modeling are covering including 3D modeling of buildings and building components, imbedded cost-estimating and the phasing the construction process. Basics of REVIT Structure and MEP are also covered. BPAC components covered include climate analysis, daylighting, wind and airflow analysis, solar radiation analysis and whole building energy analysis. Upon completion student will receive a PBA certification from Autodesk
Requisite: Junior Status or Permission of Instructor.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

CAE 570. Advanced Foundation Engineering. 3 Credit Hours.
Prerequisite: CAE 470. Or Requisite: Permission of Instructor.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

CAE 580. Hospital and Health Care Facility Design. 3 Credit Hours.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 581. Energy-Efficient Building Design. 3 Credit Hours.
Concepts and methods of energy-efficient building design and sustainable performance. Topics cover building envelope, mechanical, power and lighting, and service water heating systems. Computer-based energy simulation methods and building energy standards are emphasized.
Prerequisite: CAE 481.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

CAE 582. Building Energy Modeling and Simulation. 3 Credit Hours.
Modeling and analysis of building energy performance using state-of-art whole building energy simulation programs. Topics include dynamic simulation of heating and cooling loads in buildings, modeling of building equipment and control system, and integrated simulation of equipment and building loads.
Prerequisite: Or Co-requisite: CAE 581.
Components: LAB.
Grading: GRD.
Typically Offered: Spring.

CAE 590. Special Topics. 1-3 Credit Hours.
Sub-titles describing the topics to be offered will be shown in parentheses in the printed class schedule, following the title "Special Topics."
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 591. Special Topics. 1-3 Credit Hours.
Sub-titles describing the topics to be offered will be shown in parentheses in the printed class schedule, following the title "Special Topics."
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 594. Special Topics. 1-3 Credit Hours.
Sub-titles describing the topics to be offered will be shown in parentheses in the printed class schedule, following the title "Special Topics."
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 595. Special Problems. 1-4 Credit Hours.
Project course introducing methods of research through an individual investigation of current problems. Offered by special arrangement only.
Components: IND.
Grading: GRD.
Typically Offered: Offered by Announcement Only.
CAE 599. Cooperative Education. 1 Credit Hour.
Practical application of classroom theory through alternating semester or summer employment with industries offering positions consistent with the student's field of study. Course may be repeated. Periodic reports and conferences are required.

Components: IND.
Grading: SUS.
Typically Offered: Offered by Announcement Only.