

CIVIL AND ARCHITECTURAL ENGINEERING

<https://cae.coe.miami.edu>

Dept. Code: CAE

The department offers three undergraduate degrees:

- Bachelor of Science in Civil Engineering,
- Bachelor of Science in Architectural 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.

Advanced Writing and Communication Skills

Civil and Architectural 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 and Architectural Engineering students acquire Advanced Writing and Communication skills in the following core courses:

- CAE 111 - Introduction to Engineering
- CAE 212 - Structures Laboratory (Civil and Architectural Engineering)
- CAE 371 - Geotechnical Laboratory (Civil and Architectural Engineering)
- CAE 402 - Professional Engineering Practice

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 115. Introduction to Engineering II: Geospatial Data (Surveying and GIS). 2 Credit Hours.

This course will introduce students to Surveying/Geomatics Engineering and it will familiarize them with the fundamentals of Geographic [Geospatial] Information Systems (GIS). It includes hands on application of various surveying instruments to collect geospatial data as well as using GIS software packages to analyze the collected data. The students will learn how to use several surveying equipment and will also become familiar with new advanced technologies such as Lidar and drone mapping.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

CAE 202. Sustainable Materials. 3 Credit Hours.

This course review basic materials principles, with a specific focus on civil engineering materials and sustainability.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & Spring.

CAE 204. Water, Energy and Public Health. 3 Credit Hours.

This course reviews principles of healthy and sustainable living and design in context of green buildings, sustainable materials and structures, protection and preservation of energy and water resources, awareness about hazards from environmental pollutants aiming to define resilience for the next generation of societies facing climate change impacts.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & Spring.

CAE 206. Introduction to Risk Management and Resilience. 3 Credit Hours.

This course introduces students to the concept of risk management and resilience, and to equips them with the knowledge and skills necessary to understand, identify and manage risk in a variety of contexts. Through a combination of theoretical frameworks, case studies and practical exercises, students will develop an understanding of the factors that contribute to societal resilience, the different types of risk that organizations and societies face, and the strategies and tools that can be used to manage these risks.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & Spring.

CAE 208. Structures, the Environment and People. 3 Credit Hours.

This course provides an overview of structures as a critical component in the development of human civilization. Different typologies and paradigms of structures will be analyzed in the context of human development, their impact for the local community, design and technological advancements while making the link with today's principles of sustainable development and resilience. Structural design principles, architectural considerations, construction, and other aspects from techno-economic to cultural heritage will be discussed.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & 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. This course may be offered in the Flipped Classroom format, which emphasizes discussion-based learning. Prerequisite: Engineering Program - PHY 221 And MTH 151 Or 161 Or 171. Non-Engineering Program - PHY 101 Or 103 Or 201 And MTH 130 Or 161 Or 171.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & Spring.

CAE 211. Mechanics of Solids II. 3 Credit Hours.

Fundamental material behavior including stresses, strains, and deformations associated with axial, bearing, flexural, shear, thermal, and torsional loading. Composite beams, elastic buckling of columns, combined loading, Mohr's Circle, and statically indeterminate analysis of axial members 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.

Pre or Corequisite: CAE 211 and ISE 311.

Components: LAB.

Grading: GRD.

Typically Offered: Fall & Spring.

CAE 213. Behavior of Structural Systems I. 3 Credit Hours.

The course begins with a review of basic structural principles. From this basis, analysis and design of simple axial loaded structural systems and members is covered. Through the use of project based learning the students are introduced to the principles of statics using both graphical and calculated methods. Concurrent and non-concurrent systems are defined and analysis of concurrent systems is covered in this course. Structural systems based on concurrent forces are covered including cable suspension structures, concrete shells, trusses, fan like structures and membrane structures. The requirements of building codes are included in the lectures. The class concludes with discussion of structural materials and failure modes accompanied with a visit to the Civil/Architectural Engineering Laboratory.

Prerequisite: ARC 231.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

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.

Upon completion the students will understand the application of fundamental methods of structural frame systems and their place in architectural design. The bending action of beams, including shear and moment diagrams and shear and bending stress calculations are covered. Structural material design for steel, concrete, wood and masonry are covered as separate topics. They will also understand the integration of basic elements into structural systems that resist both gravity and lateral loads. The course allows students to develop foundation and framing systems.

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.

Pre 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.

Pre 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 211. And PHY 222.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & Spring.

CAE 350. Transportation Engineering I. 3 Credit Hours.

Transportation systems and organizations. Characteristics of driver, vehicles and roads. Basic probability and statistics. Traffic studies and data collection. Signal timing design, basic capacity and analysis. Basic geometric design and route surveying. Highway safety. Sustainable transportation systems.

Prerequisite: MTH 211 and Requisite: Junior Standing.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

CAE 361. Building Information Modeling I. 3 Credit Hours.

The course prepares students to utilize AutoCAD and Building Information Modeling (BIM) in a coordinated, integrated and consistent approach for the Architecture, Engineering and Construction (AEC) Industry. The basics of AutoCAD drafting and usage are covered in the first five weeks of the course. The remaining time is dedicated to high-quality 4 dimensional BIM modeling, including 3D modeling of buildings and building components, embedded cost-estimating and scheduling for the construction process. Basics of REVIT Structure and MEP are also covered.

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. And 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: WRS 107. And ISE 311. And Corequisite: CAE 370.

Components: LAB.

Grading: GRD.

Typically Offered: 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 223 or PHY 230.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

CAE 381. Building Mechanical Systems I: Hvac Fundamentals. 3 Credit Hours.

Moist air properties and psychrometric chart. Indoor air quality and thermal comfort. Air conditioning systems and processes. Heat transfer in buildings. Solar radiation. Space load analysis and calculation.

Prerequisite: MAE 303 and Corequisite: CAE 330.

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. 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) examination. For credit only.

Senior Standing.

Components: LEC.

Grading: CNC.

Typically Offered: Offered by Announcement Only.

CAE 401. Civil and Architectural Engineering Seminars. 1 Credit Hour.

Seminar series required for all students in the Civil and Architectural Engineering programs. The faculty Professor will set up a series of weekly Seminars on topics such as: Overview of the construction industry, Principles of sustainability, risk, resilience, diversity, equity, and inclusion. Speakers will include leading researchers and specialists from the construction industry.

Senior Standing or Permission of Instructor.

Components: SEM.

Grading: GRD.

Typically Offered: Fall.

CAE 402. Professional Engineering Practice. 3 Credit Hours.

Principles of engineering economics and economic evaluation of engineering projects. A discussion of professional practice issues including the philosophy and methodology of engineering, professional licensure and ethics. Discussion of the business aspects of engineering including business organization, management, contracts and legal issues. Engineering leadership in the formulation of public policy.

Senior Standing.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & Spring.

CAE 403. Senior Design Project I - Engineering Design. 3 Credit Hours.

A two semester comprehensive design project applying the knowledge acquired during earlier coursework and implementing the pedagogy of life-long learning. Team projects incorporate interdisciplinary design skills, engineering standards and realistic constraints. The faculty coordinator working with practicing design professionals provide consultation, guidance and recommendations on aspects such as problem definition, evaluation of design alternatives and approaches. The course progresses along the customary design sequence of pre-design, schematic design and design development phases established in Civil, Architectural and Environmental Engineering practice.

Requisite: Senior Standing.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

CAE 404. Senior Design Project II - Integrated Engineering Documents. 3 Credit Hours.

The second semester of a two semester comprehensive design project applying the knowledge acquired during earlier coursework and implementing the pedagogy of life-long learning. Team projects incorporating interdisciplinary design skills, engineering standards and realistic constraints. The faculty coordinator working with several practicing design professionals provide consultation, guidance, and recommendations on aspects of preparing the construction documents required for project procurement and construction. Using the designs produced in CAE 403 the course develops the drawings, specifications and calculations required for a comprehensive construction documents package.

Prerequisite: CAE 403.

Components: LEC.

Grading: GRD.

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: Offered by Announcement Only.

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 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.

Senior Standing.

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 or CET 330. And 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 or CET 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. And CAE 330.

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 methods, failure theories, and brittle fracture.

Prerequisite: CAE 211. And CAE 310.

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 axial, flexural torsional, and composite members. Basic flexural and stiffness methods and matrix development are also included.

Prerequisite: CAE 211. And CAE 310.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

CAE 520. Advanced Design of Concrete Structures. 3 Credit Hours.

Analysis and design of reinforced concrete elements in the context of the current ACI Building Code; beams subjected to combined loading, flat plates, flat slabs, slender columns, connections, and concrete building systems are included.

Prerequisite: CAE 310. CAE 320 and senior standing.

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.

Prerequisite: CAE 310. CAE 321 and senior standing.

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.

Prerequisite: CAE 310. And 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.

Prerequisite: CAE 310. And CAE 320.

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 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: 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 storm water 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.

Prerequisite: CAE 430 or CET 430.

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.

Prerequisite: CAE 430.

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 intrusion. Ground-water flow in the unsaturated zone. Engineered systems. Introduction to contaminant fate and transport in ground water.

Prerequisite: CAE 430.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

CAE 560. Sustainable Construction. 3 Credit Hours.

Drivers and foundations of sustainable construction. Principles of sustainable construction: integrated planning and design, life-cycle view of projects, resource selection and optimization, protection of the natural environment, toxics and pollutants elimination, durability and quality. Green building assessment initiatives, green building policies, and code impacts. Evaluation of the environmental impacts of construction operations. Innovative design and construction practices. Economic viability. Subtropical and coastal issue and opportunities. Case studies.

Pre or Corequisite: CAE 403. Or CAE 404.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

CAE 570. Advanced Foundation Engineering. 3 Credit Hours.

Rock and soil formation. Subsurface exploration. Advanced design and analysis of shallow and deep foundations. Design and analysis of cofferdams.

Prerequisite: CAE 470.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

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.

Pre-Co-requisite: CAE 581.

Components: LEC.

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 595. Special Problems. 1-3 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.