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.

Disciplines
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 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 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.

Degree Programs
The Department of Civil, Architectural, and Environmental Engineering offers graduate programs leading to the degrees of:

- Master of Science in Architectural Engineering
- Master of Science in Civil Engineering
- Master of Science in Civil Engineering - Environmental Engineering emphasis
- Doctor of Philosophy in Civil Engineering
- Doctor of Philosophy in Civil Engineering - Architectural Engineering emphasis
- Doctor of Philosophy in Civil Engineering - Environmental Engineering emphasis

The specialty areas of study in Civil Engineering include:

- Structural Engineering and Structural Materials
- Environmental Engineering
- Water-Resources Engineering

The specialty areas of study in Architectural Engineering include:

- Integrated Building Systems
- MEP Systems

Admission Requirements
All applicants to the graduate program are required to submit official academic transcripts, GRE scores, and a minimum of three letters of recommendation. Specific admission criteria are described in this Bulletin under Engineering (http://bulletin.miami.edu/graduate-academic-programs/engineering) - General Admission Requirements.

Applicants who hold a bachelor’s degree in a field other than civil, architectural, or environmental engineering may be admitted to the graduate program (and to candidacy, if applicable) upon completion of (a) the regular graduate degree requirements, and (b) undergraduate deficiency courses, which include:

1. Calculus (10 credits)
2. Advanced Mathematics (6 credits)
3. General Chemistry (4 credits)
4. Calculus-based Physics (8 credits)
5. Statics (3 credits)
6. Engineering Science related to area of study (3 credits)
7. Engineering Design related to area of study (6 credits)

In general, items 1 through 7 apply to students without an undergraduate degree in engineering, and items 6 and 7 apply to students with an undergraduate degree in engineering. The student’s Program of Study committee will select courses for items 6 and 7 on an individual basis.
Research Opportunities

Civil Engineering: Current research activities include properties of concrete materials, composite structural systems, fiber-reinforced concrete, modeling and simulation of engineering materials, multi-scale modeling of materials, fracture mechanics, structural steel behavior, structural health monitoring, structural repair and rehabilitation.

Architectural Engineering: Current research activities include energy, indoor air quality, heating, ventilating and air conditioning (HVAC), environmentally compatible construction materials and systems, life-cycle building systems integration, and sustainable affordable housing.

Environmental Engineering: Current research activities include development of new physicochemical water and wastewater treatment processes, potable wastewater reuse, solid and hazardous waste management, health and environmental risks analysis, environmental/economic planning for sustainable development, hazardous waste remediation, environmental health studies, water quality studies, groundwater, surface water, and contaminant transport processes, hydrologic processed, water resources planning and management, and water policy.

Graduate Academic Standing

A student enrolled in any CAE graduate program is required to make adequate progress towards graduation, maintain a minimum Grade Point Average (GPA), and achieve acceptable course grades. Throughout their graduate study, a student’s graduate academic standing will either be Good Standing, or Probation.

Good Standing: A student’s status is considered Good Standing if he/she is:

(i) making adequate progress towards graduation,

(ii) maintaining an overall cumulative GPA greater than or equal to 3.000,

(iii) achieving a term GPA greater than or equal to 3.000 in every semester, and

(iv) achieving grades of "C" or better in all coursework.

A student who does not satisfy all of the above requirements will be placed on Probation or dismissed from the program.

Probation: A student that does not meet all of the requirements for being in Good Standing must consult with his/her Advisor and/or Supervisory Committee to review his/her progress and develop a plan to rectify the performance problems. A student will be given one semester to improve his/her performance and satisfy the requirements of Good Standing. Otherwise, the student will be dismissed from the program.

To be eligible for graduation, a student must have a minimum cumulative GPA of 3.000 and no grade below "C" in all courses in the student’s approved Program of Study. In accordance with university policy, all course grades are included in the GPA and the Graduate School’s Repeat Rule applies to courses with grades lower than "C".

Masters Programs in Civil, Architectural and Environmental Engineering

• M.S. (http://bulletin.miami.edu/graduate-academic-programs/engineering/civil-architectural-environmental-engineering/civil-engineering-ms) Civil Engineering (http://bulletin.miami.edu/graduate-academic-programs/engineering/civil-architectural-environmental-engineering/civil-engineering-ms)
• M.S. (http://bulletin.miami.edu/graduate-academic-programs/engineering/civil-architectural-environmental-engineering/architectural-engineering-ms) (http://bulletin.miami.edu/graduate-academic-programs/engineering/civil-architectural-environmental-engineering/architectural-engineering-ms)Architectural Engineering (http://bulletin.miami.edu/graduate-academic-programs/engineering/civil-architectural-environmental-engineering/architectural-engineering-ms)
• B.S./M.S. Civil Engineering Program (http://bulletin.miami.edu/graduate-academic-programs/engineering/civil-architectural-environmental-engineering/civil-engineering-bs-ms)

Doctoral Program in Civil, Architectural and Environmental Engineering

• Ph.D. in Civil Engineering Program (http://bulletin.miami.edu/graduate-academic-programs/engineering/civil-architectural-environmental-engineering/civil-engineering-phd)

CAE 604. Master's Design Project. 3 Credit Hours.
Course is taken in place of CAE 404 for students accepted to the Bachelor to Master (4+1) degree program in the CAE Department. A project elaborating on a topic from the student’s Senior Design course is the basis of the course. See CAE 403 and CAE 404 for the description of the Senior Design Project.
Prerequisite: CAE 403.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

CAE 610. 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.
Pre-requisite: CAE 211 AND CAE 310.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 611. Advanced Structural Analysis. 3 Credit Hours.
General methods of indeterminate analysis. Elements of energy methods, and matrix methods and matrix development are also included.
Pre-requisite: CAE 211 AND CAE 310.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 620. 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.
Pre-requisite: CAE 310 AND CAE 320.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.
CAE 621. 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 and CAE 321.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

CAE 622. 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.
Pre-requisite: CAE 310 AND CAE 320.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 623. 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. Archs, vaults, and buttresses are also included.
Pre-requisite: CAE 310 AND CAE 320.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 625. 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 630. 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.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

CAE 631. 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 632. Ground-Water Hydrology. 3 Credit Hours.
Prerequisite: CAE 430.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 633. 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.
Pre or Corequisite: CAE 430 and CAE 440.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 640. Environmental Chemistry. 3 Credit Hours.
Kinetics, equilibrium, acid-base, oxidation-reduction, and reaction chemistry applied to water and wastewater engineering.
Prerequisite: CHM 112.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

CAE 641. 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: Fall.

CAE 642. Solid and Hazardous Waste Engineering. 3 Credit Hours.
Solid-waste characteristics, recycling, incineration, hazardous waste character istics, prevention, and physical and chemical treatment are covered. Design projects are also included.
Prerequisite: CAE 340.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

CAE 643. 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.
Prerequisite: MAE 303 and CAE 330. Or MAE 309. Or Permission of Instructor.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.
CAE 653. 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. Prerequisite: CAE 450.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 660. Sustainable Construction. 3 Credit Hours.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 661. Computer Aided Architecture 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, embedded 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 can receive a PBA certification from Autodesk.
Requisite: Senior Status.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 670. Advanced Foundation Engineering. 3 Credit Hours.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

CAE 680. Hospital and Health Care Facility Design. 3 Credit Hours.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 681. Energy-Efficient Building Design. 3 Credit Hours.
Concepts and methods of energy-efficient and environmentally-friendly building design. Topics include energy and sustainable design strategies, climate, passive and active solar design, passive cooling systems, day lighting, and computer simulation of energy flows in buildings. A quantitative understanding of energy fundamentals, examples from practice, and design exercises using computer simulation programs are emphasized. Prerequisite: CAE 481.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

CAE 682. 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: LEC.
Grading: GRD.
Typically Offered: Spring.

CAE 690. 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 695. 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.

CAE 699. 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: GRD.
Typically Offered: Offered by Announcement Only.

CAE 702. Finite Element Methods. 3 Credit Hours.
Variational principles and their application to finite element methods. Applications to: plane stress and plane strain, three-dimensional stress analysis, bending of plates, and axi-symmetric shells. Lecture, 3 hours. Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 711. Theory of Elasticity. 3 Credit Hours.
Grading: GRD.
Typically Offered: Offered by Announcement Only.
CAE 712. Structural Reliability. 3 Credit Hours.
Basic theory and tools of structural reliability including theory of probability, statistical assessments as well as inference and model building. Topics include: review probability theory; descriptive statistics; uncertainty modeling; estimation and model building; structural reliability theory; first and second order reliability methods; Level I methods/code calibration; load combinations; Bayesian decision analysis and reliability updating.
Prerequisite: IEN 311.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 714. Structural Dynamics. 3 Credit Hours.
Elementary structural dynamic analysis covering single degree-of-freedom and multiple degree-of-freedom systems. Topics include: free, damped and forced vibrations; transmissibility and ground motion; arbitrary, step and pulse excitation; numerical evaluation; rigid and flexible bodies; natural frequencies and modes; tuned-mass dampers; responses and spectrum; practical indications as well as an introduction to wind and earthquake engineering.
Prerequisite: CAE 310.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 716. Fracture Mechanics. 3 Credit Hours.
Theory of fracture mechanics for linear elastic and nonlinear material behavior, energy release rate, stress intensity factor, and J-integral with practical application to brittle fracture and fatigue. Case studies involving civil infrastructure such as bridges, buildings, pipelines and ships. Metallurgical aspects of fatigue and fracture.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 730. Environmental Hydrology. 3 Credit Hours.
Principles of ecohdrology, agricultural hydrology, impacts of climate change, fundamentals of remote sensing and geographic information systems for hydrologic applications, statistical applications in hydrology.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 731. Wastewater Treatment and System Design. 3 Credit Hours.
Characterization of domestic wastewater and flows. Sources of wastewater and health considerations. Unit processes for treatment of wastewater including screening, sedimentation, filtration, flocculation, floatation, activated sludge, disinfection, sludge digestion, and sludge disposal.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 732. Water Treatment and System Design. 3 Credit Hours.
Drinking water treatment standards, philosophy of setting standards, public health aspects of organic and inorganic contaminants, basis for design of treatment facilities, design of unit processes for aeration, sedimentation, coagulation, filtration, softening, disinfection, and oxidation are covered. Theory of membrane processes, ion exchange, and water treatment plant residuals are also included.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 735. Water and Wastewater Engineering: Treatment and Reuse. 3 Credit Hours.
Physical treatment processes; Chemical unit processes; Advanced biological treatment processes; Sludge treatment and disposal; Industrial water supply and wastewater treatment; Membrane systems for wastewater treatment and case studies; Advanced wastewater treatment and reuse; Environmental nanotechnology
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

CAE 743. Risk Analysis. 3 Credit Hours.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 780. Indoor Environmental Modeling. 3 Credit Hours.
Prediction of indoor environment using computational fluid dynamics techniques. Advanced topics in thermal comfort and indoor air quality. Basic concepts of turbulence modeling and numerical methods for natural, forced, and mixed convection and jet flows indoors. Simulation of air velocity, temperature, and contaminant concentrations in buildings. Comparison of the simulated results with measured data.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 781. Advanced Building Energy Modeling and Simulation. 3 Credit Hours.
Equation-based object-oriented building energy modeling. Coupling of different building simulation tools. Applications in rapid prototyping of new building systems, model-based design and evaluation of building control, and building performance evaluation.
Pre-requisite: CAE 582 or CAE 682.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

CAE 790. Advanced Topics. 1-3 Credit Hours.
Subject matter offerings based upon student demand and availability of faculty. Subtitles describing the topics to be offered will be shown in parentheses in the printed class schedule, following the title “Advanced Topics”.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 792. Professional Communication Skills for Engineering Grad Students. 0 Credit Hours.
This course covers fundamental areas in professional communication for Engineering graduate students. Topic areas include: presenting research at conferences, writing manuscripts for publication, preparing the dissertation, the PhD comprehensive exams, effective teaching and mentoring, and obtaining positions in academia. Through interactive workshops, in-class exercises, brief presentations and assignments, students will have an opportunity to practice and strengthen necessary communication skills, developing collaborations, and developing effective presentation skills.
Components: MOD.
Grading: SUS.
Typically Offered: Fall & Spring.
CAE 795. Special Problems. 1-3 Credit Hours.
Research and/or design projects. Individual investigation of current problems. Offered by special arrangement only.
Components: IND.
Grading: GRD.
 Typically Offered: Offered by Announcement Only.

CAE 810. Master's Thesis. 1-6 Credit Hours.
The student working on his/her Master's thesis enrolls for credit as determined by his/her advisor. Credit is not awarded until the thesis has been accepted.
Components: THI.
Grading: SUS.
Typically Offered: Fall, Spring, & Summer.

CAE 820. Research in Residence. 1-6 Credit Hours.
Used to establish research in residence for the thesis for the Master's degree after the student has enrolled for the permissible cumulative total in CAE 810. Credit not granted. May be regarded as full-time residence.
Components: THI.
Grading: SUS.
Typically Offered: Fall, Spring, & Summer.

CAE 825. Continuous Registration--Master's Study. 1 Credit Hour.
To establish residence for non-thesis master's students who are preparing for major examinations. Credit not granted. Regarded as full-time residence.
Components: THI.
Grading: SUS.
Typically Offered: Fall, Spring, & Summer.

CAE 830. Pre-Candidacy Doctoral Dissertation. 1-12 Credit Hours.
Doctoral dissertation credits taken prior to the Ph.D. student's candidacy. The student will enroll for credit as determined by his/her advisor. Not more than 12 credit hours of CAE 830 may be taken in a regular semester, nor more than 6 credit hours in a summer session.
Components: THI.
Grading: SUS.
Typically Offered: Fall, Spring, & Summer.

CAE 840. Post-Candidacy Doctoral Dissertation. 1-12 Credit Hours.
Doctoral dissertation credits taken after the Ph.D. student has been admitted to candidacy. The student will enroll for credit as determined by his/her advisor. Not more than 12 credit hours in CAE 840 may be taken in a regular semester, nor more than 6 credits in a summer session.
Components: THI.
Grading: SUS.
Typically Offered: Fall, Spring, & Summer.

CAE 850. Research in Residence. 1 Credit Hour.
Used to establish research in residence for the Ph.D. after the student has been enrolled for the permissible cumulative total in appropriate doctoral research. Credit not granted. May be regarded as full-time residence as determined by the Dean of the Graduate School.
Components: THI.
Grading: SUS.
Typically Offered: Fall, Spring, & Summer.