CIVIL AND ARCHITECTURAL ENGINEERING

https://cae.coe.miami.edu/index.html

Dept. Code: CAE

Mission Statement

The mission of the Department of Civil and Architectural Engineering is to:

- Provide high-quality undergraduate and graduate education in civil and architectural 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.

Degree Programs

The Department of Civil and Architectural Engineering offers graduate programs leading to the degrees of:

- Master of Science in Architectural Engineering
- Master of Science in Civil Engineering
- Executive Master of Science in Construction Management
- Master of Science in Construction Management
- Doctor of Philosophy in Civil Engineering
- Doctor of Philosophy in Civil Engineering - Architectural Engineering emphasis

The specialty areas of study in Civil Engineering include:

- Structural Engineering and Structural Materials
- 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 and a minimum of three letters of reference. 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 or architectural engineering may be admitted to the graduate program (and to candidacy, if applicable) upon completion of (a) the regular graduate degree requirements, and (b) supplementary undergraduate courses to provide a strong foundation of fundamental skills necessary for the graduate program. An admitted student's Supervisory Committee will identify the undergraduate courses, which may include (but are not limited to): Calculus, Mathematics, Probability and Statistics, Chemistry, Calculus-based Physics, Statics, Engineering Science related to area of study, and Engineering Design. Examples of Engineering Science courses include Mechanics

of Materials, Fluid Mechanics, Dynamics, and Thermodynamics. Examples of Engineering Design courses include Concrete Structures, Steel Structures, Water-Resources Engineering I, and Water Quality Control Systems.

The undergraduate courses listed above apply to students without an earned undergraduate degree in engineering, while the Engineering Science and Engineering Design courses apply to students with an earned undergraduate degree in engineering, but not necessarily in civil or architectural engineering.

Additional undergraduate credits may also be warranted based upon the recommendations of a student's advisor and/or Supervisory Committee. Students should be cognizant that the course list is not exhaustive and may not necessarily include all prerequisite courses needed to enroll in their desired graduate-level coursework. A student must still satisfy the prerequisites of graduate-level courses prior to enrollment. Therefore, ample care should be taken when planning a Program of Study upon matriculation.

Prior Coursework Evaluation: Students may be exempt from individual undergraduate courses if they have already completed these credits at another institution. A student's prior coursework can be evaluated and shall be based upon a student's official transcript. A student's Supervisory Committee or delegated CAE Faculty member in the student's primary area of study shall determine which, if any, undergraduate credits are needed and may have already been satisfied. Questions regarding the equivalency of coursework (completed at another institution) to its counterpart here at the University of Miami shall be addressed by the relevant department and instructor at the University of Miami.

Prior Work Experience: In rare cases, students may be able to satisfy specific undergraduate credits if they can demonstrate a substantive knowledge of the subject area through examination using written/oral assessment and supportive evidence such as peer-reviewed journal articles authored by the student, professional licenses, or other quantifiable experience. An examination of all evidence of experience shall be vetted by the relevant instructor at the University of Miami prior to making a recommendation to the CAE Graduate Program to either waive or require undergraduate credits for a specific subject area.

Course Selection and Enrollment: Undergraduate-level courses at the University of Miami typically range between the 100 and 400 levels. The student's Advisor and/or Supervisory Committee will select courses on an individual basis. If a student has not yet selected an advisor nor established a Supervisory Committee, the Graduate Program Director shall serve as the student's advisor in the interim. The Graduate Program Director will identify coursework in consultation with a delegated faculty member in the student's area of study.

In accordance with Graduate School Policy, a student in deficiency status may not enroll in supervised research, but is permitted to enroll in graduate-level courses as long as the student has satisfied the course prerequisites.

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.

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:

1. maintaining an overall cumulative GPA greater than or equal to 3.000,
2. achieving a term GPA greater than or equal to 3.000 in every semester,
3. achieving grades of "C" or better in all coursework,
4. complying with the University of Miami's Honor Code,
5. making adequate progress towards graduation (see below for criteria), and
6. making satisfactory progress towards the completion of a dissertation or thesis (for Ph.D. and thesis-based M.S. students)

To be eligible for graduation, a student must have a GPA greater than or equal to 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".

Progress: Failure to make adequate progress towards graduation includes, but is not limited to:

- failure to maintain the GPA requirements or grades specified for Good Standing
- having Incomplete grades in more than 30% of the total credit hours registered towards the degree

- withdrawing (with a W grade) from more than 30% of the total credit hours registered towards the degree
- Failure to progress in research needed to complete a dissertation or thesis

It is the student's responsibility to provide regular updates (at least once per semester) to his/her Advisor and Supervisory Committee members, and inform them of any courses in which they withdrew (with a W grade), received grades of C or below, or received an Incomplete. A student who does not satisfy all of the above requirements (for Good Standing) may be placed on Probation or dismissed from the program.

At the request of a student's Advisor or Supervisory Committee member, or at the discretion of the Graduate Program Director, the Graduate Program Director can initiate a formal assessment of a student's progress. This assessment may include a joint meeting of the student's Supervisory Committee, the Graduate Program Director, and the student. The student will be given an opportunity to present his/her case to explain any shortcomings in his/her progress or performance. The Supervisory Committee will place the student in Good Standing, on Probation, or dismiss the student from the program.

Probation: A student who 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 (on Probation status) to improve his/her performance and satisfy the requirements of Good Standing. Otherwise, the student will be dismissed from the program.

A student on Probation may not be permitted to enroll in courses, or may be limited to a certain number of credit hours specified by the Supervisory Committee, and may have an electronic hold placed on future enrollment until grades for work-in-progress are reviewed by the student's Supervisory Committee.

Dismissal: The decision to dismiss a student shall be made by the student's Supervisory Committee. If the decision is made not to dismiss, the student may be placed on Probation. A student dismissed from the graduate program can appeal the dismissal through the Graduate Program Director, then the Department Chair, then by following the guidance provided in the Graduate School's Student Handbook. The initial appeal must be formally submitted in its entirety (including all relevant supporting documents) in writing or by email to the Graduate Program Director within 30 calendar days of the dismissal notification. A subsequent appeal to the Department Chair must also be submitted within 30 calendar days of being notified that the initial appeal was denied by the Graduate Program Director.

Masters Programs in Civil and Architectural Engineering

- M.S. Architectural Engineering (http://bulletin.miami.edu/graduate-academic-programs/engineering/civil-architectural-environmental-engineering/architectural-engineering-ms/)
- Executive M.S. in Construction Management (http://bulletin.miami.edu/graduate-academic-programs/engineering/civil-architectural-environmental-engineering/construction-management-executive-ms/)
- M.S. Civil Engineering (http://bulletin.miami.edu/graduate-academic-programs/engineering/civil-architectural-environmental-engineering/civil-engineering-ms/)
- M.S. in Construction Management (http://bulletin.miami.edu/graduate-academic-programs/engineering/civil-architectural-environmental-engineering/construction-management-ms/)

Doctoral Program in Civil and Architectural Engineering

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

Certificates

- Certificate in Construction Management (http://bulletin.miami.edu/graduate-academic-programs/engineering/civil-architectural-environmental-engineering/construction-management-certificate/)
- Certificate in Sustainable Construction (http://bulletin.miami.edu/graduate-academic-programs/engineering/civil-architectural-environmental-engineering/sustainable-construction-certificate/)

Graduate Course Grouping Convention

Graduate students may be permitted to enroll in courses offered by any department in the University of Miami. Each course is categorized into one of 8 groups:

1. Group A: 700-level lecture-based CAE Courses in civil and architectural engineering
2. Group B: 600-level lecture-based CAE courses in civil and architectural engineering
3. Group C: 600- or 700-level CAE courses in Construction Management (CM)
4. Group D: Any pre-approved course in any UM Department at the 600- or 700-level (i.e. XXX 600-799), except CAE and UMI

5. Group E: CAE Independent Study (Special Problems)
6. Group F: CAE Master's Thesis
7. Group G: CAE Master's Special Projects
8. Group H: CAE PhD Dissertation
9. Group I: Professional Development

Group A

Description: 700-level lecture-based CAE Courses in civil and architectural engineering.

Code	Title	Credit Hours
CAE 711	Theory of Elasticity	3
CAE 712	Structural Reliability	3
CAE 714	Structural Dynamics	3
CAE 716	Fracture Mechanics	3
CAE 720	Concrete Materials Science	3
CAE 729	Molecular Simulation of Materials	3
CAE 744	Risk Management and Resilience	3
CAE 762	Construction Project Management	3
CAE 780		3
CAE 782	Control Theory and HVAC Applications	3
CAE 790	Advanced Topics	1-3

Group B

Description: 600-level lecture-based CAE courses in civil and architectural engineering.

Code	Title	Credit Hours
CAE 611	Advanced Structural Analysis	3
CAE 620	Advanced Design of Concrete Structures	3
CAE 621	Advanced Design of Steel Structures	3
CAE 622	Design of Prestressed Concrete Structures	3
CAE 623	Design of Masonry Structures	3
CAE 625	Timber Structural Systems	3
CAE 630	Water Resources Engineering II	3
CAE 631	Surface-Water Hydrology	3
CAE 632	Ground-Water Hydrology	3
CAE 660	Sustainable Construction	3
CAE 661	Computer Aided Architecture Engineering Design	3
CAE 670	Advanced Foundation Engineering	3
CAE 681	Energy-Efficient Building Design	3
CAE 682	Building Energy Modeling and Simulation	3
CAE 690	Special Topics	1-3

Group C

Description: 600- or 700-level CAE courses in Construction Management (CM)

Code	Title	Credit Hours
CAE 665	Facilities Operation and Management	1-3
CAE 669	Construction Management Seminars	1
CAE 691	Special Topics in Construction Management	1-3
CAE 765	Construction Accounting and Finance	3
CAE 769	Construction Management Capstone Internship	3
CAE 791	Advanced Topics in Construction Management	1-3

Group D

Description: Any pre-approved graduate course in any UM department, except CAE and UMI.

Group E

Description: CAE Independent Study (Special Problems)

Code	Title	Credit Hours
CAE 695	Special Problems	1-3
CAE 795	Special Problems	1-3

Group F

Description: CAE Master's Thesis

Code	Title	Credit Hours
CAE 810	Master's Thesis	1-6

Group G

Description: CAE Master's Special Projects

Code	Title	Credit Hours
CAE 604	Master's Design Project	3
CAE 605	Master's Project	3

Group H

Description: CAE PhD Dissertation

Code	Title	Credit Hours
CAE 830	Pre-Candidacy Doctoral Dissertation	1-12
CAE 840	Post-Candidacy Doctoral Dissertation	1-12

Group I

Description: CAE Professional Development

Code	Title	Credit Hours
CAE 703 CAE Graduate Seminar		0-1
CAE 704 CAE Graduate Teaching		1-6

Course Descriptions

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 students 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 605. Master's Project. 3 Credit Hours.
Project in civil, architectural, and environmental engineering. Course is required for the non-thesis master's student.
Components: THI.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

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.
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 method in indeterminate analysis of axial, flexural torsional, and composite members. Basic flexural and stiffness methods and matrix development are also included.
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.
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.
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.
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. Arches, vaults, and buttresses are also included.
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.
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.
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.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 632. 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.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 660. 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.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

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.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

CAE 665. Facilities Operation and Management. 1-3 Credit Hours.
Facilities management topics based on core concepts of International Facility Management Association (IFMA) involving management of corporate needs, health, safety, security, operation and maintenance of physical facilities. This course will focus on development and understanding of sustainable facilities management responsibilities involving the building envelope, preventative maintenance, system operational efficiencies, data analytics and intelligent building systems, building security, maintenance staffing, infrastructure utility requirements as well as holistically integrated assets, people, corporate strategic planning and technology. Additionally development of skills to engage in facilities management functions which include EPA environmental / waste disposal, fleet management and statuary regulations as well as emergency management planning will be emphasized.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

CAE 669. Construction Management Seminars. 1 Credit Hour.
Seminar series on construction management required for all students in the construction Management MS program. The faculty coordinator will set up a series of weekly Seminars on topics such as risk management, construction safety, environmental conservation and policy, conflict resolution, ethics, quality control and construction permitting. Speakers will include leading researchers and specialists from the construction industry. Grades will be based on reports submitted by the students on the seminar topics.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

CAE 670. 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.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

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.
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.
Pre-Co-requisite: CAE 681 or 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 691. Special Topics in Construction Management. 1-3 Credit Hours.
Sub-titles describing the topics to be offered in Construction Management's Special Topics will be shown in parenthesis, 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 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 703. Seminars in Civil and Architectural Engineering. 1 Credit Hour.
Weekly seminar series on current topics in civil and architectural engineering presented by alumni, professionals, and academics. Oral presentations by current CAE graduate students is also included.
Components: SEM.
Grading: SUS.
Typically Offered: Fall & Spring.

CAE 704. Graduate Teaching. 1-3 Credit Hours.
Teaching or assisting in a course with a substantial level of instructional responsibility. Only open to doctoral students. Professional development workshops will be optional.
Graduate student standing. Permission of instructor.
Components: EXP.
Grading: SUS.
Typically Offered: Fall, Spring, & Summer.

CAE 711. Theory of Elasticity. 3 Credit Hours.
Analysis of stress, strain, and displacement in elastic solids. Basic equations of elasticity. Two-dimensional solutions of beams and other problems in rectangular and polar coordinates. Torsion of bars. Energy methods. Selected topics. Lecture, 3 hours.
Components: LEC.
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.
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.
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 720. Concrete Materials Science. 3 Credit Hours.
This course will cover the materials science and chemistry of cementitious materials. The following topics will be covered: cement, supplementary cementitious materials, cement hydration, cement hydrates, characterization techniques, chemical admixtures, properties of concrete, concrete durability. There are four main objectives of this course: understand the materials science and chemistry of cementitious materials in some depth, understand how the materials science and chemistry can be integrated into students' research (current/future), become familiar with performing literature survey, understand how to critique publications, and improve writing and presentation skills.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 729. Molecular Simulation of Materials. 3 Credit Hours.
Students will learn the theoretical framework, computational tools, and analysis techniques necessary to simulate, analyze, and understand the behavior of nanostructured materials or molecular systems. Through a hands-on team-based final project, students will have the opportunity to apply the knowledge learned to an application of their interest. Major topics include interatomic interactions, molecular dynamics simulations, statistical thermodynamics, Monte Carlo simulations, free energy methods, and coarse-grained modeling.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 743. Risk Analysis. 3 Credit Hours.
Probabilistic risk assessment, Poisson processes, Bayesian methods, fault trees, contaminant transport models, and dose-response relationships for assessment of natural and technological risks.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 744. Risk Management and Resilience. 3 Credit Hours.
Introduction to Risk Management, and Resilience. Topics include: Hazards Risk Management, Risk Management for the Private Sector, Hazard Risk Management Approach, Mitigation Planning, Forming Partnerships and Involving the Public, Establishing Context for Risk Management, Identifying Hazards. Scope Vulnerability and Understand Capacity, Analyze and Assess Risk, Identify and Assess Risk Reduction Measures, Financing Risk Reduction.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

CAE 761. Building Information Modeling II. 3 Credit Hours.
The course prepares students to utilize the predictive capabilities Building Information Modeling (BIM) technology in the Architecture, Engineering, and Construction (AEC) Industry. Continuing from the fundamental lessons of CAE 361 BIM I, this course prepares students for in depth modeling of engineering systems within AEC projects. Modeling of Structural, Mechanical, Electrical and Plumbing systems will be covered. Using the BIM of these systems to predict the system performance will be covered in the form of analytical modeling and detailed energy modeling.
Components: LAB.
Grading: GRD.
Typically Offered: Spring.

CAE 762. Construction Project Management. 3 Credit Hours.
This course is designed to provide a practical background and working knowledge of how Construction Projects are developed and managed through professional Program Management. Elements consisting of Program Organization, Program and Project conception, Project planning, Scoping, effective project communication strategies, budgeting, scheduling, controls, resource and cost management and behaviors of the Program Manager to lead. The Project Management Body of Knowledge (PM BoK) guide relating to scope, time, cost, quality and other knowledge areas for planning and control of projects throughout their entire lifecycle. This course will also explore various applications that use construction project management software such as Primavera, eBuilder, etc. as interactive platform tools. Key leadership skills and managerial styles needed to effectively build, manage, and lead a successful project team.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

CAE 765. Construction Accounting and Finance. 3 Credit Hours.
This course will Investigate the theory and practice of financing large projects. Insights into the logic of capital structure decisions – the mix of debt and equity, the choices among debt alternatives, private/public partnerships - will require an understanding of financial theory and an investigation of the relevant literature will be conducted. Accounting techniques will be reviewed that will provide students with a toolset for performing financial analyses in the construction industry. Finally, case projects will be evaluated by the class and decisions made regarding project viability using the tools presented during the course.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

CAE 766. Forensic Engineering. 3 Credit Hours.
Objective of the course is to introduce students into the field of forensic engineering. This course is designed to provide background and working knowledge of how forensic engineering projects are initiated and managed from the engineer's and attorney's perspectives. Various elements required in a forensic investigation project from condition assessment to expert report preparation and expert testimony will be covered. The role of the forensic engineering expert will be explained from the view of the engineer and from the attorney. By engaging student in the group project assignment, in which he/she is dealing with real-life examples (defects), and by participating in a mock mediation and deposition/trial, by the end of this course the student will be equipped with knowledge allowing her/him to better deal with a real life situations.
Requisite: Graduate Standing.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

CAE 769. Construction Management Capstone Internship. 3 Credit Hours.
The Construction Management Capstone Internship is taken during the final semester of study in the MS in construction management program at location of attending student. It is designed to reinforce the knowledge and skills acquired during the program of study via an industry internship opportunity which is arranged between a student, a faculty coordinator and an industry collaborator identified by the student and approved by the coordinating faculty. The industry collaborator in coordination with faculty coordinator will guide the student through the steps in planning, coordination and execution of the acquired theoretical knowledge from earlier courses into a real industry work environment. The course will provide students experience in the use of various project management tools. Interaction and written as well as oral communication with the team members will also provide experience in solving complex and strategic issues that often arise on actual construction projects. A comprehensive internship report will be due at the end of semester which will be graded by the faculty coordinator in consultation with the industry partners.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

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.
Prerequisite: CAE 582. Or CAE 682.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

CAE 782. Control Theory and HVAC Applications. 3 Credit Hours.
The course focuses on classical control theory and its applications on HVAC systems and covers the model of dynamic physical systems, closed loop control systems, dynamic analysis in the time domain, and classical control system design approach using the root locus method
Prerequisites: CAE 581 Or CAE 681.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

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 791. Advanced Topics in Construction Management. 1-3 Credit Hours.
Sub-titles describing the topics to be offered in Construction Management's Special Topics will be shown in parenthesis, in the printed class schedule following the title, "Special Topics."
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

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.
Academic Plan Code: CENR_PHD.
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.
Milestone: CANDID and Academic Plan Code: CENR_PHD.
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.