CIVIL, ARCHITECTURAL, AND ENVIRONMENTAL ENGINEERING (CAE)

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 (Surveying). 1 Credit Hour.
Hands on application of various surveying instruments. Leveling, angles and distance measurements.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

CAE 210. Mechanics of Solids I. 3 Credit Hours.
Vectors, force systems, equilibrium, analysis of frames, machines, trusses for internal forces, friction, centroids, moment of inertia, and shear and bending moment diagrams are discussed.
Prerequisite: Engineering Program - PHY 205 And MTH 151 Or 161 Or 171. Non-Engineering Program - PHY 101 Or 103 Or 160 Or 201 And MTH 130 Or 141 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 IEN 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 240. Environmental Pollution. 3 Credit Hours.
Exploration of contemporary environmental issues. Introduction to engineering approaches for protecting and cleaning up the environment, techniques for assessing the impact of human activity on the environment, strategies for pollution control and implementation of environmental mitigation measures.
Requisite: Sophomore Standing or Higher.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

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

CAE 313. Behavior of Structural Systems II. 3 Credit Hours.
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 206.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.
CAE 340. Introduction to Environmental Engineering. 3 Credit Hours.
Environmental mass and energy balances, introduction to environmental chemistry, air pollution, water pollution, sustainable solid waste management, risk assessment, and global atmospheric change are discussed.
Prerequisite: MTH 162, and CHM 111 or CHM 151.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

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

CAE 350. Transportation Engineering I. 3 Credit Hours.
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: LAB.
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: ENG 107. And IEN 311. And Corequisite: CAE 370.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

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

CAE 381. Building Mechanical Systems I: Hvac Fundamentals. 3 Credit Hours.
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. Not for graduate credit or for baccalaureate graduation credit. Subject and credit to be arranged with the instructor.
Components: THI.
Grading: GRD.
Typically Offered: Spring.

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

CAE 400. Preparation for FE Exam. 1 Credit Hour.
Review of material in preparation for the Fundamentals of Engineering (FE) examination. For credit only.
Requisite: Senior Status.
Components: LEC.
Grading: CNC.
Typically Offered: Offered by Announcement Only.

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.
Requisite: Senior Status.
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 - Construction 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 440. Water Quality Control Systems. 3 Credit Hours.
Physical, Chemical and Biological Transformations; Water and Wastewater Treatment Processes; Water Treatment Plant Design; Wastewater Treatment Plant Design; Case Studies
Prerequisite: CAE 330. And CAE 340.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

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

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

CAE 470. Foundations and Earth Retaining Systems. 3 Credit Hours.
Natural soil deposits and subsoil exploration. Geotechnical analysis and design of shallow and deep foundations. Theories of lateral earth pressure. Design and analysis of earth-filled retaining systems.
Prerequisite: CAE 330. 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.
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. And CAE 320.
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. And CAE 321.
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.
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.
Prerequisite: CAE 430.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 533. Water-Quality Control in Natural Systems. 3 Credit Hours.
Water quality regulations, fate and transport processes, water-quality control in rivers, lakes, wetlands, oceans, and ground water.
Pre or Corequisite: CAE 430. And CAE 440.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 540. Environmental Chemistry. 3 Credit Hours.
Kinetics, equilibrium, acid-base, oxidation-reduction, and reaction chemistry applied to water and wastewater engineering.
Prerequisite: CHM 112.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

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

CAE 542. Solid and Hazardous Waste Engineering. 3 Credit Hours.
Solid-waste characteristics, recycling, incineration, hazardous waste characteristics, prevention, and physical and chemical treatment are covered. Design projects are also included.
Prerequisite: CAE 340.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 543. Air Pollution Control Engineering. 3 Credit Hours.
Fundamentals of air pollution and air quality; properties and control of particulates, volatile organic compounds, carbon monoxide, sulfur oxides, and nitrogen oxides; motor vehicle emissions; health and aesthetic effects (acid rain, visibility), laws and regulations, meteorology and pollutant transport in the atmosphere; indoor air pollution.
Prerequisite: MAE 303. And CAE 330. Or MAE 309.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

CAE 560. Sustainable Construction. 3 Credit Hours.
Pre or Corequisite: CAE 403. Or CAE 404.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.
CAE 561. Computer Aided Architectural Engineering Design. 3 Credit Hours.
The course prepares students to utilize Building Information Modeling (BIM) and Building Performance Analysis (BPA) in a coordinated, integrated and consistent approach in the Architecture, Engineering and Construction (AEC) Industry. The basics of high-quality 5 dimensional BIM modeling are covering including 3D modeling of buildings and building components, imbedded cost-estimating and the phasing the construction process. Basics of REVIT Structure and MEP are also covered. BPAC components covered include climate analysis, daylighting, wind and airflow analysis, solar radiation analysis and whole building energy analysis. Upon completion student will receive a PBA certification from Autodesk.
Requisite: Junior Status or Permission of Instructor.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

CAE 570. Advanced Foundation Engineering. 3 Credit Hours.
Prerequisite: CAE 470.
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.

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 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.
Prerequisite: 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 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 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.
Prerequisite: 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.
Prerequisite: 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. Arches, vaults, and buttresses are also included.
Prerequisite: 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 characteristics, 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.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

CAE 660. Sustainable Construction. 3 Credit Hours.
Pre or Corequisite: CAE 403. Or CAE 404.
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. BPA 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: 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 statutory regulations as well as emergency management planning will be emphasized.
Components: LEC.
Grading: GRD.
Typically Offered: 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.
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. 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. Pre-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 691. Special Topics in Construction Management. 1-3 Credit Hours.
This interdisciplinary project based course is focused on addressing site specific, regionally relevant construction problems. The topics may include environmentally adaptable solutions to most geographic locations worldwide and built to incorporate a variety of "sub-systems" such as renewable energy power sources, a net-zero water recycling system, integrated food production as well as use of innovative material and construction method options. Through research and innovation approaches, this course will inspire collegiate students to become the next generation of building science professionals who are prepared to meet the growing imperative for environmentally responsive and highly resilient building designs. Specifically, this course will help provide future architects, engineers, construction managers, and entrepreneurs with the skills and experience needed to fully integrate sustainability and building science into ultra-efficient buildings that are cost-effective and meet the design constraints of the mainstream building industry.

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 711. Theory of Elasticity. 3 Credit 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.
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 ecohydrology, 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 744. Risk Management and Resilience. 3 Credit Hours.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

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: Fall & Spring.
CAE 769. Construction Management Capstone Course. 3 Credit Hours.
The Construction Management Capstone Project is taken during the final semester of study in the MS in construction management program. It is
designed to reinforce the knowledge and skills acquired during the program of study via a simulated construction project. The faculty coordinator will
pair student teams with industry partners who will guide them through the steps in planning, coordination and execution of a building project. The
course will provide students experience in the use of various project management tools in a virtual setting. Site visits and interaction with the project
members will also provide experience in solving complex and strategic issues that often arise on actual construction projects. A comprehensive
project 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 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.
Prerequisite: 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 791. Advanced Topics in Construction Management. 1-3 Credit Hours.
This interdisciplinary project based course is focused on addressing complex site specific, regionally relevant construction problems. The course
may follow CAE 691 taken during an earlier semester or expand on topic(s) investigated by a different student enrolled in CAE 691 during the same
semester. The topics may include environmentally adaptable solutions to most geographic locations worldwide and built to incorporate a variety of
“sub-systems” such as renewable energy power sources, a net-zero water recycling system, integrated food production as well as use of innovative
material and construction method options. Through research and innovation approaches, this course will inspire collegiate students to become the
next generation of building science professionals who are prepared to meet the growing imperative for environmentally responsive and highly resilient
building designs. Specifically, this course will help provide future architects, engineers, construction managers, and entrepreneurs with the skills
and experience needed to fully integrate sustainability and building science into ultra-efficient buildings that are cost-effective and meet the design
constraints of the mainstream building industry
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.
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.