CIVIL, ARCHITECTURAL, AND ENVIRONMENTAL ENGINEERING

Alumni Memorial Hall, Suite 228
3201 S. Dearborn St.
Chicago, IL 60616
312.567.3540
caee@iit.edu
iit.edu/caee

Chair
Brent Stephens

Faculty with Research Interests
For information regarding faculty visit the Department of Civil, Architectural, and Environmental Engineering website.

Civil engineering is the oldest engineering profession. Since ancient times, civil engineers have played a vital role in designing, building, and maintaining the infrastructure that makes societies work. That role is even more important today; more than half of the world's population lives in cities and our aging, urban infrastructure is badly in need of repair and replacement. To prepare our graduates to deal with these challenges, the Department of Civil, Architectural, and Environmental Engineering at Illinois Institute of Technology offers degree programs in architectural engineering, civil engineering, and engineering management.

Architectural engineers focus on buildings. In collaboration with architects and engineers from other disciplines, they design and build structures with an eye on energy use, environmental impacts, human health, economics, and sustainability. Architectural engineering requires knowledge of architectural design; electrical, mechanical, and plumbing systems; structural engineering; and construction management.

Civil engineers work on infrastructure projects. Examples include highways, railroads, water supply and treatment systems, airports, waterways, tunnels, and buildings. Focus areas within civil engineering include structural engineering, geotechnical engineering, transportation engineering, construction engineering and management, and environmental engineering. In all cases, civil engineers work to design infrastructure that protects human and environmental health, uses resources wisely, and improves quality of life.

Engineering management professionals bring new ideas into products and services in any field of engineering. At Illinois Institute of Technology, the engineering management degree combines engineering, project management, business planning, and entrepreneurship. The engineering concentration can be in architectural, biomedical, chemical, civil, computer, electrical, or mechanical engineering.

Our undergraduate programs in CAEE provide students with a breadth of knowledge in infrastructure engineering subjects, depth of understanding in theory, and hands-on applications in professional practice. In response to the growing demand for advanced degrees, all of these programs are designed to fit into Illinois Institute of Technology's co-terminal and accelerated degree programs, which makes it possible for students to complete both a bachelor's and master's degree in as few as five years. Undergraduates who satisfy the grade point average requirement can apply to the co-terminal program as early as their fourth semester.

Our central location in Chicago provides our students with access to an extraordinary range of opportunities. Students have the opportunity to explore one of the world's great cities and the historical and cultural heart of America's architecture, engineering, and construction (AEC) industry. Our students seek and obtain internships as early as their first summer, and many are able to work part-time in engineering firms downtown while completing their final years of study. Others gain experience conducting research alongside graduate students and faculty members in CAEE. Our faculty members include a combination of research- and teaching-focused professors and adjunct professors with years of industry experience.

Degree Programs

- Bachelor of Science in Architectural Engineering
- Bachelor of Science in Civil Engineering
- Bachelor of Science in Engineering Management

Accelerated Master's Options

The Department of Civil, Architectural, and Environmental Engineering also offers several master's degrees that can be taken via the university's Accelerated Master's Program. For more information, please view the CAEE Department's graduate programs.

Minors

- Minor in Building Systems Engineering
- Minor in Construction Management
- Minor in Engineering Graphics and CAD
- Minor in Environmental Engineering
- Minor in Graphics and CAD for Non-Engineers
- Minor in Railroad Engineering
- Minor in Structural Engineering
- Minor in Sustainability
- Minor in Transportation Engineering

Course Descriptions

CAE 100
Introduction to Engineering Drawing and Design
Introduction to engineering graphics as a problem-solving tool. Basic traditional techniques of orthographic projection, multi-view, pictorial, auxiliary views, dimensioning and tolerance, sectioning, detail drawing. Use of ANSI standards; applications in civil, architectural, and engineering design.
Lecture: 1 **Lab:** 2 **Credits:** 2
Satisfies: Communications (C)

CAE 101
Introduction to AutoCAD Drawing and Design
A continuation of CAE 100. Use of PC-based CAD (Computer-Aided Drawing and Design) software for presentation and problem solving in civil and architectural engineering applications. Introduction to basic principles of design.
Prerequisite(s): CAE 100
Lecture: 1 **Lab:** 2 **Credits:** 2
Satisfies: Communications (C)

CAE 105
Surveying
Surveying and related tools and skills needed to design, build, and maintain infrastructure. Study of leveling, traversing, topographic mapping, route surveying, earthwork computation, photogrammetry, and 3D lidar. Practice in the use of auto levels, tapes, total stations, global position systems (GPS), geographic information systems (GIS), and computer-based methods in surveying.
Prerequisite(s): CAE 100*, An asterisk (*) designates a course which may be taken concurrently.
Lecture: 1 **Lab:** 3 **Credits:** 2

CAE 110
Professional Practice I
This course is an introduction to the engineering profession. The content and delivery have been designed to challenge the student's perspective of oneself and thus make the student a better engineer. The class focus is on developing the skills to become a professional learner and a successful student, increasing team learning skills, self-reflection, enhancing ethical perception and decision making abilities, and understanding the responsibilities as an engineer. In simple terms, the student will begin to "act as an engineer acts."
Lecture: 1 **Lab:** 0 **Credits:** 1

CAE 111
Professional Practice II
This course continues the introduction to the engineering profession with further studies of team learning, specializations in engineering, enhancing ethical perception and decision making abilities, and understanding the responsibilities as an engineer. The course also looks deeply at the need for continuous innovation by studying and practicing the entrepreneurial mindset needed to create value for oneself as the student, for one's company, and for society. In simple terms, the student will begin to "act as an engineer acts" and "think like an entrepreneur thinks."
Lecture: 1 **Lab:** 0 **Credits:** 1

CAE 208
Thermodynamics
Basic principles of thermodynamics applied to engineering systems using pure substances and mixtures as working fluids. Direct application of the laws of thermodynamics to analysis of closed and open systems, mass and energy flow. Extensive analysis of isentropic processes in cycles and analysis of gas mixtures.
Prerequisite(s): ((CHEM 122 and CHEM 123) or CHEM 124) and (MATH 152 and PHYS 123)
Lecture: 3 **Lab:** 0 **Credits:** 3

CAE 209
Fluid Mechanics and Heat Transfer
Introduction to fluid mechanics and analysis of fluid statics problems. Introduce and develop heat and mass transfer analysis techniques. Description and analysis of fluid kinematics, energy and momentum equations applied to internal/external flow in building engineering systems. Development and application of convection, conduction and radiation to one-, two- and three-dimensional systems in steady state and transient regimes of operation as applied to building materials and geometries.
Prerequisite(s): CAE 208 and (MATH 252* or CAE 320), An asterisk (*) designates a course which may be taken concurrently.
Lecture: 3 **Lab:** 0 **Credits:** 3

CAE 221
Engineering Geology
Geology and its relationship to civil engineering; minerals; rocks; soil formation; geologic structure; groundwater hydraulics; frost action in soils, landslides, shoreline erosion, bluff instability; earthquakes; air photo interpretation, soil and rock mechanics in relation to engineering geology; subsurface exploration; dams, reservoirs, tunnels; case-history illustrations.
Lecture: 2 **Lab:** 2 **Credits:** 3

CAE 286
Theory and Concept of Structural Mechanics
Equilibrium for particles and rigid bodies. Distributed forces, centroids, centers of gravity, and moments of inertia. Free body diagrams. Application to truss structures. Kinetics of particles: Newton's Laws of motion, energy, and momentum. Kinematics of particles.
Prerequisite(s): PHYS 123 and MATH 152
Lecture: 3 **Lab:** 0 **Credits:** 3

CAE 287
Mechanics of Structural Materials
The concepts of deformation, strain, and stress. Application of free body diagram in shear force and bending moment diagram. Elementary bending theory, normal and shear stresses in beams, and beam deflection. Axially loaded members and Euler buckling theory. Plane stress and strain, Mohr's circle, and torsion of circular sections. Combined loading.
Prerequisite(s): CAE 286
Lecture: 3 **Lab:** 0 **Credits:** 3

CAE 302
Fluid Mechanics
Fundamental concepts; fluid properties; fluid statics; fluid kinematics; mass, energy, and momentum concepts; dimensional analysis; laminar and turbulent flow in closed conduits; flow in open channels; turbo machinery; drag forces; fluid measurement.
Prerequisite(s): MATH 252* and (CAE 286 or MMAE 200), An asterisk (*) designates a course which may be taken concurrently.
Lecture: 3 **Lab:** 0 **Credits:** 3

CAE 303
Steel Structures I
Introduction to and discussion of Load and Resistance Factor Design and Allowable Stress Design, as well as their applicable load combinations, resistance factors and factors of safety as applied to steel structures – and their relationships with underlying concepts of structural behavior. Analytical study of steel materials subjected to various states of stress. Failure theories, yield and post-yield criteria. Design of tension members, columns, and beams, and simple connections for steel structures.
Prerequisite(s): CAE 287 and CAE 304 and CAE 315*, An asterisk (*) designates a course which may be taken concurrently.
Lecture: 3 **Lab:** 0 **Credits:** 3
Satisfies: CAE Design Course (D)

CAE 304
Structural Analysis I
The analysis of statically determinate trusses and frames. Determination of internal forces and calculation of deflections. Application of the principle of virtual work and energy methods. Column stability.
Prerequisite(s): MATH 252 and CAE 287
Lecture: 3 **Lab:** 0 **Credits:** 3

CAE 307
Concrete Structures I
Introduction to the design and underlying behavior of concrete structures. Proportioning of concrete mix designs, and fresh and hardened properties of concrete. Experimental and analytical study of plain and reinforced concrete subjected to various states of stress. Design loads, factors of safety, load and resistance factors. Failure theories and the ultimate strength of plain and reinforced concrete beams. Detailing of reinforcing bars.
Prerequisite(s): CAE 287 and CAE 304 and CAE 315
Lecture: 3 **Lab:** 0 **Credits:** 3
Satisfies: Communications (C), CAE Design Course (D)

CAE 312
Engineering Systems Analysis
Systems concept process, interest rate, present and future worth values, evaluation of alternatives, and elements of microeconomics. Theory of probability, laws of probabilities, random variables and distribution functions, functions of random variables, statistical estimations of data, mean and standard deviation, correlation, and regression analysis.
Prerequisite(s): MATH 251
Lecture: 3 **Lab:** 0 **Credits:** 3

CAE 315
Materials of Construction
Physical principles of elastic and plastic deformation of construction. Mechanical testing methods including tensile, compressive, toughness, creep and fatigue. Properties of concrete, wood, iron and steel and other construction materials. The emphasis is on concepts from solid mechanics which explain the behavior of materials to the extent needed in the design of load-bearing constructs.
Prerequisite(s): CAE 287
Lecture: 3 **Lab:** 0 **Credits:** 3
Satisfies: Communications (C)

CAE 323
Introduction to Geotechnical Engineering
Physical and mechanical properties of soil; elementary principles of soil identification and testing. Principles of soil permeability and seepage, consolidation, failure theories, earth pressures, and bearing capacity. Laboratory included.
Prerequisite(s): (CAE 287 and CAE 302*) or CAE 209*, An asterisk (*) designates a course which may be taken concurrently.
Lecture: 2 **Lab:** 3 **Credits:** 3
Satisfies: Communications (C)

CAE 331
Building Science
Study of the physical interactions between buildings, people, and climate (i.e., temperature, humidity, wind, sun, rain, snow, etc.). Topics include: heat transfer, psychrometrics, thermal comfort, indoor air quality, ventilation, infiltration, solar insolation, heating and cooling load calculations, building energy efficiency, and building codes.
Prerequisite(s): (CAE 208 or (MMAE 320 and CAE 209)) and (CAE 302 or MMAE 313)
Lecture: 3 **Lab:** 0 **Credits:** 3

CAE 383
Electrical and Electronic Circuits
Introduction to electrical and electronic circuits. AC and DC steady state and transient network analysis. Phasors, AC and Three Phase Power. Diodes, transistors, and operational amplifiers.
Prerequisite(s): MATH 252 and PHYS 221
Lecture: 2 **Lab:** 2 **Credits:** 3

CAE 401
Hydraulics, Hydrology, and Their Applications
Collection and distribution of water. Flow of fluids through orifices, weirs, venturi meters. Laminar and turbulent flow in closed conduits. Open channel flow. Model analysis using the principles of dimensional analysis. Rainfall and runoff.
Prerequisite(s): MATH 252*, An asterisk (*) designates a course which may be taken concurrently.
Lecture: 2 **Lab:** 3 **Credits:** 3

CAE 402
Introduction to Environmental Engineering and Sustainable Design
This course provides an overview of how environmental engineers integrate biological, chemical, and physical sciences with engineering design methods to develop solutions to environmental problems. Topics include air pollution, water pollution, solid waste management, fate and transport of contaminants, pollution prevention, environmental regulation, risk assessment, climate science, and sustainability assessment. Focuses on applications and actual design practice.
Prerequisite(s): MATH 152 and CHEM 124
Lecture: 3 **Lab:** 0 **Credits:** 3
Satisfies: CAE Design Course (D)

CAE 405
Applications of Computational Fluid Dynamics in Engineering
The course introduces concepts of computational fluid dynamics (CFD) and focuses on engineering applications of CFD. Students will learn how to use CFD tools to model internal and external flows in a wide range of architectural, chemical, civil, and mechanical engineering applications. Projects offer students flexibility in selecting their applications. Example semester long projects include design of room air distribution systems, indoor and outdoor air quality, natural ventilation, heat transfer coefficient calculations, pipe flow, rotating reference frame, and more.
Lecture: 3 **Lab:** 0 **Credits:** 3

CAE 408
Bridge and Structural Design
Design of modern bridges, bridge design requirements, LRFD approach, seismic and wind effects, fatigue in bridges, support design.
Prerequisite(s): CAE 431*, An asterisk (*) designates a course which may be taken concurrently.
Lecture: 3 **Lab:** 0 **Credits:** 3
Satisfies: CAE Design Course (D)

CAE 410
Introduction to Wind and Earthquake Engineering
Kinematics of Particles, Newton's laws of motion, energy and momentum. Kinematics of rigid bodies. Fundamentals of free, forced, and transient vibration of single and multi-degree of freedom structures. Analysis and design of structures for wind and earthquake loadings. Building code requirements. Instructor's consent may be granted to students who do not meet the prerequisite.
Prerequisite(s): CAE 411*, An asterisk (*) designates a course which may be taken concurrently.
Lecture: 3 **Lab:** 0 **Credits:** 3

CAE 411
Structural Analysis II
The analysis of statically indeterminate frames. Application of classical methods including superposition, slope deflection, and moment distribution. Introduction to the direct stiffness method and computer analysis of structures.
Prerequisite(s): CAE 304 or Graduate standing
Lecture: 3 **Lab:** 0 **Credits:** 3

CAE 412
Traffic Engineering Studies and Design
Basic traffic engineering studies including traffic volume, speed, accident, and parking studies. Capacity and analysis for various traffic facilities. Design of traffic control devices.
Lecture: 3 **Lab:** 0 **Credits:** 3
Satisfies: CAE Design Course (D)

CAE 415
Pavement Design, Construction and Maintenance
Pavement types, stresses in flexible and rigid pavements, vehicle pavement interaction. Mathematical models for pavement systems, sub grade support, design of flexible and rigid pavements. Construction procedure, drainage considerations, environmental effects. Rehabilitation and maintenance of pavements.
Prerequisite(s): CAE 323 or Graduate standing
Lecture: 3 **Lab:** 3 **Credits:** 4

CAE 416
Facility Design of Transportation Systems
Design and analysis of facilities of transportation systems. Integration of select transportation components and their interrelationships. Design of specific facilities: guide ways, terminals, and other elements for railroads, airports, and harbors.
Lecture: 3 **Lab:** 0 **Credits:** 3
Satisfies: CAE Design Course (D)

CAE 417
Railroad Engineering and Design
History of railroad industry. Train operation, train make-up, and handling. Design and analysis of railroad track structure, track irregularities, and their representation. Vehicle/track interaction and dynamic problems associated with it. Performance of railway vehicles.
Lecture: 3 **Lab:** 0 **Credits:** 3
Satisfies: CAE Design Course (D)

CAE 419
Introduction to Transportation Engineering and Design
Highway functions, design controls and criteria, element of design, cross-section elements, local roads and streets, at-grade intersections, grade separation and interchanges, highway capacity analysis, and introduction to pavement management.
Lecture: 3 **Lab:** 0 **Credits:** 3
Satisfies: CAE Design Course (D)

CAE 421
Risk Assessment Engineering
Description and concept of risk, relationship between the likelihood of loss and the impact of loss, engineering hazards assessment and risk identification and evaluation using fault tree analysis, failure mode and effect analysis, etc., risk analyses applications with practical statistics.
Lecture: 3 **Lab:** 0 **Credits:** 3

CAE 422
Sprinklers, Standpipes, Fire Pumps, Special Suppression, and Detection Systems
Review and introduction to fluid dynamics applied to sprinklers, standpipes, fire pumps, and special suppression systems; hydraulic design criteria and procedures for sprinklers requirements, standpipes, fire pumps, special suppression systems, and detection and alarm systems using nationally recognized design (National Fire Protection Association) standards, water supply requirement systems and distributions.
Prerequisite(s): CAE 209 or CAE 302 or Graduate standing
Lecture: 3 **Lab:** 0 **Credits:** 3

CAE 424
Introduction to Fire Dynamics
Introduction to fire, physics and chemistry, and mass and heat transfer principles, fire fluid mechanic fundamentals, fundamentals and requirements of the burning of materials (gases, liquids, and solids), fire phenomena in enclosures such as pre-flashover and post-flashover.
Prerequisite(s): CAE 209 or Graduate standing
Lecture: 3 **Lab:** 0 **Credits:** 3

CAE 425
Fire Protection and Life Safety in Building Design
Fundamentals of building design for fire and life safety. Emphasis on a systematic design approach. Basic considerations of building codes, fire loading, fire resistance, exit design, protective systems, and other fire protection systems.
Lecture: 3 **Lab:** 0 **Credits:** 3

CAE 430
Probability Concepts in Civil Engineering Design
Introduction to probability, modeling, and identification of nondeterministic problems in civil engineering. Development of stochastic concepts and simulation models and their relevance to design and decision problems in various areas of civil engineering.
Prerequisite(s): MATH 252 or Graduate standing
Lecture: 3 **Lab:** 0 **Credits:** 3
Satisfies: CAE Design Course (D)

CAE 431
Steel Structures II
Additional topics in the design of steel structures and study of how the behavior of members and the overall structural system inform the design of the structure. Design of typical steel frame systems, as well as composite floor construction and plate girders. Design of bolted and welded connections.
Prerequisite(s): CAE 303
Lecture: 3 **Lab:** 0 **Credits:** 3
Satisfies: CAE Design Course (D)

CAE 432
Concrete Structures II
Behavior and design of reinforced concrete beams and columns. Serviceability requirements for reinforced concrete beams. Behavior and design of reinforced concrete foundations – topics include anchor bolts, spread footings, pile caps, and retaining walls.
Prerequisite(s): CAE 307
Lecture: 3 **Lab:** 0 **Credits:** 3
Satisfies: CAE Design Course (D)

CAE 433
Repair of Existing Building Structures
Building repair and retrofit issues are discussed. Specific requirements of a building for repair and/or reconstruction are emphasized. Methods of assessing building conditions, including forensic structural engineering are covered. Repair and strengthening methods based on types of materials (steel, concrete, masonry, timber), occupancy and function (residential, commercial), and building values are covered along with demonstration case studies and illustrative examples.
Prerequisite(s): CAE 432 and CAE 431
Lecture: 3 **Lab:** 0 **Credits:** 3

CAE 435
Experimental Analysis of Structures
The analysis of structures (prototypes) with the aid of models constructed from metal, wood, plastics, and other materials. Geometrical, mathematical, demonstration, graphical and direct and indirect models will be treated. Comparisons of experimental results with results from computer models will be made. Similitude and the theory of models will be treated. Individual and group project work will be emphasized.
Prerequisite(s): (CAE 304 and CAE 411) or Graduate standing
Lecture: 2 **Lab:** 2 **Credits:** 3

CAE 436
Design of Masonry and Timber Structures
Design of unreinforced and reinforced masonry structural elements and structures. Serviceability and ultimate capacity design. Seismic response, resistance, and design. Design of wood columns and bending members. Mechanical fasteners and connectors. Instructor's consent may be granted to students who do not meet the prerequisite.
Prerequisite(s): CAE 307 or Graduate standing
Lecture: 3 **Lab:** 0 **Credits:** 3
Satisfies: CAE Design Course (D)

CAE 437
Homeland Security Concerns in Engineering Systems
Review of blast effects produced by solid phase weapons and their effects on structures and people. Estimation of the risk of threats to security of public and private systems and facilities. Review of simplified structural methods for the analysis and design of structures to meet homeland security concerns and procedures to minimize casualties. Analysis of post-attack fires and how to prevent them. Examination of potential risk to security of infrastructure systems. Development of contingency plans to include evacuation preparedness at time of emergency.
Lecture: 3 **Lab:** 0 **Credits:** 3

CAE 438
Control of Building Environmental Systems
Introduction to automatic control systems. Control issues related to energy conservation, indoor air quality and thermal comfort in buildings. Classification of HVAC control systems. Control systems hardware: selection & sizing of sensors, actuators & controllers. Practical HVAC control systems; elementary local loop and complete control systems. Case studies. Computer applications.
Prerequisite(s): CAE 331 or CAE 513 with min. grade of C or MMAE 322
Lecture: 3 **Lab:** 0 **Credits:** 3

CAE 439
Introduction to Geographic Information Systems
Geographic information system (GIS) technology allows databases which display and query information in new ways. This course will teach general GIS and GPS skills and concepts, useful to students and practitioners in a variety of disciplines. Students will complete a final GIS project relevant to their field of study. This hands-on class will use ESRI's Arc View and Spatial Analyst products, as well as Trimble GeoExplorer GPS units.
Lecture: 3 **Lab:** 0 **Credits:** 3

CAE 453
Measurement and Instrumentation in Architectural Engineering
Hands-on experience with energy and indoor air quality measurements in buildings including experimental design, data analysis, and experimental statistics. Measurements and techniques covered include: thermal performance (e.g., thermal conductivity and resistance, heat flux, and temperature); fluid flows and HVAC characteristics (e.g., velocity, pressure, and airflow); energy performance (e.g., current, voltage, and power draw); whole building diagnostics (e.g., blower door and duct blaster); and indoor air quality (e.g., tracer gas techniques for air exchange, particle measurements, and gas measurements). Course combines lectures and field measurements in buildings on campus.
Prerequisite(s): CAE 331
Lecture: 3 **Lab:** 0 **Credits:** 3

CAE 454
Building Commissioning
This course introduces students to the fundamentals and practice of building commissioning and prepares students for the Building Commissioning Professional (BCxP) Certification Exam. Building commissioning is an integrated process of quality assurance (QA), quality control (QC), and communications that is utilized to ensure that all of its systems, including mechanical, electrical, lighting, plumbing, fire protection, acoustical, and controls, perform interactively and according to the design intent. Building commissioning also ensures that building operators are prepared to operate and maintain its systems and equipment, which saves time, money, and energy, and improves the sustainability and resilience of buildings. This course is open to all majors that have familiarity with buildings and their systems.
Prerequisite(s): CAE 331 or INTM 407 or (ARCH 403 and ARCH 404)
Lecture: 3 **Lab:** 0 **Credits:** 3

CAE 457
Geotechnical Foundation Design
Methods of subsoil exploration. Study of types and methods of design and construction of foundations for structures, including single and combined footings, mats, piles, caissons, retaining walls, and underpinning. Drainage and stabilization.
Prerequisite(s): CAE 323 or Graduate standing
Lecture: 3 **Lab:** 0 **Credits:** 3
Satisfies: CAE Design Course (D)

CAE 461
Plumbing and Fire Protection Design
Study of plumbing systems, water supply, and venting systems. Study of fire protection systems for buildings including pipe sizing, pumps, sprinklers, gravity and pressure vessels, and controls.
Prerequisite(s): CAE 302 or CAE 209 or MMAE 313 or Graduate standing
Lecture: 3 **Lab:** 0 **Credits:** 3
Satisfies: CAE Design Course (D)

CAE 462
Introduction to Sustainable Building Design
This course introduces students to the fundamentals and practice of sustainable building design and certification. The core of the course is fundamental training in modern passive building, including building science fundamentals, calculations, and design strategies for a conservation first methodology. Students will be prepared to take the written and design portions of the Certified Passive House Consultant (Phius CPHC) examination. Green building certification and rating systems will be explored and their impacts on the design and construction of buildings discussed. Students will engage with the requirements of these standards in depth in preparation for the professional work environment. This course is open to all majors with interest in buildings, their systems and the sustainability and resilience of the built environment.
Lecture: 3 **Lab:** 0 **Credits:** 3
Satisfies: CAE Design Course (D)

CAE 463
Building Enclosure Design
Design of building exteriors, including the control of heat flow, air and moisture penetration, building movements, and deterioration. Study of the principle of rain screen walls and of energy conserving designs. Analytical techniques and building codes are discussed through case studies and design projects.
Prerequisite(s): CAE 331 or Graduate standing
Lecture: 3 **Lab:** 0 **Credits:** 3
Satisfies: CAE Design Course (D)

CAE 464
HVAC Systems Design
Study of the fundamental principles and engineering procedures for the design of heating, ventilating, and air conditioning systems; HVAC system characteristics; system and equipment selection; duct design and layout. Attention is given to energy conservation techniques and computer applications.
Prerequisite(s): CAE 331 or CAE 513
Lecture: 3 **Lab:** 0 **Credits:** 3
Satisfies: CAE Design Course (D)

CAE 465
Energy Conservation in Buildings
Introduction to both theory and hands-on applications in building energy conservation and energy efficiency in buildings new and old. Analyzing energy consumption patterns in buildings. Understanding building rating systems and measures to design and operate energy efficient buildings. Use of building energy simulation tools to predict energy consumption of building energy end-uses. Calibration of building energy models. Energy retrofit strategies and parametric design. Visualize and analyze building performance data.
Prerequisite(s): CAE 331 or CAE 513
Lecture: 3 **Lab:** 0 **Credits:** 3
Satisfies: CAE Design Course (D)

CAE 466
Building Electrical/Lighting Systems Design
Study of the analysis and design of electrical systems in buildings utilizing the National Electric Code. Topics include AC, DC, single-phase and three-phase circuits, transients, branch circuits, panel boards, system sizing, fault calculations and overcurrent protection design. Also studies the design and specification of emergency power backup and alternative power systems.
Prerequisite(s): CAE 383 or (ECE 216 and ECE 215)
Lecture: 3 **Lab:** 0 **Credits:** 3

CAE 467
Lighting Systems Design
An intensive study of the calculation techniques and qualitative aspects of good luminous design. Topics covered include: photometric quantities and color theory, visual perception, standards, daylight and artificial illumination systems, radiative transfer, fixture and lamp characteristics, control devices, and energy conservation techniques. Design problems, field measurements, computer, and other models will be used to explore major topics.
Lecture: 3 **Lab:** 0 **Credits:** 3

CAE 468
Architectural Design
Architectural Design is the first of a two-part sequence of architectural design and planning for architectural engineers. Students learn the basic theory and practice of the architectural design process from the architect's perspective. Topics include the logical process of architectural design development, integration of code requirement, design approach, and architectural presentation techniques taught through lecture and lab instruction.
Lecture: 2 **Lab:** 2 **Credits:** 3

CAE 470
Construction Methods and Cost Estimating
The role of estimating in construction contract administration. Types of estimates. Unit costs and production rates; job costs. Preparing bid for complete building project using manual methods and the CSI format; checking quantity take-off and cost estimating in selected divisions using a computer package.
Lecture: 3 **Lab:** 0 **Credits:** 3
Satisfies: Communications (C), CAE Design Course (D)

CAE 471
Construction Planning and Scheduling
Planning, scheduling, and progress control of construction operations. Critical Path Method and PERT. Resource leveling of personnel, equipment, and materials. Financial control/hauling of construction projects. Impact of delay on precedence networks. Construction contract administration. Computer applications.
Lecture: 3 **Lab:** 0 **Credits:** 3
Satisfies: CAE Design Course (D)

CAE 472
Construction Site Operation
Construction site layout and mobilization. Liabilities of the parties. Methods of construction. Concrete form design and fabrication. Scaffolding, temporary facilities, and equipment. Safety on sites. Introduction to construction productivity.
Lecture: 3 **Lab:** 0 **Credits:** 3

CAE 473
Construction Contract Administration
Characteristics of the construction industry. Project delivery systems. Duties and liabilities of the parties at the pre-contract stage. Bidding. Contract administration including duties and liabilities of the parties regarding payments, retainage, substantial and final completion, scheduling and time extensions, change orders, changed conditions, suspension of work, contract termination, and resolution of disputes. Contract bonds. Managing the construction company. Labor law and labor relations.
Lecture: 3 **Lab:** 0 **Credits:** 3

CAE 474
Introduction to Building Information Modeling
Fundamentals and practical use of information technologies in design; basic concepts of building information modeling (BIM); review of software and technology available for BIM; practical use of BIM in design for creating a site, viewing a model, starting a project, working in the AutoDesk "Revit" Environment, adding basic building elements to a project, conceptual energy analysis, designing a preliminary layout, and presenting a project.
Lecture: 3 **Lab:** 0 **Credits:** 3

CAE 482
Hydraulic Design of Open Channel Systems
Uniform flow design; backwater profiles in natural streams; gradually varied flow practical problems; spatially varied flow; flow through nonprismatic and nonlinear channels; gradually varied unsteady flow; rapidly varied unsteady flow; flood routing; numerical solutions of open channels.
Lecture: 3 **Lab:** 0 **Credits:** 3
Satisfies: CAE Design Course (D)

CAE 486
Soil and Site Improvement
Theory of water flow through porous media. Site improvement techniques including grading and drainage, dewatering, reinforcement, and slurry trenches. Soil improvement techniques including replacement, in situ compaction, preloading and subsurface drainage, grouting, freezing, prewetting, and heating.
Prerequisite(s): CAE 323 or Graduate standing
Lecture: 3 **Lab:** 0 **Credits:** 3

CAE 491
Undergraduate Research
Special research problems in civil and architectural engineering under individual supervision of instructor. Seminar presentation is required. (Credit: Variable; maximum 4 credit hours). Prerequisite: Senior standing, minimum GPA of 3.0, and consent of the instructor.
Credit: Variable

CAE 495
Capstone Senior Design
A group project requiring the integration of multiple engineering disciplines to satisfy client requirements for a real engineering project. Students will be required to demonstrate mastery in the application of numerous engineering disciplines to a project, work as a member of an integrated engineering team, and demonstrate the ability to understand and communicate engineering solutions to a client verbally, visually, and in written form. Course is required to satisfy ABET program objectives.
Lecture: 2 **Lab:** 3 **Credits:** 3
Satisfies: Communications (C), CAE Design Course (D)

CAE 496
Fundamentals of Engineering Preparation
Review of the materials covered in the Fundamentals of Engineering (FE) Examination. Demonstrations of solution methods, practice problems and practice exams, and strategies for preparing for and taking the FE examination. Senior and Graduate students only.
Lecture: 0 **Lab:** 0 **Credits:** 0
Satisfies: Ethics (E)

CAE 497
Special Project
Special design project under individual supervision of instructor. Prerequisite: Senior standing, minimum GPA of 3.0, and consent of instructor.
Credit: Variable

EG 225
Engineering Graphics for Non-Engineers
Designed for students in business, liberal arts and non-technical programs. Basic drafting techniques and applications, lettering, geometric constructions, charts and graphs, technical sketching, multiview projection, pictorial drawings, dimensioning, blueprint reading and working drawings. Introduction to computer graphics. Credit for this course is not applicable to an engineering degree.
Lecture: 2 **Lab:** 1 **Credits:** 3

EG 305
Advanced Engineering Graphics and Design
Advanced study of auxiliary views and sectioning, gears and cams, threads and fasteners, working drawings, assembly drawings, electronic drafting, ANSI drafting standards, and computer-aided drawing and design. Engineering design project.
Prerequisite(s): CAE 101 or MMAE 232
Lecture: 2 **Lab:** 1 **Credits:** 3

EG 306
Engineering Descriptive Geometry
Graphic solutions of problems involving point, line, and plane relationships by auxiliary views and revolutions. Developments and intersections of surfaces. Parallelism and perpendicularity, vectors, mining and civil engineering applications. Shades and shadows, conics, map projection and spherical triangles. Emphasis on applications which promote visualization and introduce new engineering experiences. Applications of computers to problem solving.
Prerequisite(s): CAE 101 or MMAE 232
Lecture: 2 **Lab:** 2 **Credits:** 3

EG 325
Advanced Engineering Graphics for Non-Engineers
Threads and fasteners, sectioning and auxiliary views, limit dimensioning, detail and assembly drawings, data representation, principles of descriptive geometry, manufacturing processes and computer graphics/CAD. Credit for this course is not applicable to an engineering degree.
Prerequisite(s): EG 225
Lecture: 2 **Lab:** 1 **Credits:** 3

EG 329
Graphic Representation for Non-Engineers
Basic techniques of graphics applied to communications and report writing. Use of computer graphics to generate charts and graphs including line charts, two- and three-dimensional bar charts, and pie charts. Integration of graphical presentations into technical and business reports. Credit for this course is not applicable to an engineering degree.
Prerequisite(s): EG 225
Lecture: 3 **Lab:** 0 **Credits:** 3

EG 405
Mechanical Design Graphics
Basic concepts of mechanical design and analysis. Advanced design layouts, details, assemblies, tolerance systems, surface finish control, materials, processes, ANSI drafting standards, engineering design processes, systems and procedures, application of computers to design, and CAD/CAM. Requires junior standing.
Prerequisite(s): EG 305
Lecture: 2 **Lab:** 2 **Credits:** 3

EG 406
Technical and Pictorial Illustration
Theory and construction of parallel and perspective pictorial projections, axonometric and oblique projections, parallel and angular perspective. Exploded pictorial assemblies. Basic rendering techniques used in technical illustration. Introduction to computer-generated pictorials. Requires junior standing.
Prerequisite(s): CAE 101 or MMAE 232
Lecture: 2 **Lab:** 2 **Credits:** 3

EG 409
Computer-Generated Pictorial Projections
Study of computer-generated representations of three-dimensional objects. Projections include multiview, perspective, axonometric (isometric, dimetric, and trimetric), and oblique.
Prerequisite(s): EG 406
Lecture: 2 **Lab:** 2 **Credits:** 3

EG 419
Computer Graphics in Engineering
Techniques of PC-based (AutoCAD) computer-aided drawing and design. Study of computer graphic hardware and software systems through demonstrations and use. Both 2D and 3D representation of components and assemblies from various engineering disciplines. Requires junior standing.
Prerequisite(s): CAE 101 or MMAE 232
Lecture: 2 **Lab:** 2 **Credits:** 3

EG 425
Computer Graphics for Non-Engineers
Principles and applications of computer graphics in business and nontechnical fields. Study of computer graphics hardware and software systems. Use of computer in producing charts, graphs, and technical drawings. Use of PC-CAD in problem solving and design. Credit for this course is not applicable to an engineering degree. Requires junior standing.
Prerequisite(s): EG 325
Lecture: 2 **Lab:** 1 **Credits:** 3

EG 429
Computer Graphics for Desktop Publishing
Integration of computer graphic-generated images into technical and business reports produced with popular desktop publishing software. Emphasis on creation and selection of graphical presentations for optimum readability. Scanning and retouching techniques for two- and three-dimensional presentations. Introduction to multi-media and slide presentations. Credit for this course is not applicable to an engineering degree. Junior standing required.
Prerequisite(s): EG 329
Lecture: 2 **Lab:** 2 **Credits:** 3

EG 430
Introduction to Building Information Modeling
Fundamentals and practical use of information technologies in design; basic concepts of building information modeling (BIM); review of software and technology available for BIM; practical use of BIM in design for creating a site, viewing a model, starting a project, working in the AutoDesk "Revit" Environment, adding basic building elements to a project, conceptual energy analysis, designing a preliminary layout, and presenting a project.
Lecture: 3 **Lab:** 0 **Credits:** 3

EG 497
Special Problems
Special problems. Requires junior standing.
Credit: Variable

EMGT 363
Creativity, Inventions, and Entrepreneurship for Engineers and Scientists
This course will introduce students to theories, processes, and best practices that invoke creativity, innovation, inventions, and entrepreneurship in engineers and scientists to create a patentable technology by the end of the semester. Skills will be developed in understanding and searching for patents, learning and applying brainstorming, team learning, exploring deep needs, market and industry analysis, finding "white space," and creating effective elevator pitches for your idea. Students will learn to support and pitch the need, uniqueness of their approach, cost versus benefits, competition, and alternatives so their ideas can take advantage of the exponential economy.
Lecture: 3 **Lab:** 0 **Credits:** 3

EMGT 406
Entrepreneurship and Intellectual Property Management
This course intends to introduce and develop a number of diversified professional skills necessary for success in an engineering research and development environment. Selected topics in the areas of technology entrepreneurship, opportunity assessment, creativity and innovation, project management, management of organizational change, and entrepreneurial leadership are discussed. Significant effort is placed on understanding and managing intellectual property.
Lecture: 3 **Lab:** 0 **Credits:** 3

EMGT 470
Project Management
Introduction and practice of project form of organization for accomplishing tasks in engineering firms. Develops the attributes required of a project manager. Introduction to project management form most appropriate for engineering tasks, evaluating projects for funding, establishing planning, budgeting, and initiation process, extensive analysis of scheduling techniques, resource allocation during scheduling, monitoring project progress, the project control cycle, avoiding scope creep, auditing projects and completion of the project. The case study method is used throughout the class to provide students experiential-learning opportunities. This class cannot be substituted for courses in the construction management major in CAEE.
Lecture: 3 **Lab:** 0 **Credits:** 3

ENVE 201
Earth Environ Sci
This course introduces students to the fundamentals of earth and environmental science. Topics include: earth systems science; geologic processes, soils, and minerals; global tectonics and earthquakes; environmental systems and biogeochemical cycles; land resources and agriculture; renewable and nonrenewable energy; water resources and water pollution; air pollution; solid waste; climate alteration and global climate change; and environmental sustainability.
Prerequisite(s): CHEM 122 or CHEM 124
Lecture: 3 **Lab:** 0 **Credits:** 3

ENVE 401
Introduction to Water Resources Engineering
The theory and practice involved in planning and design of water systems are introduced in this course. Topics include hydraulics, hydrology, storm water management, water supply distribution, and waste water collection and transport systems. Hydraulics includes flow of fluids through orifices, weirs, venturi meters, laminar and turbulent flow in closed conduits, open channel flow. Hydrology includes rainfall, runoff, and collection and distribution of water. Model analysis using the principles of dimensional analysis and software applications.
Prerequisite(s): CAE 302 or CAE 209 or MMAE 313 or CHE 301
Lecture: 3 **Lab:** 0 **Credits:** 3
Satisfies: CAE Design Course (D)

ENVE 402
Introduction to Environmental Engineering and Sustainable Design
This course provides an overview of how environmental engineers integrate biological, chemical, and physical sciences with engineering design methods to develop solutions to environmental problems. Topics include air pollution, water pollution, solid waste management, fate and transport of contaminants, pollution prevention, environmental regulation, risk assessment, climate science, and sustainability assessment. Focuses on applications and actual design practice.
Prerequisite(s): CHEM 124 or (MATH 152 and CHEM 123 and CHEM 122)
Lecture: 3 **Lab:** 0 **Credits:** 3
Satisfies: CAE Design Course (D)

ENVE 403
Occupational and Environmental Health and Safety
This course is intended to introduce students to the basics of occupational and environmental safety and health. Topics include fundamental principles in industrial hygiene and occupational and environmental safety based in the anticipation, recognition, evaluation, and control of chemical, biological, physical, and ergonomic hazards that can be encountered in the workplace and other settings. Applications include indoor air pollution control, natural disaster mitigation, and infectious disease transmission and control. Understanding of basic chemistry and elementary statistics is recommended.
Lecture: 3 **Lab:** 0 **Credits:** 3

ENVE 404
Water and Wastewater Engineering
Water quality and water supply issues make up this course including the physical, chemical, and biological processes involved in water treatment. Process design, operations, and management are also considered.
Prerequisite(s): ENVE 402 or CAE 402
Lecture: 3 **Lab:** 0 **Credits:** 3

ENVE 422
Global Environmental Change and Sustainability Analysis
This course introduces students to concepts of global biogeochemistry and environmental sustainability, including the practice of life cycle assessment (LCA). The course begins with an overview of the global energy, water, carbon, and nitrogen cycles and their relationships to human activities. The focus then shifts to LCA, which is an analytical approach for quantifying the relationships between economic activities and environmental issues. LCA is often used to develop sustainability metrics to compare alternative approaches to meet economic needs such as transportation, food provision, and building construction. This course is open to all majors with familiarity in basic chemistry, but students will be expected to conduct quantitative analyses and perform basic engineering calculations.
Prerequisite(s): (CHEM 122 and CHEM 123) or CHEM 124
Lecture: 3 **Lab:** 0 **Credits:** 3

ENVE 423
Geoenvironmental Engineering
This course provides students with a comprehensive understanding of global geoenvironmental challenges. Subject matter includes interactions between soils, rocks, groundwater, and contaminants; issues related to hazardous and non-hazardous waste management; contaminated site remediation; and the principles of sustainable development. Essential topics include (1) geoenvironmental problems and the need for geoenvironmental engineering, (2) the fundamental background needed to understand and address geoenvironmental problems, (3) management of wastes through engineered landfills and impoundments, (4) characterizing, assessing, and remediating contaminated sites, (5) beneficial use of waste and recycled materials, and (6) incorporating sustainability in waste management and pollution control. By the end of the course, students will be equipped with the fundamental knowledge and practical skills to address and resolve a range of geoenvironmental issues.
Prerequisite(s): ENVE 201
Lecture: 3 **Lab:** 0 **Credits:** 3
Satisfies: CAE Design Course (D)

ENVE 444
Carbon Capture, Utilization, and Storage
To address the climate impacts of anthropogenic sources of carbon dioxide (CO2), it has become increasingly important to focus on solutions for CO2 removal processes, especially directly from CO2 emission sources. Carbon capture and sequestration/storage (CCS) is the process of capturing CO# formed during power generation and other industrial processes and sequestering it so that it is not emitted into the atmosphere. CCS technologies have significant potential to reduce CO2 emissions in energy systems. This course will review and explore, in detail, the engineering design principles for solutions of carbon capture at the source or direct air capture (DAC) from the atmosphere, utilization, and storage. Topics include an overview of the importance current and future potential of CCS and other technologies such as direct air capture; power generation fundamentals related to carbon emissions and our reliance on fossil energy; current state of research and development on carbon capture technologies; storage, monitoring, and utilization of CO2; CO2 transportation (e.g., pipeline and marine modes); and economics of technologies for removing CO2 from the atmosphere and additional methods of reducing CO2 concentrations and other greenhouse gases in the atmosphere.
Lecture: 3 **Lab:** 0 **Credits:** 3
Satisfies: CAE Design Course (D)

ENVE 463
Introduction to Air Pollution Control
Air pollution sources and characteristics of source emissions, atmospheric reactions, effects of pollutants, and techniques of emission control are presented in this course. Legal and administrative aspects of air pollution control are also described.
Prerequisite(s): ENVE 402 or CAE 402
Lecture: 3 **Lab:** 0 **Credits:** 3

ENVE 476
Engineering Control of Industrial Hazards
Design of control systems to enhance occupational safety and health; how to recognize and control existing or potential safety and health hazards.
Prerequisite(s): ENVE 426*, An asterisk (*) designates a course which may be taken concurrently.
Lecture: 3 **Lab:** 0 **Credits:** 3

ENVE 485
Industrial Ecology
This course provides an overview of industrial ecology, the study of the science and engineering relationships between cultural and ecological systems, and how those relationships can be managed to achieve a more sustainable economy. Because it is an interdisciplinary field, topics include technology (science and engineering), public policy and regulatory issues, and business administration.
Lecture: 3 **Lab:** 0 **Credits:** 3

ENVE 495
Environmental Capstone Design
This is a project-based course requiring the integration of multiple disciplines to satisfy client requirements for a real environmental engineering design project. By completing this course, students are expected to demonstrate that they can work in multidisciplinary teams to solve an environmental problem; design an environmental engineering system that includes considerations of risk, uncertainty, sustainability, life-cycle principles, and environmental impacts; and communicate an environmental design in written reports, drawings, and oral presentations.
Lecture: 2 **Lab:** 3 **Credits:** 3
Satisfies: CAE Design Course (D), Ethics (E)

ENVE 497
Special Project
Special design project under individual supervision of instructor. Consent of instructor is required.
Credit: Variable