Civil, Materials, and Environmental Engineering (CME)

Courses

CME 112. Evolution of Infrastructure and Society. 3 hours.
Evolution of infrastructure and its interaction with US society. Examples include development of transportation systems, water infrastructure, electrical grid, structural and geotechnical technology. Ethical and societal implications of new systems. Course Information: Field trips required at a nominal fee. Prerequisite(s): ENGL 160; or consent of the instructor. US Society course.

CME 119. Introduction to Environmental Engineering and Science. 3 hours.
Polution and the environment. Impact of human economic activity on the environment. Principles of environmental engineering and science with application to natural and engineered environmental systems. Course Information: Prerequisite(s): Consent of the instructor.

CME 197. Introduction to Civil and Environmental Engineering. 0 hours.
Introduction to careers in civil and environmental engineering, introduction to business practice in civil and environmental engineering, professional ethics and challenges currently faced by the civil and environmental engineering profession. Course Information: Satisfactory/Unsatisfactory grading only. All CME freshmen and transfer students will be required to take course during the first year of enrollment at UIC.

CME 201. Statics. 3 hours.
Analysis of forces, equilibrium of two- and three-dimensional structures, frames and machines. Friction, centroids, virtual work and energy. Course Information: Prerequisite(s): MATH 181 and PHYS 141.

CME 203. Strength of Materials. 3 hours.
Relationships between the stresses and strains within a deformable body. Axially loaded members, torsion and the bending of bars. Stress transformation equations. Column theory. Course Information: Prerequisite(s): CME 201.

CME 205. Structural Analysis I. 3 hours.
Analysis of trusses, beams and frames. Classical methods and analysis with microcomputers. Displacements, shear and bending moments, influence lines. Course Information: Prerequisite(s): CME 203.

CME 207. Engineering Probability and Economics. 3 hours.
Principles of probability in civil and environmental engineering; theories and principles of economics in civil and environmental engineering; managerial decision making techniques for design and construction of projects. Course Information: Prerequisite(s): MATH 181.

CME 211. Fluid Mechanics and Hydraulics. 3 hours.
Covers the basic fluid mechanics topics of statics and kinematics, with emphasis on civil engineering aspects of open channel hydraulics and pipe flow. Course Information: Prerequisite(s): CME 201. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture.

CME 215. Hydraulics and Hydrology. 3 hours.
Hydraulics of pipe flow, open channel flow and hydraulic machinery. Ground water and surface water hydrology. Course Information: Prerequisite(s): ME 211. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture-Discussion.

CME 260. Properties of Materials. 3 hours.
Introduction to the relationships between composition and microstructure; correlation with physical and mechanical behavior of metals, ceramics, and polymers. Manufacturing methods. Service performance. Materials selection. Course Information: Credit is not given for CME 261 if the student has credit for CME 261. Prerequisite(s): CHEM 122 and CHEM 123, and PHYS 141, and MATH 181.

CME 261. Materials for Manufacturing. 2 hours.
Introductory-level course in materials engineering to familiarize students with relationships between processing, structure and properties of materials used to manufacture devices. Course Information: Same as ME 261. Credit is not given for CME 261/ME 261 if the student has credit for CME 260. Prerequisite(s): CHEM 122 and CHEM 123, and PHYS 141, and MATH 181.

CME 290. Engineering Surveying. 2 hours.
Horizontal and vertical distance measurement, angles and direction, traverses, errors, control and construction surveys, coordinate systems, land records, and coordinate geometry, office and field practice. Course Information: Prerequisite(s): MATH 181; or consent of the instructor. Class Schedule Information: To be properly registered, students must enroll in one Lecture-Discussion and one Discussion and one Laboratory.

CME 297. Civil and Environmental Engineering Drawing and Design. 3 hours.
Manual and computer-aided drawing and drafting principles for civil and environmental engineering practice. Application of building information modeling in civil and environmental engineering professional practice. Course Information: Prerequisite(s): ENGL 160. Interested students not enrolled in a degree program in the College of Engineering shall obtain permission from the instructor.

CME 300. Composition and Properties of Concrete. 2 hours.
Properties and types of cements and aggregates, hydration, mix design, properties of fresh and hardened concrete. Course Information: Prerequisite(s): Credit or concurrent registration in CME 203. Class Schedule Information: To be properly registered, students must enroll in one Discussion/Recitation and one Laboratory.

CME 301. Behavior and Design of Metal Structures. 3 hours.
Design of metal structures, behavior of members and their connections, theoretical, experimental and practical basis for proportioning members. Course Information: Prerequisite(s): CME 205.

CME 302. Transportation Engineering. 3 hours.
Fundamentals of transportation engineering. Design, operations and planning of transportation systems of various technologies, emphasizing road and public transit. Course Information: Extensive computer use required. Field trips and computer laboratory required. Prerequisite(s): CS 107 or CS 109. Class Schedule Information: Students outside the stated restrictions may be admitted with the consent of the instructor. To be properly registered, students must enroll in one Laboratory and one Lecture-Discussion.
CME 310. Design of Reinforced Concrete Structures. 3 hours.
Analysis and design of reinforced concrete structural elements: beams, slabs, columns, and foundations. Use of current ACI 318 building code. Course Information: Prerequisite(s): CME 205 and credit or concurrent registration in CME 300.

CME 311. Water Resources Engineering. 3 hours.
Principles of water-resources engineering including hydrologic processes and frequency analysis; fluids mechanics applied to closed conduits and open channels; groundwater engineering; urban water distribution. Laboratory experiments. Course Information: Extensive computer use required. Prerequisite(s): CME 211. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture-Discussion.

CME 315. Soil Mechanics and Laboratory. 4 hours.
Soil formation, phase relationships, index properties and soil classification, soil composition, soil compaction, water in soils, stresses in soils, consolidation, shear strength, soils laboratory. Course Information: Prerequisite(s): CME 203 and CME 211. Class Schedule Information: To be properly registered, students must enroll in one Laboratory-Discussion and one Lecture-Discussion.

CME 322. Environmental Engineering. 3 hours.
Environmental engineering and design for water and waste problems. Interactive effects of man-made projects on resources and the environment. Course Information: Previously listed as CME 216. Prerequisite(s): CHEM 112; and credit or concurrent registration in CME 211. Class Schedule Information: To be properly registered, students must enroll in one Laboratory-Discussion and one Lecture-Discussion.

CME 359. Mechanical Vibrations. 3 hours.
Free and forced vibrations of damped linear single and multiple degree of freedom systems. Approximate methods, instrumentation, and applications. Course Information: Same as ME 308. Prerequisite(s): CS 109; and ME 210; and MATH 220.

CME 391. Civil and Materials Engineering Practicum. 1 hour.
Provides students with the opportunity to apply the skills and knowledge gained in previous engineering courses within a professional, working environment. Course Information: Satisfactory/Unsatisfactory grading only. May be repeated. A maximum of 1 hour awarded toward degree requirements. Prerequisite(s): Approval of the Department.

CME 392. Undergraduate Research. 1-3 hours.
Research and indepth study of a subject of interest under the close supervision of a faculty member. A report is required. Course Information: Prerequisite(s): Senior standing.

CME 394. Undergraduate Seminar. 1-3 hours.
Students conduct an indepth study of areas of engineering of special interest to them which will be presented to the class in a seminar format. Course Information: Prerequisite(s): Senior standing.

CME 396. Civil Engineering Systems Design. 2 or 3 hours.
Introduction to design process and methodologies. Aspects of civil engineering project management and the deterministic and probabilistic design methods. Professional Verbal and Written Communication. Preparation of senior design projects. Course Information: Prerequisite(s): Students who will be graduating any time during the next calendar year are eligible to enroll.

CME 400. Advanced Design of Reinforced Concrete Structures. 3 or 4 hours.
Design of reinforced concrete building structures, including design for lateral loads due to wind, structural systems for reinforced concrete buildings, shear walls, and design for seismic forces. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): CME 310 or the equivalent.

CME 401. Advanced Design of Metal Structures. 3 or 4 hours.
Plate girders: unsymmetrical bending; torsion of thin-walled structures; lateral-torsional instability; composite construction. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): CME 301.

CME 402. Geometric Design of Highway Facilities. 3 or 4 hours.
Elements of geometric design. Driver, vehicle and roadway system characteristics. Horizontal and vertical alignment design. Intersection design and operation. Capacity and level of service. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): CME 302.

CME 403. Hydraulic Design. 3 or 4 hours.
Groundwater hydraulics, movement, recharge and well design; migration and drainage; design of dams, spillways and turbines; wave and coastal engineering design. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): CME 311.

CME 404. Railroad Track Engineering. 3 hours.
Railroad track engineering concepts including track components, response of track to wheel loads, design and analysis of railroad tracks, construction, evaluation, and maintenance of railroad tracks, load distribution, and track substructures. Course Information: Prerequisite(s): CME 315; or consent of the instructor. Recommended Background: Basic knowledge of strength of materials, soil mechanics, and structures.

CME 405. Foundation Analysis and Design. 3-4 hours.
Site characterization; analysis and design of shallow foundations, deep foundations and earth retaining structures; foundations on difficult soils; effects of construction; instrumentation and monitoring. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): CME 315.

CME 406. Bridge Design I. 3 or 4 hours.
Theory and design procedures related to the analysis and design of modern bridges. Using the AASHTO Code, includes concrete and steel structures, construction practices and procedures. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): CME 301 and CME 310.

CME 407. Soil and Site Improvement Methods. 3 or 4 hours.
Compaction, preloading, vertical drains, grouting, admixture stabilization, thermal stabilization, soil reinforcement, geosynthetics; construction of embankments on soft clay, embankments on mechanically stabilized earth walls, hydraulic barriers; case studies. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): CME 318.

CME 408. Traffic Engineering and Design. 3 or 4 hours.
Highway Traffic control with an emphasis on highway capacity analysis and Traffic Signal Design. Queuing theory, traffic flow theory, corridor management, and Traffic Safety. Course Information: 3 undergraduate hours. 4 graduate hours. Extensive computer use required. Field work required. Prerequisite(s): CME 302 or consent of the instructor.

CME 409. Structural Analysis II. 3 or 4 hours.
Approximate analysis of structures including trusses and multistory frames. Influence lines, cables and arches. Principles of limit analysis for structures and structural elements. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): CME 205 or consent of the instructor.
CME 410. Design of Prestressed Concrete Structures. 3 or 4 hours.
Principles of prestressed concrete. Analysis and design of statically
determinate prestressed concrete members. Introduction to design and
detailing of connections. Course Information: 3 undergraduate hours. 4
graduate hours. Prerequisite(s): CME 310.

CME 411. Chemistry for Environmental Professionals. 3 hours.
Introductory atmospheric chemistry, aspects of air pollution, chemistry
related to natural water and water treatment; priority organic pollutants
and heavy metals. Course Information: Same as EOHS 440.
Prerequisite(s): One year of college chemistry.

CME 413. Design of Wood Structures. 3 or 4 hours.
Covers the properties and behavior of wood as a structural material;
the focus will be on the analysis of structural wood elements. Course
Information: 3 undergraduate hours. 4 graduate hours.
Prerequisite(s): CME 301; or CME 310; or consent of the instructor.

CME 414. Design of Masonry Structures. 3 or 4 hours.
Material characteristics of masonry as an engineering material, design
of masonry members subjected to axial loads, bending, combined axial
and bending loads, design of masonry shear walls, and design of multi-
story masonry buildings. Course Information: 3 undergraduate hours.
4 graduate hours.
Prerequisite(s): CME 301; or CME 310; or consent of the instructor.

CME 415. Environmental Geotechnology. 3 or 4 hours.
Environmental laws and regulations, sources and types of waste
materials, waste materials in geotechnical engineering applications,
geotechnical management of municipal, industrial, mine and nuclear
wastes. Course Information: 3 undergraduate hours. 4 graduate hours.
Prerequisite(s): CME 315.

CME 419. Structural Loads Determination. 3 or 4 hours.
Loads applied to buildings and other structures. Live and dead loads.
Snow, wind, earthquake and flood loads. Historical overview of loading
standards and current loading standards. Course Information: 3
undergraduate hours. 4 graduate hours.
Prerequisite(s): CME 310; or consent of the instructor.

CME 420. Water and Wastewater Analysis Laboratory. 0-4 hours.
Laboratory class for environmental engineering. Analysis of water,
wastewater and soil for nutrients, pollutants, physical parameters and
biological parameters. Course Information: 3 undergraduate hours. 4
graduate hours.
Prerequisite(s): CME 216; or graduate standing. Class
Schedule Information: To be properly registered, students must enroll in
one Laboratory-Discussion and one Lecture-Discussion.

CME 421. Water Treatment Design. 3 or 4 hours.
Water quality control systems. Physical-chemical unit processes applied
to systems designed for treatment of municipal and industrial waters.
Course Information: 3 undergraduate hours. 4 graduate hours. Field trip
required at nominal fee. Prerequisite(s): CME 322. Students in programs
outside stated restrictions may be admitted with the consent of the
instructor.

CME 422. Wastewater Treatment Design. 3 or 4 hours.
Processes involved in the biological treatment of wastewater. Aerobic
and anaerobic treatment, sludge stabilization, and nutrient removal. Course
Information: 3 undergraduate hours. 4 graduate hours. Field trip required.
Prerequisite(s): CME 322 or the equivalent.

CME 423. Management of Solid and Hazardous Wastes. 3 hours.
Management of solid and hazardous waste, including radioactive
waste: landfills, incineration, recycling, composting, source reduction,
groundwater and air pollution impacts, control, regulations, siting, health
impacts. Course Information: Same as EOHS 472, and GEOG 444.

CME 425. Environmental Remediation Engineering. 3 or 4 hours.
Sources of contamination, regulations, site characterization, impact
assessment, waste disposal and containment options, waste treatment
options, case studies. Course Information: 3 undergraduate hours. 4
graduate hours. Prerequisite(s): CME 315.

CME 427. Engineering Hydrology. 3 or 4 hours.
Processes, techniques and concepts in hydrology of interest to the
engineer: precipitation, interception, evaporation, groundwater, unit
hydrographs, flood routing, and statistics. Course Information: 3
undergraduate hours. 4 graduate hours.
Prerequisite(s): CME 211 and senior standing.

CME 430. Theory of Elasticity I. 3 or 4 hours.
The boundary value problems of linear elasticity. Uniqueness of solution.
Reduction to two dimensions: the plane problems, torsion, bending. Polar
coordinates and general orthogonal coordinates. Course Information: 3
undergraduate hours. 4 graduate hours.
Prerequisite(s): CME 205 and Math 220; or the equivalents.

CME 431. Introduction to Continuum Mechanics. 3 or 4 hours.
Vectors and tensors, stress, principal stresses and principal axes,
deformation, compatibility conditions, constitutive equations, isotropy
and mechanical properties of fluids and solids. Course Information: 3
undergraduate hours. 4 graduate hours.
Prerequisite(s): CME 203 and CME 211; or CME 203 and ME 211.

CME 432. Energy Methods in Mechanics. 3 or 4 hours.
Variational theorems of elasticity. Applications to establish approximate
systems and their solution. Beams (including shear deformation.)
Introduction to instability theory. Course Information: 3 undergraduate
hours. 4 graduate hours.
Prerequisite(s): CME 205.

CME 433. Fracture Mechanics and Failure Analysis I. 3 or 4 hours.
Classical theory of strength of materials. Fracture mechanisms maps.
Continuum damage mechanics. Introduction to fracture mechanics.
Irwin-Orowan, Barenblatt-Dugdale theories. Course Information: 3
undergraduate hours. 4 graduate hours.
Prerequisite(s): CME 430.

CME 434. Finite Element Analysis I. 3 or 4 hours.
Establishment of basic finite element, matrix relations for one-dimensional
heat conduction problems: Truss, beam and frame structural systems.
Solution methods of the resulting equations. Introduction to two-
dimensional analysis. Course Information: 3 undergraduate hours. 4
graduate hours.
Prerequisite(s): CME 302 and CME 311; or consent of the instructor.

CME 435. Theory of Vibrations I. 3 or 4 hours.
Analytical and numerical treatment of linear, discrete systems. Nonlinear
discrete systems. Course Information: 3 undergraduate hours. 4 graduate
hours.
Prerequisite(s): CME 200 or the equivalent and Math 220.

CME 440. Cities and Sustainable Infrastructure. 0-4 hours.
Integrated urban infrastructure planning based on sustainability and
resilience; energy, water and transportation systems; design of green
buildings; urban network design; methods of environmental assessment
and infrastructure economics. Course Information: 3 undergraduate
hours; 4 graduate hours.
Prerequisite(s): CME 302 and CME 311; or consent of the instructor.
Class Schedule Information: To be properly registered, students must enroll in
one Lecture-Discussion and one Laboratory-Discussion.
CME 450. Probability and Reliability in Structural Design. 3 or 4 hours.
Maximum uncertainty principle and probability distributions of random variables. Distributions of extremes and their applications. Statistics of failure. The weakest link theory. Time to failure. Structural reliability. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): Consent of the instructor.

CME 453. Experimental Stress Analysis. 0-4 hours.
Structural similitude and dimensional analysis. Strain measurement techniques. Introduction to photoelasticity. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): CME 430. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture.

CME 454. Structural Analysis and Design of Tall Buildings. 3 or 4 hours.
State-of-the-art introduction to structural analysis and design of tall buildings. Load impact on different structural systems. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): CME 401 or CME 409 or the equivalent, or consent of the instructor. Recommended background: Major structural analysis and design courses.

CME 460. Crystallography and X-Ray Diffraction. 4 hours.
Fundamentals of crystallography. Theory of x-ray diffraction, experimental methods and applications. Course Information: Prerequisite(s): CME 260. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture-Discussion.

CME 470. Physical and Mechanical Properties of Materials. 4 hours.
Basic metallurgical phenomena; kinetics and phase stability; diffusion and transformation rates. Mechanical properties of materials; creep; fatigue and fracture. Course Information: Prerequisite(s): CME 260. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture-Discussion.

CME 471. Thermodynamics of Materials. 0-4 hours.
Application of chemical and thermodynamic principles to processing and characterization of materials. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): CME 260. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture-Discussion.

CME 480. Welding Metallurgy. 4 hours.
Metallurgy of metals joining processes. Selection of processes and design of products manufactured by joining processes. Course Information: Prerequisite(s): CME 260. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture-Discussion.

CME 485. Construction Engineering and Management. 3 or 4 hours.
Overview of construction engineering and project management. Construction industry, project cycles, contract administration, financing, legal management structures. Resource management; planning, quality control, productivity and safety. Course Information: 3 undergraduate hours. 4 graduate hours. Non-COE students shall obtain permission from the instructor prior to enrolling in the course.

CME 486. Construction Equipment and Design Methods. 3 or 4 hours.
Overview of the equipment and machinery that is used in construction engineering; Calculating Cycle Times, Production Rates and Cost; Earthwork Estimations; Construction Methods and Design. Course Information: 3 undergraduate hours. 4 graduate hours. Other non-COE students shall obtain permission from the instructor prior to enrolling in the course.

CME 490. Undergraduate Senior Design Thesis I. 0-8 hours.
Introduction to engineering design and research methods: design tools, product conception and development, simulation, optimization, technical reports and presentations, literature survey and undergraduate thesis. Course Information: Credit only given to non-degree students. No graduation credit given to students enrolled in Engineering. Extensive computer use required. Prerequisite(s): Consent of the instructor.

CME 491. Undergraduate Senior Design Thesis II. 0-8 hours.
Introduction to engineering design and research methods: design tools, product conception and development, simulation, optimization, technical reports and presentations, literature survey and undergraduate thesis. Course Information: Extensive computer use required. Prerequisite(s): Consent of the instructor.

CME 493. Seminar. 1-3 hours.
Topics of mutual interest to a faculty and a group of students. Offered as announced in the Timetable.

CME 494. Special Topics in Civil and Materials Engineering. 1-4 hours.
Subject matter varies from section to section and from semester to semester, depending on the specialties of the instructor. Course Information: May be repeated. Students may register in more than one section per term. Prerequisite(s): Consent of the instructor.

CME 496. Special Problems. 1-4 hours.
Special problems or reading by special arrangement with a faculty member. Course Information: Prerequisite(s): Consent of the instructor.

CME 497. Capstone Design. 2 or 3 hours.
Application of principles of engineering and design methods to the solution of a large-scale design program. Communicating design solutions through verbal and written media. Course Information: Previously listed as CME 397. Prerequisite(s): CME 396 CME 396 and at least three courses from the following list: CME 301, CME 302, CME 310, CME 311, CME 315, CME 322.

CME 500. Design of Concrete Plate and Shell Structures. 4 hours.
Practical design of reinforced concrete slabs, walls, and shells of single and double curvatures. Includes barrel roofs, domes, and storage tanks. Course Information: Prerequisite(s): CME 310.

CME 501. Urban Transportation. 4 hours.
Transportation technology, and its relation to travel and location phenomena in large urban areas, as a basis for planning, operating and design of multimodal transportation systems. Course Information: Prerequisite(s): Grade of C or better or concurrent registration in CME 302; and MATH 210 and ECON 120. Recommended background: For transportation and urban planning majors.

CME 502. Bridge Design II. 4 hours.
Theory and design procedures related to the analysis and design of modern bridges, using AASHTO code. Includes concrete and steel structures, construction practices and procedures. Course Information: Prerequisite(s): CME 406.
CME 503. Advanced Transportation Demand Analysis. 4 hours.
Advanced quantitative analysis and modeling of transportation demand for planning purposes. Disaggregate choice models, traveler behavior and values, activity-based and microsimulation approach to demand modeling. Course Information: Extensive computer use required. Prerequisite(s): CME 508.

CME 505. Advanced Soil Mechanics. 4 hours.
Soil structure, stresses in soil mass, fluid flow, consolidation, drained and undrained shear strength, stress-strain relations, laboratory determination of strength and compressibility of soils. Course Information: Prerequisite(s): CME 315. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture-Discussion.

CME 506. Physical/Chemical Principles in Environmental Systems. 4 hours.
Physical and chemical principles in natural and engineered environmental systems. Environmental process equilibria and rates. Reactor design and mass transfer in environmental systems. Multiphase environmental processes. Course Information: Prerequisite(s): CME 507.

CME 507. Sustainable Transportation Systems. 4 hours.
Transportation network analysis, mobile source emission modeling and life-cycle based transportation energy modeling. Course Information: Prerequisite(s): Credit or concurrent registration in CME 501; and credit or concurrent registration in CME 508. Recommended Background: Transportation engineering, urban planning, and environmental engineering.

CME 508. Urban Travel Forecasting. 4 hours.
Theory and methods of forecasting travelers' choices of route, mode, destination, departure time, trip frequency and origin location in congested urban transportation networks.

CME 509. Transportation Networks. 4 hours.
Application of constrained optimization methods to the analysis, planning and design of urban transportation networks. Course Information: Prerequisite(s): CME 501 and ECON 501 and MATH 484 and CME 508.

CME 510. Advanced Design of Prestressed Concrete Structures. 4 hours.
Analysis and design of indeterminate prestressed concrete members. Composite beams, torsion, deflections and design and detailing of connections, special topics such as anchorage zone design. Course Information: Prerequisite(s): CME 410.

CME 514. Sustainable Engineering. 4 hours.
Principles of sustainability; sustainability frameworks, indicators, metrics and tools; apply the tools to assess and/or design various engineering applications; case studies; challenges and opportunities. Course Information: Prerequisite(s): Graduate student in the College of Engineering or consent of instructor. Class Schedule Information: To be properly registered, students must enroll in one Lecture and one Lecture-Discussion.

CME 516. Design of Landfills and Impoundments. 4 hours.
Regulatory overview, site selection, waste characterization, design and construction of landfill and impoundment components, operations, performance monitoring, closure plans, long-term impacts and monitoring, economic analysis. Course Information: Prerequisite(s): CME 315.

CME 518. Pollution Prevention Engineering. 4 hours.
Pollution prevention concepts, planning and economics. Improved manufacturing operations and life cycle assessment. Design for the environment, resource conservation and sustainable development. Course Information: Prerequisite(s): CME 216.

CME 519. Earthquake Resistant Design for Structural Steel Systems. 4 hours.
Design of steel of buildings for earthquake resistance. Topics include: behavior of various steel systems subjected to earthquake ground motion, seismic design of steel systems using the current codes, current research and innovative steel systems. Course Information: Prerequisite(s): CME 301; and CME 520; or CME 494 or authorized equivalent courses or consent of the instructor.

CME 520. Earthquake Engineering of Concrete Structures. 4 hours.
Earthquake phenomena; response spectrum and design spectrum concepts; dynamic response of structures to earthquakes, methods of analysis; code approach to earthquake resistant design; alternative approaches. Course Information: Prerequisite(s): CME 310.

CME 521. Environmental Microbiology. 4 hours.
Microbial cell structure and function, applications of molecular biology in microbial ecology, biogeochemical cycles. Course Information: Prerequisite(s): Credit or concurrent registration in CME 422; or consent of the instructor. Recommended background: A basic understanding of biology.

CME 522. Environmental Organic Chemistry. 4 hours.

CME 524. Water Chemistry. 4 hours.
Chemical equilibria and kinetic principles as applied to processes occurring in natural and engineered water systems. Course Information: Same as EOHS 542. Prerequisite(s): EOHS 440 or CME 411.

CME 525. Applied Environmental Biotechnology. 4 hours.
Advanced biological treatment processes for environmental restoration. Stoichiometry of biological reactions, kinetics, bioremediation, biochemical pathways for pollutant biodegradation, biological nutrient removal. Course Information: Prerequisite(s): Credit or concurrent registration in CME 521; or consent of the instructor.

CME 526. Air Quality Management II. 2 hours.
Air quality management: Integration of diverse aspects. Data interpretation; standards setting; policy implementation; equipment design; hazardous spill modeling; indoor air pollution; case studies. Course Information: Same as EOHS 532. Prerequisite(s): EOHS 431 or CME 419.

CME 528. Environ Fate & Trans Processes. 4 hours.
Understanding of the coupled physical transport and biogeochemical reactions of fluids, particles, chemicals, and biota in water, air, and soil environments relevant to environmental engineering and science applications. Course Information: Prerequisite(s): Graduate students in College of Engineering or the Graduate College or consent of instructor.

CME 530. Theory of Elasticity II. 4 hours.
CME 531. Nonlinear Continuum Mechanics. 4 hours.
Matrices and general tensors, isotropic tensor functions, representation theorem, kinematics, polar decompositions, Cauchy-Green tensors, Cauchy stress, Piola-Kirchoff stresses, constitutive laws, frame indifference, hyperelastic materials and universal solutions. Course Information: Prerequisite(s): CME 430 or CME 431.

CME 533. Fracture Mechanics and Failure Analysis II. 4 hours.

CME 534. Finite Element Analysis II. 4 hours.
Application of the finite element method to the analysis of complex continuum and structural linear systems. Introduction to error analysis and convergence of the finite element solutions. Course Information: Same as ME 534. Prerequisite(s): CME 434.

CME 535. Theory of Vibrations II. 4 hours.
Harmonic vibrations; vibrations of a string; vibrations of a beam; vibrations of a membrane; periodic systems; Floquet waves; nonlinear vibrations. Course Information: Same as ME 535. Prerequisite(s): CME 435 or ME 408 or the equivalent.

CME 536. Nondestructive Testing of Concrete. 4 hours.
Strength and durability of concrete structures by nondestructive evaluation of the material through acoustic, magnetic, thermal, electrical, optical phenomena; nondestructive methodologies for evaluation of concrete structures. Course Information: Prerequisite(s): CME 310.

CME 537. Plasticity I. 4 hours.

CME 539. Elastic Stability. 4 hours.

CME 541. Mechanics of Composite Materials. 4 hours.
Anisotropic elastic materials; stress analysis for isotropic materials; Stroh formalism for anisotropic materials; singularities at free-edges; stress analysis in composites; wave propagation in composites. Course Information: Prerequisite(s): CME 430 or equivalent.

CME 544. Structural Dynamics. 4 hours.
Formulation and solution methods for time dependent systems. Pertinent numerical techniques and their application to seismic analysis, blast loading and heat transfer problems. Course Information: Prerequisite(s): CME 434.

CME 546. Research Methods for Landscape Ecological and Anthropogenic Processes. 4 hours.
Students will develop the skills to choose and utilize relevant methods and tools used in the study and management of altered natural landscapes to achieve research and management objectives through hands-on interdisciplinary laboratory modules. Course Information: Same as BIOS 546 and EAES 546. Prerequisite(s): Consent of the instructor. Class Schedule Information: To be properly registered, students must enroll in one Lecture and one Laboratory/Discussion.

CME 547. Field Experiences in Landscape Ecological and Anthropogenic Processes. 4 hours.
Evaluation of the issues and needs of various landscape restorations and related urban-impacted sites in the Chicago metropolitan area based upon selected readings, site visits and presentations and discussions with the site manager/coordinators. Course Information: Same as BIOS 547 and EAES 547. Prerequisite(s): Consent of the instructor. Class Schedule Information: To be properly registered, students must enroll in one Lecture/Discussion and one practice.

CME 548. Capstone Project in Landscape, Ecological and Anthropogenic Processes. 4 hours.
Interdisciplinary capstone project course that explores a "real-world" environmental issue selected by the students and approved by the faculty. Students will conduct research and analysis collaboratively and develop solutions and recommendations. Course Information: Same as BIOS 548 and EAES 548. Prerequisite(s): Grade of B or better in BIOS 540 or Grade of B or better in BIOS 546 or Grade of B or better in CME 540 or Grade of B or better in EAES 540 or Grade of B or better in UPP 555; and Grade of B or better in BIOS 540 or Grade of B or better in CME 547 or Grade of B or better in EAES 547 or Grade of B or better in UPP 555. Class Schedule Information: To be properly registered, students must enroll in one Lecture-Discussion and one Studio.

CME 549. Subsurface Flow and Contaminant Transport Modeling. 4 hours.
Definitions, basic principles, fluid flow in vadose zone, groundwater flow, contaminant transport in vadose zone, contaminant transport in groundwater, numerical models and field implementation, case studies. Course Information: Prerequisite(s): CME 415 or consent of the instructor.

CME 550. Dynamics of Floating Offshore Structures. 4 hours.
Covers environmental loads and dynamics of floating structures in fluid. Course Information: Same as ME 550. Prerequisite(s): ME 210 and CME 211 and ME 211 and MATH 220; or consent of the instructor.

CME 554. Nonlinear Finite Element Analysis. 4 hours.
Nonlinear elastostatics, consistent linearization. Newton and modified-Newton methods, line search techniques, arc-length methods. Hyperelasticity, B-bar type methods. Finite deformation elastodynamics, semi-discretization, time-stepping algorithms. Course Information: Prerequisite(s): CME 531 and CME 534; or consent of the instructor.

CME 555. Transportation Systems Analysis. 4 hours.
Integrate the fundamental tools of systems analysis, including those of microeconomic theory, system optimization, evaluation and decision making into transportation engineering and planning. Course Information: Prerequisite(s): CME 302 or equivalent.

CME 562. Biomedical Implants in Orthopedics and Dentistry. 4 hours.
Advanced aspects of implant design, including biomaterials, surface coatings, biomechanics, corrosion, tribocorrosion, failure mechanisms, implant monitoring, clinical and regulatory concerns, critical review of current research. Course Information: Same as BME 562 and ME 562. Credit is not given for CME 562 if the student has credit in BIOE 562 or BME 562 or ME 562. Prerequisite(s): BIOE 460 or BME 460.
CME 567. Principles of Computational Transportation Science. 4 hours.
Builds on the fundamentals of transportation science and emphasizes its high-level computational aspects. Topics covered include database design and theory, spatial and temporal information systems issues and travel modeling. Course Information: Same as CS 567 and UPP 567. Prerequisite(s): Grade of B or better or concurrent registration in UPP 560. Open only to Ph.D. students; or consent of the instructor.

CME 568. Kinetics of Reactions and Phase Transformations in Metals. 4 hours.
Nucleation and growth kinetics, order of transformation, grain growth recovery, recrystallization, solidification, phase transformation in solids, precipitation hardening, spinodal decomposition and martensitic transformations. Course Information: Prerequisite(s): Consent of the instructor.

CME 570. Diffusion Phenomena in Materials. 4 hours.
Diffusion mechanisms in crystals; Kirkendall effect; diffusion in ionic solids; diffusion in gases and liquids; diffusion through porous media; kinetics of diffusion controlled processes.

CME 572. Advanced Thermodynamics of Materials. 4 hours.
Treatment of multicomponent system thermodynamics with emphasis on metallurgical process applications. Development of relation between structure of metallic solutions, molten salts, and quasi-chemical models.

CME 575. Computational Materials Science and Design. 4 hours.
Atomic forces and interactions in solids, classical molecular mechanics and dynamics, Monte-Carlo methods, ab initio numerical methods, computational materials design, data driven materials science. Course Information: Prerequisite(s): CME 470 or consent of the instructor. Recommended background: Courses in modern physics and quantum theory, i.e. PHYS 240.

CME 580. Infrastructure Management. 4 hours.
Integrated approach to the management of infrastructure systems: design, construction, operations, maintenance and rehabilitation of facilities. Performance of facilities, approaches to management, and available tools and developing technologies. Course Information: Same as UPP 569. Prerequisite(s): IE 201 or the equivalent or consent of instructor. Recommended background: Familiarity with computer spreadsheets.

CME 581. Vadose Zone Hydrology. 4 hours.
Soil physics and biochemical processes. Flow and contaminants transport in Vadose Zone. Theory of Soil Water Movement. Course Information: Prerequisite(s): CME 311; and graduate standing; or consent of the instructor.

CME 582. Lake and Watershed Management. 4 hours.
Lake and watershed processes influencing water quality, diffuse pollution, integrated management and sustainable development of Lotic and Lentic water resources, watershed restoration. Course Information: Prerequisite(s): CME 311; and graduate or professional standing; or consent of the instructor.

CME 583. Corrosion Engineering. 4 hours.
Corrosion of Metals, Polymers and Ceramics by electrochemical and chemical processes. Environmental Degradation of Material Properties, Corrosion Control Strategies. Course Information: Prerequisite(s): CME 260 and graduate standing; or consent of the instructor.

CME 584. Ceramic Materials Engineering. 4 hours.
Processing, structure, and properties of engineering ceramic materials. Applications of ceramics in engineering systems. Course Information: Prerequisite(s): CME 260 and graduate standing; or consent of the instructor.

CME 585. Construction Engineering Project Controls. 4 hours.
Metrics and control mechanisms in construction engineering and management; control systems during construction; Risk and Quality Control; Earned-Value Analysis and Operational effects on Cost and Schedule. Course Information: Recommended Background: CME 485 - Construction Engineering and Management. COE undergraduate students will need prior permission from the instructor; Other non-COE graduate students shall obtain permission from the instructor prior to enrolling in the course.

CME 586. Construction Regulations and Organizational Management. 4 hours.
Construction laws and regulations; construction contractual agreements; Professional Engineering Ethics; Construction Safety and Environmental Considerations; Organizational Management in civil and construction engineering. Course Information: Recommended Background: CME 485 - Construction Engineering and Management. COE undergraduate students will need prior permission from the instructor.

CME 587. Construction Estimating and Scheduling. 4 hours.
Cost and schedule estimations per project specifications. Construction quantity take-offs, cost estimation, scheduling through deterministic and probabilistic methods, resource management, accelerated construction, and schedule updating. Course Information: Prerequisite(s): Consent of the instructor. COE undergraduate students shall obtain permission from the instructor prior to enrolling in the course.

CME 591. Civil and Materials Engineering Internship. 1 hour.
Provides students with the opportunity to apply the skills and knowledge gained in previous engineering courses within a professional, working environment. Course Information: Satisfactory/Unsatisfactory grading only. May be repeated. A maximum of 4 hours awarded toward degree requirements. Prerequisite(s): Approval of the Department.

CME 594. Advanced Special Topics in Civil and Materials Engineering. 1-4 hours.
Subject matter varies from section to section and from semester to semester, depending on the specialties of the instructor. Course Information: May be repeated. Students may register in more than one section per term. Prerequisite(s): Graduate standing and consent of the instructor.

CME 596. Independent Study. 1-4 hours.
Special problems of reading by special arrangement with a faculty member. Course Information: Prerequisite(s): Consent of the instructor.

CME 598. Master's Thesis Research. 0-16 hours.
M.S. thesis work under the supervision of a faculty member. Course Information: Satisfactory/Unsatisfactory grading only. May be repeated. Students may register in more than one section per term.

Ph.D. thesis work under the supervision of an advisor. Course Information: Satisfactory/Unsatisfactory grading only. May be repeated. Students may register in more than one section per term.