CIVIL & ENVIRONMENTAL ENGR (CE)

Courses

CE 001. Statics. 0 or 3 Credits.
Fundamentals of statics; composition and resolution of forces; the analysis of force systems in two and three dimensions; and centroids and moments of inertia. Prerequisites: MATH 022 or MATH 023; PHYS 031.

CE 002. CE Graphic Design. 0 or 3 Credits.
Computer-aided and hand generation of: geometric shapes, dimensioning, pipe drafting, foundations and structures, survey plots, graphs and charts, topography, and highway geometry.

CE 003. SU: Intro to Civil & Envir Engr. 0 or 2 Credits.
Introduction to Civil and Environmental Engineering, sustainability, ethics, systems thinking, teamwork in engineering, laboratories, hands-on design projects, and computational exercises.

CE 010. Geomatics. 0 or 4 Credits.
An introduction to surveying including distance and angle measurements, leveling, traverse surveys, error propagation, topographical mapping, global positioning systems (GPS), and geographic information systems (GIS). Prerequisites: MATH 010, MATH 019, or MATH 021; Sophomore standing.

CE 090. Internship. 1-3 Credits.
On-site supervised work experience combined with a structured academic learning plan directed by a faculty member or a faculty-staff team in which a faculty member is the instructor of record, for which academic credit is awarded. Offered at department discretion.

CE 095. Special Topics. 1-18 Credits.
See Schedule of Courses for specific titles.

CE 100. Mechanics of Materials. 0 or 3 Credits.
Stress, strain, temperature relationships, torsion, bending stresses, and deflections. Columns, joints, thin-walled cylinders. Combined stresses and Mohr’s circle. Prerequisite: CE 001 with a grade of C- or better. Co-requisite: MATH 121. Cross-listed with: ME 014.

CE 101. Materials and Structures Lab. 3 Credits.
Experimental stress analysis methods; experimental verification of static force-displacement relationship for beams, frames, and trusses; fundamental mechanical properties of metals, plastics, and wood; effects of size, shape, method, speed of loading and strain history on these properties. Co-requisites: CE 100 or ME 014, and CE 170.

CE 132. SU: Environmental Systems. 3 Credits.
Systems thinking and the systems approach as applied to environmental systems; sustainability, mass and energy balances, kinetics, ecosystem health and the public welfare, environmental risk, green engineering, water and wastewater treatment, air resources engineering, solid-waste management. Prerequisites: CHEM 031; MATH 019 or MATH 021.

CE 133. Transportation Systems. 3 Credits.
Transportation systems planning, analysis, and design with foci on safety, modeling, decision support, and environmental impacts. Co-requisite: CE 010.

CE 134. Sustainable Eng. Economics. 0 or 3 Credits.
A framework for applying systems analysis tools to engineering economic decision analysis to address the environmental impacts, energy efficiency and cost effectiveness with applications to climate change needed for sustainable engineering solutions. Prerequisite: CE 132. Co-requisite: CS 020.

CE 140. Transportation. 3 Credits.
Analysis of transportation systems; technological characteristics; the transportation planning process and techniques of travel modeling and forecasting for both urban and rural areas. Prerequisite: CE 010.

CE 150. Environmental Engineering. 3 Credits.
Basic phenomena and theoretical principles underlying water supply, air and water pollution control, and industrial hygiene. Prerequisites: CHEM 031, MATH 022.

CE 151. SU: Water & Wastewater Engr. 3 Credits.
Fundamentals and design of sustainable systems for water supply, domestic and industrial wastewater treatment, soil and groundwater remediation; semester-long design projects; energy and resource recovery. Prerequisite: CE 132 with a grade of C- or better.

CE 160. Hydraulics. 3 Credits.
Mechanics of incompressible fluids, flow meters, flow in closed conduits and open channels, elements of hydraulic machinery. Prerequisites: CE 001 with a grade of C- or better, MATH 121. Co-requisite: CS 020.

CE 162. Hydraulics Lab. 0-2 Credits.
Performing various laboratory studies of flow and hydraulic machinery determine index; computer modeling of hydraulic systems; associated laboratory and project report writing and presentations. Co-requisites: CE 160.

CE 170. Structural Analysis. 0 or 3 Credits.
Analysis of statically determinate beams, frames, and trusses; expected loads, reactions; influence lines; moving loads; geometric methods for displacement calculations; introduction to matrix analysis for trusses. Prerequisites: MATH 271, CS 020. Co-requisites: MATH 122 or MATH 124; CE 100 or ME 014.

CE 172. Structural Steel Design. 3 Credits.
Theory and design of steel structures including flexural members, axially loaded members and combined stress members; design of composite members; and plastic analysis and design. Prerequisite: CE 170.

CE 173. Reinforced Concrete. 3 Credits.
Analysis of stresses in plain and reinforced concrete members; design of reinforced concrete structures; and theory of prestressed concrete. Prerequisite: CE 170.

CE 175. Senior Design Project. 0 or 3 Credits.
Student teams will integrate the multiple areas of specialization in Civil/Environmental Engineering in comprehensive design experience; professional practice; ethics; written and oral presentations to professional review panels. Prerequisite: Senior standing only.
CE 180. Geotechnical Principles. 3 Credits.
Characteristics and classification of soils; physical, mechanical and hydraulic properties of soils; seepage; the effective stress principle; stress distribution, consolidation, settlement; shear strength. Prerequisite: CE 100 or ME 014.

CE 182. Geotechnical Principles Lab. 0-2 Credits.
Performing various laboratory tests to determine index, hydraulic, and mechanical properties of soils; computer modeling of geotechnical systems; associated laboratory and project report writing and presentations. Prerequisite: CE 100 or ME 014. Co-requisite: CE 180.

CE 185. SU: Capstone Design I. 3 Credits.
Integrate knowledge from multiple subdisciplines of Civil/Environmental Engineering in team-based contemporary design projects promoting sustainability under realistic constraints (economic, environmental, social, regulatory, safety, constructability); consider risk, uncertainty, life-cycle principles, and environmental impacts in the design; professional practice; ethics; effective communication. Prerequisite: Senior standing; Civil Engineering or Environmental Engineering major.

CE 186. Capstone Design II. 3 Credits.
Student teams will integrate the knowledge from multiple subdisciplines of Civil/Environmental Engineering in a contemporary design project involving realistic constraints such as economic, environmental, social, regulatory and sustainability; professional practice; ethics; written and oral presentations to professional review panels. Prerequisite: CE 185.

CE 190. Internship. 1-18 Credits.
On-site supervised work experience combined with a structured academic learning plan directed by a faculty member or a faculty-staff team in which a faculty member is the instructor of record, for which academic credit is awarded. Offered at department discretion.

CE 192. Independent Study. 1-18 Credits.
A course which is tailored to fit the interests of a specific student, which occurs outside the traditional classroom/laboratory setting under the supervision of a faculty member, for which credit is awarded. Offered at department discretion. Prerequisites: Senior standing; Department permission.

CE 193. College Honors. 1-6 Credits.
CE 194. College Honors. 1-6 Credits.
CE 195. Special Topics. 1-18 Credits.
See Schedule of Courses for specific titles. Prerequisites: Senior standing in Civil Engineering or Environmental Engineering.

CE 197. Teaching Assistantship. 1-3 Credits.
Undergraduate student service as a teaching assistant, usually in an introductory-level course in the discipline, for which credit is awarded. Offered at department discretion.

CE 198. Undergraduate Research. 1-18 Credits.
Undergraduate student work on individual or small team research projects under the supervision of a faculty member, for which credit is awarded. Offered at department discretion.

CE 199. Cooperative Ed Experience. 12 Credits.
On-site, full-time, supervised work experience in civil or environmental engineering or related field appropriate for sophomore or junior levels that also satisfies the overall educational objectives defined by the CEMS Engineering Co-op Program. Prerequisites: Civil Engineering or Environmental Engineering major; Sophomore or Junior standing.

CE 201. Sustainable Eng Materials. 3 Credits.
Introduces the fundamentals of materials with a focus on sustainable engineering, including structure and bond, interatomic potential, metals, fracture, strength testing, cement chemistry, aggregates, composites, reinforced concrete, asphalt, bamboo and wood. Prerequisite: CE 100, ME 014, or Instructor permission.

CE 211. Sustainable Eng. Materials. 3 Credits.
Introduces the fundamentals of materials with a focus on sustainable engineering, including structural bonding, metals, fracture, strength testing, cement chemistry, aggregates, composites, reinforced concrete, asphalt, bamboo, wood, and bio-inspired materials and structures. Prerequisites: CE 100 or ME 014 or Instructor permission.

CE 218. Numerical Methods for Engineer. 3 Credits.
Foundational concepts of numerical integration, numerical differentiation, and numerical approximation and solution of differential and partial differential equations of the type encountered in the analysis of engineering problems and data processing. Prerequisites: MATH 271, CS 020; MATH 122 or MATH 124. Cross-listed with: ME 218.

CE 220. Intro to Finite Element Anyl. 3 Credits.
Introduction to finite element analysis: applications in solid mechanics, hydrodynamics, and transport: analysis of model behavior: Fourier analysis. Computer project required. Prerequisites: CS 020; MATH 122 or MATH 124.

CE 226. Civil Engineering Systems Anyl. 3 Credits.
Linear programming, dynamic programming, network analysis, simulation; applications to scheduling, resource allocation, routing, and a variety of civil engineering problems. Prerequisites: Minimum Senior standing in Civil & Environmental Engineering. Cross-listed with: CSYS 226.

CE 238. Design/Planning for Bikes/Peds. 3 Credits.
Interdisciplinary introduction to design/planning concepts for bikes/pedestrians from a systems view. Examines current best practices on how effectively they address social, environmental, economic, and health related transportation issues. Prerequisite: Minimum Senior standing.

CE 241. Traffic Operations & Design. 3 Credits.
Advanced concepts of traffic engineering and safety; human, vehicle and environment factors; simulation and statistical analysis software; transportation design manuals. Prerequisite: CE 133.
CE 245. Intelligent Transportation Sys. 3 Credits.
Introduction to Intelligent Transportation Systems (ITS), ITS user services, ITS applications, the National ITS architecture, ITS evaluation, and ITS standards. Prerequisite: CE 133. Cross-listed with: CSYS 245.

CE 247. Alt Sustainable Waste Treatment. 3 Credits.
Consideration of cultural paradigms that encourage waste generation. Design of alternative treatment systems including composting, constructed wetlands, anaerobic digestion. Research and hands-on design project. Prerequisite: CE 151.

CE 248. Hazardous Waste Mgmt Engr. 3 Credits.
Management of hazardous and industrial waste from generation to disposal; emphasis on pollution prevention within industry; waste minimization, recovery, reuse, treatment technologies; environmental regulations, risk assessment, costs and public policy; group projects. Prerequisite: Senior standing in engineering or sciences.

CE 249. Solid Wastes. 3 Credits.
Significance of solid wastes from municipal, industrial, agricultural, mining; optimization and design of collection, disposal, recycle systems; sanitary landfills, incineration, composting, material recovery. Prerequisite: CHEM 031.

CE 250. Fate/Transport Organic Chem. 3 Credits.
Chemical transfers between environmental media; molecular structure-reactivity models; chemical, photochemical and biochemical transformation rates; emphasis on predicting environmental concentrations and risk. Graduate student independent modeling project. Prerequisites: CHEM 031, CHEM 032, CE 132.

CE 251. Envr Facility Dsgn/Wastewater. 3 Credits.
Design of wastewater conveyance and treatment facilities; sewage treatment plant design; equipment selection. Prerequisite: CE 151.

CE 253. Transportation & Air Quality. 3 Credits.
Air pollution sources, measurement methods, legislation, vehicle emissions formation, control and transport processes. Emphasis on emission factor and dispersion multi-scale modeling using latest modeling tools. Prerequisites: CE 132, CE 133.

CE 254. Environmental Quantitive Anyl. 0 or 4 Credits.
Course focuses on chemical, biochemical and physical processes; diffusion, equilibria, reaction kinetics, acids/bases, colloids, air/water exchange; laboratories demonstrate standard environmental engineering techniques. Prerequisites: CHEM 032, CE 132, STAT 143.

CE 255. Phys/Chem Proc Water/Wstwater. 0 or 3 Credits.
Theory of physical/chemical processes for treating waters and wastewaters; reactor dynamics, mass transfer, adsorption, ion exchange, precipitation. Prerequisite: CE 151.

CE 256. Biol Proc Water/Wastewater Tr. 0 or 3 Credits.
Theory and application of biological processes for treating industrial and domestic wastewaters and contaminated ground water; microbiological considerations; aerobic and anaerobic processes; reactor design, in-situ bioremediation; bench-scale and pilot-scale experimentation. Prerequisite: CE 151.

CE 259. Msmt of Airborne Contaminants. 3 Credits.
Quantifying airborne contaminants from processes and ambient levels. Laboratories demonstrate calibration and measurement, stack sampling and ambient air monitoring, and specific contaminant generation and measurement. Prerequisite: CE 132.

CE 260. Hydrology. 3 Credits.
Theory of precipitation, run-off, infiltration, and ground water; precipitation and run-off data; and application of data for use in development of water resources. Pre/Co-requisite: CE 160.

CE 261. Open Channel Flow. 3 Credits.
Application of the laws of fluid mechanics to flow in open channels, design of channels and transition structures, modeling, uniform and gradually-varied flows. Prerequisite: CE 160.

CE 262. Advanced Hydrology. 3 Credits.
Introduces computer modeling of hydrological systems and involves a semester-long design project. Simple overland flow, flood routing, water quality, and groundwater models are developed using finite difference techniques. Stochastic hydrology and hydrologic time series analysis are also introduced. Prerequisite: CE 260.

CE 265. Ground Water Hydrology. 3 Credits.
Principles of ground water hydraulics, well characteristics, aquifers, and use of numerical methods to solve ground water flow problems. Prerequisite: CE 160.

CE 271. Advanced Structural Analysis. 3 Credits.
Virtual work, energy theorems, analysis of structures by the displacement method and the finite element method, non-linear structural analysis. Prerequisite: CE 170.

CE 272. Structural Dynamics. 3 Credits.
Vibrations, matrices, earthquake engineering, stability and wave propagation. Prerequisites: Senior standing in Engineering or Physical Sciences or Instructor permission. Cross-listed with: ME 270.

CE 273. Structural Design - Wood. 3 Credits.
Analysis and design of solid and glue laminated timber members and structural systems including tension members, beams, columns, beam-columns, diaphragms, shear walls, and connections; LRFD and ASD design methods; application of IBC for timber systems; current developments in wood design/construction. Prerequisite: CE 170.

CE 281. Geotechnical Design. 3 Credits.
Subsurface explorations; bearing capacity, lateral earth pressures, slope stability; analysis and design of shallow and deep foundations, retaining structures, and slopes. Prerequisite: CE 180.
CE 283. Designing with Geosynthetics. 3 Credits.
Geotextiles, geogrids, geonets, geomembranes, geocomposites, geopipes. Design for separation, reinforcement, filtration, drainage, erosion, control, liners. Applications in transportation, drainage, solid waste containment. Material testing, behavior. Prerequisite: CE 180.

CE 284. Site Characterization. 3 Credits.
A comprehensive approach to subsurface site characterization for geotechnical and environmental designs and a systems approach for integrating the two. Prerequisites: CE 160, CE 180.

CE 285. Geo-energy Systems. 3 Credits.
An introduction to Geoenergy technologies for subsurface energy extraction (shallow and deep geothermal systems, enhanced oil recovery, shale gas extraction) and secure storage of byproducts of energy production (carbon dioxide and nuclear wastes). Prerequisite: CE 180.

CE 286. Foundation Design. 3 Credits.
Subsurface explorations; geotechnical analysis, design, construction, preservation, remediation, and monitoring aspects of shallow and deep foundations. Prerequisite: CE 180.

CE 287. Design of Earth Structures. 3 Credits.
Soil and rock properties using laboratory, field and in-situ testing; analysis and design of slopes, embankments and retaining structures. Prerequisite: CE 180.

CE 288. Geoenvironmental Engineering. 3 Credits.
Site characterization, site restoration, geotechnical aspects of waste disposal and containment, landfill design, geosynthetics. Prerequisite: CE 180.

CE 290. Independent Study. 1-18 Credits.
A course which is tailored to fit the interests of a specific student, which occurs outside the traditional classroom/laboratory setting under the supervision of a faculty member, for which credit is awarded. Offered at department discretion.

CE 292. Internship. 1-18 Credits.
On-site supervised work experience combined with a structured academic learning plan directed by a faculty member or a faculty-staff team in which a faculty member is the instructor of record, for which academic credit is awarded. Offered at department discretion.

CE 295. Special Topics. 1-18 Credits.
Content is dictated by expanding professional interest in newly developing, or recently developed, technical areas in which there is particular need or opportunity. Prerequisite: Minimum Senior standing.

CE 297. Teaching Assistantship. 1-3 Credits.
Undergraduate student service as a teaching assistant, usually in an introductory-level course in the discipline, for which credit is awarded. Offered at department discretion.

CE 298. Undergraduate Research. 1-18 Credits.
Undergraduate student work on individual or small team research projects under the supervision of a faculty member, for which credit is awarded. Offered at department discretion.

CE 299. Cooperative Ed Experience. 12 Credits.
On-site, full-time, supervised work experience in civil or environmental engineering or related field appropriate for senior level that also satisfies the overall educational objectives defined by the CEMS Engineering Co-op Program. Prerequisites: Civil Engineering or Environmental Engineering major; Senior standing.