CEE - CIVIL AND ENVIRON ENGINEERING

CEE Class Schedule (https://courses.illinois.edu/schedule/DEFAULT/DEFAULT/CEE/)

Courses

CEE 190 Project-Based Introduction to CEE credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/190/)
Allows first year and transfer students to explore topics in Civil and Environmental Engineering through a project-based learning format. The course also develops competencies in critical skills such as technical writing in CEE, data management and computation, and design thinking in a collaborative team environment. Credit is not given for both CEE 190 and CEE 195.

CEE 198 Special Topics credit: 1 to 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/198/)
Subject offerings of new and developing areas of knowledge in civil and environmental engineering intended to augment the existing curriculum. Approved for Letter and S/U grading. May be repeated up to 6 hours in the same semester and to a maximum of 9 hours in separate semesters, if topics vary. See Class Schedule or departmental course information for topics and prerequisites.

CEE 199 Undergraduate Open Seminar credit: 1 to 5 Hours. (https://courses.illinois.edu/schedule/terms/CEE/199/)
May be repeated.

CEE 201 Systems Engrg & Economics credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CEE/201/)
Introduction to the formulation and solution of optimization problems in civil engineering from a quantitative economics-based perspective, integrated with the computational tool Python. Topics include engineering economics, classical optimization, linear and integer programming, network optimization problems, critical path methods, and decision theory. Credit is not given for both CEE 201 and IE 310. Prerequisite: MATH 231; CS 101 or CS 124; credit or concurrent registration in MATH 257 or MATH 415.

CEE 202 Engineering Risk & Uncertainty credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CEE/202/)
Identification and modeling of non-deterministic problems in civil engineering design and decision making integrated with the computational tool R. Introductory course on development of stochastic concepts and simulation models with application to design and decision problems in various areas of civil engineering. Credit is not given for both CEE 202 and IE 300. Prerequisite: Credit in CS 101 or CS 124; Credit or concurrent registration in MATH 241.

CEE 300 Behavior of Materials credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/300/)
Macroscopic mechanical behavior in terms of phenomena at the nanometer and micrometer levels for the three types of engineering materials (metals, ceramics, and polymers) with emphasis on specific materials used in civil engineering -- steel, rocks, clay, portland cement concrete, asphaltic concrete, and wood. Same as TAM 324. Credit is not given for both CEE 300 and either ME 330 or MSE 280. Prerequisite: Completion of Composition I general education requirement; CHEM 104; TAM 251.
This course satisfies the General Education Criteria for:
Advanced Composition

CEE 310 Transportation Engineering credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CEE/310/)
Design, planning, operation, management, and maintenance of transportation systems; integrated multi-modal transportation systems (highways, air, rail, etc.); layout of highways, airports, and railroads with traffic flow models, capacity analysis, and safety. Design of facilities and systems with life cycle costing procedures and criteria for optimization. Prerequisite: TAM 251; credit or concurrent registration in CEE 202.

CEE 320 Construction Engineering credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CEE/320/)
Construction engineering processes: contracting and bonding, planning and scheduling, estimating and project control, productivity models, and construction econometrics. Prerequisite: CEE 201; credit or concurrent registration in CS 101 and CEE 202.

CEE 330 Environmental Engineering credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CEE/330/)
Sources, characteristics, transport, and effects of air and water contaminants; biological, chemical, and physical processes in water; atmospheric structure and composition; unit operations for air and water quality control; solid waste management; environmental quality standards. Prerequisite: CHEM 104 or CHEM 204.

CEE 331 Fluid Dynamics in the Natural and Built Environment credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/331/)
Fundamentals of fluid motion and transport processes in the natural, managed, and built environment. Focus on physical understanding of the behavior of fluids for applications in natural and engineering challenges. Hydrostatics, dimensional analysis, equations of incompressible fluid motion, open channel flow, flow in porous media, groundwater, pipe flow, boundary layers, drag and lift, turbulence, fluids and energy, are covered within a global context to emphasize the role of fluid dynamics on the environment within the framework of the hydrologic cycle in nature and in the built environment. Credit is not given for CEE 331 and either TAM 335 or ME 310. Prerequisite: TAM 211. Credit or concurrent registration in TAM 212.

CEE 340 Energy and Global Environment credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CEE/340/)
Introduction to evaluating multiple impacts of engineering decisions. Topics include mass and chemical balances; effects of engineered systems on local and global environment, health, and risk; economic, consumer, and social considerations; provision of conventional and renewable energy; and future projections. Design projects emphasize making appropriate decisions by quantifying total impact and evaluating social environment. Approved for Letter and S/U grading. Prerequisite: PHYS 211; PHYS 213 or ME200; CEE 201 or IE 310; CEE 202, IE 300, or STAT 200.
This course satisfies the General Education Criteria for:
Advanced Composition

CEE 350 Water Resources Engineering credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CEE/350/)
Quantitative aspects of water in the earth's environment and its engineering implications, including design and analysis of systems directly concerned with use and control of water; quantitative introduction to hydrology, hydraulic engineering, and water resources planning. Prerequisite: CEE 202; credit or concurrent registration in CEE 201.

CEE 360 Structural Engineering credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CEE/360/)
Analysis, behavior, and design of trusses and framed structures under static loads; member forces in trusses, shear and moment diagrams, deflections, simple applications of the force method and slope-deflection; computer applications. Prerequisite: TAM 251.

CEE 380 Geotechnical Engineering credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CEE/380/)
Classification of soils, compaction in the laboratory and in the field, soil exploration, boring and sampling, permeability of soils, one-dimensional settlement analyses, strength of soil, and foundations. Prerequisite: TAM 251.

CEE 398 Special Topics credit: 0 to 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/398/)
Subject offerings of new and developing areas of knowledge in civil and environmental engineering intended to augment the existing curriculum. See Class Schedule or departmental course information for topics and prerequisites. Approved for letter and S/U grading. May be repeated in the same or separate terms if topics vary.

CEE 401 Concrete Materials credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/401/)
Examination of the influence of constituent materials (cements, water, aggregates and admixtures) on the properties of fresh and hardened concrete, concrete mix design, handling and placement of concrete, and behavior of concrete under various types of loading and environment. Laboratory exercises utilize standard concrete test methods. Field trips are held during some scheduled laboratory sessions. 4 undergraduate hours. 4 graduate hours. Prerequisite: CEE 300.

CEE 405 Asphalt Materials I credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/405/)
Properties and control testing of bituminous materials, aggregates for bituminous mixtures, and analysis and design of asphalt concrete and liquid asphalt cold mixtures; structural properties of bituminous mixes; surface treatment design; recycling of mixtures. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 310.

CEE 406 Pavement Design I credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/406/)
Analysis, behavior, performance, and structural design of highway flexible and rigid pavements; climate factors, drainage, traffic loading analysis, and life cycle cost analysis. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 310.

CEE 407 Airport Design credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/407/)
Basic principles of airport facilities design to include aircraft operational characteristics, noise, site selection, land use compatibility, operational area, ground access and egress, terminals, ground service areas, airport capacity, and special types of airports. 3 undergraduate hours. 3 or 4 graduate hours.

CEE 408 Railroad Transportation Engrg credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/408/)
Principles and analysis of railroad transportation efficiency, economics, energy, and engineering; effect on production and markets. Railroad infrastructure; locomotive and rolling stock design, function, and operation. Computation of train speed, power, and acceleration requirements; railway traffic control and signaling. Quantitative analytical tools for rail-transportation decision-making and optimization. Field trip to observe railroad infrastructure, equipment and operations. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 310.

CEE 409 Railroad Track Engineering credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/409/)
Railroad track engineering concepts including track component and system design, construction, evaluation, maintenance, load distribution, and wheel-rail interaction. Design and analysis tools for railroad track engineering and maintenance. Field trip to observe railroad track system and components. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 310.

CEE 410 Railway Signaling & Control credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/410/)
Railway traffic control and signaling systems; train performance and scheduling tools; analysis of temporal and spatial separation of trains for safety and efficiency; train movement authority and operating rules, track circuit and wireless train position monitoring technology; interlocking design; railroad capacity modeling tools; economic analysis of traffic control system design, optimization, and selection. Field trip to observe signal system infrastructure and railway traffic operations control center. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 310.

CEE 411 RR Project Design & Constr credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/411/)
Critical elements in the development and planning of railroad construction projects; project economic justification; route alternative analysis procedures; cost estimation; site civil design; computer-aided track design; surveying; construction management; construction procedures for typical railroad projects. Design project covering a typical railroad capital construction projects. Field trip to observe the construction of a railroad capital project. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 310.

CEE 412 High-Speed Rail Engineering credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/412/)
Development, engineering, design and construction of high-speed rail (HSR) passenger transport systems with particular emphasis on the unique engineering elements of HSR technology. Key elements of HSR systems and subsystems including: core systems (trains, power, signal, communication and control), track system and civil infrastructure (earthwork, bridges, viaducts and tunnels). Also covered are basic design and construction of HSR stations and rolling stock maintenance facilities. 3 undergraduate hours. 4 graduate hours.

CEE 415 Geometric Design of Roads credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/415/)
Highway classification; analysis of factors in developing a transportation facility; highway geometrics design and safety standards; roadway design element; human factors in roadway design; roadway location principles; intersection, interchange, and ramp design; drainage factors. 4 undergraduate hours. 4 graduate hours. Prerequisite: CEE 310.

CEE 416 Traffic Capacity Analysis credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/416/)
Fundamentals of traffic engineering; analysis of traffic stream characteristics; capacity of urban and rural highways; design and analysis of traffic signals and intersections; traffic control; traffic impact studies; traffic accidents. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 310.

CEE 417 Urban Transportation Planning credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/417/)
Same as UP 430. See UP 430.

CEE 418 Public Transportation Systems credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/418/)
Transit systems basics, demand issues, design standards, economic and sustainability implications. Transit service planning for shuttle, corridor, and network systems, hybrid hierarchical systems, paratransit and demand-responsive services. Management of transit systems, fleet operations, and crew scheduling. Operational issues, vehicle movement, headway and schedule control. 3 undergraduate hours. 4 graduate hours. Prerequisite: CEE 310 or equivalent.

CEE 419 Transportation Economics credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/419/)
Uses analytical and numerical models of decision-making to analyze phenomena such as traffic congestion, apply vocabulary and techniques from economics, and to explore ways to provide and regulate transportation. Students will write Python code for optimization, simulation, visualization and choice modelling. Engineers will gain from learning to think rigorously about the fact that the humans in the systems they design make their own choices. 4 undergraduate hours. 4 graduate hours. Prerequisite: CEE 310.

CEE 420 Construction Productivity credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/420/)
Application of scientific principles to the measurement and forecasting of productivity in construction engineering. Conceptual and mathematical formulation of labor, equipment, and material factors affecting productivity. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 320.

CEE 421 Construction Planning credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/421/)
Project definition; scheduling and control models; material, labor, and equipment allocation; optimal schedules; project organization; documentation and reporting systems; management and control. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 320.

CEE 422 Construction Cost Analysis credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/422/)
Application of scientific principles to costs and estimates of costs in construction engineering; concepts and statistical measurements of the factors involved in direct costs, general overhead costs, cost markups, and profits; the fundamentals of cost recording for construction cost accounts and cost controls. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 320.

CEE 432 Stream Ecology credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/432/)
Description of physical, chemical, and biological characteristics in streams and rivers including an integrated treatment of the environmental factors affecting the composition and distribution of biota; emphasizes the application of ecological principles in aquatic ecosystem protection and management. Same as IB 450. 3 undergraduate hours. 3 or 4 graduate hours.

CEE 433 Water Technology and Policy credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/433/)
This course will cover technical and social concepts of water and wastewater treatment; water resources; water law, policy, and economics; and water in integrated systems. Emphasis will be on the intersection between engineering and policy. Communication is an important element of this course: engineers will learn to "speak" policy via writing assignments, multimedia presentation, and briefings. Course activities include lecture, discussion, presentations, and field trips. 3 undergraduate hours. 4 graduate hours. Prerequisite: CEE 340 or CEE 350.

CEE 434 Environmental Systems I credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CEE/434/)
Introduction to the concepts and applications of environmental systems analysis. Application of mathematical programming and modeling to the design, planning, and management of engineered environmental systems, regional environmental systems, and environmental policy. Economic analysis, including benefit-cost analysis and management strategies. Concepts of tradeoff, non-inferior sets, single- and multi-objective optimization. Practical application to case studies to convey an understanding of the complexity and data collection challenges of actual design practice. 3 undergraduate hours. 3 graduate hours. Prerequisite: CEE 201 and CEE 330.

CEE 435 Public Health Engineering credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/435/)
Aimed at building a next generation of engineers who are able to incorporate the principles of public health in all engineering designs. The course starts with the basic principles of epidemiology (types, methods, models and limitations). Next, the course covers various modes of environmental toxicity and the models to represent these modes. The course then covers infectious diseases, various models to represent their spread, the effect of environmental factors and the role of public health in breaking the chain of infection. The course also discusses environmental, social and behavioral factors in public health (e.g. environmental tobacco smoke including E-vaping) in the prevalence of chronic diseases. Finally, we cover the topics on public health risk assessment and management. In every aspect of the topic, the role of engineering in solving the problems of public health is explored and emphasized. 3 undergraduate hours. 4 graduate hours. Prerequisite: CEE 330.

CEE 437 Water Quality Engineering credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CEE/437/)
Fundamental theory underlying the unit processes utilized in the treatment of water for domestic and industrial usage, and in the treatment of domestic and industrial wastewaters. 3 undergraduate hours. 3 graduate hours. Prerequisite: CEE 330; credit or concurrent registration CEE 331 or TAM 335.

CEE 438 Science & Environmental Policy credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CEE/438/)
Environmental treaties, the role of science and scientists in managing the national and global environment, effective science communication, scientific assessments, and the use of quantitative tools to inform policy decisions. 3 undergraduate hours. 3 graduate hours. Prerequisite: CEE 202 or IE 300, STAT 400, or equivalent introductory probability and statistics course. Senior and Graduate students.

CEE 440 Fate Cleanup Environ Pollutant credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/440/)
Investigation of the regulatory and technical issues affecting solid and hazardous waste management, with an emphasis on the principles governing the transport, fate, and remediation of solid and hazardous waste in the subsurface, including advection, dispersion, sorption, interphase mass transfer, and transformation reactions. 4 undergraduate hours. 4 graduate hours. Prerequisite: CEE 330.

CEE 441 Air Pollution Sources, Transport and Control credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/441/)
A design approach to air pollution fate and control for the protection of human health and welfare. Air pollution transport and deposition. Gaussian plume, chemical mass balance models. Gaseous and particulate air pollutant physical and chemical properties and control. Evaluation of air pollutant emission control strategies based on cost and regulatory requirements for compliance with regulatory ambient air quality standards. 4 undergraduate hours. 4 graduate hours. Prerequisite: CEE 331 or equivalent; CEE 202 or equivalent.

CEE 442 Environmental Engineering Principles, Physical credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/442/)
Analysis of the physical principles which form the basis of many water and air quality-control operations; sedimentation, filtration, inertial separations, flocculation, mixing, and principles of reactor design; energy flows, thermal pollution, earth's energy balance. 4 undergraduate hours. 4 graduate hours. Prerequisite: CEE 437.

CEE 443 Env Eng Principles, Chemical credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/443/)
Application of principles of chemical equilibrium and chemical kinetics to air and water quality. Thermodynamics, kinetics, acid-base chemistry, complexation, precipitation, dissolution, and oxidation-reduction. Applications. 4 undergraduate hours. 4 graduate hours. Prerequisite: CEE 330.

CEE 444 Env Eng Principles, Biological credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/444/)
Application of principles of biochemistry and microbiology to air and water quality, wastes, and their engineering management; biological mediated changes in water and in domestic and industrial wastewater. 4 undergraduate hours. 4 graduate hours. Prerequisite: CEE 443 or CHEM 360.

CEE 447 Atmospheric Chemistry credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/447/)
Same as ATMS 420. See ATMS 420.

CEE 449 Environmental Engineering Lab credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CEE/449/)
Traditional analysis tools and techniques in analysis, control, and design of natural and engineered environmental systems including air, water, wastewater, solid and hazardous waste, and ecological systems. 3 undergraduate hours. 3 graduate hours. Prerequisite: CEE 330.

CEE 450 Surface Hydrology credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CEE/450/)
Descriptive and quantitative hydrology dealing with the distribution, circulation, and storage of water on the earth's surface; principles of hydrologic processes; methods of analysis and their applications to engineering and environmental problems. 3 undergraduate hours. 3 graduate hours. Prerequisite: CEE 350.

CEE 451 Environmental Fluid Mechanics credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CEE/451/)
Incompressible fluid mechanics with particular emphasis on topics in analysis and applications in civil engineering areas; principles of continuity, momentum and energy, kinematics of flow and stream functions, potential flow, laminar motion, turbulence, and boundary-layer theory. 3 undergraduate hours. 3 graduate hours. Prerequisite: CEE 331 or TAM 335.

CEE 452 Hydraulic Analysis and Design credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CEE/452/)
Hydraulic analysis and design of engineering systems: closed conduits and pipe networks; hydraulic structures, including spillways, stilling basins, and embankment seepage; selection and installation of hydraulic machinery. 3 undergraduate hours. 3 graduate hours. Prerequisite: CEE 331 or TAM 335.

CEE 453 Urban Hydrology and Hydraulics credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/453/)
Hydraulic analysis and design of urban, highway, airport, and small rural watershed drainage problems; discussion of overland and drainage channel flows; hydraulics of storm-drain systems and culverts; determination of design flow; runoff for highways, airports, and urban areas; design of drainage gutters, channels, sewer networks, and culverts. 4 undergraduate hours. 4 graduate hours. Prerequisite: CEE 350.

CEE 457 Groundwater credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CEE/457/)
Physical properties of groundwater and aquifers, principles and fundamental equations of porous media flow and mass transport, well hydraulics and pumping test analysis, role of groundwater in the hydrologic cycle, groundwater quality and contamination. 3 undergraduate hours. 3 graduate hours. Prerequisite: CEE 350 and CEE 331 or TAM 335.

CEE 458 Water Resources Field Methods credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/458/)
Scientific principles of measurement technologies and protocols used for water-resources measurements and experimental design of field-scale water-resources and environmental studies. Planning field studies; instruments and protocols for surface-water, and water-quality sampling; description of data quality. One-half-day laboratory field trips to streamflow monitoring stations and groundwater monitoring wells nearby. 4 undergraduate hours. 4 graduate hours. Prerequisite: CEE 350.

CEE 459 Ecohydraulics credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/459/)
Interactions between hydraulic, ecological, and geomorphic processes in river environments at a wide range of both spatial and temporal scales. Draws upon and synthetize fundamental concepts from biology, ecology, fluid mechanics and morphodynamics, to apply them to truly interdisciplinary problems. Such an approach, coupled with hands-on experience involving planning, conducting and analyzing hands-on experiments at the Ven Te Chow Hydrosystems Laboratory and field surveys on local natural waters will provide the students with a broad perspective on the interconnections between physical and ecological systems. Students will apply their knowledge of fundamental processes to assess complex problems involving monitoring, management, conservation and restoration of ecosystems. Same as GGIS 459. 4 undergraduate hours. 4 graduate hours.

CEE 460 Steel Structures I credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CEE/460/)
Introduction to the design of metal structures; behavior of members and their connections; theoretical, experimental, and practical bases for proportioning members and their connections. 3 undergraduate hours. No graduate credit. Prerequisite: CEE 360.

CEE 461 Reinforced Concrete I credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CEE/461/)
Strength, behavior, and design of reinforced concrete members subjected to moments, shear, and axial forces; emphasis on the influence of the material properties on behavior. 3 undergraduate hours. No graduate credit. Prerequisite: CEE 360.

CEE 462 Steel Structures II credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/462/)
Metal members under combined loads; connections, welded and bolted; moment-resistant connections; plate girders, conventional behavior, and tension field action. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 460.

CEE 463 Reinforced Concrete II credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/463/)
Strength, behavior, and design of indeterminate reinforced concrete structures, with primary emphasis on slab systems; emphasis on the strength of slabs and on the available methods of design of slabs spanning in two directions, with or without supporting beams. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 461.

CEE 465 Design of Structural Systems credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CEE/465/)
Examination of the whole structural design process including definition of functional requirements, selection of structural scheme, formulation of design criteria, preliminary and computer-aided proportioning, and analysis of response, cost, and value. 3 undergraduate hours. No graduate credit. Prerequisite: Credit in either CEE 460 or CEE 461 with concurrent registration in the other.

CEE 467 Masonry Structures credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/467/)
Analysis, design, and construction of masonry structures. Mechanical properties of clay and concrete masonry units, mortar, and grout. Compressive, tensile, flexural, and shear behavior of masonry structural components. Strength and behavior of unreinforced bearing walls. Detailed design of reinforced masonry beams, columns, structural walls with and without openings, and complete lateral-force resisting building systems. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 461.

CEE 468 Prestressed Concrete credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/468/)
Strength, behavior, and design of prestressed reinforced concrete members and structures, with primary emphasis on pretensioned, precast construction; emphasis on the necessary coordination between design and construction techniques in prestressing. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 461.

CEE 469 Wood Structures credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/469/)
Mechanical properties of wood, stress grades, and working stresses; effects of strength-reducing characteristics, moisture content, and duration of loading and causes of wood deterioration; glued-laminated timber and plywood; behavior and design of connections, beams, and beam-columns; design of buildings and bridges; other structural applications: trusses, rigid frames, arches, and pole-type buildings; prismatic plates and hyperbolic paraboloids. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 460 or CEE 461.

CEE 470 Structural Analysis credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/470/)
Direct stiffness method of structural analysis; fundamentals and algorithms; numerical analysis of plane trusses, grids and frames; virtual work and energy principles; finite element method for plane stress and plane strain. 4 undergraduate hours. 4 graduate hours. Credit is not given for both CEE 470 and ME 471. Prerequisite: CEE 360.

CEE 471 Structural Mechanics credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/471/)
Beams under lateral load and thrust; beams on elastic foundations; virtual work and energy principles; principles of solid mechanics, stress and strain in three dimensions; static stability theory; torsion; computational methods. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: MATH 285 and TAM 251.

CEE 472 Structural Dynamics I credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/472/)
Analysis of the dynamic response of structures and structural components to transient loads and foundation excitation; single-degree-of-freedom and multi-degree-of-freedom systems; response spectrum concepts; simple inelastic structural systems; systems with distributed mass and flexibility. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 360, MATH 285, and TAM 212.

CEE 473 Wind Effects on Structures credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/473/)
This course treats fundamental aspects of wind engineering – defined here as the salient characteristics of the wind and its effects on the built and natural environment. Students are expected to understand the behavior of wind relevant to wind engineering, the mechanisms for induced loading from wind, and associated structural responses. Specific topics include prediction of wind speeds for structural design, the atmospheric boundary layer, bluff-body aerodynamics, dynamic analysis, use of wind tunnels, wind loading on low-rise and high-rise buildings, wind loading on bridges, windstorm damage and risk. As the wind is a stochastic process, simulation of large data sets of wind speed, wind-induced pressure, and structural responses are required. Treatment of wind engineering topics for structural design for wind in codes and standards such as those in ASCE 7 are discussed. Analysis of field collected data required. 4 undergraduate hours. 4 graduate hours. Prerequisite: CEE 202 or STAT 400, TAM 335, and CEE 360.

CEE 474 Mechanics of Additive Manufacturing credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/474/)
Introduction to process physics for additive manufacturing (AM); Basic materials science for AM, cement-based materials, polymer-based materials. Fundamental mechanics principles involved in layered additive manufacturing; Mathematical models for AM, transport phenomena and flow modeling, curing and property evolution, residual stresses and fatigue effects; Introduction to the Role of Robotics, Machine Learning and Data Science in modern AM. 3 undergraduate hours. 4 graduate hours. Prerequisite: MSE 280, or CEE 300, or ME 330, or CEE 471, or consent of instructor.

CEE 483 Soil Mechanics and Behavior credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/483/)
Composition and structure of soil; water flow and hydraulic properties; stress in soil; compressibility behavior and properties of soils; consolidation and settlement analysis; shear strength of soils; compaction and unsaturated soils; experimental measurements. 4 undergraduate hours. 4 graduate hours. Prerequisite: CEE 380.

CEE 484 Applied Soil Mechanics credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/484/)
Application of soil mechanics to earth pressures and retaining walls, stability of slopes, foundations for structures, excavations; construction considerations; instrumentation. 3 or 4 undergraduate hours. 4 graduate hours. Prerequisite: Credit or Concurrent registration in CEE 483.

CEE 490 Computer Methods credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/490/)
Computer methods and their programming for solving common types of differential equations arising in civil and environmental engineering (hyperbolic, parabolic, and elliptic equations, with emphasis on prototypical cases, such as the convection-diffusion equation, as well as Laplace's / Poisson's equation). Exposure to state-of-the-art open-source numerical methods libraries. The course enables students in civil and environmental engineering to develop high-performance and high-purpose codes in these open-source frameworks for their research problems in an efficient way. 3 undergraduate hours. 4 graduate hours. Prerequisite: CEE 360 and TAM 335.

CEE 491 Decision and Risk Analysis credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/491/)
Development of modern statistical decision theory and risk analysis, and application of these concepts in civil engineering design and decision making; Bayesian statistical decision theory, decision tree, utility concepts, and multi-objective decision problems; modeling and analysis of uncertainties, practical risk evaluation, and formulation of risk-based design criteria, risk benefit trade-offs, and optimal decisions. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 202.

CEE 492 Data Science for Civil and Environmental Engineering credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/492/)
Students will learn to leverage data to study civil and environmental engineering problems, identify patterns, and make actionable insights. This course includes training in computational thinking and exploratory data analysis; data processing techniques including singular value decomposition, principal component analysis, and Fourier and wavelet transforms; and machine learning techniques including k-means, classification trees, neural networks, and neural differential equations. Students are required to bring a laptop computer to class. 3 undergraduate hours. 4 graduate hours. Prerequisite: CS 101; CEE 202; and CEE 300, CEE 330, or CEE 360.

CEE 493 Sustainable Design Eng Tech credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/493/)
Quantitative sustainable design (QSD) and how to navigate engineering decision-making. Economic (life cycle costing, techno-economic assessment) and environmental (life cycle assessment, LCA) sustainability assessments, and how to link these tools to design decisions under uncertainty. Design of engineered technologies individually and in teams, with special attention to water infrastructure and bioenergy production. Semester-long design project that includes components from two of the following three CEE sub-disciplines: environmental, hydraulic, geotechnical. 4 undergraduate hours. 4 graduate hours. Prerequisite: CEE 340 or Graduate Standing.

CEE 495 Professional Practice credit: 0 Hours. (https://courses.illinois.edu/schedule/terms/CEE/495/)
Series of lectures by outstanding authorities on the practice of civil engineering and its relations to economics, sociology, and other fields of human endeavor. 0 undergraduate hours. 0 graduate hours. Approved for S/U grading only.

CEE 497 Independent Study credit: 1 to 16 Hours. (https://courses.illinois.edu/schedule/terms/CEE/497/)
Individual investigations or studies of any phase of civil engineering selected by the student and approved by the department. 1 to 4 undergraduate hours. 1 to 16 graduate hours. May be repeated. Prerequisite: Consent of instructor.

CEE 498 Special Topics credit: 1 to 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/498/)
Subject offerings of new and developing areas of knowledge in civil and environmental engineering intended to augment the existing curriculum. See Class Schedule or departmental course information for topics and prerequisites. 1 to 4 undergraduate hours. 1 to 4 graduate hours. May be repeated in the same or separate terms if topics vary.

CEE 502 Advanced Cement Chemistry credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/502/)
Advanced topics in chemistry of portland cement, chemistry and microstructure of cements, chemical reactions that lead to hardening, chemistry and microstructure of hydrated cements, effects of chemical and mineral admixtures, and chemical issues involved in the engineering behavior of the cements. Prerequisite: CEE 401.

CEE 503 Constr Matls Deterioration credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/503/)
Fundamental processes for deterioration mechanisms of infrastructure materials: corrosion of metals including thermodynamics, kinetics, passivity and rate measurements; degradation of cement-based materials including freezing and thawing, ASR, sulfate attack, fire attack and steel reinforcement corrosion; degradation of organic materials including photo-oxidation and ageing. A research literature review exercise related to material degradation. Prerequisite: CEE 401 or CEE 405.

CEE 504 Infrastructure NDE Methods credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/504/)
Fundamental bases and methodologies of non-destructive evaluation (NDE) techniques for infrastructure materials: methods for steel including ultrasound, radiography, eddy-current and magnetic-particles; methods for concrete including sounding, semi-destructive, ultrasound, seismic, impact-echo, impulse-response, ground-penetrating radar, infrared-thermography, and nuclear; planning and carrying out NDE structural investigations. Weekly laboratory sessions, a research paper, and an associated presentation related to NDE required. Prerequisite: CEE 401 or CEE 405.

CEE 505 Transportation Soil Stabilization credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/505/)
Aims to introduce theory, techniques and applications of chemical and mechanical stabilization of soils and aggregates used in construction and maintenance of roads, railroads, and airfields. Chemical stabilization includes use of lime, cement, fly ash, and emulsions as compaction aids to soils, as binders and water repellents, to treat weak soils and aggregates. Mechanical stabilization deals with the use of non-biodegradable reinforcement, such as geosynthetics and fibers, to improve strength and stiffness. 4 graduate hours. 4 professional hours. Prerequisite: CEE 483.

CEE 506 Pavement Design II credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/506/)
Development of layered elastic and plate theory models for area analysis of pavement systems; performance prediction of flexible and rigid pavements; characterization of aircraft traffic; design of airfield pavement systems; construction material fatigue and failure criteria (strength theory and fracture mechanics); industrial floor and reinforced concrete slab design; climatic factors. Prerequisite: CEE 406.

CEE 508 Pavement Evaluation and Rehab credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/508/)
Concepts and procedures for condition survey assessment; pavement evaluation by nondestructive testing and data analysis (roughness, friction, structural capacity, internal flaws, and thickness measurements): destructive testing, maintenance strategies, rehabilitation techniques of pavement systems for highways and airfields, cost analysis, preservation techniques. Prerequisite: CEE 406.

CEE 509 Transportation Soils credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/509/)
Occurrence and properties of surficial soils, soil classification systems, soil variability; subgrade evaluation procedures, repeated loading behavior of soils; soil compaction and field control; soil moisture, soil temperature, and frost action; soil trafficability and subgrade stability for transportation facility engineering. Prerequisite: CEE 483.

CEE 511 Railway Terminal Design and Operations credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/511/)
Geometric design, operations planning and optimization of terminal facilities required for the railway network to function as an efficient freight transportation system. Design of classification yards, intermodal facilities and bulk terminals, and organization of these facilities into an optimal freight transportation network. Horizontal yard track layout and turnout configurations; railcar rolling resistance, speed control and vertical profile design and simulation; railcar distribution, locomotive and crew assignment models. Design project covering a typical railroad terminal development. Prerequisite: CEE 408 or CEE 409 or CEE 411.

CEE 512 Logistics Systems Analysis credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/512/)
Planning, design and operations of complex logistics systems: logistics costs; production, transportation and distribution systems; lot-sizing; traveling salesman problem (TSP) and vehicle routing problem (VRP); transshipments; facility location problem; supply chain management and inventory control; order instability; analytical methods and practical solution techniques. Prerequisite: CEE 310 and IE 310.

CEE 515 Traffic Flow Theory credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/515/)
Fundamentals of traffic flow, traffic flow characteristics, statistical distributions of traffic flow parameter, traffic stream models, car following models, continuum follow models, shock wave analysis, queuing analysis, traffic flow models for intersections, network flow models and control, traffic simulation. Prerequisite: CEE 416 and knowledge of probability and statistics.

CEE 517 Traffic Signal Systems credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/517/)
Theory and application of concepts in traffic signal systems control, signal timing design, signal cabinet components, signal controllers, traffic signal theory and control, vehicle detection technologies, communication methods, interconnected rail-highway crossing signals, signal coordination, and signal systems network. Field trips to observe or utilize equipment in the Traffic Operations Lab (TOL) in ATREL or similar facilities. Prerequisite: CEE 416.

CEE 521 Building Information Modeling credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/521/)
Targeted to introduce and explore the application of Building Information Modeling (BIM) both as a product and a process. BIM is an approach to building and infrastructure project delivery in which a digital representation of the building process is used to facilitate the exchange and interoperability of information. Successful implementation of BIM generates significant benefits, including improved design quality, reduction in design errors, improved field productivity, reduction in conflicts and their associated changes, and finally reduction in construction cost and time. 4 graduate hours. 4 professional hours. Prerequisite: CEE 420, CEE 421 and CEE 422 are recommended.

CEE 522 Visual Data Analytics credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/522/)
An introduction to 2D and 3D visual sensing for data acquisition and analysis of buildings and civil infrastructure systems. It is intended mainly for graduate students who want to acquire basic understanding of the theoretical concepts as well as application of computer vision and image processing for sensing buildings, civil infrastructure systems and sustainable construction operations. Prerequisite: CEE 420, CEE 421 and CEE 422 recommended.

CEE 524 Construction Law credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/524/)
Legal aspects of the construction process and the potential liability that engineers can incur through the design, and post-construction processes. Organization and operation of the American court system, contact formation, defenses, remedies, and typical areas of dispute, and design services contracts, torts, product liability, agency, business organizations, intellectual property, and risk managements. Mock trial of a recent construction-related case with the class serving as plaintiffs and defendants. Prerequisite: CEE 420, CEE 421, and CEE 422.

CEE 525 Construction Case Studies credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/525/)
Case studies of bridges, tunnels, buildings, transportation systems, heavy industrial construction, waterways, and marine structures in the context of construction engineering and management. Research, a team-oriented term project, presentations, and discussions in studio-style format. Prerequisite: Two of CEE 420, CEE 421, and CEE 422.

CEE 526 Construction Optimization credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/526/)
Optimizing construction project decisions during the planning and construction phases including the optimization of bid decisions; contractor and material supplier selection; site layout planning; tradeoffs among construction time, cost and quality; repetitive construction scheduling; resource allocation and leveling; and building sustainability. Prerequisite: One of CEE 420, CEE 421 or CEE 422.

CEE 528 Construction Data Modeling credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/528/)
State-of-the-art research and literature in the construction data modeling domain. Fundamental techniques of construction data modeling; existing construction data representation approaches and specifications for the architecture, engineering, and construction domain; building information models; capabilities and limitation of data process models and representation approaches and techniques. Prerequisite: Two of CEE 420, CEE 421, CEE 422.

CEE 534 Surface Water Quality Modeling credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/534/)
Mathematical modeling of the movement and fate of pollutants and other substances in streams, lakes, and other natural water bodies. Development of one-, two-, and three-dimensional differential conservation equations, one-, two-, and three-dimensional steady-state and transient solutions. Finite difference, finite element, and finite particle methods. Lagrangian and Eulerian formulations, diffusion and dispersion tensors, numerical dispersion, and solution stability. Kinetic relationships describing important physical, chemical, and biochemical water constituent transformation phenomena. Field or laboratory experiment in model calibration and verification. Prerequisite: MATH 285, CEE 442, and CEE 451.

CEE 535 Environmental Systems II credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/535/)
Fundamental concepts of uncertainty, risk, and reliability applied to environmental and water resources decision making. Chance constraints, Markov and Monte Carlo modeling, geostatistics, unconditional and conditional simulation, genetic algorithms, neural networks, simulated annealing, and a review of relevant portions of basic probability and statistical theory. Many techniques are applied to a real-world environmental decision making problem initially developed in CEE 434. Prerequisite: CEE 202 and CEE 434.

CEE 537 Water Quality Control Proc I credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/537/)
Theory and basic design of processes used in water and wastewater treatment, including adsorption, ion exchange, chemical oxidation and reduction, disinfection, sedimentation, filtration, coagulation, flocculation, and chemical precipitation. Prerequisite: Credit or concurrent registration in CEE 442 and CEE 443.

CEE 538 Water Quality Control Proc II credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/538/)
Theory and its application for design and operation of processes used in water and wastewater treatment; emphasis is on biological treatment processes and related processes for gas transfer, sludge dewatering, sludge disposal, and solids separations. Prerequisite: CEE 442 and CEE 443; credit or concurrent registration in CEE 444.

CEE 540 Remediation Design credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/540/)
Evaluation and design of alternative treatment processes for hazardous waste sites contaminated with organic or metal wastes. Group design project due at the end of the term. Prerequisite: CEE 440.

CEE 543 Env Organic Chemistry credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/543/)
Molecular-scale processes that control the fate of organic contaminants in natural environments and engineered treatment systems, including partitioning between environmental phases (water, air, organic, and biological phases), sorption onto solids (soils, sediments, aerosol particles), and transformation reactions (chemical, photochemical, and biochemical). Emphasis on quantitative approaches for predicting contaminant fate using thermodynamic principles and molecular property descriptors. Prerequisite: CEE 443 or NRES 490.

CEE 544 Advanced Surface Science credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/544/)
The overall goal of this course is to provide an in-depth knowledge of surface science principles. The specific goals are to elaborate the classical theories, to identify their limitations from a fundamental level, and to provide the state-of-the-art extensions of classical theories, and alternative approaches based on recent literature. The course also seeks to provide students with state-of-the-art experimental approaches, and to provide a link between surface science and the student's research project or other interests, which is pursued through literature discussion in presentations and term paper. Prerequisite: CEE 442.

CEE 545 Aerosol Sampling and Analysis credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/545/)
Principles of sampling for particles and gases in the field of air pollution; instrumental techniques relevant to the design of sampling systems used in process control, ambient air monitoring, and laboratory experiments; methods of sample analysis and their limitations. Same as ATMS 535. Prerequisite: CEE 441.

CEE 549 Globalization of Water credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/549/)
This course focuses on water, food, and trade at the global scale. The course draws from hydrology, engineering, economics, causal inference, and complex systems analysis. Focus on global water resources, water footprints, network statistics, and causal inference. This class will enable graduate students to understand and contribute to research in this domain. Prerequisite: CEE 450.

CEE 550 Hydroclimatology credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/550/)
Application of deterministic and probabilistic concepts to simulate and analyze hydrologic systems; discussion of the theory and application of linear and nonlinear, lumped, and distributed systems techniques in modeling the various phases of the hydrologic cycle. Prerequisite: CEE 450.

CEE 551 Open-Channel Hydraulics credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/551/)
Advanced hydraulics of free surface flow in rivers and open channels; discussion of theory, analytical and numerical solution techniques, and their applications to gradually and rapidly varied nonuniform flows, unsteady flow, and flow in open-channel networks. Prerequisite: CEE 451.

CEE 552 River Basin Management credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/552/)
Multidisciplinary knowledge (hydrology, economics, systems engineering, etc.) and methodological skills (optimization, simulation, etc.) for river basic management. River basin characterization-natural and social features; water availability assessment based on hydrology, infrastructure, and policy; environmental flow requirements; water demand management and microeconomics theory; integrated river basic management modeling. Prerequisite: CEE 350 and CEE 434.

CEE 553 River Morphodynamics credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/553/)
River morphology and characteristics of river sediment. Response of alluvial and bedrock rivers to changes in sediment supply, hydrology, and tectonics. Numerical modeling of river morphodynamics in gravel and sand bed rivers and deltas. Same as GEOL 573. Prerequisite: TAM 335.

CEE 554 Hydrologic Variability credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/554/)
Advanced quantitative treatment of catchment hydrology, focusing on analysis of observed hydrologic and hydroclimatic variability, and their interpretation in terms of the underlying processes. Concepts of heterogeneity and variability, scale and scaling, process change and process interactions will be emphasized. Theoretical foundations of hydrologic applications, such as flood estimation, water balance analyses, hydrologic modeling and associated scale problems will be discussed in sufficient detail to prepare students to undertake advanced research and professional practice. Prerequisite: CEE 450.

CEE 555 Mixing in Environmental Flows credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/555/)
Physical processes involved in transport of pollutants by water; turbulent diffusion and longitudinal dispersion in rivers, pipes, lakes, and the ocean; diffusion in turbulent jets, buoyant jets, and plumes. Prerequisite: MATH 285 and TAM 335.

CEE 556 Hydrocomplexity credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/556/)
Application of complex system science to water cycle and related processes in the atmosphere, ecosystems, critical zone and human systems. The course covers analytical and data driven approaches for characterization and understanding of non-linear systems, feedbacks and causality, chaos and fractals, complex network science, and emergent behavior. The course emphasizes emerging research frontiers along with traditional foundations through analytical understanding of non-linear dynamical systems, and their identification and characterization from observations. Prerequisite: CEE 450.

CEE 557 Groundwater Modeling credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/557/)
Theory and application of numerical methods, finite differences and finite element, for solving the equations of groundwater flow and solute transport; transport of chemically reacting solutes; model calibration and verification. Prerequisite: CEE 457 and MATH 285.

CEE 558 Environmental Hydrodynamics: Modeling of Boundary-layer Flows in Rivers, Lakes and Oceans credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/558/)
Introduction to dynamics, control, and modeling of flows in natural aquatic environments in the presence of space and time variations in density stratification caused by temperature, salinity, and suspended particles. Tools include scaling, dimensional analysis and turbulent boundary-layer theory leading to integral methods for solving flows such as plumes, density currents, thermal pollution, lake stratification, air-entrainment in spillways and salt wedges in estuaries. Integral methods are used to obtain engineering solutions followed by numerical modeling of turbulent boundary-layer flows in rivers, lakes and oceans. Prerequisite: CEE 451.

CEE 559 Sediment Transport credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/559/)
Physical processes of transportation and deposition of sediment particles in liquid bodies with particular emphasis on fluvial sediment problems; sediment in desilting basins; reservoirs and delta formation; erosion; stable channel design; river morphology. Prerequisite: CEE 551.

CEE 560 Steel Structures III credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/560/)
Theories of ultimate behavior of metal structural members with emphasis on buckling and stability of members and frames; theory of torsion applied to beam torsion, lateral-torsional buckling, curved beams with emphasis on design criteria; post-buckling strength of plates and post-buckling versus column behavior. Prerequisite: CEE 462.

CEE 562 Highway Bridge Design credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/562/)
This course introduces current practices in highway bridge design. It provides students with the background to understand the American Association of State Highway and Transportation Officials (AASHTO) code. The course covers topics related the behavior, analysis, and design of bridge superstructure and substructure systems under various bridge loads. The course specifically addresses highway bridge types constructed using reinforced concrete, prestressed concrete, and steel. In addition, the course gets the students familiar with state-of-art methodologies adopted for bridge seismic retrofitting. This class will meet twice a week for 80 minutes per class. Prerequisite: CEE 460, CEE 461, CEE 472.

CEE 570 Finite Element Methods credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/570/)
Theory and application of the finite element method; stiffness matrices for triangular, quadrilateral, and isoparametric elements; two- and three-dimensional elements; algorithms necessary for the assembly and solution; direct stress and plate bending problems for static, nonlinear buckling and dynamic load conditions; displacement, hybrid, and mixed models together with their origin in variational methods. Same as CSE 551. Prerequisite: CEE 471 or TAM 551.

CEE 571 Computational Plates & Shells credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/571/)
Classical and first-order shear deformable plate and shell models: assumptions, applicability, valid boundary conditions, analytical solutions; finite element methods for plates and shells: convergence, instabilities, shear and membrane locking, mixed methods for plates and shells; implementation and verification of finite elements for plates and shells; buckling of plates and shells; boundary layer effects; introduction to high order hierarchical plates and shell models and to isogeometric analysis of shells. Same as CSE 554. Prerequisite: CEE 471 or TAM 551. Credit or current registration in CEE 570 Finite Element Methods or ME 471 Finite Element Analysis.

CEE 572 Earthquake Engineering credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/572/)
Source mechanisms, stress waves, and site response of earthquake shaking; effect on the built environment; nature of earthquake actions on structures; fundamental structural response characteristics of stiffness, strength, and ductility; representation of the earthquake input in static and dynamic structural analysis; modeling of steel and concrete structures under earthquake effects; outputs for safety assessment; comprehensive source-to-design actions project. Prerequisite: CEE 472.

CEE 573 Structural Dynamics II credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/573/)
Advanced concepts in structural dynamics and fundamentals of experimental structural dynamics. Modern system theory; data acquisition and analysis; digital signal processing; experimental model analysis theory and implementation; random vibration concepts; system identification; structural health monitoring and damage detection; pseudo-dynamic testing and model-based simulation; smart structures technology (e.g., smart sensors; passive, active, and semi-active control). Prerequisite: CEE 472.

CEE 574 Probabilistic Loads and Design credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/574/)
Application of probabilistic methods in describing and defining loads on structures with emphasis on the random fluctuation in time and space. Random vibration methods and applications to dynamic response of structures under wind and earthquake loads. Computer simulation of structural loads and responses. Probability-based safety criteria and review of current methods of selection of design loads and load combinations. Prerequisite: CEE 202 and CEE 472.

CEE 575 Fracture and Fatigue credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/575/)
Fatigue and fracture behavior of metallic structures and connections; fatigue and fracture mechanics theory; generation and use of laboratory data; background and application of international testing and assessment standards. Same as AE 521. Prerequisite: One of CEE 471, TAM 451, TAM 551.

CEE 576 Nonlinear Finite Elements credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/576/)
Nonlinear formulations in solid mechanics and nonlinear equation solving strategies; finite deformation (hyperelasticity) elastostatics and elastodynamics, semi-discrete weighted residual formulations, implicit and explicit time-stepping algorithms and stability analysis; theory of mixed finite element methods, strain-projection methods, and stabilized methods; mixed methods for nonlinear coupled-field problems. Same as CSE 552. Prerequisite: CEE 471 or TAM 445; CEE 470 or ME 471.

CEE 577 Computational Inelasticity credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/577/)
Theoretical foundations of inelasticity and advanced nonlinear material modeling techniques; constitutive models for inelastic response of metals, polymers, granular materials, biomaterials. Phenomenological models of viscoelasticity, viscoplasticity, elastoplasticity, porous plasticity and cyclic plasticity. Small-strain and finite-strain numerical implementation and code development. Same as CSE 553. Prerequisite: CEE 471 or TAM 551; CEE 570 or ME 471.

CEE 578 Structural Design Optimization credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/578/)
Covers the fundamental theory, classic numerical methods, modern techniques, and practical applications of structural optimization to engineering design problems, such as large-scale civil structures and mechanical systems. We will also introduce the modern topology optimization methods together with the application to material and structural systems. Students will also be introduced with rapid prototyping and 3D printing techniques. Also features a project, which will use those state-of-the-art techniques and methods, as well as practical design optimization problems from various engineering industries. Prerequisite: CEE 470.

CEE 580 Excavation and Support Systems credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/580/)
Classical and modern earth pressure theories and their experimental justification; pressures and bases for design of retaining walls, bracing of open cuts, anchored bulkheads, cofferdams, tunnels, and culverts. Prerequisite: Credit or concurrent registration in CEE 484.

CEE 581 Dams, Embankments, and Slopes credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/581/)
Fundamentals of static and seismic slope stability and shear strength; seepage in composite sections and anisotropic materials; methods of stability analyses; mechanism of failure of natural and man-made slopes; compaction; field observations. Prerequisite: CEE 483 - Applied Soil Mechanics.

CEE 582 Consolidation of Clays credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/582/)
Elastic solutions relevant to soil mechanics; permeability; general application of Terzaghi's theory of one-dimensional consolidation; advances in consolidation theories; mechanism of volume change; delayed and secondary compressibility and creep; theory of three-dimensional consolidation and solutions; radial flow and design of sand drains; analysis and control of settlement. Prerequisite: CEE 483.

CEE 583 Shear Strength of Soils credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/583/)
Physico-chemical properties of soils; fabric and structure of soil; mechanism of shearing resistance; residual shear strength of overconsolidated clays and clay shales; long-term shear strength of overconsolidated clays; Hvorslev shear strength parameters; undrained shear strength of clays. Prerequisite: CEE 483.

CEE 585 Deep Foundations credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/585/)
Ultimate capacities and load-deflection of piles and drilled shafts subjected to compressive loads, tensile loads, and lateral loads; effects of duration of load, soil-structure interaction; two- and three-dimensional analysis of pile groups with closely-spaced piles; effects of installation; inspection of deep foundations and full-scale field tests. Prerequisite: CEE 484.

CEE 586 Rock Mechanics and Behavior credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/586/)
Rock classification, stress and strain, elastic and inelastic deformation, failure criteria, rock-fluid interaction, poroelasticity, fluid flow in rock, thermal effect on rock deformation, geo-energy applications. Prerequisite: CEE 483 and TAM 451.

CEE 587 Applied Rock Mechanics credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/587/)
Application of rock mechanics to engineering problems; shear strength of rock masses; dynamic and static stability of rock slopes; deformability of rock masses; design of pressure tunnel linings and dam foundations; controlled blasting and blasting vibrations; tunnel support; machine tunneling; design and construction of large underground openings; field instrumentation. Prerequisite: CEE 586.

CEE 588 Geotechnical Earthquake Engrg credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/588/)
Seismic hazard analysis, cyclic response of soils and rock; wave propagation through soil and local site effects; liquefaction and post liquefaction behavior, seismic soil-structure of foundations and underground structures, seismic design of retaining walls, underground structures and tunnels. Construction and machine vibrations. Blasting. Prerequisite: CEE 472 and CEE 483.

CEE 589 Computational Geomechanics credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/589/)
Numerical modeling, multi-phase domain equations, constitutive modeling of soils and rock, continuum and discrete element modeling. Upper and lower bound limit analysis methods. Simulation of soil-structure interaction problems and construction activities. Prerequisite: CEE 483. Recommended: one of AE 420, CEE 470, CSE 451, or ME 471.

CEE 590 Geotechnical Field Measurement credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/590/)
Discussion of observational method in geotechnical engineering. Historical, theoretical, experimental, and empirical development of in-situ tests and instrumentation in geotechnical engineering. Practical applications and limitation of field testing devices and instruments. Interpretation of test results and measurements for geotechnical site characterization. Discussion of data acquisition systems and data management. Introduction of emerging technologies in field testing and instrumentation. Prerequisite: CEE 483 and CEE 484.

CEE 591 Reliability Analysis credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/591/)
Introduction to applied probability theory and random processes, Bayesian analysis of model uncertainties. Formulation of reliability for components and systems. Exact solutions for special cases. Approximate solutions by second-moments, first- and second-order reliability methods (FORM and SORM), the response surface method, simulation methods including importance sampling techniques. Reliability-based optimal design and probabilistic design codes. Time- and space-variant reliability formulations. Prerequisite: CEE 491.

CEE 592 Sustainable Urban Systems credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/592/)
Fundamental concepts of sustainability and resilience in urban systems, including the complex interactions among human, engineered, and natural systems. Project-based format, focusing on real-world problems solicited from government agencies, industry, and non-governmental organizations in one or more partnering cities. Students work in multidisciplinary teams with faculty advisors from multiple departments and colleges. Same as NRES 592 and UP 576. Prerequisite: One of ATMS 421, CEE 491, NRES 439, UP 456, UP 480, or equivalent course related to sustainable urban systems; and one of NRES 454, UP 418, GEOG 480, or equivalent course related to geographic information systems (GIS).

CEE 593 Tunneling in Soil and Rock credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/593/)
History of development of tunneling design and methods. Relationship of geology on anticipated ground response to tunneling. Study of tunneling methods unique to tunnels in soil, tunnels in rock, caverns in soils and caverns in rock. Analysis approaches for tunnels in soils and rock. Geotechnical Baselines report and other risk allocation tools for tunnel construction. Case histories of tunneling projects. The course lectures will be scheduled for twice a week for 80 minutes each class during a 16 week semester. Prerequisite: CEE 483 required. Credit or concurrent enrollment in CEE 484 is required.

CEE 595 Seminar credit: 0 to 1 Hours. (https://courses.illinois.edu/schedule/terms/CEE/595/)
Discussion of current topics in civil and environmental engineering and related fields by staff, students, and visiting lecturers. Approved for S/U grading only. May be repeated.

CEE 597 Independent Study credit: 1 to 16 Hours. (https://courses.illinois.edu/schedule/terms/CEE/597/)
Individual investigations or studies of any phase of civil engineering selected by the student and approved by the adviser and the staff member who will supervise the investigation. May be repeated. Prerequisite: Consent of instructor.

CEE 598 Special Topics credit: 1 to 4 Hours. (https://courses.illinois.edu/schedule/terms/CEE/598/)
Subject offerings of new and developing areas of knowledge in civil and environmental engineering intended to augment the existing curriculum. See Class Schedule or departmental course information for topics and prerequisites. May be repeated in the same or separate terms if topics vary.

CEE 599 Thesis Research credit: 0 to 16 Hours. (https://courses.illinois.edu/schedule/terms/CEE/599/)
Approved for S/U grading only. May be repeated in the same term or in separate terms.