Chemistry—CEM

938 Analytical Chemistry Seminar
Fall, Spring. 1(1-0) A student may earn a maximum of 3 credits in all enrollments for this course. R: Open only to graduate students in College of Natural Science or College of Engineering. Advances in analytical chemistry reported by graduate students, faculty, and guest lecturers.

956 Selected Topics in Organic Chemistry
Fall, Spring. 1 to 3 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Open only to graduate students in College of Natural Science or College of Engineering. Heterocyclic and organometallic chemistry, natural products, photochemistry, free radicals, or reaction mechanisms.

958 Organic Chemistry Seminar
Fall, Spring. 1(1-0) A student may earn a maximum of 2 credits in all enrollments for this course. R: Open only to graduate students in College of Natural Science or College of Engineering. Advances in organic chemistry reported by graduate students.

971 Emerging Topics in Chemistry
Fall, Spring. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to doctoral students in the Chemistry or Chemical Physics major. Discussion of a research topic of emerging interest in chemistry. Preparation of a proposal for funding of research.

987 Selected Topics in Physical Chemistry I
Fall. 1 to 3 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to doctoral students or approval of department. Topics such as kinetics and photochemistry, macromolecular and surface chemistry, molecular spectroscopy, electronic and magnetic properties of matter, or applications of statistical mechanics to chemical problems.

991 Quantum Chemistry and Statistical Thermodynamics I
Fall. 3(3-0) R: Open only to graduate students in College of Natural Science or College of Engineering. Principles and applications of quantum chemistry. Partition functions, spectroscopic measurements, and thermodynamic applications.

101 Elementary Chinese I
Fall. 5(5-0) Not open to students with credit in CHS 112. Pronunciation, writing system, and basic vocabulary and sentence patterns, with emphasis on conversation.

102 Elementary Chinese II
Spring. 5(5-0) P.M.: (CHS 101) Not open to students with credit in CHS 105. Further work on conversation, character writing, and comprehension, with increasing emphasis on vocabulary building and grammar.

402 Fourth-Year Chinese II
Spring. 3(3-0) P.M.: (CHS 401) Further reading, discussion and writing based on original materials, including classical texts of broad cultural interest.

128 Introduction to Environmental Engineering
Fall, Spring. 3(3-0) P.M.: (CEM 141 or CEM 151 or LBS 171) and (MTH 132 or concurrently or MTH 152H or concurrently or LBS 118 or concurrently) Elements of hydrology. Groundwater and surface water supply and contamination. Treatment systems for drinking water, wastewater, air, and solid and hazardous waste. Noise and radiation pollution.
305 Introduction to Structural Analysis and Design
Fall, Spring. 4(3-2) P:M: (MSM 211) R: Open only to juniors or seniors in the Department of Civil and Environmental Engineering. Analysis and design of structural systems. Loads estimation and placement. Structural analysis theory. Manual and computer analysis methods and validation of results from computer analysis methods. Proportioning of structural members in steel and reinforced concrete. Applications including bridges and building frames.

312 Soil Mechanics
Fall, Spring. 4(3-3) P:M: (MSM 211) and completion of Tier I writing requirement. R: Open only to juniors or seniors in the Department of Civil and Environmental Engineering or in the Biosystems Engineering major. Engineering properties of soil and their measurement. Effective-stress concept. Permeability and seepage. Compaction. Consolidation, shear strength and stress-strain behavior.

321 Introduction to Fluid Mechanics
Fall, Spring. 4(3-2) P:M: (MTH 234 or MTH 254H or LBS 220) and (ME 221) and completion of Tier I writing requirement. R: Open only to juniors or seniors in the Department of Civil and Environmental Engineering or in the Biosystems Engineering major. Not open to students with credit in ME 332. Fluid properties, fluid statics, fluids in motion. Conservation of mass, energy and momentum. Dimensional analysis and similarity. Internal and external flows. Applications.

337 Civil Engineering Materials I
Fall, Spring. 4(3-3) P:M: (MSM 211 or concurrently) R: Open only to juniors or seniors in the Department of Civil and Environmental Engineering. Common civil engineering construction and paving materials: aggregates, inorganic cements, asphalt, concrete, wood and steel. Composition, structure, physical and mechanical properties, tests, and production mix design.

341 Transportation Engineering
Fall, Spring. 4(3-3) P:M: (MTH 234 or concurrently or MTH 254H or concurrently or LBS 220 or concurrently) and completion of Tier I writing requirement. RB: (STT 351) R: Open only to juniors or seniors in the Department of Civil and Environmental Engineering or in the Urban and Regional Planning major. SA: CE 346 Overview of transportation system issues and problems. Fundamentals of highway design and operations. Planning and evaluation of transportation system alternatives.

375 Cost Engineering and Engineering Ethics
Fall. 3(3-0) R: Open only to juniors or seniors in the College of Engineering. SA: CE 370 Cost engineering concepts and applications. Time value of money, alternative definitions and decision criteria. Equivalent cash flows. Cost benefit analysis, rate of return, depreciation. Moral foundations, engineering codes of ethics and case studies.

400 Structural Mechanics
Spring. 3(3-0) P:M: (CE 305) R: Open only to juniors or seniors or graduate students in the Department of Civil and Environmental Engineering. Matrix methods of structural analysis. Flexibility method. Direct stiffness method for plane structures. Elastic supports, inclined supports, member releases and non-prismatic members. Application software.

405 Design of Steel Structures
Spring. 3(3-0) P:M: (CE 305) R: Open only to juniors or seniors or graduate students in the Department of Civil and Environmental Engineering. Design of steel beams, columns, tension members and connections. Stability and plastic strength.

406 Design of Concrete Structures
Spring. 3(3-0) P:M: (CE 305 and CE 337) R: Open only to juniors or seniors or graduate students in the Department of Civil and Environmental Engineering. Design of reinforced concrete beams, slabs, columns and footings.

418 Geotechnical Engineering
Fall, Spring. 4(4-0) P:M: (CE 312) R: Open only to juniors or seniors or graduate students in the Department of Civil and Environmental Engineering. Shallow foundation design including bearing capacity, stress distribution, and settlement analysis. Pile foundations. Design of retaining structures including rigid walls, braced excavations, and sheet-pile walls. Stability of slopes and embankments.

421 Engineering Hydrology
Fall. 3(2-2) P:M: (CE 321) RB: (STT 351) R: Open only to juniors or seniors or graduate students in the College of Engineering or College of Natural Science or Department of Crop and Soil Sciences. Hydrologic design of stormwater systems. Equilibrium hydrograph analysis, unit hydrographs, infiltration, hydrograph synthesis, and reservoir routing. Groundwater: Darcy's law, flow nets, well hydraulics, design of capture wells.

422 Applied Hydraulics
Spring. 3(2-2) P:M: (CE 321 or ME 332) R: Open only to juniors or seniors or graduate students in the Department of Civil and Environmental Engineering or Department of Mechanical Engineering or in the Biosystems Engineering major. Fundamentals of open-channel flow. Rapidly and gradually varied nonuniform flow analysis. Confined flows past submerged bodies, in pipe networks, and in turbo machinery. Design applications.

431 Pavement Design and Analysis I
Fall. 4(4-0) P:M: (CE 312 and CE 337) R: Open only to juniors or seniors or graduate students in the Department of Civil and Environmental Engineering. Highway and airfield pavement structural design. Performance measures. Failure mechanisms, popular thickness design procedures, and design considerations for surface friction, pavement joints, and drainage. Design of rehabilitation alternatives, design of overlays.

432 Pavement Rehabilitation
Spring. 3(3-0) P:M: (CE 312 and CE 337) RB: (CE 431) R: Open only to juniors or seniors or graduate students in the Department of Civil and Environmental Engineering. Engineering concepts and information needed to rehabilitate pavements. Network and project survey and evaluation: design of rigid and flexible overlays, other methods of rehabilitation, selection of rehabilitation alternatives. Initial and life cycle cost analysis of various rehabilitation alternatives.

444 Principles of Traffic Engineering
Fall. 3(3-0) P:M: (STT 351) RB: (CE 341) R: Open only to juniors or seniors or graduate students in the Civil Engineering major. Driver and vehicle characteristics affecting traffic flow and safety. Speed, density, capacity relationships. Signal control in street networks. Freeway management systems. Risk management and liability.

448 Transportation Planning
Spring. 3(3-0) P:M: (CE 341 and STT 351) Transportation planning process and procedures. Estimation of travel demand using traditional models of trip generation, trip distribution, modal split, and traffic assignment. Use of "quick-response" procedures. Traffic impact of new facilities.

462 Technical Communication
Fall, Spring. 4(3-0) P:M: (CE 341) R: Open only to juniors or seniors or graduate students in the Department of Civil and Environmental Engineering. Major modes of technical communication such as letters, memoranda, research reports, analysis/decision papers, presentations, information graphics, procedures. Communication planning, audience analysis, and information design. Case studies, exercises and writing workshops.

471 Construction Engineering - Equipment, Methods and Planning
Spring. 3(3-0) P:M: (CE 305 and CE 312) or (BCM 305 and BCM 322) R: Open only to juniors or seniors or graduate students in the Department of Civil and Environmental Engineering and the Building Construction Management program. Engineering and construction fundamentals of earthwork operations, moving of materials, concrete construction, form work, false work and other temporary structures. Relationship to a construction project's constructability, cost and schedule.

480 Water and Wastewater Analysis Laboratory
Fall. 1(0-3) P:M: (CEM 161 or CEM 185H or LBS 171L) and (CE 481 or concurrently) R: Open only to juniors or seniors or graduate students in the Department of Civil and Environmental Engineering. Chemical and microbial analysis of water and wastewater.
Civil Engineering—CE

481 Environmental Engineering Chemistry
Fall. (3-0) P.M: (CEM 151 and CEM 152) or (CEM 181H and CEM 182H) or (LBS 171 and LBS 172) and (CEM 251 or CEM 351) Chemistry of environmental processes including alkalinities, precipitation-dissolution reactions, chemical complexity and redox reactions. Engineering applications to processing plants for water and wastewater.

483 Water and Wastewater Treatment
Fall, 3(3-0) P.M: (CE 280 and CE 321 or concurrently) R: Open only to juniors or seniors or graduate students in the Department of Civil and Environmental Engineering. Distribution of water and collection of sewage. Theory and design of water treatment processes.

485 Solid and Hazardous Waste Management
Spring, 3(3-0) P.M: (CE 280) R: Open only to juniors or seniors or graduate students in the College of Engineering. Design of solid waste collection and disposal systems. Definition of hazardous waste problems and selection of treatment alternatives.

487 Microbiology for Environmental Health Engineering
Spring, 3(3-0) P.M: (CHE 201) R: Open only to juniors or seniors or graduate students in the College of Engineering or graduate students in the College of Natural Science. Use and control of microorganisms for the protection of public health and the environment. Thermodynamics of microbial populations and microbial transformations.

490 Independent Study
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to juniors or seniors in the Department of Civil and Environmental Engineering. Approval of department. Civil engineering problems of specific interest to the student and a faculty member. May be analysis or design.

491 Civil Engineering Design Project
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to juniors or seniors in the Department of Civil and Environmental Engineering. Approval of department. Planning, specification, and design of a civil engineering project or facility.

492 Selected Topics in Civil Engineering
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Approval of department. Selected topics related to construction engineering, environmental engineering, fluid mechanics, geotechnical engineering, hydrology, pavements, structural engineering, or transportation engineering.

800 Bridge Design
Spring of odd years. 3(3-0) RB: CE 400 and CE 405 and CE 406 and CE 312 and CE 806) R: Open only to graduate students in the College of Engineering or approval of department. Design and analysis of bridge structures including bridge types, materials, load conditions, construction, methods, and rehabilitation. Analysis of beam-slab, box girder, curved, and skewed bridges. Conceptual or preliminary design of a bridge project.

802 Introduction to Dynamics and Earthquake Engineering
Fall. 2 credits. RB: (MSM 306) Not open to students with credit in ME 461. Dynamic response of single degree-of-freedom systems. Damping in structures and soils. Time domain and frequency domain methods. Analytical and numerical solution techniques. Earthquake response spectra.

803 Structural Dynamics

804 Advanced Mechanics for Civil Infrastructure
Fall, 3(3-0) RB: (CE 400) Matrix structural analysis R: Open only to graduate students in the College of Engineering. Advanced linear mechanics. Potential energy principle. Finite element formulations. Applications to problems in structural, geotechnical and pavement engineering.

805 Advanced Design of Steel Structures
Spring, 3(3-0) Flexural and torsional instability of columns and beams. Slender cross-sectional elements, design of beam-columns. Torsion, plastic design, plate girders, composite steel-concrete construction, connections.

806 Advanced Structural Concrete Design
Fall, 3(3-0) SA: CE 808 Analysis and design of prestressed and conventionally reinforced concrete structures.

810 Reliability-Based Design in Civil Engineering
Fall, 3(3-0) Probabilistic treatment of live and dead loads: earthquakes, floods, material properties, and capacity. Reliability basis of design specifications, reliability index, probability of failure, design for reliability. Reliability of engineering systems.

811 Advanced Hydrogeology
Spring, 3(3-0) Interdepartmental with Department of Geological Sciences. Administered by Department of Geological Sciences. RB: (CE 821) Processes influencing groundwater flow and solute transport. Mathematical equations and numerical methods to describe these processes.

812 Mechanical Properties of Soils
Fall, 3(2-3) Permeability, consolidation theory, stress-strain behavior, conditions of failure, shear strength. Laboratory determination of soil properties including interpretation of experimental data.

813 Soil Dynamics

815 Selected Topics in Geotechnical Engineering
Spring, 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course. Selected topics related to soil stabilization, highway and airport soils, and frozen ground engineering.

818 Advanced Geotechnical Design

821 Groundwater Hydraulics
Fall, 3(3-0) Physical properties of porous media. Equations of flow in saturated media. Flow nets, well flow and parameter measurement. Transport processes and the advective-dispersion equation for conservative contaminants.

831 Pavement Design and Analysis II
Spring, 3(3-0) Theoretical models for analysis of pavement systems. Evaluation and application of current design practices related to elastic and plastic theory. Formulation of improved design procedures.

835 Engineering Management of Pavement Networks
Spring of even years. 3(3-0) Theoretical and statistical analysis of pavement networks. Engineering monitoring. Determination of distress mechanisms and engineering solutions. Assignment of priorities to engineering actions.

837 Civil Infrastructure Materials
Fall, 3(3-0) Elastic and inelastic behavior and modeling of materials for civil infrastructure; design for desired properties and response of infrastructure components and systems. Constituents, manufacturing, stiffness, strength, failure, and durability of pavements, structural concretes, and fiber reinforced polymer composites.

841 Traffic Flow Theory
Spring, 3(3-0) Microscopic and macroscopic traffic flow models. Queueing theory. Gap acceptance. Simulation models for network analysis. Intelligent vehicle highway systems.

843 Simulation and Optimization of Urban Traffic Flow
Fall of even years. 3(3-0) RB: (CE 841) Statistical analysis of highway geometric designs and operational-control strategies with respect to the optimal flow of traffic: intersection, arterial, network design and control models. Traffic simulation. System management and optimization.
844 Highway and Traffic Safety
Fall of odd years. 3(3-0)

846 Statewide Transportation Network Evaluation
Spring of odd years. 3(3-0)
Transportation system measures, needs studies, sufficiency ratings. Cost allocation models, programming and budget constraints. Corridor analysis, transportation economics, demand elasticity.

847 Simulation Models for Transportation Applications
Fall of even years. 3(3-0)
Simulation models for analysis and optimization of transportation systems. Experimentation with planning and traffic simulation models for signal timing and capacity analysis.

849 Transportation Research Methods
Spring. 3(3-0)
Application and interpretation of quantitative methods and design of experiments for transportation research; ANOVA, non-parametric, discriminant analysis, factor analysis, multivariate regression, SPSS.

850 Intelligent Transportation Systems (ITS)
Fall of odd years. 3(3-0) RB: Traffic and Transportation engineering
Technical and policy aspects emerging from the application of advanced technologies to transportation problems. Intelligent Transportation Systems (ITS) user services requirements, available and emerging technologies, case studies of ongoing operational tests, legal institutional and planning issues related to ITS development and deployment.

851 Transportation and the Environment
Spring of even years. 3(3-0) RB: R: Not open to freshmen.

872 Finite Element Method
Fall, Spring. 3(3-0) Interdepartmental with Mechanical Engineering. Administered by Department of Mechanical Engineering. SA: AE 809, MSM 809
Theory and application of the finite element method to the solution of continuum type problems in heat transfer, fluid mechanics, and stress analysis.

890 Independent Study in Civil Engineering
Fall, Spring, Summer. 1 to 4 credits. R: Open only to Civil Engineering master's students. Approval of department. Research problems of limited scope not pertaining to thesis accomplished under CE 899 or CE 999.

891 Selected Topics in Civil Engineering
Fall, Spring, Summer. 2 to 4 credits. R: Open only to Civil Engineering master's students. Approval of department. Research problems of limited scope not pertaining to thesis accomplished under CE 899 or CE 999.

892 Master's Research Project
Fall, Spring, Summer. 1 to 5 credits. A student may earn a maximum of 5 credits in all enrollments for this course. R: Open only to master's students in the Civil Engineering major. Approval of department. Master's degree Plan B individual student research project. Original research, research replication, or survey and reporting on a research topic.

893 Master's Design Project
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 3 credits in all enrollments for this course. R: Open only to master's students in the Civil Engineering major. Approval of department. Master's degree Plan B individual student civil engineering design project.

899 Master's Thesis Research
Fall, Spring, Summer. 1 to 8 credits. A student may earn a maximum of 24 credits in all enrollments for this course. Master's thesis research.

900 Independent Study in Civil Engineering
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to Civil Engineering doctoral students. Research problems of limited scope not pertaining to thesis accomplished under CE 999.

999 Doctoral Dissertation Research
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 72 credits in all enrollments for this course. Doctoral dissertation research.

COM—Communication

Department of Communication
College of Communication
Arts and Sciences

100 Human Communication
Fall, Spring, Summer. 3(3-0)
Process and functions of communication. Principles underlying communication behavior. Practice in analyzing communication situations and in speaking and writing.

200 Methods of Communication Inquiry
Fall, Spring, Summer. 4(3-2) RB: Completion of University mathematics requirement.
Nature and conduct of communication inquiry. Significant questions about communication and finding systematic answers.

225 An Introduction to Interpersonal Communication
Fall, Spring, Summer. 3(3-0)
Principles and practices of interpersonal communication. Emphasis on effective and responsible interpersonal communication.

240 Introduction to Organizational Communication
Fall, Spring, Summer. 4(4-0)
Theories, systems, structures and processes of organizational communication. Organizational cultures. Communication in multinational organizations and in individual, leadership, supervisor-subordinate and small group situations.

275 Effects of Mass Communication
Fall, Spring, Summer. 3(3-0) RB: (TC 100) R: Not open to freshmen.
Major social effects of mass media on audience behavior. Political communication. Media effects on children. Message strategies producing attitude change. Interrelationships between mass media and interpersonal communication.