Descriptions — Chemistry of Courses

913. Selected Topics in Inorganic Chemistry
Fall, Spring. 3(3-0) May reenroll for a maximum of 9 credits if different topic is taken. Rare earth elements; recent advances in the chemistry of nonmetals; high temperature chemistry. Coordination chemistry and nonaqueous solvents.

915. Seminar in Inorganic Chemistry
Fall, Winter, Spring. 1(2-0) May reenroll for a maximum of 3 credits. Discussions of recent advances and reports by graduate students on research problems.

924. Selected Topics in Analytical Chemistry
Fall, Winter, Spring. 3(3-0) or 2(2-0) May reenroll for a maximum of 9 credits if different topic is taken. Among topics which may be discussed are: advances in electroanalytical chemistry or spectroscopy; nonaqueous solvents; complexation equilibria; surface chemistry; analytical chemistry of polymers.

938. Seminar in Analytical Chemistry
Fall, Winter, Spring. 1(1-0) May reenroll for a maximum of 3 credits. Discussions of recent advances and reports by graduate students on research problems.

956. Selected Topics in Organic Chemistry
Fall, Winter, Spring. 2(2-0) or 3(3-0) May reenroll for a maximum of 12 credits if different topic is taken. Approval of department. Topics may be selected from heterocyclic chemistry, natural products, free radicals, carbonium ions, organic sulfur or nitrogen compounds, acidity functions, isotope effects, photochemistry and others.

958. Seminar in Organic Chemistry
Fall, Winter, Spring. 1(2-0) May reenroll for a maximum of 3 credits. Discussions of recent advances and reports by graduate students on research problems.

985. Statistical Thermodynamics
Winter, Spring. 3(3-0) May reenroll for a maximum of 9 credits if different topic is taken. Approval of department. Partition functions; spectroscopic measurements and applications; nonequilibrium statistical thermodynamics and thermodynamics. Time correlation functions and spectroscopic line shapes, light scattering, and magnetic relaxation. Transport properties of fluids and gases.

987. Selected Topics in Physical Chemistry
Fall, Winter. 3(3-0) May reenroll for a maximum of 9 credits if different topic is taken. Approval of department. Mathematical preparation for quantum chemistry. Selected topics: kohn-sham and photochemistry, macromolecular and surface chemistry, molecular spectroscopy, electro and magnetic properties of matter, application of statistical mechanics to chemical problems.

988. Selected Topics in Physical Chemistry
Winter, Spring. 3(3-0) May reenroll for a maximum of 9 credits if different topic is taken. Approval of department. Topics may be chosen from analysis and interpretation of the spectra of molecules, advanced molecular structure, magnetic resonance, spectroscopy, X-rays and crystal structure, statistical mechanics.

991. Selected Topics in Quantum Chemistry
Fall, Winter. 3(3-0) May reenroll for a maximum of 9 credits if different topic is taken. Approval of department. Principles of quantum mechanics and application to chemical problems. Selected topics from spectroscopy, properties of atoms and molecules in electric and magnetic fields, and theories of molecular electronic structure.

998. Seminar in Physical Chemistry
Fall, Winter, Spring. 1(1-0) May reenroll for a maximum of 3 credits. Discussions of recent advances and reports by graduate students on research problems.

999. Doctoral Dissertation Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department. Research in analytical, inorganic, organic, and physical chemistry.

CHINESE
See Linguistics and Germanic, Slavic, Asian and African Languages.

CIVIL AND ENVIRONMENTAL ENGINEERING

CIVIL ENGINEERING

251. Elementary Surveying
Spring. 4(3-3) Not open to majors. Use of the tape, compass, level, and transit with simple map making; slope, closure, and area computations. Profile, cross section and stadia surveys, U.S. land system.

252. Surveying I
Fall. Spring. 4(3-3) Engineering majors or approval of department. Instruments, theory of measurements, error analysis, stadia, horizontal and vertical curves, U.S. Public Land System, observation for meridian.

250. Introduction to Environmental Engineering
Fall, Winter, Spring. 4(4-0) ECE 141; or ECE 121, MTH 113, CHM 120. Hydrology: ground water and surface water supply systems; wastewater treatment, methods of pollution control for solid waste, air, and noise.

305. Structural Analysis I
Fall, Winter. 3(3-0) MMM 211. Stability and determinacy: linearity, Plane trusses, shear and bending in beams and frames. Virtual work calculation of forces and displacements in statically-determinate plane structures.

306. Structural Analysis II

308. Engineering Materials I
Fall, Winter, Spring. 4(3-3) MMM 211 or concurrently. Structure: composition; physical, mechanical and rheological properties of non-metallic construction materials. Emphasis on aggregates, asphalt, inorganic cements, concrete, and wood.

312. Soil Mechanics
Winter, Spring, Summer. 4(3-3) MMM 211. Engineering properties of soils and their measurement. Effective stress concept; permeability; fluid flow in soils; stress-strain behavior; soil strength; compaction and consolidation of soils; field exploration and design problems.

311. Introductory Fluid Mechanics
Fall. Winter. 3(3-0) MTH 310. Fluid properties; hydrostatics; control volume approach to conservation of mass, momentum and energy; dimensional analysis and dynamic similarity; fluid resistance and open channel flows; boundary layer concepts.

346. Transportation
Winter, Spring, Summer. 4(4-0) MTH 113. Planning, design, and evaluation of transportation systems; highway, street, and intersection capacity; basic elements of geometric design.

347. Geometric Design of Highways
Fall, Winter. 3(3-3) C E 346 or concurrently. Geometric design of streets and highways as related to capacity, construction costs, and safety. State and national design standards and practice.

370. Cost and Optimization Engineering
Fall, Winter. 3(3-0) MTH 113. Formulation of engineering decisions governed by current and future costs and returns. Comparison and optimization of alternative engineering projects, products and processes.

372. Construction Estimating
Fall, Spring. 3(3-0) Juniors. Cost studies of construction activities with emphasis on labor productivity and operating characteristics of equipment under various site conditions. Interpretation of drawings and specifications.

374. Legal Aspects of Engineering
Spring. 3(3-0) Juniors. The professional engineer's relationship with the legal aspects of engineering. Special emphasis on contract documents.

390. Civil Engineering Analysis
Fall, Spring. 3(3-3) MTH 310, CPS 120. Analysis of civil engineering problems by numerical methods. Use of microcomputers to analyze problems. Technical reports to present methods and computed results.
392. Civil Engineering Fundamentals for Planners
394. Civil Engineering Design Project
Fall, Winter, Spring. 3(2-2) May reenroll for a maximum of 6 credits. Seniors, approval of department.
Planning, specifications and design of a civil engineering project or facility.

400. Structural Mechanics I
401. Structural Design Concepts
Fall. 4(4-0) C E 306, C E 390.
Miscellaneous topics in displacement calculation by virtual work. Matrix formulation of the general principles of framed structural analysis. Examine the study of the flexibility and stiffness methods.

402. Structural Design in Steel
403. Structural Design in Concrete
Fall, Winter. 4(4-0) C E 306 or concurrently, C E 390.

404. Structural Design Concepts
Spring. 3(3-0) C E 406, C E 408.
Develop and expand design concepts through study, investigation and project design of various structural systems. Criteria for material selection and creative design of unusual structural systems pursued.

410. Structural Mechanics II
Winter. 4(4-0) C E 400, CPS 120.
Continuation of C E 400. Matrix analysis of framed structures. Introduction to inelastic behavior of structures. Use of programmed computer solution techniques.

415. Foundation Engineering
Fall. 3(3-0) C E 312, C E 390.
Bearing capacity and settlement of shallow foundations; analysis and design of single piles and groups; stress distribution in soil masses; site investigation, data evaluation for field and laboratory tests.

416. Stability of Soil Masses
Winter. 3(3-0) C E 312, C E 390.
Stability of natural and cut slopes; design of embankments and fills; soil placement and compaction; seepage through soil masses; slope stabilization techniques; lateral earth pressures, retaining walls, and braced excavations.

421. Hydrology I
Fall. 4(3-2) C E 280, C E 321, C E 390.
Engineering hydrology: frequency and precipitation analysis, streamflow analysis and the unit hydrograph; flood prediction; rainfall-runoff correlations; urban hydrology.

422. Open Channel Flow I
Winter. 3(3-2) C E 321 or M E 333, C E 300 or M E 351.
Fundamentals of free surface flow; steady uniform and nonuniform concepts; energy and momentum principles; subcritical and supercritical regimes; gradually and rapidly varied flows; design applications; laboratory assignments.

423. Closed Conduit Hydraulics
Spring. 3(2-2) C E 321 or M E 333, C E 300 or M E 351.
Steady flow in piping; numerical analyses of pipe networks; theory of turbomachinery; fluid measurements; design of water supply systems; introduction to unsteady flow; laboratory assignments.

441. Highway Operations
Fall. 3(3-0) C E 346, STT 351 or approval of department.
Driver and vehicle characteristics affecting traffic flow; traffic flow density, headway and speed measurements; signing and signal control for efficient intersection operation, parking characteristics and capacity analysis.

442. Airport Planning and Design
Fall. Spring. 4(3-2) C E 346.
The planning and design of the components of the airport system including ground access facilities; aircraft characteristics; the air traffic control system; airport configuration; capacity analysis; management systems.

448. Water and Wastewater Treatment
Fall, Winter, Spring. 4(3-2) C E 346.
The planning and design of the components of the airport system including ground access facilities; aircraft characteristics; the air traffic control system; airport configuration; capacity analysis; management systems.

449. Highway Engineering
Spring. 4(3-3) C E 308, C E 347.
Design concepts of roadways, facilities, drainage and pavement design. Maintenance, construction, and supervision methods and procedures.

451. Scheduling Construction Activities
Winter. 3 credits. Approval of department.
Techniques for coordinating and controlling construction projects. Scheduling under the constraints of deadlines, uncertain time estimates and limited resources. Computer programs and data files for effective management.

452. Water and Wastewater Treatment
Winter. 3(3-2) C E 320, C E 321 or concurrently, C E 390.
Water treatment design and including sedimentation, coagulation, softening, iron removal and chlorination; wastewater treatment theory and design including grit chambers, activated sludge, trickling filter, and anaerobic digesters.

453. Water and Wastewater Treatment
Winter. 4(3-2) C E 280, C E 321 or concurrently, C E 390.
Water treatment theory and design including sedimentation, coagulation, softening, iron removal and chlorination; wastewater treatment theory and design including grit chambers, activated sludge, trickling filter, and anaerobic digesters.

454. Environmental Health Engineering
Spring. 4(3-2) C E 280, C E 321 or concurrently, STT 351.
Design of small water, wastewater and solid waste facilities. Epidemiology of communicable disease transmission by air, water, food and arthropods. Engineering measures to control disease spread.
815. Principles of Highway and Airport Soils
Fall, 4-4-0 C E 347.
Foundation problems as related to highways and airports, relation of subsurface conditions to design and construction, analytical review of laboratory and field results.

817. Mechanical Properties of Soils
Fall, 4-3-3 C E 419 or approval of department.
Mechanical properties of soil including stress-strain behavior; conditions of failure and shear strength; consolidation theory and permeability. Laboratory determination of soil properties including interpretation of experimental data for use in practice.

818. Advanced Soil Mechanics
Winter, 4-4-0 C E 419; C E 817 recommended.
Foundations and earth retaining structures; bearing capacity, lateral resistance and settlement of deep foundations; earth pressures on braced excavations and sheet pile walls; design of caissons and cofferdams.

819. Soil Stabilization in Geotechnical Engineering
Summer, 3-3-0 C E 419.
Techniques to improve the performance of soil in engineering applications; compaction, blending, admixture, grouting, electromosion, vibroflotation, compaction piles, thermal treatment, load bearing and hydraulic fills, precompression, reinforced earth.

820. Geotechnical Engineering for Cold Regions
Spring, 3-3-0 C E 418 or approval of department.
Physical and thermal properties of ice and frozen soils; ground thermal regime; mechanical properties of frozen ground; thaw consolidation problems; foundation design; slope stability problems; and artificial freezing for construction.

821. Porous Media Flow I
Fall, 3-3-0 C E 422 or approval of department.

823. Hydrology II
Winter of even-numbered years, 3-3-0 C E 421, C E 422, STT 351 or approval of department.

824. Coastal Engineering
Fall of even-numbered years, 3-3-0 C E 422 or approval of department.

826. Environmental Fluid Mechanics I
Winter of even-numbered years, 3(3-0) C E 422 or approval of department.
Fundamentals: the convective-diffusion equation; solution methods; analytical solutions; simplified solutions, numerical modeling. Molecular diffusion; momentum, mass and heat transport; turbulent diffusion; the effects of stratification.

827. Environmental Fluid Mechanics II
Winter of odd-numbered years, 3(3-0) C E 826 or approval of department.
Continuation of C E 422 showing adaptation of theory to describe transport in environments selected from the following: rivers, lakes, estuaries, groundwater, the atmosphere, near-field regions. Physical modeling.

828. Open Channel Flow II
Spring, 3(3-0) C E 422 or M E 333 or approval of department.
Advanced topics in steady flow analysis. Unsteady flow phenomena; method of characteristics; propagation of discontinuities; gradually and rapidly-varied unsteady flow analysis; computer based design applications.

829. Fluid Transients
Fall, 3(3-0) M E 333 or approval of department.
Advanced topics in unsteady flow concepts and wave mechanics to hydraulic engineering; method of characteristics, surges and waterhammer in piping systems; resonance phenomena.

830. Intermediate Fluid Mechanics
Fall, 3(3-0) M E 332 or C E 321. Interdepartmental with the Department of Mechanical Engineering.
Deformable control volumes, Navier-Stokes equations, dimensionless variables, vorticity and circulation, turbulent flow, inviscid flow, and boundary layer theory.

840. Pavement Design
Spring of even-numbered years, 3(3-0) C E 449 or approval of department.
Pavement types and wheel loads, stresses in flexible pavements, stresses in rigid pavements, pavement behavior under loadings, climate effects on pavement performance, evaluation of subsoil strengths, subgrades, and pavement design criteria.

841. Optimization of Urban Traffic Flow
(SYS 841.) Fall of even-numbered years, 3(3-0) C E 346, STT 351 or approval of department. Interdepartmental with Systems Science.
Traffic flow models used in design of computerized traffic control systems. Optimal freeway ramp metering algorithm. Offline and online optimization of traffic signal timing.

842. Pavement Rehabilitation
Spring of odd-numbered years, 4(4-0) C E 449 or approval of department.
Strengthening existing pavements, pavement overlay design criteria, epoxy and polyester resin repair and rehabilitation; evaluation of resurfacing practices for bituminous and cement pavements.

843. Traffic Engineering Characteristics
Winter, 3(3-0) C E 346, STT 351 or approval of department.
Safety analyses, flow and capacity characteristics, statistical properties of traffic, queuing characteristics at intersections, delay characteristics and analyses.

844. Highway and Traffic Safety
Spring of odd-numbered years, 3(3-0) C E 843.
Highway safety improvement programs; identification of hazardous locations; selection and evaluation of countermeasures; programming improvements.

845. Environmental Impacts of Transportation Facility Design Decisions
Spring of even-numbered years, 3(3-0) C E 346 or C E 392, C E 448, or approval of department.
The context in which current transportation planning and design decisions are made, legislation; socio-economic effects; air, noise, and water pollution. Preparation of environmental impact statements.

846. Statewide Transportation Planning
Fall of odd-numbered years, 3(3-0) C E 340 or approval of department.
Highway inventory, road use studies and programming, analysis of highway costs, economic considerations in location and design.

847. Advanced Geometric Design of Highways
Winter of even-numbered years, 3(3-0) C E 437.
Advanced geometric design of highways and freeways, including the redesign of existing systems with development and evaluation of geometric alternatives.

848. Travel Demand Forecasting
Fall of even-numbered years, 3(3-0) C E 448.
Advanced topics in travel demand; disaggregate and behavioral models, error analysis, and model sensitivity.

849. Design of Research Programs I
Fall, 2(2-0) Approval of department. To receive credit C E 849 and C E 850 must be completed satisfactorily except by prior arrangement with instructor.
Two term sequence to design a major research program not thesis related, e.g., response to a request for a proposal. Includes experiment design, detailed literature review and synthesis.

850. Design of Research Programs II
Winter, 2(2-0) C E 849. To receive credit C E 849 and C E 850 must be completed satisfactorily except by prior arrangement with instructor.
Continuation of C E 849.

850. Special Problems in Civil Engineering
Fall, Winter, Spring, Summer, 1 to 6 credits. May reenroll for a maximum of 12 credits in C E 880 and S E 880 combined. Approval of department.
Research problems of limited scope not pertaining to thesis accomplished under C E 889 or C E 999.

890. Special Topics in Civil Engineering
Fall, Winter, Spring, Summer, 2 to 4 credits. May reenroll for a maximum of 9 credits. Approval of department.
Selected topics in new or developing areas of civil engineering.

899. Master's Thesis Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.
905. Advanced Theory and Design of Reinforced Concrete II
Spring. 3(3-0) C E 805.
Continuation of C E 803 with application of theory to analysis and design of tanks, rigid frames, and shells.

906. Advanced Structural Steel Design
Spring. 3(3-0) C E 406.
Analysis and design of multiple-story building frames, continuous trusses and rigid-frame girder bridges. Plastic design.

909. Elastic Thin Shells
Spring. 4(4-0) C E 804 or MM 515 or approval of department; MTH 421. Interdepartmental with the Department of Metallurgy, Mechanics, and Materials Science.
Elements of differential geometry, membrane theory of shells, Puck's stress function, deformation and bending of shells of revolution and shallow shells.

912. Theory of Plates
Winter. 4(4-0) C E 804 or MM 815 or approval of department; MTH 422. Interdepartmental with and administered by the Department of Metallurgy, Mechanics, and Materials Science.
Bending of thin elastic plates with various shapes and boundary conditions; application of energy principles and approximate methods of solution; thick plates, large deflection theory; sandwich plates.

915. Earth Structure
Spring. 3(3-0) C E 817 or approval of department.
Embankments, earth dams, natural and cut slopes, stability of circular and composite slip surfaces; performance of embankments on soft foundations; seepage through earth dams; instrumentation for field performance evaluation.

916. Soil Dynamics
Winter. 4(4-0) C E 817 or approval of department.
Characteristics of ground motions during earthquakes; dynamic soil properties; liquefaction and settlement under transient and repeated loadings; foundation design for vibratory loads; wave propagation in soil media.

921. Porous Media Flow II
Winter. 3(3-0) C E 809. C E 821.
Mathematical formulations for unsteady groundwater flow and convection/dispersion phenomena. Emphasis placed upon finite-difference and finite-element solution techniques, computer based analysis of field data, and design applications.

941. Urban Public Transport: Issues and Technology
Fall. 3(3-0) Approval of department.
Planning and operating urban transportation systems; system technology. Regional and rapid rail systems, light rail, bus, paratransit, transportation system management.

999. Doctoral Dissertation Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

Environmental Engineering ENE

800. Environmental Engineering Seminar
(S E 800.) Fall, Winter, Spring. 1(1-0) May reenroll for a maximum of 3 credits. Graduate major in C E or ENE.
Current research, reports, and literature reviews.

802. Physical Chemical Processes of Environmental Engineering
(S E 802.) Winter. 3(3-0) ENE 482.
Analysis of physical and chemical principles which form the basis of air and water pollution control and solid waste disposal; process dynamics, sedimentation, coagulation, filtration, adsorption, absorption, oxidation.

804. Biological Processes of Environmental Engineering
(S E 804.) Winter. 3(3-0) MPH 200.
Aerobic and anaerobic degradation of liquid and solid wastes. Biochemical reactions; activated sludge and trickling filter kinetics; sludge digestion and composting.

805. Biological Waste Treatment Laboratory
(S E 805.) Spring. 1(0-3) ENE 804.
Treatability studies to develop parameters for design of biological waste treatment systems; reactor kinetics; oxygen uptake; sludge settling rate; biomass production.

822. Air Resource Management
(S E 822.) Spring of even-numbered years. 4(4-0) ENE 502.
Characteristics of air contaminants and noise; sources and source inventory; microclimatology and pollutant transport; pollutant effects; introduction to sampling and control.

832. Solid Waste Management
(S E 822.) Spring of odd-numbered years. 4(4-0) C E 485 or approval of department.
Generation rates: storage; collection; transfer and transport; processing, resource recovery; landfill; siting; design; operation; closure and monitoring; hazardous waste.

880. Special Problems in Environmental Engineering
(S E 880.) Fall, Winter, Spring. 1 to 6 credits. May reenroll for a maximum of 12 credits in C E 880 and ENE 880 combined. Approval of department.
Solution of environmental engineering problems, of limited scope not pertaining to thesis.

999. Doctoral Dissertation Research
(S E 899.) Fall, Winter, Spring, Summer. Variable credit. Approval of department.

999. Doctoral Dissertation Research
(S E 899.) Fall, Winter, Spring, Summer. Variable credit. Approval of department.

COMMUNICATION COM

College of Communication Arts and Sciences

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

115. Oral Communication
Fall, Winter, Spring, Summer. 3(3-0) COM 100 or approval of department.
Principles and practice in adapting to audiences, creating and structuring messages, and developing effective delivery of formal and informal speeches. Critical evaluation of speeches by instructor and peers.

125. Interpersonal Communication
Fall, Winter, Spring, Summer. 3(3-0) COM 100.
Develop students' abilities to become more effective, responsible participants in interpersonal communication relationships, with emphasis on relating communicatively with others.

199. Methods of Inquiry
Fall, Winter, Spring, Summer. 3(3-0) COM 125.
Major theoretic orientations toward communication. Primary tools of scholarly inquiry.

205. Persuasion
Fall, Winter, Spring. 4(4-0) COM 100.
Process of influencing human behavior through persuasive communication. Experience in creating persuasive messages and in evaluating the acceptability of persuasive attempts.

210. Leadership and Group Communication
Fall, Winter, Spring, Summer. 3(3-0) COM 100.
Principles and practice in the utilization of communication for effective leadership, with special emphasis on group communication.

250. Argumentation
Fall, Winter, Spring, 4(4-0) COM 199.
Development and use of arguments; recent perspectives in argumentation; rhetorical and empirical study of argumentative messages.