

Chemistry—CEM

- 913 Selected Topics in Inorganic Chemistry**
Fall, Spring. 1 to 3 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to graduate students in College of Natural Science or College of Engineering.
Chemistry of metal-metal bonds and clusters, organometallic chemistry, layered oxides, and complex layered oxides. Photochemistry. Solid state chemistry and applications of quantum mechanics.
- 918 Inorganic 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 Chemistry.
Advances in inorganic chemistry reported by graduate students.
- 924 Selected Topics in Analytical Chemistry**
Fall, Spring. 2 to 3 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to graduate students in College of Natural Science or College of Engineering.
Advanced computer techniques, surface chemistry, analytical chemistry of polymers, or statistics for chemists.
- 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, electric and magnetic properties of matter, or applications of statistical mechanics to chemical problems.

- 988 Selected Topics in Physical Chemistry II**
Spring. 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 analysis and interpretation of molecular spectra, advanced molecular structure theory, magnetic resonance, X-rays and crystal structure, scientific analysis of vacuum systems, or problems in statistical mechanics.
- 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.
- 992 Quantum Chemistry and Statistical Thermodynamics II**
Spring. 3(3-0) RB: (CEM 991)
Analytical and numerical methods for solving quantum chemical problems. Statistical mechanics of solids and liquids.
- 993 Advanced Topics in Quantum Chemistry**
Spring of odd years. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to graduate students in the College of Natural Science or the College of Engineering.
Spectroscopic theory, properties of atoms and molecules in electric and magnetic fields, intermolecular forces. Many-body theory, molecular electronic structure, solid state chemistry, or molecular reaction dynamics.
- 994 Advanced Topics in Statistical Mechanics**
Spring of even years. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to graduate students in the College of Natural Science or the College of Engineering.
Nonequilibrium statistical mechanics and thermodynamics. Correlation functions and spectroscopy, light scattering, magnetic relaxation, transport properties of fluids and gases, or statistical mechanics of chemical reactions.
- 998 Physical 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 Chemistry.
Advances in physical chemistry reported by graduate students.
- 999 Doctoral Dissertation Research**
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 120 credits in all enrollments for this course. R: Open only to doctoral students in Chemistry and Chemical Physics.
Doctoral dissertation research.

CHINESE

CHS

Department of Linguistics and Germanic, Slavic, Asian and African Languages College of Arts and Letters

- 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: (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.
- 105 Introductory Chinese with Business Emphasis**
Summer. 5(5-0) SA: CHS 111, CHS 112 Not open to students with credit in CHS 101.
Beginning-level speaking, listening comprehension, and reading for Chinese in business-related contexts. Economic conditions and business culture in China.
- 201 Second-Year Chinese I**
Fall. 5(5-0) P: (CHS 102)
Intermediate-level work on skills in conversation, comprehension, and grammar. Practice in composition.
- 202 Second-Year Chinese II**
Spring. 5(5-0) P: (CHS 201)
Further intermediate-level work on skills in conversation, comprehension, and grammar. Continued practice in composition.
- 301 Third-Year Chinese I**
Fall. 4(4-0) P: (CHS 202)
Advanced-level work on speaking, listening comprehension, reading, and writing skills, based on materials of cultural interest.
- 302 Third-Year Chinese II**
Spring. 4(4-0) P: (CHS 301)
Advanced-level work on speaking, listening comprehension, reading, and writing skills, based on materials of cultural interest.
- 350 Studies in the Chinese Language**
Spring. 3(3-0) P: (CHS 201)
Grammatical structures of modern Chinese. Grammar review, sound system, word formation, sentence and discourse structures, historical evolution of the Chinese language, dialects, sociolinguistics.
- 401 Fourth-Year Chinese I**
Fall. 3(3-0) P: (CHS 302) R:
Reading, discussion, and writing of advanced materials, including classical texts of broad cultural interest.
- 402 Fourth-Year Chinese II**
Spring. 3(3-0) P: (CHS 401)
Further reading, discussion and writing based on original materials, including classical texts of broad cultural interest.

- 499 Senior Thesis Research**
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 4 credits in all enrollments for this course. R: Approval of department.

An individual research project supervised by a faculty member that demonstrates the student's ability to do independent research and submit or present a major paper.

CIVIL ENGINEERING CE

Department of Civil and Environmental Engineering College of Engineering

- 271 Engineering Surveying**
Fall, Spring. 4(3-3) P: (MTH 114 or MTH 116 or MTH 124 or MTH 132 or MTH 152H or LBS 117 or LBS 118)

Application of surveying and error analysis to civil engineering problems. Earth work. Calculations. Layout and management of construction sites.

- 280 Introduction to Environmental Engineering**
Fall, Spring. 3(3-0) P: (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: (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: (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: (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 similitude. Internal and external flows. Applications.

- 337 Civil Engineering Materials I**
Fall, Spring. 4(3-3) P: (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, asphalts, concretes, wood and steel. Composition, structure, physical and mechanical properties, tests, and production mix design.

- 341 Transportation Engineering**

Fall, Spring. 3(3-0) P: (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: (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**

Fall. 3(3-0) P: (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: (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. 3(3-0) P: (CE 312) R: Open only to juniors or seniors or graduate students in the Department of Civil and Environmental Engineering.

Shallow foundation design: 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: (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: (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. 3(3-0) P: (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. Design considerations for surface friction, pavement joints, and drainage.

- 432 Pavement Rehabilitation**

Spring. 3(3-0) P: (CE 312 and CE 337) RB: (CE 431) R: Open only to 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: (STT 351 and CE341) 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: (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.

- 449 Highway Design**

Fall, Spring. 3(3-0) P: (CE 341) R: Open only to juniors or seniors or graduate students in the Department of Civil and Environmental Engineering.

Geometric design of highways. Operation, capacity, safety, and geometric features. Alignment, drainage and pavement design. Use of CAD systems in preparing contract plans.