304 Oceanography
Fall. 4(4-0) Interdepartmental with Zoology. Administered by Zoology. P: (CEM 141 or CEM 181H or LB 171) and (PHY 231 or PHY 183 or PHY 193H or LB 273)
Physical, chemical, biological, and geological aspects of oceanography: ocean circulation, waves, tides, air-sea interactions, chemical properties of ocean water, ocean productivity, shoreline processes, and sediments.

305 Physical and Biological History of the Earth
Spring. 4(3-2) P: GLG 201 or ISP 203A SA: GLG 202

306 Environmental Geomorphology
Fall of even years. 3(3-0) Interdepartmental with Geography. Administered by Geography. P: CSS 210 or GEO 206 or GEO 333 or GLG 201 or GLG 304 or ISP 203A
Relationships of running water, weathering, gravity, ice, waves, wind, and biota (including humans) to terrain and soils. Evolution of landscapes. Classical and modern interpretations.

319 Introduction to Earth System Science
Fall. 3(3-0) Interdepartmental with Entomology and Plant Biology and Sociology and Zoology. Administered by Entomology. RB: Completion of one course in biological or physical science.
Systems approach to Earth as an integration of geochemical, geophysical, biological and social components. Global dynamics at a variety of spatio-temporal scales. Sustainability of the Earth system.

321 Mineralogy and Geochemistry
Fall. 4(3-2) P: (GLG 201 or concurrently) and (CEM 142 or CEM 152 or CEM 182H or LB 172) and (MTH 132 or LB 118) Earth materials and their origin, modification, structure, dynamics and history. Crystallography and crystal chemistry, and geochemical properties and processes in mineral crystallization and recrystallization. Analytical identification and characterization of minerals in their lithologic context.

335 Plants Through Time
Spring of odd years. 3(3-0) Interdepartmental with Plant Biology. Administered by Plant Biology. P: BS 162 or PLB 105 or GLG 201 or LB 144 or BS 182H R: Open to juniors or seniors. SA: BOT 335 Evolutionary history of plants, development of ecosystems, and use of plant fossils in the reconstruction of ancient environments and climate.

361 Petrology

401 Global Tectonics and Earth Structure (W)
Fall. 4(3-2) P: (GLG 304) and completion of Tier I writing requirement) and (MTH 114 or MTH 116 or MTH 124 or MTH 126 or MTH 132 or MTH 133 or LB 118 or LB 119) (PHY 183 or PHY 183B or PHY 231 or PHY 231C) R: Open to seniors or graduate students. SA: GLG 371 Structural geology, geological and geophysical methods of studying the structure and dynamics of the earth and planets. Plate kinematics and global geodynamic processes, plate margin processes and evolution, marine geology. Field trip required.

411 Hydrogeology
Fall. 3(3-0) RB: MTH 114 or MTH 116 or MTH 124 or MTH 126 or MTH 132 or MTH 133 or LB 118 or LB 119 R: Not open to freshmen or sophomores.
Source, occurrence, and movement of groundwater emphasizing geologic factors and controls.

412 Glacial Geology and the Record of Climate Change
Spring. 3(3-0) Interdepartmental with Geography. Administered by Geological Sciences. RB: GLG 201 or GEO 306 or GEO 408 or GLG 301 R: Not open to freshmen or sophomores.
In-depth analysis of glacial geology and the record of climate change, with emphasis on North America and Europe. One weekend field trip required.

421 Environmental Geochemistry
Spring. 4(3-2) RB: GLG 201 and (CEM 141 or CEM 151 or CEM 181H or LB 171) Natural and anthropogenic processes affecting environmental chemistry with emphasis on the water cycle. Chemical equilibria, kinetics, geochemical cycling, acid rain, carbon dioxide, heavy metals, toxic organics, global change and the greenhouse effect.

431 Sedimentology and Stratigraphy
Geological Sciences—GLG

801 Seminar in Geochemistry
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to graduate students in the Department of Geological Sciences. Approval of department; application required.
Recent developments in geochemistry, including aqueous, biologic and mineralogic aspects.

802 Seminar in Geophysics and Geodynamics
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. RB: GLG 401 or GLG 470 or GLG 471 R: Open only to graduate students in the Department of Geological Sciences. Applied, solid-earth, and theoretical geophysics, global and regional geodynamics. Plate tectonics, marine geophysics, and polar earth sciences.

803 Seminar in Hydrogeology
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. RB: GLG 411 or GLG 421 R: Open only to graduate students in the Department of Geological Sciences. Occurrence, movement and composition of groundwater in geologic settings.

804 Seminar in Paleobiology
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to graduate students in the Department of Geological Sciences. Invertebrate, vertebrate and plant paleobiology.

805 Seminar in Petrology
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. RB: GLG 361 R: Open only to graduate students in the Department of Geological Sciences. Current topics in igneous petrology.

806 Seminar in Sedimentology and Stratigraphy
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to graduate students in the Department of Geological Sciences. Recent developments in stratigraphy and deposition, and diagenesis of sedimentary rocks.

807 Seminar in Structural Geology and Tectonics
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to graduate students in the Department of Geological Sciences. Rock deformation and major lithospheric structure.

808 Seminar in Planetary Geology and Astromaterials
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. RB: Upper university-level coursework in GLG or AST R: Open to graduate students in the Department of Geological Sciences. Approval of department. Current topics in planetary geology and astromaterials, including meteorites and returned samples.

809 Seminar in Geotechniques
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to graduate students in the Department of Geological Sciences. Geotechnique of department; application required.

810 Seminar in Structural Geology
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to graduate students in the Department of Geological Sciences. Recent developments in structural geology.

811 Seminar in Marine Geology
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to graduate students in the Department of Geological Sciences. Approvals of department. Current topics in marine geology and paleoceanography.

812 Seminar in Geomorphology
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to graduate students in the Department of Geological Sciences. Approvals of department. Recent developments in geomorphology.

813 Seminar in Hydrology
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to graduate students in the Department of Geological Sciences. Approvals of department. Recent developments in hydrology.

814 Seminar in Geochemistry
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to graduate students in the Department of Geological Sciences. Approvals of department. Recent developments in chemical geology.

815 Seminar in Geomaterials
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to graduate students in the Department of Geological Sciences. Approvals of department. Recent developments in geomaterials.

816 Seminar in Geophysics
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to graduate students in the Department of Geological Sciences. Approvals of department. Recent developments in geophysics.

817 Seminar in Geomorphology
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to graduate students in the Department of Geological Sciences. Approvals of department. Recent developments in geomorphology.

818 Seminar in Marine Geology
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to graduate students in the Department of Geological Sciences. Approvals of department. Recent developments in marine geology.

819 Seminar in Geomaterials
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to graduate students in the Department of Geological Sciences. Approvals of department. Recent developments in geomaterials.

820 Seminar in Geophysics
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to graduate students in the Department of Geological Sciences. Approvals of department. Recent developments in geophysics.

821 Aqueous Geochemistry
Fall of odd years. 3(2-2) RB: CE 481 or CEM 363 or CSS 455 or FW 472 or GLG 421 or GLG 422 R: Open only to graduate students. Controls on the chemical and isotopic nature of water (fresh, marine, brine) and its solutes. Data acquisition and synthesis. Chemical modeling and evolution of water masses.

822 Stable Isotope Biogeochemistry
Spring of even years. 2(1-2) Interdepartmental with Zoology, Administered by Zoology. RB: CEM 142 or CEM 152 or CEM 182H or LB 171 Principles of stable isotope chemistry applied to biogeochemical problems: climate change, ecology, contaminants, oceanography, limnology, and paleobiology.

823 Igneous Petrology
Fall of even years. 4(3-2) RB: GLG 361 R: Open only to graduate students. Origin and evolution of magmatic systems. Relationship of igneous activity to tectonic setting.

824 Basin Analysis
Spring of even years. 3(3-0) RB: GLG 351 and GLG 431 Paleogeographic evolution of sedimentary basins. Principles of facies analysis, subsidence history, thermal history and diagenesis. Methods of stratigraphic analysis.

825 Special Problems in Planetary Geology and Astromaterials
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. RB: Upper university-level coursework in GLG or AST R: Open to graduate students in the Department of Geological Sciences. Approval of department. Individual study on current topics in planetary geology and astromaterials, including meteorites and returned samples.

826 Special Problems in Geochemistry
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 graduate students in the Department of Geological Sciences. Approval of department. Individual study on problems in geochemistry, including aqueous, biologic, and mineralogic aspects.

827 Special Problems in Geophysics
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 graduate students in the Department of Geological Sciences. Approval of department. Individual study on problems in geophysics, including aquatic, biologic, and mineralogic aspects.

828 Special Problems in Geodynamics
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Upper university-level coursework in GLG or AST R: Open to graduate students in the Department of Geological Sciences. Approval of department. Individual study on current topics in geodynamics.

829 Special Problems in Structural Geology
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 graduate students in the Department of Geological Sciences. Approval of department. Individual study on current topics in structural geology.

830 Special Problems in Marine Geology
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 graduate students in the Department of Geological Sciences. Approval of department. Individual study on current topics in marine geology.

831 Special Problems in Geomaterials
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 graduate students in the Department of Geological Sciences. Approval of department. Individual study on current topics in geomaterials.

832 Special Problems in Hydrogeology
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: GLG 411 or GLG 421 R: Open only to graduate students in the Department of Geological Sciences. Approval of department. Individual study on the movement, occurrence and composition of groundwater in geologic environments.

833 Special Problems in Paleobiology
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 graduate students in the Department of Geological Sciences. Approval of department. Individual study on current problems in paleobiology.

834 Special Problems in Petrology
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 graduate students in the Department of Geological Sciences. Approval of department. Individual study on current problems in petrology.

835 Special Problems in Sedimentology and Stratigraphy
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 graduate students in the Department of Geological Sciences. Approval of department. Individual study on problems in sedimentology and stratigraphy.

836 Special Problems in Structural Geology and Tectonics
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 graduate students in the Department of Geological Sciences. Approval of department. Individual study on problems in structural geology and tectonics.

837 Special Problems in Geochemistry
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 graduate students in the Department of Geological Sciences. Approval of department. Individual study on problems in geochemistry.

838 Special Problems in Geophysics
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 graduate students in the Department of Geological Sciences. Approval of department. Individual study on problems in geophysics.

839 Special Problems in Geodynamics
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 graduate students in the Department of Geological Sciences. Approval of department. Individual study on problems in geodynamics.

840 Master's Thesis Research
Fall, Spring, Summer. 1 to 10 credits. A student may earn a maximum of 36 credits in all enrollments for this course. R: Open only to masters students in the Department of Geological Sciences. Approval of department. Master's thesis research.
900  **Research Strategies and Methods in Environmental Engineering and Science**  
Spring. 1(1-0) Interdepartmental with Environmental Engineering. Administered by Environmental Engineering. R: Open to graduate students in the Department of Civil and Environmental Engineering and open to graduate students in the Department of Geological Sciences. Not open to students with credit in CE 900.  
Criteria for quality research, scientific method, scientific arguments, statistical testing, critical thinking skills, reviewing journal articles, literature synthesis, writing proposals and papers, giving presentations, responsible conduct of research.

901  **Research Strategies and Methods**  
Fall, Spring. 1(1-0) A student may earn a maximum of 3 credits in all enrollments for this course. RB: Undergraduate degree in Engineering or Sciences  
Selected topics in the earth and environmental sciences.

999  **Doctoral Dissertation Research**  
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 36 credits in all enrollments for this course. R: Open to doctoral students in the Department of Geological Sciences. Approval of department.  
Doctoral dissertation research.