

Descriptions—Geography of Courses

- 814. Applied Research Methods for Planning and Development**
Spring. 3(2-2) Interdepartmental with Urban Planning. Administered by Urban Planning. P: UP 813. R: Open only to graduate students in Urban and Regional Planning, Public Administration, and Geography.
Techniques in urban and regional planning analysis. Forecasting models. Methods of urban project evaluation.
- 819. Spatial Epidemiology and Medical Geography**
Spring of even years. 3(3-0) Interdepartmental with Epidemiology. Administered by Epidemiology. P: EPI 810. R: Open only to master's students in the Epidemiology major or approval of department.
Concepts, techniques, and utilization of spatio-epidemiologic analyses for human health.
SA: HM 819
- 823. Map Automation**
Fall of even years. 3(2-2)
Use of computers in cartography. Cartographic algorithms, interpolation, and line generalization. Program intelligence. Cartographic data bases.
- 825. Geoprocessing**
Fall of odd years. 4(4-0)
Integration of digital remote sensing data, geographic information systems, spatial analysis, and expert systems in solving research problems. Class research project.
- 826. Seminar in Cartography and Geoprocessing**
Spring. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course.
Review of research in cartography, geographic information systems, and remote sensing.
- 832. Environmental and Natural Resource Law**
Fall. 3(3-0) Interdepartmental with Resource Development; Agricultural Economics; Crop and Soil Sciences; and Forestry. Administered by Resource Development. P: RD 430.
Origin and development of environmental law. Theories of power, jurisdiction, sovereignty, property interests, pollution, and other bases for legal controls of natural resources. Common law and constitutional limitations on governmental power.
- 850. Seminar in Regional Geography**
Spring. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course.
Review of research on contemporary geographic issues in different world regions.
- 854. Economics of Planning and Development**
Spring. 3(3-0) Interdepartmental with Urban Planning. Administered by Urban Planning. P: UP 801.
The physical urban environment and local economic development.
- 865. Advanced Quantitative Methods in Geography**
Spring. 4(4-0) P: GEO 465.
Statistical and mathematical approaches. Multiple regression, principal components and factor analysis, discriminant analysis. Related taxonomic methods.

- 867. Methods and Modeling in Regional Science**
Spring of even years. 3(3-0) Interdepartmental with Resource Development; and Urban Planning. P: EC 820, GEO 865; GEO 415 or RD 461.
Techniques for regional research: economic base analysis, input-output analysis, mathematical programming, and econometric and simulation analysis.
- 886. Research Design in Geography**
Spring. 3(3-0)
Research and writing in geography. Identification of geographic problems and their relative importance. Structuring and stating hypotheses. Data acquisition and tests for validity.
- 890. Advanced Readings in Geography**
Fall, Spring, Summer. 1 to 8 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Approval of department.
Advanced independent readings.
- 892. Advanced Research in Geography**
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 12 credits in all enrollments for this course.
Advanced independent research.
- 899. Master's Thesis Research**
Fall, Spring, Summer. 1 to 12 credits. A student may earn a maximum of 30 credits in all enrollments for this course. R: Open only to graduate students in Geography.
- 986. Theory and Methods in Geography**
Spring. 3(3-0) R: Open only to Ph.D. students in Geography.
Historical development of the discipline within social and intellectual contexts. Current methodological and philosophical approaches to geographic research.
- 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.

GEOLOGICAL SCIENCES

GLG

Department of Geological Sciences College of Natural Science

- 201. The Dynamic Earth**
Fall, Spring. 4(3-2) Not open to students with credit in GLG 301.
Physical and chemical processes related to the past, present and future behavior of the earth system, and the energy systems that drive these processes. A study of the earth's materials, the earth's surface and the earth's interior.
- 202. Physical and Biological History of the Earth**
Fall, Spring. 4(3-2) P: (GLG 201 or ISP 203)
Origin of the Earth. Differentiation of the Earth's core, mantle and crust. Lithospheric tectonics over geologic time. Origin and evolution of the Earth's hydrosphere, atmosphere and climate. Origin and evolutionary history of biological life. Interactions of life with the Earth's endogenic and exogenic systems.
- 302. Geology of Michigan**
Spring. 3(3-0) P: (GLG 201 or GLG 301 or ISP 203)
Integration of the geological evolution of Michigan with its social and economic development.
- 303. Oceanography**
Fall. 4(4-0) P: (CEM 141 or CEM 142 or CEM 151 or CEM 152 or CEM 181H or CEM 182H or LBS 165) and (PHY 183 or PHY 183B or PHY 193H or PHY 231 or PHY 231B or PHY 231C or LBS 164)
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.
- 319. Introduction to Earth System Science**
Fall. 3(3-0) Interdepartmental with Entomology; Botany and Plant Pathology; Zoology; and Sociology. Administered by Entomology. P: 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 or GLG 301) and (CEM 142 or CEM 152 or CEM 182H or LBS 266) and (MTH 124 or MTH 132 or LBS 118)
Geochemical properties and processes in the origin, modification, structure, dynamics and history of Earth materials. Crystallography and crystal chemistry. Mineral classification and identification.
- 332. Social Impact of Paleobiology**
Spring. 3(3-0) P: (ISB 200 or ISP 202 or ISP 203 or GLG 201 or BS 110 or LBS 144) and completion of Tier I writing requirement and one ISS course and one IAH course.
Social impact and influence of paleobiological thought and discoveries, from early ideas on the origins of fossils to evolution as a dominant force shaping the design of organic life. Involvement of paleobiology in social Darwinism, evolutionary humanism, evolutionary mysticism, and conflicts with creationists.
- 335. Plants Through Time**
Spring of odd years. 3(3-0) Interdepartmental with Botany and Plant Pathology. Administered by Botany and Plant Pathology. P: BS 110 or BOT 105 or GLG 201 or LBS 144. R: Juniors and above.
Evolutionary history of plants, the development of ecosystems, and the use of plant fossils in the reconstruction of ancient environments and climate.
- 351. Structural Geology**
Fall. 4(3-2) P: (GLG 202 and GLG 361) and (MTH 116 or LBS 117) RB: Introductory physics.
Mechanical behavior and kinematic history of the lithosphere. Stress and strain. Deformation features such as folds, faults and microstructure. Methods of analysis and interpretation. One weekend field trip required.

361. Petrology (W)

Spring. 4(3-2) P: (GLG 321) and completion of Tier I writing requirement.

Evolution, origin, occurrence and tectonic setting of igneous and metamorphic rocks. Phase relations of igneous and metamorphic systems. Studies of rocks in thin sections.

SA: GLG 461

371. Plate Tectonics (W)

Spring. 4(3-2) P: (GLG 201 or GLG 301) and (MTH 104 or MTH 116 or LBS 117) and (PHY 183 or PHY 183B or PHY 231 or PHY 231B or LBS 164) and completion of Tier I writing requirement.

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.

411. Hydrogeology

Fall. 4(3-2) P: (MTH 116 or LBS 117 or MTH 104)

Source, occurrence, and movement of groundwater emphasizing geologic factors and controls.

412. Glacial and Quaternary Geology

Spring. 4(3-2) Interdepartmental with Geography. P: (GLG 201 or GLG 301 or GEO 306 or GEO 408) R: Not open to freshmen or sophomores.

Glacial and Quaternary geology with emphasis on North America and Europe. Laboratory focuses on glacial processes. One weekend field trip required.

419. Advanced Earth System Science

Spring. 3(2-2) Interdepartmental with Entomology; Botany and Plant Pathology; Zoology; and Sociology. Administered by Entomology. P: ENT 319

Systems science theory applied to analysis of the biological, geological, physical, and social causes and consequences of global changes. Issues of sustaining the Earth system.

421. Environmental Geochemistry

Spring. 4(3-2) P: (GLG 201 or GLG 301) and (CEM 141 or CEM 151 or CEM 181H or LBS 165)

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.

422. Organic Geochemistry (W)

Fall. 3(3-0) P: (CEM 141 or CEM 142 or CEM 151 or CEM 152 or CEM 181H or CEM 182H or LBS 165) and completion of Tier I writing requirement. RB: (GLG 201 Or GLG 202 Or GLG 301)

Organic geochemistry applied to global cycling of organic matter and diagenesis. Use of stable isotopes and molecular analyses to trace the fate of bulk organic matter and individual compounds in the environment.

426. Biogeochemistry

Summer. 3 credits. Given only at W.K. Kellogg Biological Station. Interdepartmental with Microbiology; Crop and Soil Sciences; and Zoology. Administered by Microbiology. P: (BS 110 or LBS 144 or LBS 148H or BS 111 or LBS 145 or LBS 149H) and (CEM 143 or CEM 251)

Integration of the principles of ecology, microbiology, geochemistry, and environmental chemistry. Societal applications of research in aquatic and terrestrial habitats.

SA: MPH 426

431. Sedimentology and Stratigraphy (W)

Spring. 4(3-2) P: (GLG 351) and completion of Tier I writing requirement.

Sediments, sedimentary rocks, sedimentary processes, and depositional environments through geologic time. Facies events correlation. Fossils as tools in stratigraphy and environmental analysis. Biostratigraphy, paleoecology and taphonomy.

433. Vertebrate Paleontology

Fall of even years. 4(3-2) Interdepartmental with Zoology. P: (ZOL 328)

Fossil vertebrates with emphasis on evolution and interrelationships of major groups. Modern techniques of identification and interpretation of fossils.

434. Evolutionary Paleobiology

Fall. 4(3-2) Interdepartmental with Zoology. P: (BS 110 or GLG 202 or LBS 144 or LBS 148H)

Patterns and processes of evolution known from the fossil record including speciation, phylogeny, extinction, heterochrony and biogeography.

471. Applied Geophysics

Fall. 4(3-2) P: (MTH 133 or concurrently or LBS 119 or concurrently) and (PHY 184 or concurrently or PHY 184B or concurrently or PHY 232 or concurrently or PHY 232B or concurrently or PHY 232C or concurrently or PHY 294H or concurrently or LBS 267 or concurrently)

Application of seismic, gravity, magnetic, resistivity, and electromagnetic methods to problems related to engineering studies, mineral and oil exploration, groundwater, subsurface mapping, pollution, and hazardous waste.

481. Reservoirs and Aquifers

Fall of odd years. 3(3-0) P: (GLG 431)

Principles of the origin and evolution of porous media. Porosity and permeability of sediments and sedimentary rocks. Computing techniques for evaluating reservoirs and aquifers.

491. Field Geology—Summer Camp (W)

Summer. 6 credits. Given only in Utah. P: (GLG 431) and completion of Tier I writing requirement.

R: Open only to students in the Department of Geological Sciences. Approval of department.

Field analysis of rock types: igneous, metamorphic, sedimentary. Structural analysis. Preparation of stratigraphic sections, geologic maps and cross sections. Air photo analysis.

499. Independent Study in Geological Sciences

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 Geological Sciences. Approval of department; application required.

Advanced individual study of special topics in the geological sciences.

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 Geological Sciences.

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. P: GLG 371 or GLG 471 or GLG 472. R: Open only to graduate students in Geological Sciences.

Applied, solid-earth, and theoretical geophysics, global and regional geodynamics. Plate tectonics, marine geophysics, and polar earth sciences.

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 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. P: GLG 461. R: Open only to graduate students in 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 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 Geological Sciences.

Rock deformation and major lithospheric structure.

811. Advanced Hydrogeology

Spring. 3(3-0) Interdepartmental with Civil Engineering. P: CE 821

Processes influencing groundwater flow and solute transport. Mathematical equations and numerical methods to describe these processes.

Descriptions—Geological Sciences of Courses

821. Aqueous Geochemistry

Fall of odd years. 3(2-2) P: CE 481 or CEM 383 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. Analytical Applications for Biogeochemical Research

Fall of even years. 3(3-0) P: 12 credits in biological science, biochemistry, or chemistry; 6 credits in geological sciences.

Carbon and nutrient cycling in the natural environment. Oxidic and anoxic processes. Flows of carbon in lacustrine, marine, terrestrial and global ecosystems. Development of the carbon cycle over geologic time.

823. Isotope Geochemistry

Spring of even years. 3(3-0) P: CEM 151; CEM 152; PHY 183, PHY 184, or PHY 231, PHY 232. R: Open only to graduate students.

Fundamentals of isotope behavior, fractionation, and interpretation and application of isotope data. Radiogenic isotopes including geochronology and environmental tracing.

825. Clay Mineralogy and Soils Genesis

Spring of even years. 4(3-2) Interdepartmental with Crop and Soil Sciences. Administered by Crop and Soil Sciences. R: Open only to graduate students in College of Agriculture and Natural Resources, College of Engineering, or College of Natural Science.

Mineral structures. X-ray diffraction, pedogenic processes, and mineral transformations and stability.

830. Paleobotany

Fall of even years. 3(2-3) Interdepartmental with Botany and Plant Pathology. Administered by Botany and Plant Pathology. R: Open only to graduate students. Approval of department.

Survey of fossil plants: preservation, occurrence, geological relations, taphonomy, whole plant reconstruction, evolutionary history, and paleoecology.

831. Quantitative Paleobiology

Spring of even years. 3(2-2) Interdepartmental with Zoology. P: GLG 431 or ZOL 345.

Analysis of paleobiological problems using quantitative techniques such as cladistics, morphometrics, ordination, and stereology.

861. Evolution of the Crust and Mantle

Fall of even years. 3(3-0) P: GLG 461. R: Open only to graduate students.

Origin and evolution of the Earth's crust and mantle. Petrology, tectonics and geophysics of the Earth.

862. Igneous Petrology

Fall of odd years. 4(3-2) P: (GLG 361)

Origin and evolution of magmatic systems. Relationship of igneous activity to tectonic setting.

863. Mineral-Water Interactions

Spring of odd years. 4(3-2) Interdepartmental with Crop and Soil Sciences. R: Open only to graduate students in Crop and Soil Sciences or Geological Sciences or Geography.

Mineralogy, petrology and geochemistry of fluid-rock reactions in geologic, sedimentary and geochemical cycles. Rock and mineral weathering, soil formation, genesis and burial diagenesis of sediments and sedimentary rocks, and metamorphism.

871. Seismology and Geodynamics (MTC)

Fall of even years. Spring of even years. 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course. P: MTH 234, PHY 184.

Seismological theory, earthquakes. Quantitative modeling of the applications to Earth structure, seismic source mechanisms and geodynamics. Behavior and deformation of the lithosphere.

881. Sedimentary Petrology

Fall of even years. 4(3-2) P: (GLG 361 and GLG 431)

Origin of sedimentary particles and their chemical and physical alterations after deposition. Geochemical cycles in Earth history.

882. Basin Analysis

Spring of even years. 3(3-0) P: (GLG 351 and GLG 431)

Paleogeographic evolution of sedimentary basins. Principles of facies analysis, subsidence history, thermal history and diagenesis. Methods of stratigraphic analysis.

891. Special Problems in Geochemistry

Fall, Spring, Summer. 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 Geological Sciences. Approval of department.

Individual study on problems in geochemistry, including aqueous, biologic, and mineralogic aspects.

892. Special Problems in Geophysics and Geodynamics

Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. P: GLG 371 or GLG 471 or GLG 472. R: Open only to graduate students in Geological Sciences. Approval of department.

Individual study on problems in applied and solid-earth geophysics, global and regional geodynamics, and polar earth sciences.

893. Special Problems in Hydrogeology

Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. P: GLG 411 or GLG 421. R: Open only to graduate students in Geological Sciences. Approval of department.

Individual study on the movement, occurrence and composition of groundwater in geologic environments.

894. Special Problems in Paleobiology

Fall, Spring, Summer. 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 Geological Sciences. Approval of department.

Individual study on invertebrate, vertebrate and plant paleobiology.

895. Special Problems in Petrology

Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. P: GLG 461. R: Open only to graduate students in Geological Sciences. Approval of department.

Individual study on current problems in petrology.

896. Special Problems in Sedimentology and Stratigraphy

Fall, Spring, Summer. 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 Geological Sciences. Approval of department.

Individual study on problems in sedimentology and stratigraphy.

897. Special Problems in Structural Geology and Tectonics

Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. P: GLG 351. R: Open only to graduate students in the Department of Geological Sciences. Approval of department.

Individual study on rock deformation or major expressions of deformation. From two to seven weeks of field study during semester breaks may be required for certain research projects.

898. Special Problems in Environmental Geosciences

Fall, Spring, Summer. 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 environmental geosciences.

899. Master's Thesis Research

Fall, Spring, Summer. 1 to 10 credits. A student may earn a maximum of 24 credits in all enrollments for this course. R: Open only to master's students in the Department of Geological Sciences. Approval of department.

999. Doctoral Dissertation Research

Fall, Spring, Summer. 1 to 48 credits. A student may earn a maximum of 99 credits in all enrollments for this course. R: Open only to doctoral students in the Department of Geological Sciences. Approval of department.

GERMAN

GRM

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

101. Elementary German I

Fall, Spring, Summer. 4(4-1) R: No previous experience in German or designated score on German Placement Test. Not open to students with credit in GRM 150.

German language, civilization, and culture for beginning students. Work on all language skills with emphasis on speaking.