200. The Geology of Man's Environment
Fall, Winter, Spring, Summer. 3(3-0)
Not open to Geology majors. Credit will be given in only one of the following: GLG 200, GLG 201, GLG 306.
Man and his geologic environment: earthquakes, volcanoes, landslides, subsidence, flooding, coastal erosion, hydrology and human use, waste disposal, geologic aspects of environmental health, resources and energy, environmental law.

201. Earth Processes
Fall, Winter, Spring. 4(4-2). Credit will be given for only one of the following: GLG 200, GLG 201, GLG 306.
Physical processes concerning evolution of Earth and its environment. Conservation and interaction of energy and matter through time. Laboratory stresses interpretation of process through studies of geologic data.

202. Evolution of the Earth
Fall, Winter, Spring. 4(4-2). GLG 200, or GLG 201; or GLG 306.
Integration of physical, chemical and biological processes from which man's present environment has evolved; problems and controversies in the development of ideas of geologic and organic evolution.

205. Oceanology-The Marine Environment and Man
Fall. 3(3-0)
Physical oceanography, including origin, hydrologic, chemical, geological properties; and environmental quality of the oceans. Man-sea interactions are emphasized including resource utilization and pollution.

221. Minerals, Rocks and Fossils
Spring. 3(2-3). Not open to majors.
Description, occurrence and identification of minerals, rocks, fossils, and additional features of especial significance to general science teachers and other earth science interest groups.

282. Energy Resources of the Earth
Winter. 3(3-0)
World energy resources of petroleum, coal, and atomic fuel. Social, political, economic and environmental problems of fuels.

300. Solar System Geology
Winter. 4(4-0) AST 119 or AST 217 or AST 229; GLG 201 and/or GLG 202; or approval of department.
The origin, relationships, make-up and features of the bodies in the solar system emphasizing recent space exploration results and developing theories.

302. Vertebrate Life of the Past
Fall. 3(3-0). One course in a physical or biological science or Juniors. Interdepartmental with the Department of Zoology.
Fossil vertebrates from fish to man.

304. Geology of Michigan
Fall. 3(3-0) GLG 200 or GLG 201 and/or GLG 202; or approval or department.
A historical accounting of the physical, historical and economic geology of Michigan and its environments; a course designed for students seeking an overall picture of the rather unique Michigan geological environment.

305. Engineering Geology
Fall, Spring. 3(3-2) Credit will be given for only one of the following: GLG 200, GLG 201, GLG 306. Sophomore Engineering students.
Fundamental principles of geology as applied to civil engineering practice. Minerals and rocks, aerial photographs, topographic and areal geologic maps and geologic cross sections studied in laboratory. Source of geologic literature and maps.

307. Geology Central Appalachians
Winter. 1(0-2) GLG 200, or GLG 201, or GLG 202, or concurrently. GLG 306.

308. Field Excursion-Central Appalachians
Spring. 2 or 3 credits. GLG 207.
Training in stratigraphic, sedimentological, paleontologic, and structural principles as applied to field methods.

321. Mineralogy
Fall. 3(4-4). One term of chemistry.

322. Optical Mineralogy
Winter. 3(3-4) GLG 321.
Continuation of GLG 321 with emphasis on the theory, principles and mineralogical applications of the polarizing microscope. Identification, structural relationships and determination of composition of non-optic rock-forming minerals in thin-section.

323. Introduction to Optical Mineralogy
Winter. 1(0-3) GLG 321.
Basic principles underlying the use of the polarizing microscope. Recognition and understanding fundamental optical properties. Identification of minerals and texture in thin sections of rocks.

335. Fossil Plants, Their History and Paleobotany
Spring. 3(3-0). One course in geology or botany or biology or approval of department.
Interdepartmental with the Department of Botany and Plant Pathology.
The history of plants through geologic time; their form and evolution, how and where found, identified and reconstructed; their use in determining ancient geographic patterns, paleoenvironments, paleoclimates and community structure. Field trip.

337. The Fossil Record of Organic Evolution
Spring. 3(3-0). One course in a natural science; Juniors. Interdepartmental with the Department of Zoology.

344. Field Geology-Summer Camp
Summer. 9 credits. GLG 202, GLG 363. Trigonometry, GLG 446, GLG 437, GLG 451 recommended.
Methods and techniques of geological surveying and mapping. Field interpretation of geological phenomena in igneous, metamorphic and sedimentary rocks in northern Michigan and Wisconsin.

A. Introduction to Field Techniques
3 credits.
Introduction to field techniques with stress in those areas that apply to sedimentary rocks. Stratigraphic correlation.

B. Methods of Geological Mapping
4 credits.
Plate table surveys, aerial photo and reconnaissance mapping. Examination and interpretation of structural and textural relations in igneous and metamorphic rocks.

C. Geologic Interpretation of Selected Areas
2 credits.
Independent mapping and interpretation.

351. Structural Geology
(45L) Fall. 4(3-5) GLG 202; MTH 111.
Description, classification, and origin of secondary structures such as folds, faults, joints, cleavages, foliations and lineations. Three-dimensional visualization stressed. Economic laboratory problems involving descriptive geometry, stereographic projections, areal, and structural geologic maps.

363. Lithology
Spring. 4(3-4) GLG 321.
Processes that form igneous and metamorphic rocks: origin, distribution, variation and occurrence of rock. Study of rock properties in the field, laboratory, and with the microscope.

375. Introduction to Geophysics
Winter. 3(3-0) GLG 201; MTH 111; PHY 200 or PHY 205.
Earth's interior, lithosphere tectonics, and geophysical exploration including: refraction seismology, gravity, magnetism, earth's internal structure, global seismology, plate tectonics, structure of plate margins, and planetary geology.
392. Sedimentology
(492.) Spring. 3(2-3) GLG 392.
Grain and aggregate properties of sediments; relationships of these properties to processes in the environment of deposition and to the pre-depositional and post-depositional history.

400H. Honors Work
Fall, Winter, Spring. Variable credit. 3.00 grade-point average or approval of chairperson; written proposal approved by faculty sponsor and chairperson.

403. Fluvial Geomorphology
Fall. 4(3-4) junior majors in GLG, C E, and CSS; one course in physical geology and junior standing in geology, civil engineering or soil science.
Quantitative analyses of the fluvial processes associated with the development of drainage basin morphology, with emphasis on stream bed erosion and sediment transport. Field trips are required.

411. Hydrogeology
Winter. 3(3-2) One term of geology and trigonometry.
Principles of the sources, occurrence, and movement of ground water. Surface and subsurface investigations of ground water and elementary ground water hydrology.

413. Glacial Geology
Spring. 4(3-4) GLG 201.
Geological aspects of glaciers and glaciation. Theories of ice ages through geologic time. Origins and development of glacial geomorphic features. Character and chronology of the Pleistocene. Laboratory techniques, with field trips to observe glacial materials and features of Michigan.

426. Optical and X-ray Mineralogy
Fall. 4(3-4) GLG 321. PHY 239 or PHY 298.
Theory, principle and application of the polarizing microscope and X-ray diffractometer in mineral analysis.

430. Vertebrate Paleontology
Winter. 4(3-3) ZOL 428 or approval of department. Interdepartmental with the Department of Zoology.
Fossil vertebrates with emphasis on the evolution of major groups. Laboratories on modern techniques and on the identification and interpretation of fossils.

437. Invertebrate Paleontology
Fall. 4(3-4) GLG 292 or ZOL 303 or approval of department. Interdepartmental with the Department of Zoology.
Systematics and evolution of marine invertebrates; use of fossils in correlation and delineation of geologic time; structure and morphology of fossils as related to evolutionary development.

438. Paleoecology
Spring. 4(3-4) GLG 292 or ZOL 380 or approval of department. Interdepartmental with the Department of Zoology.
Distribution and abundance of marine fossils; response of skeletal morphology to environmental conditions; use of fossils in reconstructing ancient climates and depositional environments.

445. Field Studies
Fall, Winter, Spring. Summer. Variable credit. May reenroll for a maximum of 12 credits. Approval of department.
Advanced geologic or geophysical field studies.

446. Principles of Stratigraphy
Winter. 3(3-4) GLG 437, GLG 392 or approval of department.
Covers principles of stratigraphy and application and exemplification of these principles to known geologic occurrences.

452. Petrology
Winter. 4(3-4) GLG 363, GLG 426.
Introduction to the chemical and physical processes that are responsible for the origin and evolution of igneous and metamorphic rocks. Laboratory studies of rock suites that illustrate basic processes in petrology.

474. Exploration Geophysics
Fall. 4(3-2) GLG 201 or GLG 306; GLG 375; MTH 214, PHY 239 or PHY 298.
Techniques used in geophysical exploration, with application in petroleum prospecting, minerals exploration, and engineering. Includes gravity, magnetic, seismics, electrical and other methods, and well logging. Interpretation of geophysical data.

475. Solid Earth Geophysics
Winter. 3(3-0) GLG 201 or GLG 306; GLG 375; MTH 215, PHY 239; MTH 310 recommended.
Geophysics, including Earth's composition and structure, its dynamic character, radioactivity and age determinations, seismicity and seismology, gravity and magnetic fields, heat flow, physical properties of earth materials.

482A. Mineral Resources
Spring. 3(3-0) GLG 351; GLG 474 or GLG 475.

482B. Mineral Resources Evaluation
Spring of odd-numbered years. 4(4-0) GLG 321, GLG 451.
Emphasis on practical applications of geoscience to mineral resources and the extractive industry. Aspects of exploration and development of reserves including evaluation, grade estimation, drilling, recovery, and beneficiation.

483. Petroleum Geology
Fall. 4(3-2) Approval of department.
Fundamental principles of the origin, migration and accumulation of petroleum. Exploration techniques to include well drilling, electric and radioactive well logging, surface and subsurface exploration methods, seismic surveys, land leasing and oil field development. Laboratory study of well log plotting and subsurface mapping techniques.

484. Applied Petroleum Geology
Winter. 4(1-6) GLG 483.
Microscopic examination of well cuttings, practices in the use of electric and radioactivity logs, exploration for petroleum in selected areas by subsurface mapping techniques, economics of petroleum exploration. Field trips.

485. Carbonate Sedimentology
Fall. 3(3-0) GLG 322, GLG 392.
Genesis of carbonate sediments including discussion of carbonate-secreting organisms, effects of environment on mineralogy, depositional environments and diagenesis.

493. Geochemistry
Fall. 3(3-0) GLG 201, CEM 152 or approval of department.
Origin of the elements. Geochemical evolution of universe, solar system, earth. Factors affecting the distribution of elements in earth including the applications of thermodynamics and crystal field theory. Isotope geology.

500. Special Problems
Fall, Winter, Spring. Summer. Variable credit. Approval of department.
Special problems in hydrogeology, geomorphology and glacial geology, mineralogy and crystallography, petrology, paleontology, structural geology, and petroleum geology, stratigraphy, aerogeology, geophysics, economic geology, petroleum geology, sedimentation, and geochemistry.

503. World Regional Geology
Spring of even-numbered years. 3(3-6)
One course each in structural geology, sedimentation.
World regional geology emphasizing mountain building, basin structure and associated sediments, continental drift and plate tectonics.

510. Seminar
Fall, Winter, Spring. 1 to 3 credits. May reenroll for a maximum of 12 credits.
Seminar relating to current research in geology.

525. Clay Mineralogy
Winter. 4(3-4) CSS 840, CSS 850 or approval of department. Interdepartmental with the Department of Crop and Soil Sciences.
Structures and properties of clay; their origins, occurrence, and utilization. Methods of studying clays including X-ray diffraction, differential thermal analysis, infrared absorption and other chemical and physical techniques.

530. Paleobotany
Fall. 4(3-4) Approval of department. Interdepartmental with and administered by the Department of Botany and Plant Pathology.
Survey of fossil plants: their preservation, occurrence, geology, palaeoecology, palaeoecology, evolutionary history, classification and representative types. One weekend field trip to fossil plant locality.

531. Palynology
Spring of even-numbered years. 4(3-4)
Approval of department. Interdepartmental with the Department of Botany and Plant Pathology.
An introduction to the principles and techniques of spore and pollen analysis, both fossil and recent, and utilization of plant microfossils for stratigraphic determinations and paleoecological interpretations of modern accumulations and rocks. Includes certain algae, protozoans, similar organisms of uncertain affinity and associated fragments of larger organisms.
833. Advanced Invertebrate Paleontology
B. Quantitative Paleontology
Fall. 3-2-4. GLG 437 or GLG 438. Interdepartmental with the Department of Zoology.
Application of mathematical tools to paleontological problems, including statistical applications and numerical taxonomy; computer applications.

C. Paleocology
Fall. 3-2-4. GLG 437 or GLG 438. Interdepartmental with the Department of Zoology.
Advanced problems in population, community, and province level paleocology, primarily of marine invertebrates, including study of taxonomy, diversity, and adaptation.

D. Developmental Paleontology
Fall. 3-2-4. GLG 437 or GLG 438, ZOL 317 or approval of department, Interdepartmental with the Department of Zoology.
Application of the principles of development to the ontogeny and phylogeny of fossil invertebrates as known from skeletal morphology.

834. Advanced Vertebrate Paleontology
Winter of even-numbered years. 3(3-0)
GLG 430 or approval of department. Interdepartmental with the Department of Zoology.
Recent advances and controversial issues in vertebrate paleontology including origin, classification, phylogeny, and stratigraphic relationships of fossil vertebrates.

835. Advanced Paleobotany
Winter. 3(2-4). Approval of department. Interdepartmental with the Department of Botany and Plant Pathology.
Morphology, anatomy, phylogenetic relationship and classification of fossil plants. Microscopic analysis of tissues and organs prepared by thin section, transfer, peel, polished and etched surfaces, and maceration.

843. Paleozoic Stratigraphy
Winter of even-numbered years. 4(5-0)
GLG 446, GLG 392. Classification, distribution, paleogeography, paleontology, interpretation, and structural setting of stratigraphic units within the Paleozoic systems. Laboratory work involves construction of correlation charts, structure and restored sections, paleogeologic, paleoecographic, and lithofacies maps, and study of certain key fossils.

844. Mesozoic and Cenozoic Stratigraphy
Winter of odd-numbered years. 3(3-0)
GLG 446. Stratigraphy and paleontology with emphasis on tectonics and sedimentation.

852. Structure of Ore Bodies
Winter of even-numbered years. 3(2-4)
GLG 451, MTH 514. Mathematics and physics applied to problems in structural geology.

861. Evolution of the Earth's Crust and Mantle
Fall. 3(3-4). GLG 462. The composition, mineralogy and petrology of the Earth’s mantle and crust. Plate tectonics and its relationship to earlier models of geosynclines, orogenic cycles, continental drift, etc.

862. Petrology-Igneous
Spring. 3(2-4). GLG 462. Formation of solid, igneous rocks. Origin and classification of metamorphic rocks. Study includes thin section, X-ray, and analytical techniques.

863. Petrology-Metamorphic
Spring of odd-numbered years. 3(3-0). May reenroll for a maximum of 8 credits. GLG 462. Must enroll for laboratory with initial registration.
Origin and classification of metamorphic rocks. Study includes thin section investigation of the metamorphic textures and mineral associations and the physical-chemical principles involved in their development.

870. Topics in Geophysics
Spring. 1 to 3 credits. May reenroll for a maximum of 12 credits. Approval of department.
Topics and problems in geophysics, such as tectonophysics, terrestrial heat flow, processing and analysis of geophysical data, geomagnetism, paleomagnetism, high-pressure geophysics.

873. Seismology I
Fall. 3(3-0). MTH 215 or concurrently; PHY 289 or concurrently.
Theory and application of seismic wave propagation in earth materials.

874. Seismology II
Winter of odd-numbered years. 3(3-0). GLG 873 or approval of department. Continuation of GLG 873.

875. Advanced Geophysical Exploration I
Fall. 3(3-2). GLG 474. Techniques and theory of gravity and magnetic methods, and their use in geophysical exploration. Associated practical exercises.

876. Advanced Geophysical Exploration II
Winter of even-numbered years. 4(3-2). GLG 474, MTH 214. Methods and techniques in geophysical exploration, including electrical, electromagnetic, radiactivity, magnetotelluric, and the physical principles of well logging. Associated practical exercises.

877. Geophysics of the Lithosphere II
Fall. 3(3-0). GLG 475, GLG 479. Structure and tectonic processes at convergent and divergent plate margins. Earthquake location and prediction, thermal modeling of slabs, origin of back-arc basins, and inter- and intra-plate stresses. Regional tectonic analyses.

878. Dynamic Processes in the Earth's Crust
Fall of odd-numbered years. 3(3-0). GLG 451, GLG 475, MTH 310 or approval of department.
Stress and strain analysis, rheology of materials, buckling and bending of strata, lithospheric stresses, geophysical flow, surface waves, attenuation, and other seismological topics.

884. Regional Petroleum Geology
Spring of odd-numbered years. 3(3-0). Approval of department.
Regional study of tectonics, stratigraphy and sedimentation in the U.S. and their relationship to petroleum occurrences in sedimentary basins. Analysis of petroleum distribution with emphasis on creative thinking in petroleum exploration. Practice in the analysis of petroleum possibilities in selected foreign areas.

891. Advanced Sedimentology

894. Aquatic Geochemistry
Spring of odd-numbered years. 3(3-0). GLG 495 or a course in physical chemistry or approval of department.
Nature and regulation of electrolytes in solution (fresh water, seawater, brine); activity, complexity, and redox effects. Trace metals in solution. Carbonate, silica, alumina systems. Chemical weathering and mobility of elements.

895. Topics in Geochemistry
C. Analytical Geochemistry
Fall of odd-numbered years. 3(3-0). GLG 495 or GLG 894.
Institutional techniques for the analysis of geological materials. Topics on application of X-ray diffraction, X-ray fluorescence, neutron activation analysis, and atomic absorption spectroscopy. Recently developed techniques in geochemistry will be discussed.

896. Applied Geochemistry
Spring of even-numbered years. 3(3-0). GLG 495 or GLG 894.
Migrations of elements in the near surface environment. Prediction of mineral deposits, hydrocarbon traps and harmful concentrations of both naturally occurring and artificially introduced hazardous elements and compounds.

899. Master's Thesis Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

900. Special Problems
Fall, Winter, Spring, Summer. Variable credit. Approval of department.
Special problems in hydrogeology, geomorphology and glacial geology, mineralogy and crystallography, petrology, paleontology, structural geology and petrofabrics, stratigraphy, aerogeology, geophysics, economic geology, petroleum geology, sedimentation, and geochemistry.

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

445. Field Studies
Fall, Winter, Spring, Summer. 1 to 9 credits. May reenroll for a maximum of 15 credits. Approval of department.
Experience and techniques in field investigation of the near surface layers of the earth.

446. Laboratory Investigations
Fall, Winter, Spring, Summer. 1 to 6 credits. May reenroll for a maximum of 15 credits. Independent laboratory investigation of materials and phenomena obtained from field studies.

800. Problems in Earth Science
Fall, Winter, Spring, Summer. 1 to 6 credits. May reenroll for a maximum of 12 credits. Approval of department.
Independent study in topics related to earth science education.

German and Russian Courses

College of Arts and Letters
Students who have had high school work in the foreign language in which they wish to continue their studies must take a placement examination in that language. Placement in the appropriate course is determined by the results of this examination. University credit is not given for courses waived by performance on the placement examination.

German and Russian Courses

303. Folklore
Spring, 3(3-0)
Folk heritage of peoples as revealed in their legends, superstitions, ballads, folksongs, hero tales, sayings, customs, and beliefs. Historical development of traditional lore as a reflection of social attitudes and the source for national mythology.

418. Scandinavian Contributions to Literary Tradition
Winter, 3(3-0)
Approval of department.
Interdepartmental with the departments of English, and Romance and Classical Languages. Administered by the Department of English.
Development and influence of the ideas, forms and motifs of the Scandinavian literatures in the literatures of the world.

498. Topics in Comparative Literature
Fall, Winter, Spring, 3(3-0) or 4(4-0)
May reenroll for a maximum of 12 credits if different topics are offered. Interdepartmental with the departments of English, and Romance and Classical Languages. Administered by the Department of Romance and Classical Languages.
Varying topics on relationships among writers, themes, genres, movements and periods in different national literatures, and between literature and other arts.

825. Comparative Literature: Studies in Theme and Idea
Fall, 3(3-0) May reenroll for a maximum of 9 credits. Interdepartmental with the departments of Romance and Classical Languages, and English. Administered by the Department of Romance and Classical Languages.
Myths, archetypes, 'Topoi,' significant ideas and intellectual currents in different periods and cultural traditions.

856. Comparative Literature: Literature and Other Disciplines
Winter, 3(3-0) May reenroll for a maximum of 9 credits. Interdepartmental with the departments of Romance and Classical Languages, and English. Administered by the Department of Romance and Classical Languages.
Relations between literature and the sciences and other arts; social, historical, psychological, philosophical bases of literary study.

902. Comparative Literature: Studies in Form and Genre
Winter, Spring, 3(3-0) Interdepartmental with the departments of English, and Romance and Classical Languages. Administered by the Department of English.
Rationale and techniques of study in comparative literature.

103. Elementary German
Fall, Winter, Spring, Summer. 4(4-1) GRM 102.
Continuation of GRM 102.

105. Intensive Elementary German
Winter, Spring. 5(5-2) GRM 101 with 3.0 or better or approval of department. May not receive credit for both GRM 105 and GRM 102, GRM 103.
Combination of GRM 102. GRM 103 in one term.

111. German for Travelers
Spring, 2(3-0) Not applicable to major or minor requirements.
Essential German for travelers: basic grammar, vocabulary and useful phrases. Introduction to German culture and life through lectures, audio-visual aids and reading.

201. Intermediate German
Fall, Winter, Spring, Summer. 4(3-1) GRM 103.
Systematic review of grammar, oral practice, intensive and extensive reading of modern texts. This course or equivalent is required of majors and those planning to take advanced work in German.

202. Intermediate German
Fall, Winter, Spring, Summer. 4(3-1) GRM 201.
Continuation of GRM 201.

203. Intermediate German
Fall, Winter, Spring, Summer. 4(3-1) GRM 202.
Continuation of GRM 202.

204. Intensive Second Year German
Spring. 10(0-0) GRM 103
Intensive second year, combining in one term the work of GRM 201, GRM 202, GRM 203.

241. German Literature in English Translation
Fall, 3(3-0) Knowledge of German not required. Not applicable to major requirements.
Selections from narrative prose, drama, and lyric poetry chosen to encourage and develop an appreciation of German literature.

242. German Literature in English Translation
Winter. 3(3-0) Knowledge of German not required. Not applicable to major requirements.
Continuation of GRM 241.

243. German Literature in English Translation (A)
Spring. 3(3-0) Knowledge of German not required. Not applicable to major requirements.
Continuation of GRM 242.

299. Special Projects
Fall, Winter, Spring, Summer. 1 to 12 credits. May reenroll for a maximum of 12 credits. Approval of department.
Work in areas outside regular course offerings.

301. Introduction to German Literature
Fall. 3(3-0) GRM 295. Required of majors.
Representative works of eighteenth and early nineteenth century authors.