901. Problems in Cultural Geography
Fall, Winter, Spring. Variable credit. May reenroll for a maximum of 6 credits. Approval of department. Special research problems.

902. Problems in Physical Geography
Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 6 credits. Supervised research in specific topics of physical geography.

906. Problems in Economic Geography
Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 6 credits. Approval of department. Special research problems.

908. Problems in Political Geography
Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 6 credits. Approval of department, GEO 416. Special research problems.

910. Problems in Historical Geography
Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 6 credits. Approval of department. Special research problems in historical geography.

912. Independent Study in Regional Geography
Fall, Winter, Spring. Variable credit. May reenroll for a maximum of 15 credits. Approval of department. Individual studies in regional geography.

918. Problems in Geography
Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 9 credits. Approval of department. Research on specific geographical problems.

934. Problems in Population
Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 9 credits. Approval of department. Special research problems.

970. Problems in Medical Geography
Fall, Winter, Spring, Variable credit. May reenroll for a maximum of 6 credits. Approval of department. Selected research topics in medical geography.

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

GEOLoGY

College of Natural Science

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 202. 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.

200L. Laboratory-Geology of Man's Environment
Fall, Winter, Spring, Summer. 10(3-3) GLG 200.
Laboratory study of geologic processes associated with environmental hazards. Emphasis placed on land-use planning, applying geologic criteria to evaluate land potentials.

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 environments. 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 development of ideas of geologic and organic evolution.

205. Oceanography-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(3-0) Not open to majors.
Description, occurrence and identification of minerals, rocks and fossils with special emphasis on the significance of fossils for general science teachers and other earth science interest groups.

271. Geophysics and the Earth
Spring. 3(3-0) GLG 200 or GLG 201 or GLG 306 or approval of department.
Basic concepts used in geophysics, including description of the Earth and its interior, methods of determining conditions and distributions of the interior, and processes determining the movement of the crust of the Earth.

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 200 or GLG 306.
The origin, relationships, make-up and use 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 sciences for Juniors. Interdepartmental with the Department of Zoology.
Fossil vertebrates from fish to man.

303. Introductory Geomorphology
Fall. 4(3-4) GLG 200 or GLG 201 or GLG 306.
Descriptive course treating the geological origin and development of important surface features including special consideration of Pleistocene landforms of the Great Lakes region. Field trips required.

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

306. Engineering Geology
Fall, Spring. 3(3-2) Credit will be given for only one of the following: GLG 206, GLG 201, GLG 306. Sophomore Engineering students.
Fundamental principles of geology as applied to civil engineering practice. Minerals and rocks, aerial photography, topographic and aerial geologic maps and geologic cross sections studied in laboratory. Source of geologic literature and maps.

307. Geology Central Appalachians
Winter. 3(3-0) GLG 200, or GLG 201, or GLG 202, or concurrently.
General geology of the Central Appalachians. A preparatory course for GLG 308. Field excursions-Central Appalachians during spring vacation.

308. Field Excursion-Central Appalachians
Spring. 2 or 3 credits. GLG 307.
Training in stratigraphic, sedimentological, paleontologic, and structural principles as applied to field methods.

321. Mineralogy
Fall. 5(4-4) One term of chemistry.
Introduction to crystal systems and forms exhibited by minerals, followed by study of composition, occurrence, classification, and identification of nonmetallic minerals.

322. Mineralogy
Winter. 4(3-4) GLG 321.
Economic and chemical importance of minerals; mineralogy of non-silicates; practical crystallography, geochemistry of minerals.

335. Fossil Plants, Their History and Paleocology
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.
History of plants through geologic time; their form and evolution, how and where found, identified and reconstructed; their use in determining ancient geologic 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 302, GLG 303, GLG 406, 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 that apply to sedimentary rocks. Stratigraphic correlation.

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

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

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

392. Sedimentology
(492.) Spring. 3(2-3) GLG 363.
Grain and aggregate properties of sediments; relationships of these properties to processes in the environment of deposition and to the depositional and post-depositional history.

400H. Honors Work
Fall, Winter. 3(3-0) Variable credit. Approval of department.

401. Environmental Geology
Spring of odd-numbered years. 3(3-0) GLG 200, or GLG 201, or GLG 306, MTH 113, or approval of department.
Quantitative solution of geological problems applied to environmental planning and management, including surface and ground water waste disposal, toxicology, and methods for prediction of geologic hazards and resources.

411. Hydrogeology
Winter. 3(3-2) One term of geology and trigonometry.
Principles of the source, 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. Trends of ice ages through geologic time. Origin and development of glacial geomorphic features. Character and chronology of the Pleistocene. Laboratory techniques, with field trips to observe glacial material and features of Michigan.

425. Optical and X-ray Mineralogy
Fall. 4(3-4) GLG 321, PHY 239 or PHY 289.
Theory, principle and application of the polarizing microscope and X-ray diffraction technique in mineral analysis.

430. Vertebrate Paleontology
Winter. 4(3-3) ZOL 420 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.

IDC. Introductory Meteorology
For course description, see Interdisciplinary Courses.

437. Invertebrate Paleontology
Fall. 4(3-4) GLG 202 or ZOL 303 or approval of department. Interdepartmental with the Department of Zoology.
Systematics and evolution of marine invertebrates; uses of fossils in correlation and delineation of geologic time; structure and morphology of fossils as related to evolutionary development.

438. Paleocology
Spring. 4(3-4) GLG 202 or ZOL 389 or approval of department. Interdepartmental with the Department of Zoology.
Distribution and abundance of marine fossils; response of skeletal morphology to environmental conditions; uses of fossils in reconstructing ancient climates and depositional environments.

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

446. Principles of Stratigraphy
Fall. 3(3-0) GLG 437, GLG 392 or approval of department.
Covers principles of stratigraphy and application and exemplification of these principles to known geologic occurrences.

451. Structural Geology
Spring. 4(2-6) GLG 202.
Description, classification, and origin of secondary structures such as folds, faults, joints, cleavages, foliations and lineations. Three-dimensional visualization stressed in economic laboratory problems involving descriptive geometry, stereographic projections, area, and structural geologic maps.

462. Petrology
Winter. 4(3-4) GLG 203.
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
Winter. 4(3-2) GLG 201 or GLG 306; MTH 112; PHY 239 or PHY 289.
Techniques used in geophysical exploration, with emphasis in petroleum prospecting, mineral exploration, and engineering. Includes gravity, magnetic, seismic, electrical and other methods, and well logging. Interpretation of geophysical data.

475. Solid Earth Geophysics
Fall. 3(3-0) MTH 112; PHY 239 or PHY 289, one term of geology.
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.

479. Geotectonics
Winter of even-numbered years. 3(3-0) GLG 451 or approval of department.
Aspects of global dynamics and geotectonics. Includes the origin and distribution of major structural features, geological and geophysical evidence for crustal movements, continental drift, behavior of earth materials.

482A. Mineral Resources
(482.) Spring of odd-numbered years. 4(4-0) GLG 321, GLG 431.

482B. Mineral Resources Evaluation
Spring of even-numbered years. 3(3-0) GLG 321, GLG 451 and approval of department.
Emphasis on practical applications of geoscience to mineral resources and the extractive industries. Aspects of exploration and development of reserves including evaluation, grade estimation, mining, development, 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 radioactivity logging, surface and sub-surface exploration methods, seismic and gravity surveys, lease holding and oil field development. Laboratory study of well log plotting and subsurface mapping technique.

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

489. Carbonate Sedimentology
Winter. 3(2-3) GLG 392.
Genesis of carbonate sediments including discussion of carbonate-secretory organisms, effects of environment on mineralogy, depositional environments and diagenesis.

495. Geochemistry
Winter. 3(3-0) GLG 201, CEM 152 or approval of department.
Processes affecting the distributions of elements in rocks, soils, waters, the atmosphere, interior of the earth and in meteorites. Origin of the elements. Evolution of the mantle, crust, atmosphere and oceans.

800. Special Problems
Fall, Winter, Spring. 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.

803. World Regional Geology
Spring of even-numbered years. 3(3-0)
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.
825. **Clay Mineralogy**

Winter. 4(3-4) CSS 140, CSS 830 or approval of department. Interdepartmental with the Department of Crop and Soil Sciences. Structures and properties of clays; their origins, occurrence, and utilization. Methods of studying clays including x-ray diffraction, differential thermal analysis, infrared absorption and other chemical and physical techniques.

830. **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, paleography, palaeobotany, evolutionary history, classification and representative types. One weekend field trip to fossil plant locality.

831. **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 to the fossil record of plant micro-fossils for stratigraphic determinations and palaeocological interpretations of most sedimentary accumulations and rocks. Includes certain algae, protozoans, similar organisms of uncertain affinities and dissociated fragments of larger organisms.

832. **Advanced Invertebrate Paleontology**

A. **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.

B. **Paleoecology**
Fall. 3-2(4) GLG 437 or GLG 438. Interdepartmental with the Department of Zoology. Advanced problems in population, community, and province level paleoecology, primarily of marine invertebrates, including study of taxonomy, diversity, and adaptation.

C. **Paleoecology**
Fall. 3-2(4) GLG 437 or GLG 438. 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.

D. **Evolutionary Paleontology**
Fall. 3-2(4) GLG 437 or GLG 438. Interdepartmental with the Department of Zoology. Aspects of evolutionary biology that can be studied from a fossil record, with emphasis on marine invertebrates.

833. **Mesozoic and Cenozoic Stratigraphy**

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

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 origins, classification, phylogeny, and stratigraphic relationships of fossil vertebrates.
Earth Science

D. Geochemical Cycles
Spring of even-numbered years. 1 to 3 credits. May reenroll for a maximum of 12 credits. GLG 492, GLG 495.
Examination of the natural circulation of the elements and man's impact on these cycles.

897. Isotope Geochemistry
(892.) Winter of odd-numbered years. 3(3-0) GLG 495 or approval of department.
The abundances of stable and radiogenic nuclides and their variations in nature. Applications to geochronology and petrogenesis. Principles and application of neutron activation analysis to geological problems.

899. 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, palaeontology, structural geology and petrofabrics, stratigraphy, aerogeology, geophysics, economic geology, petroleum geology, sedimentation, and geochemistry.

German and Russian Courses

GERMAN AND RUSSIAN

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, folk songs, hero tales, sayings, customs, and beliefs. Historical development of traditional lore as a collection of social attitudes and the source for national mythologies.

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

418. Scandinavian Contributions to Literary Tradition
Winter, 3(3-0) Approval of department.
Interdepartmental with the departments of English and Romance and Classical Languages. Continuation of G R 417.

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 and 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 fo 9 credits. Interdepartmental with the departments of Romance and Classical Languages and English and 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 and 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.

875. Comparative Literature: Methods in the Study of Comparative Literature
Fall, 3(3-0) Interdepartmental with the departments of English and Romance and Classical Languages and administered by the Department of English.
Rationale and techniques of study in comparative literature.

902. Comparative Literature: Studies in Form and Genre
Winter, Spring, 3(3-0) Interdepartmental with the departments of English and Romance and Classical Languages and administered by the Department of English.
Development and interrelationships of individual and collective forms and genres of literatures of the Western world, including the drama, tragedy, the novel, the short story, the theory and forms of poetry, popular literature, and the tale.

903. Comparative Literature: Studies in Periodization
Fall, Winter, Spring, 3(3-0) Interdepartmental with the departments of English and Romance and Classical Languages and administered by the Department of English.
Analysis of the manner in which various genres, conventions and continuing traditions of literature interact with the creative and critical climates of particular periods and movements, such as classicism, the Middle Ages, the baroque, or romanticism, in qualifying or modifying characteristic literary works.

987. Seminar: Special Topics in Comparative Literature
Spring, 3(3-0) Advanced graduates. Interdepartmental with the departments of Romance and Classical Languages and English and administered by the Department of Romance and Classical Languages.

German

101. Elementary German
Fall, Winter, Spring, Summer, 5(5-0) German language, civilization, and culture. Development of language skills in contemporary German. Independent practice in the language laboratory.

102. Elementary German
Fall, Winter, Spring, Summer, 5(5-0) GRM 101. Continuation of GRM 101.

103. Elementary German
Fall, Winter, Spring, Summer, 5(5-0) GRM 102. Continuation of GRM 102.

105. Intensive Elementary German
Winter, Spring, 10(10-0) 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, 3(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.