970. Problems in Medical Geography
Fall, Winter, Spring. Variable credit. May re-enroll 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.

GEOL
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: 200, 201, 306.
The relation of geological processes and Earth materials to man. The nature and evolution of the Earth and life upon it. Man's exploitation of the non-renewable resources of the Earth.

200L. Laboratory—Geology of Man's Environment
Fall, Winter, Spring, Summer. 1(0-3)
200 or concurrently.
The geological reasoning concerning the nature and evolution of the Earth.

201. Earth Processes
Fall, Winter, Spring. 4(4-2) Credit will be given in only one of the following: 200, 201, 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) 200; or 201; or 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.

1DC. Introduction to Study of the Moon
For course description, see Interdisciplinary Courses.

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

221. Minerals, Rocks and Fossils
(325) Spring 3(2-2) 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.

271. Geophysics and the Earth
Spring. 3(3-0) 200 or 201 or 306 or approval of department.
Basic concepts used in geophysics, including description of the Earth and its interior; methods of exploring for mineral and energy resources. Contributions of physical methods to understanding our terrestrial environment.

281. Mineral Resources of the Earth
Fall. 3(3-0)
Mineral resources; their genesis, occurrence, exploitation and use. Future projections from historic and current developments. The impact on international affairs and the welfare of nations. Field trip.

282. Energy Resources of the Earth
Winter. 2(0-2)
World energy resources of petroleum, coal, and atomic fuel. Social, political, economic and environmental problems of fuels.

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

303. Introductory Geomorphology
Winter. 3(3-0) 200 or 301 or 306.
Descriptive course treating the geological origin and development of important surface features including special consideration of Pleistocene landforms of the Great Lakes region.

303L. Laboratory—Introductory Geomorphology
Winter. 10(0-2) 303 or concurrently.
Methods of map interpretation and use of aerial photographs in geomorphology. Supplemental field trip to study the geology of pertinent landforms.

304. Geology of Michigan
Fall. 3(3-0) 200 or 201 and/or 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 geologic environment.

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

307. Geology Central Appalachians
Winter. 10(0-2) 200, or 201, or 202, or concurrently.

308. Field Excursion—Central Appalachians
Spring. 2 or 3 credits. 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) 321.
Economic and chemical importance of minerals; mineralogy of non-silicates; practical crystallography; geochemistry of minerals.

335. Fossil Plants, Their History and Paleoecology
Spring. 3(3-0) One course in geology or botany or biology or approval of department. Interdepartmental with the Botany and Plant Pathology Department.
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.

344. Field Geology—Summer Camp
Summer. 5 credits. 302, 303, 321, 322, 357. Tri­gonometry; GLG 446, 437, 451 recommended.
Methods and techniques of geological surveying and mapping. Field interpretation of geologic 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 on those that apply to sedimentary rocks. Stri­ographic correlation.

B. Methods of Geologic 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
(323, 423) Spring. 4(3-4) 321.
Processes that form igneous, metamorphic and igneous rocks, origin, distribution, variation and occurrence of rocks. Study of rock properties in the field, in laboratory, and with the microscope.

400H. Honors Work
Fall, Winter, Spring. Variable credit. Approval of department.

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

411. Hydrogeology
Spring. 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. 3(3-2) 201.  
Geological aspects of glaciers and glaciation.  
Theories 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 materials and features of Michigan.

425. Optical and X-ray Mineralogy  
(461) Fall. 4(3-4) 321, PHY 239 or 299.  
Theory, principle and application of the polarizing microscope and X-ray diffractometer in mineral analysis.

430. Vertebrate Paleontology  
Winter. 4(3-3) ZOL 314 or approval of department. Interdepartmental with the Zoology Department.  
Vertebrate vertebrates with emphasis on the evolution of major groups. Laboratories on modern techniques and on the identification and interpretation of fossils.

IDC. Introduction to Meteorology  
For course description, see Interdisciplinary Courses.

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

437. Invertebrate Paleontology  
Fall. 4(3-4) 202 or ZOL 381 or approval of department. Interdepartmental with the Zoology Department.  
Systemsatics 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. Palaeoecology  
Winter. 4(3-3) 202 or ZOL 389 or approval of department. Interdepartmental with the Zoology Department.  
Distribution and abundance of marine fossils; response of skeletal morphology to environment; studies of fossils in reconstructing ancient climates and depositional environments.

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

446. Principles of Stratigraphy  
(434) Fall. 3(3-0) 437, 492 or approval of department.  
Core principles of stratigraphy and application and exemplification of these principles to known geologic occurrences.

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

462. Petrology  
Winter. 4(3-4) 363.  
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(3-3) 201 or 366; MTH 239 or 289.  
Techniques used in geophysical exploration, with application in petroleum prospecting, minerals exploration, and engineering. Includes gravity, magnetics, seismics, electromagnetic and other methods, and well logging, interpretation of geophysical data.

475. Solid Earth Geophysics  
Fall. 3(3-0) MTH 112; PHY 239 or 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.

50. Geotectonics  
Winter of even-numbered years. 2(3-0) 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.

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

493. Petroleum Geology  
Fall. 3(3-2) Approval of department.  
Application of mathematical tools to paleontologic, sedimentary, structural, and economic geology, petroleum geology, and sedimentation, and geochemistry.

803. World Regional Geology  
Spring of even-numbered years. 3(3-0) One course each in structural geology, sedimentation.

812. Principles of Geomorphology  
Fall of odd-numbered years. 3(3-2) 201, 303, or approval of department.  
Landforms and processes involved in their origin and development. Emphasis on fundamental concepts as they relate to denudational and constructional stresses on earth materials. Introduction to quantitative laboratory and field methods.

825. Clay Mineralogy  
Winter. 4(3-4) CSS 849, 850 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(2-3) Approval of department. Interdepartmental with and administered by the Botany and Plant Pathology Department.  
Survey of fossil plants: their preservation, occurrences, and importance; paleogeography, paleoecology, 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 Botany and Plant Pathology Department.  
An introduction to the principles and techniques of spore and pollen analysis, both fossil and recent, and utilization of plant micro-fossils for stratigraphic determinations and paleoecologic interpretations of most sedimentary accumulations and rocks. Includes certain algae, protozoa, similar organisms of uncertain affinity and associated fragments of larger organisms.

833. Advanced Invertebrate Paleontology  
B. Quantitative Paleontology  
Spring. 3(3-4) 437, 438. Interdepartmental with the Zoology Department.  
Application of mathematical tools to paleontological problems, including statistical applications and numerical taxonomy, computer applications.
C. PALEOLOGY
Spring. 3(2-4) 437 or 438. Interdepartmental with the Zoology Department. Advanced problems in the distribution and abundance of fossil invertebrates; morphological adaptations to environmental pressures.

D. FOSSIL MORPHOLOGY
Spring. 3(2-4) 437 or 438. Interdepartmental with the Zoology Department. skeletal morphology of fossil invertebrates emphasizing the multivariate morphometric approach and other modern methods of morphological analysis.

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

835. Advanced Paleobotany
Winter. 2(2-4) or approval of department. Interdepartmental with and administered by 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, transfers, pools, polished and etched surfaces, and macerations.

843. Paleozoic Stratigraphy
Winter of even-numbered years. 4(3-0)
444, 492. Classification, distribution, paleogeography, paleontology, interrelation, and structural setting of stratigraphic units within the Paleozoic systems. Laboratory work involves construction of correlation charts, structure and restored sections, paleogeologic, paleoecologic, and lithofacies maps, and study of certain key fossils.

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

852. Advanced Structural Geology
Winter of even-numbered years. 3(2-4)
451, MTH 214. Mathematics and physics applied to problems in structural geology.

861. Evolution of the Earth’s Crust and Mantle
Fall. 3(3-0) 483. 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 of even-numbered years. 2 to 4 credits. May re-enroll for a maximum of 8 credits. 462. Must enroll for laboratory with initial registration. Physical and chemical principles involved in the origin of igneous rocks. Application of experimental techniques in petrology.

863. Petrology—Metamorphic
Spring of odd-numbered years. 2 to 4 credits. May re-enroll for a maximum of 8 credits. 462. Must enroll for laboratory with initial registration. Origin and classification of metamorphic rocks. Study includes this section investigation of the metamorphic textures and mineral assemblages and the physical-chemical principles involved in their development.

870. Topics in Geophysics
Spring. 1 to 3 credits. May re-enroll 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, palaeomagnetism, high-pressure geophysics.

872. Exploratory Seismology
Fall of even-numbered years. 4(2-4)
474. Theory and technique of field seismic exploration methods. An associated geophysical survey will be conducted and a report prepared.

873. Seismology I
Winter of odd-numbered years. 3(3-0) MTH 215 or concurrently; EHT 289 or concurrently. Theory and application of seismic wave propagation in earth materials.

874. Seismology II
Spring of odd-numbered years. 3(3-2) 873 or approval of department. Continuation of 873.

875. Advanced Geophysical Exploration I
Fall of odd-numbered years. 4(3-2)
474. Theory and technique of gravity and magnetic methods, and their use in geophysical exploration. Associated practical exercises and laboratory work.

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

879. Rock Magnetism and Paleomagnetism
Spring of even-numbered years. 3(3-0)
321, 475, one year mathematics, one year physics or engineering or physics majors. Geomagnetism, and applications to earth science. Character and history of the Earth’s magnetic field, physics of remanent magnetism, magnetic properties of minerals and rocks, palaeomagnetism, experimental results and procedures.

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
A. RECENT DEVELOPMENTS IN SEDIMENTOLOGY
(Spring.) Spring. 3(2-4) May re-enroll for a maximum of 12 credits. 495, approval of department. New techniques for study of sediments and sedimentary rocks. Discussion of significant new findings and applications of sedimentology.

B. QUANTITATIVE ANALYSIS OF SEDIMENTS
(Spring.) Spring. 3(2-4) May re-enroll for a maximum of 12 credits. 495, approval of department. Representation and analysis of sediment variation from microscale to regional scale. Definition of efficient empirical variables. Role of mathematical and stochastic models.

895. Topics in Geochemistry
A. THERMODYNAMICS IN GEOLOGY
Fall of even-numbered years. 1 to 3 credits. May re-enroll for a maximum of 12 credits 462, 495. Interpretation and prediction of natural mineral assemblages from thermochronological studies. High pressure and high temperature techniques in petrology. Phase equilibria studies and diffusion phenomena in natural systems.

B. AQUEOUS GEOCHEMISTRY
Winter of odd-numbered years. 1 to 3 credits. May re-enroll for a maximum of 12 credits 462, 495. Ideal and non-ideal solutions, ion activities in natural waters, carbonate sedimentation, evaporite deposits, colloids, chemical weathering and diagenesis. Importance of organic species in natural waters and their effect in metal complexing. Redox reactions.

C. ANALYTICAL GEOCHEMISTRY
Fall of odd-numbered years. 1 to 3 credits. May re-enroll for a maximum of 12 credits 462, 495. Instrumental techniques for the analysis of geological materials. Topics on application of X-ray diffraction, X-ray fluorescence, neutron activation analysis, and atomic absorption spectrometry. Recently developed techniques in geochemistry will be discussed.

897. Isotope Geochemistry
(Fall.) Winter of even-numbered years. 3(3-0) 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. 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. Research
Fall, Winter, Spring. Variable credit. Approval of department.

Earth Science

407. Earth Science for Teachers
Fall. 3(3-0) or 4(3-3) Fundamentals of climatology and its relationship to weathering in rocks; agents of erosion, transportation, and deposition; study of the common minerals; the three classes of rocks, and igneous, sedimentary and metamorphic processes; geomorphic features including glaciers, volcanoes, oceans, lakes, deserts, caves and others. Laboratory includes identification of minerals, rocks; study of topographic maps; and field trips to points of geologic interest.

410. Earth Science Seminar for Teachers
Fall. 1(2-0) May re-enroll for a maximum of 4 credits. One earth science subject matter course or concurrent. Earth science subject matter areas will be inter-related through student presentation and discussion and their interdisciplinary significance developed.
9.6 College credits. GERMAN AND RUSSIAN Courses

Experience and techniques in field investigation of the near surface layers of the earth.

Independent laboratory investigation of their studies must take a placement examination. University credit courses waived by performance on the placement examination. 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. University credit is not given for courses waived by performance on the placement examination.

445. Field Studies
Fall, Winter, Spring, Summer. 1 to 9 credits. May re-enroll 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 re-enroll for a maximum of 15 credits. 445 or concurrently.

Independent laboratory investigation of materials and phenomena obtained from field studies.

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, folksongs, hero tales, sayings, customs, and beliefs. Historical development of traditional lore as a reflection 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 417.

825. Comparative Literature: Studies in Theme and Idea
Fall. 3(3-0) May re-enroll 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.

Myths, archetypes, Topoi, significant ideas and intellectual currents in different periods and cultural traditions.

878. Comparative Literature: Methods in the Study of Comparative Literature
Fall. 3(3-0) Interdepartmental with the department 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
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 climate of particular periods and movements, such as classicism, the Middle Ages, the baroque, or romanticism, in qualifying or modifying characteristic literary works.

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

Continuation of 101.

201. Intermediate German Conversation
Fall, Winter, Spring. 6(5-1) Knowledge of German not required. Not applicable to major requirements.

Representative works of eighteenth and early nineteenth century authors.

202. Intermediate German Conversation
Fall, Winter, Spring. 6(5-1) Knowledge of German not required. Not applicable to major requirements.

Representative works of twentieth century authors.

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.

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

Continuation of 242.

299. Special Projects
(G R 399). Fall, Winter, Spring, Summer. 1 to 12 credits. May re-enroll 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) 203. Required of majors.

Representative works of eighteenth and early nineteenth century authors.

302. Introduction to German Literature
Winter. 3(3-0) 301.

Representative works of nineteenth century authors.

303. Introduction to German Literature
Spring. 3(3-0) 302.

Representative works of twentieth century authors.

321. German Composition and Conversation
Fall. 3(3-0) 303.

Essential and difficult points of grammar reviewed. Written and oral reports; active participation in class discussion. Designed especially for students who plan to teach German.

322. German Composition and Conversation
Winter. 3(3-0) 321.

Continuation of 321.

323. German Composition and Conversation
Spring. 3(3-0) 322.

Continuation of 322.

325. German Civilization and Culture
Fall. 3(3-0) 203 or approval of department. A third year sequence for students not primarily interested in literature.

The cultural heritage of the German peoples. Readings and discussions in German based upon texts from history, the arts, philosophy, psychology, etc., from 1850 to World War I.

A-87