450. Natural Resource Administration
Fall, Winter. 4(4-0) Interdepartmental with the Fisheries and Wildlife, Park and Recreation Resources, and Resource Development Departments. Concepts and methods of economics and administration and application of techniques to management of wildlands.

454. World Forestry
Winter. 4(3-0)
Forest resources, forestry practices, and the forest economy throughout the world.

455. Harvesting Forest Products
Fall, Winter. 3(2-2) 450. Planning, organizing, and controlling the utilization of timber resources, including cost control in timber harvesting systems.

456. Forest Resource Policy
Spring. 3(3-0) 455 or approval of department. Evolution and development of public and private forest policy in the United States.

457. Forest Resource Planning
Spring. 4(2-2) 455. Integrative planning for multiple-use forest resource management.

460. Arboriculture
(360.) Spring. 3(2-3) Approval of department. Principles and techniques of species selection, establishment, and cultural practices used in the care and maintenance of shade and ornamental trees. Two-day field trip required.

465. Forest and Wood Science Problems
Fall, Winter, Spring, Summer. 1 to 5 credits. Seniors only with a 2.50 average, or approval of department. Special problems course for students qualified for advanced study in some phase of forestry or wood science.

801. Special Problems
Fall, Winter, Spring, Summer. 2 to 5 credits. May re-enroll for credit with a maximum of 10 credits for the master's degree. Advanced work in any of the following specialties: forest biometrics; forest photogrammetry; dendrology; silviculture; forest management; forest economics; forest influences; forest ecology; forest genetics; Arboriculture; forest hydrology; forest soils; forest recreation; tree physiology; forest policy; forest products harvesting; wood chemistry; wood preservation; timber mechanics; wood conversion.

809. Natural Resources Economics
Winter. 3(3-0) Approval of department. Interdepartmental with the Resource Development Department. Applications of economic analysis to natural resource problems.

828. Seminar
Fall, Winter, Spring. 1 to 3 credits. May re-enroll for a maximum of 12 credits if a different topic is taken. Critical study and discussion of advanced forestry topics including natural resource economics, forest biology, and natural resource program budgeting.
401. Geography of Culture
Winter. 4(4-0) 204.
A spatial analysis of the interactions among selected elements of the physical and cultural environment. Special emphasis is placed on variations in the relationship between man and the land with emphasis upon non-Western cultures.

405. Geography of South America
Winter, Spring. 3(3-0) 204 or Juniors.
Regional geography of South America excluding countries bordering the Caribbean Sea; an analysis of present and potential economic developments.

406. Geography of Middle America
Fall. 3(3-0) 204 or Juniors.
Description and interpretation of the physical and cultural environment of Mexico, Central America, West Indies, and northern South America.

407. Geography of Michigan
Spring, Summer. 3(3-0) 204 or Juniors.
Regional analysis of natural and human phenomena.

408. Geography of Canada
Spring. 3(3-0) 204.
Places and regions of Canada, what they are like and how they are related to each other in fashioning the important role played by Canada among the countries of the world.

411. Problems in Geography
Fall, Winter, Spring, Summer. 1 to 6 credits. Approval of department. Research on specialized geographic problems.

413. Geography of Manufacturing
Winter. 3(3-0) 213 or Juniors.
Evaluation of the place to place variation of different types of manufacturing industries. Emphasis will be on industrial location theory and methods of regional analysis.

415. Techniques of Field Research
Fall, Spring. 4(1-7) May re-enroll for a maximum of 8 credits. Approval of department. Detailed and reconnaissance field work including classification of natural and cultural features, interview procedures, and presentation of geographical reports and maps based on field data.

416. Political Geography
Winter, Summer. 3(3-0) 204 or Juniors.
Examination of the mutual relationships between the earth and the state in various type countries, the world distribution of political characteristics, and the evolution and present status of political geography.

418. Geography of Polar Regions
Winter of even-numbered years. 3(3-0) 204 or Juniors.
The Arctic, including the continental fringes of North America and Eurasia, and the Antarctic. Emphasis on exploration, physical geography, and recent developments in settlement and resource use.

420. Geography of Africa
Spring. 3(3-0) 204 or Juniors. Natural, cultural, and regional aspects with special attention given to colonialism.

426. Advanced Cartography
Spring of even-numbered years. 3(1-6) 223; Juniors. Development of skills in selection of cartographic source materials and in map construction.

427. Quantitative Methods in Geographic Research
Fall. 3(3-0) Approval of department. Introduction to role of selected quantitative techniques used in the theory of geographic distributions and the analysis and classification of regional data.

430. Climates of the World
Spring. 3(3-0) 206 or approval of department. Regional differentiation of the weather and climates of the major land and ocean areas of the world.

431. Advanced Physical Geography
Fall. 3(3-0) 206 or approval of department. Selected problems of physical geography.

432. Biogeography
Winter. 3(3-0) 206 or approval of department. Spatial distribution and physiognomic analysis of earth's basic life zones.

440. Geography of Western Europe
Winter. 3(3-0) or 5(3-0) 204 or Juniors. Geographic analysis of physical and human resources of Western Europe (Scandinavia, British Isles, Benelux, Germany, France, and Switzerland).

441. Geography of Eastern and Southern Europe
Spring. 3(3-0) 204 or Juniors. Geographic interpretation of Mediterranean and Slavic Europe (excluding the Soviet Union) with special attention to the recent changes in economic and political structures and to international relations.

450. Geography of Australia and Pacific Islands
Winter of odd-numbered years. 3(3-0) 204 or Juniors.
Physical and cultural geography of Australia, New Zealand, Melanesia, Micronesia, and Polynesia.

460. Geography of the Soviet Union
Fall. 3(3-0) 204 or Juniors. Physical and human geography of the U.S.S.R., including its role in world affairs.

461. Geography of Southern and Southwestern Asia
Fall. 3(3-0) 204 or Juniors. A regional survey of India and Southwestern Asia.

476. Canadian-American Studies
For course description, see Interdisciplinary Courses.

806. Economic Geography
Fall, Winter, Spring, Summer. Variable credit. May re-enroll for a maximum of 12 credits. Bibliographic review and analysis of primary source materials in economic geography, including field studies where feasible.

810. Historical Geography
Fall, Winter, Spring, Summer. Variable credit. May re-enroll for a maximum of 9 credits. Work in the historical record aimed at the reconstruction of the geographic of former times.

814. Techniques in Geography
Fall, Winter, Spring, Summer. Variable credit. May re-enroll for a maximum of 12 credits. Investigations in the techniques of presentation of map and field data and the varied approaches to field work in geography.

816. Theory and Methodology
Fall, Winter, Spring, Summer. Variable credit. May re-enroll for a maximum of 12 credits. Analysis of the monographic and serial literature dealing with the theory and evolution of geographical science.

818. Problems in Geography
Fall, Winter, Spring, Summer. Variable credit. May re-enroll for a maximum of 15 credits. Research on specific geographical problems.

838. Interdisciplinary Seminar on Africa
For course description, see Interdisciplinary Courses.

879. Interdisciplinary Seminar: Behavioral and Historical Approaches to Problems of Selected Foreign Areas
For course description, see Interdisciplinary Courses.

899. Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.
902. Physical Geography
Fall, Winter, Spring, Summer. Variable credit. May re-enroll for a maximum of 10 credits. Advanced consideration of the distribution and interrelations of components of the earth's physical environment.

912. Regional Geography
Fall, Winter, Spring, Summer. Variable credit. May re-enroll for a maximum of 15 credits. Use of primary documents and field work in an effort to understand the complex geographic interrelationships that characterize the areas of the earth.

918. Problems in Geography
Fall, Winter, Spring, Summer. Variable credit. May re-enroll for a maximum of 20 credits. Research on specific geographical problems.

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

GEOLOGY

College of Natural Science

200. Foundations of Earth Science
Fall, Winter, Spring. 3(3-0) Credit will be given for only one of the following: 200, 201, 306. An intercollege cultural course for non-geology majors, designed primarily for students who desire to obtain a broad perspective of the science.

200L. Laboratory—Foundations of Earth Science
Fall, Winter, Spring. 1(0-3) 200 concurrently.
Practical training in earth science including work with minerals, rocks, fossils, maps, meteorology, and astronomy; field trips to points of geologic interest.

201. General Geology—Physical
Fall, Winter, Spring. 4(4-2) Credit will be given for only one of the following: 200, 201, 306. Minerals and rocks of the earth's crust; constructive and destructive forces including vulcanism, mountain building, rock deformation, erosion and deposition; economic aspects of geology; concepts of earth origin and methods of age determination. Laboratory study of minerals, rocks, experimental models and maps; field trips.

202. General Geology—Historical
Fall, Winter, Spring. 4(4-2) 301 or 306; or approval of department. Historical development of the earth including mountain building, marine inundations, formation of minerals, rocks and fuels, and reconstruction of fossil representatives of plants and animal life. Laboratory work will include a field trip.

302. Vertebrate Life of the Past
Fall. 3(3-0) Not open to zoology majors. Interdepartmental with the Zoology Department. Fossil vertebrates from fish to man.

303. Introductory Geomorphology
Spring. 3(3-0) 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
Spring. 1(0-2) 303 concurrently.
Methods of map interpretation and use of aerial photographs in geomorphology. Supplemental field trip to study the geomorphology of pertinent landforms.

306. Engineering Geology
Fall. 3(2-2) 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 areal geologic maps and geologic cross sections studied in laboratory. Source of geologic literature and maps.

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

344. Field Geology—Summer Camp
Summer. 9 credits. 302, 433, Trigonometry, GLG 431, 434, and 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. Stratigraphic correlation.

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

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

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

411. Ground Water Geology
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. 3(2-2) 201. Geologic 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.

421. Mineralogy
Fall. 4(4-0) 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.

422. Mineralogy
Winter. 4(3-4) 421. Selective qualitative analysis of minerals by blow pipe and other methods.

431. Lithology
Spring. 4(3-4) 421. Identification of common rocks with hand lens. Origin, variation, occurrence, associations and field classifications of important rock types.

430. Vertebrate Paleontology
Winter. 4(3-2) 302 or ZOL 381 or approval of department. Identification and morphology of fossil vertebrates. Nomenclature, evolution, fossilization, site of fossils in correlation and determining affinities. Laboratory techniques in preparation. Observations and collections will be made in the field.

431. Invertebrate Paleontology
Spring. 4(3-2) 302 or ZOL 381 or approval of department. Identification and morphology of fossil invertebrates. Nomenclature, evolution, fossilization, site of fossils in correlation and determining affinities. Laboratory techniques in preparation. Observations and collections will be made in the field.

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

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

434. Principles of Stratigraphy
Fall. 3(3-0) 451 concurrently; 492; or approval of department. Covers principles of stratigraphy and application and exemplification of these principles to known geologic occurrences.

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

451. Structural Geology
Spring. 4(3-0) 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.

461. Optical Mineralogy
Winter. 3(2-4) 421. Theory and practice of determining optical constants of crystals with aid of polarizing microscope.

462. Petrography
Fall. 4(3-4) 453. Analysis, with the aid of polarizing microscope, of a set of specimens and thin sections of the most common igneous, sedimentary and metamorphic rocks.

471. Photogrammetry
Winter. 4(2-0) MTH 102 or approval of department; Sophomores. Map construction from aerial photographs using standard photogrammetric equipment; interpretation of topographic and geologic features from aerial maps, relation of surface features to underlying rock character and structure.

474. Geophysical Methods
Winter. 4(3-2) 201; MTH 112; PHY 239. Principles of gravitational, magnetic, seismic, electrical, radiographic, and well logging methods. Application to mining, petroleum, and engineering problems.