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*

(421.) 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*

(452.) Spring. 3(3-0) 455 or approval of department.

Evolution and development of public and private forest resource 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 with a 2.80 average, or approval of department.

Special problems course for students qualified for advanced study in some phase of forestry or wood science.

806. *Forest Research Methods*

Fall. 3(3-0)

Procedures in systematic and objective investigation of natural phenomena; methods of critical and exhaustive experimentation aimed at discovering new facts, theories, or laws.

807. *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.

830. *Physiological Genetics*

Winter. 3(3-0) Approval of department. Interdepartmental with the Crop Science Department.

Physiological bases for genetic variation in higher plants including adaptive physiology, quantitative genetics, growth correlations, biochemical genetics, hybrid physiology, and genecology.

851. *Public Program Budgeting*

Fall. 3(3-0) Approval of department. Interdepartmental with the Resource Development Department.

Survey of the federal government's planning-programming-budgeting system, stressing executive branch budget decision-making and budget administration in the natural resource bureaus.

899. *Research*

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

999. *Research*

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

FRENCH

See Romance Languages

GEOGRAPHY GEO

College of Social Science

Courses are classified as follows:

Introductory

A. Sequence designed as an introduction to cultural and physical geography: 204, 206.

B. One-term cultural introduction: 204.

C. One-term physical introduction: 206.

Physical—206, 206L, 305, 430, 431, 432, 902.

Economic and Land Use—213, 308, 309, 312, 413, 806.

Historical and Cultural—310, 401, 810.

Methodology and Theory—425, 816.

Political—416, 808.

Population, Settlement, and Urban—318, 320, 804.

Regional—204, 300, 390, 391, 405, 406, 407, 408, 418, 420, 440, 441, 450, 460, 461, 462, 879, 912.

Techniques and Research—222, 223, 324, 400H, 411, 415, 424, 426, 427, 814, 818, 899, 918, 999.

200. *Resource Ecology and Man*

For course description, see **Interdisciplinary Courses.**

204. *World Regional Geography*

Fall, Winter, Spring, Summer. 4(3-0)

Regional analysis of the countries of the world, including their cultural and natural aspects.

206. *Physical Geography*

Fall, Winter, Spring, Summer. 4(4-0)

Principal earth surface elements of physical geography including weather, climate, landforms, soils, water and biotic resources, in their genetics, distributional and functional interrelationships.

206L. *Physical Geography Laboratory*

Fall, Winter, Spring. 1(0-2) 206 or concurrently.

Laboratory study of geographic aspects of map interpretation, aerial photographs, weather, climate, soils, landforms, and vegetation.

213. *Economic Geography*

Fall, Winter, Spring, Summer. 3(3-0)

Primary emphasis on world distribution of manufactural industries and their raw materials. Factors of industrial location stressed.

222. *The World in Maps*

Fall. 3(3-0)

Nature, significance, and evolution of maps from ancient times to the present including types, sources and uses of maps, and contributions of major cartographers.

223. *Elementary Cartography and Graphics*

Fall, Winter. 4(2-4)

Principles and techniques of constructing maps and other graphic devices; types of map reproduction; application of quantitative methods and recent developments to map drawing.

300. *Geography of North America*

Fall, Winter, Summer. 3(3-0) or 5(3-0)

Human and physical geography of North America, north of the Mexican border.

305. *Landforms of North America*

Winter. 3(3-0) 206 or GLG 201.

Description and interpretation of the surface configuration of the United States and Canada.

308. *Geography of World Trade and Transportation*

Fall. 3(3-0)

Major localities involved in world trade. Principal carriers of trade, main overland and oceanic routes used by commerce, types and volume of commodities. Spatial theory of trade and transportation.

309. *Recreational Land Use*

Spring. 3(3-0)

Survey of recreational land use in the United States including analysis of resources basic to such land use and their distribution.

310. *Historical Geography of the United States*

Spring, Summer. 3(3-0) or 5(3-0)

Reconstruction of geographies of the United States as they existed in the past.

312. *Geography of Agriculture*

Winter. 3(3-0)

Analysis of the nature, importance and world distribution of agriculture, some attention to commercial fisheries and forest exploitation.

318. *Cities of the World*

Winter, Summer. 3(3-0) or 5(3-0)

World distribution of cities, their functions and relationship of function to the immediate and regional area; systems of urban land classification and geographic aspects of forces affecting urban land use.

320. *Geography of World Population*

Spring. 3(3-0)

A regional approach to world population in relation to geographical factors including coverage of such topics as numbers, densities, growth rates, and distributional patterns.

324. *Aerial-Photo Interpretation*

Fall. 4(2-4) Sophomores.

Use of photographs in geographic investigation and map construction with particular reference to identification of natural and cultural features. The significance of new developments in the field such as unconventional imagery and electronic sensing are introduced.

390. *Survey of Subsaharan Africa*

For course description, see **Interdisciplinary Courses.**

391. Survey of Subsaharan Africa

For course description, see **Interdisciplinary Courses.**

400H. Honors Work

Fall, Winter, Spring. 1 to 16 credits. Approval of department.

Independent and informal study for superior students.

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 preparation 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 fringe lands 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.

424. Advanced Aerial-Photo Interpretation

Spring. 3(2-4) 324 or approval of department.

Advanced interpretation of terrestrial geographic features as shown on aerial photographs. Quantitative and qualitative characteristics and the use of photographs in both regional and systematic studies will be emphasized.

425. Development of Geographic Thought

Winter, Spring. 3(3-0) May re-enroll for a maximum of 6 credits. Approval of department.

Evolution, conceptual framework and methodology of geographic science.

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.

462. Geography of the Far East

Winter. 3(3-0) 204 or Juniors.

Physical and cultural geography of eastern Asia —China, farther India, Indonesia, Philippines, Formosa, and Japan.

476. Canadian-American Studies

For course description, see **Interdisciplinary Courses.**

804. Geography of Population and Settlement

Fall, Winter, Spring, Summer. Variable credit. May re-enroll for a maximum of 9 credits.

Analysis of ways man and his culture have come to be deployed, including study of sources of population information, problems of gathering primary data and cartographic presentation.

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.

808. Political Geography

Fall, Winter, Spring, Summer. Variable credit. May re-enroll for a maximum of 9 credits.

Documentary and field knowledge relating to the areal differentiation of political phenomena over the earth, including the mutual interrelationships that exist between the earth and the state.

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 geography 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 9 credits.

Advanced consideration of the distribution and interrelation 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 9 credits.

Research on specific geographical problems.

999. *Research*

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

GEOLOGY GLG

College of Natural Science

200. *Foundations of Earth Science*

Fall, Winter, Spring, Summer. 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, Summer. 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 volcanism, 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) 201 or 306; or approval of department.

Historical development of the earth including mountain building, marine inundations, formation of mineral deposits 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 geology of pertinent landforms.

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 areal geologic maps and geologic cross sections studied in laboratory. Source of geologic literature and maps.

326. *Minerals, Rocks and Fossils*

Spring, Summer. 3(2-3) 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.

344. *Field Geology—Summer Camp*

Summer. 9 credits. 202, 423; Trigonometry; GLG 431, 434, and 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 on 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.

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(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.

421. *Mineralogy*

Fall. 4(3-4) 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.

422. *Mineralogy*

Winter. 4(3-4) 421.

Selective qualitative analysis of minerals by blow pipe and other methods.

423. *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(3-3) 302 or ZOL 305 or 315, or approval of department. Interdepartmental with and administered by the Zoology Department.

Fossil vertebrates with emphasis on the evolution of major groups. Laboratories on modern techniques and on the identification and interpretation of fossils.

431. *Invertebrate Paleontology*

Spring. 4(3-4) 202 or ZOL 381 or approval of department.

Identification and morphology of fossil invertebrates. Nomenclature, evolution, fossilization, uses of fossils in correlation and determining origins of sediments. 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) 431 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, Summer. 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(2-6) 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, 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) 423.

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(2-6) 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, radioactive, and well logging methods. Application to mining, petroleum, and engineering problems.