975. Least Squares Analysis and Linear Programming in Forestry Research
Fall of odd-numbered years. 4(4-0)
MTU 112, STT 423, CFS 110 or CFS 120.
Application of least squares analysis and linear programming to problems in forestry research. Include both linear and nonlinear least squares models. Case studies from several forestry disciplines.

976. Multivariate Methods in Forestry Research
Winter of even-numbered years. 4(4-0)
FOR 975 or approval of department.
Application of multivariate techniques such as principal components, canonical analysis, factor analysis, and clustering to problems in forestry research. Case studies drawn from several forestry disciplines.

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

FRENCH
See Romance and Classical Languages.

GENETICS

College of Natural Science

800. Genetics Seminar
Fall, Winter, Spring. 1(1-0) May reenroll for a maximum of 12 credits. Approval of instructor.
Student seminar to cover genetics subjects not considered in formal courses. Course is also intended to give students experience in reviewing and organizing literature in a subject, and orally presenting and defending the analysis.

804. Gene Transmission
Fall, Winter, Spring. 3(3-0) ZOL 441 or approval of instructor.
Molecular and formal genetic studies of the replication, recombination, repair and segregation of genetic information in procaryotes and eucaryotes. Experimental design and methodology will be emphasized.

805. Genetic Organization, Action and Regulation
Winter. 3(3-0) GEN 804.
Molecular and formal genetic studies of the organization, expression and regulation of gene activity in procaryotes and eucaryotes. Experimental design and methodology will be emphasized.

806. Population and Quantitative Genetics
Fall, Winter, Spring. 3(3-0) ZOL 441 or approval of instructor.
Genetics of quantitative characteristics in populations with special reference to polygenic variation and its interactions with environment, gene action and its measurement, mating systems, and selection.

850. Special Problems
Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 12 credits. Approval of instructor.
Students with special interests and abilities may study published literature in a selected genetics topic or they may carry on research in the laboratory on a selected subject in collaboration with genetics faculty.

890. Selected Topics in Genetics
Fall, Winter, Spring. 2 to 5 credits. May reenroll for a maximum of 9 credits. ZOL 441 and approval of instructor.
Topics will be selected from molecular genetics, physiological genetics, quantitative genetics, evolution, radiology and mutagenesis, microbial genetics, somatic cell genetics, behavioral genetics, and human genetics.

999. Doctoral Dissertation Research
Fall, Winter, Spring, Summer. 3 to 12 credits. Major's approval for the doctoral dissertation in genetics.

GEOGRAPHY

College of Social Science

Courses are classified as follows:
Cultural—170, 201, 401, 801, 901
Economic—213, 406, 412, 413, 435, 454, 806, 809, 835, 905
Field Techniques—415, 850
Geographic Education—458, 856
Historical—310, 810, 910
Independent Research—400H, 411, 410, 810, 806, 809, 915, 990
Medical—410, 870, 970
Physical—206, 206L, 423, 430, 431, 432, 451, 834, 902
Political—170, 416, 908
Population—219, 320, 836, 934
Quantitative Methods—427, 428, 811
Recreational and Environmental—100, 300, 500, 826
Science and Mathematics—150, 280, 400, 825, 826, 827
Urban—319, 401, 402, 403, 466, 806
Visual Media and Techniques—122, 223, 224, 424, 426, 446

100. Man, Location and Environment
Fall, Winter, Spring. 3(3-0)
Concepts, theory, and methods of modern Geography.

122. The World of Maps
Fall, Spring. 3(3-0)
Discussion of types, practical applications, and sources of maps.

150. Geography of Selected Current Problems
Fall, Winter, Spring. 2(2-0)
The geographic perspective is used to examine U.S. and world problems of major concern such as international conflicts, environment quality, spatial change, and economic development.

170. Future Worlds (S)
Fall, Spring, Summer. 3(3-0)
Geographical approach to environmental, biological, economic, social and political problems facing mankind between now and year 2000.

IDC. Resource Ecology and Man
For course description, see Interdisciplinary Courses.

201. Geography of Culture
Fall, Winter, Spring. 4(3-0)
A systematic discussion of cultural geography, stressing cultural processes and relationships.

204. World Regional Geography (S)
Fall, Winter, Spring. 4(4-0)
Man's relationship with natural and cultural environments.

206. Physical Geography
Fall, Winter, Spring. 4(4-0)
Analysis of weather, climate, landforms, soils, water and biotic factors of man's environment, including their spatial, genetic, and functional interrelationships.

206L. Physical Geography Laboratory
Fall, Winter. 1(0-2) GEO 206 or concurrently.
Laboratory study of geographic aspects of map interpretation, aerial photographs, weather, climate, soils, landforms, and vegetation.

IDC. Introduction to Latin America I
For course description, see Interdisciplinary Courses.

213. World Economic Geography
Fall, Winter, Spring. 4(4-0)
Emphasis on distribution of natural resources, industries and services activities, stressing factors of location and economic concepts of locational change.

215. World Food Issues
Spring. 3(3-0) Interdepartmental with Food Science.
Food resources as related to world distributions of population, soil, water, fuel and minerals. Special attention to urbanization, irrigation, and future food needs and global constraints.

223. Introduction to Cartography
Fall, Winter, Spring. 4(4-0)
Principles and techniques of constructing maps and other graphic devices. Types of map reproduction.

224. Remote Sensing: Airphoto Interpretation
Fall, Winter. 4(2-4)
Use of aerial photographs in the identification and interpretation of physical and cultural features of the terrestrial environment. Includes principles of photogrammetry, and stresses application and practice.

IDC. Continuing Revolution in China: Problems and Approaches
For course description, see Interdisciplinary Courses.

280. Perspectives on Geography
Spring. 2(2-0)
Introduction to the profession of geography for majors.

300. North America
Fall, Winter, Summer. 4(3-0)
Human and physical geography of North America, north of the Mexican border.

Geography - Descriptions of Courses
107.  *Geography of Environmental Quality*
   Spring. 4(3-0) Sophomores or approval of department.
   Identification of the physical, cultural and psychological factors which constitute human environments, and how they vary and may be modified or controlled.

309.  *Geography of Recreation*
   Winter. 3(3-0)
   Natural and cultural factors influencing the use of space for recreation. Emphasis on recreation land use in the United States and current problems and conflicts.

310.  *Historical Geography of the United States*
   Spring, Summer. 4(3-0)
   Reconstruction of geographies of the United States as they existed in the past.

315.  *South America*
   Spring. 4(3-0) Sophomores or approval of department.
   Regional geography of South America with special attention to contemporary geographic problems.

316.  *Middle America*
   Winter. 4(3-0) Sophomores or approval of department.
   Interpretation of physical and cultural environment of Mexico, Central America, and the West Indies. Special attention to contemporary geographic problems.

318.  *Cities of the World*
   Fall, Spring, Summer. 4(3-0)
   A cross-cultural examination of cities, their historic growth, regional functions, and internal dynamics.

319.  *Polar Regions* (418.) Winter of even-numbered years.
   4(3-0) Sophomores or approval of department.
   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.

320.  *Geography of Population*
   Fall. 4(3-0)
   Relationship of the size, composition, and distribution of population to geographic variations in the nature of places.

321.  *Africa*
   Fall. 4(3-0) Sophomores or approval of department.
   Emphasis on continent south of Sahara: environment, peoples, problems, and potentials.

322.  *Africa: Contemporary Problems*
   Spring. 4(3-0) Sophomores or approval of department. GEO 321 recommended.
   Major development problems examined from environmental, historical, economic, and social perspectives.

340.  *Western Europe*
   Winter. 4(3-0) Sophomores or approval of department.
   Geographic analysis of physical and human character and resources of Western Europe (Scandinavia, British Isles, Benelux, Germany, France, and Switzerland). Emphasis on major problems.

1DC.  *Contemporary Problems of South Asia*
   For course description, see Interdisciplinary Courses.

342.  *Eastern and Southern Europe*
   Spring. 4(3-0) Sophomores or approval of department.
   A geographical analysis of countries of Eastern and Southern Europe with emphasis on economic, political, social and ethnic problems.

350.  *Australia and Pacific Islands*
   Winter of odd-numbered. 4(3-0) Sophomores or approval of department.
   Physical and cultural geography of Australia, New Zealand, Melanesia, Micronesia, and Polynesia.

351.  *Weather and Climate*
   Fall. 3(3-0)
   Non-mathematical treatment of general weather processes and patterns, including surface and middle atmospheric (jet stream) features, with emphasis on the U.S.

360.  *The Soviet Union*
   Fall. 4(3-0) Sophomores or approval of department.
   A geographical analysis of the Soviet Union and its inhabitants with emphasis on economic, social, political and ethnic problems.

361.  *South Asia*
   Fall of odd-numbered years. 4(3-0) Sophomores or approval of department.
   A geographical analysis of the physical environment and human societies of India, Pakistan and Ceylon.

362.  *East Asia*
   Winter. 4(3-0) Sophomores or approval of department.
   A geographical analysis of the major developmental (modernization) problems of East Asia. Focus is on China in odd-numbered years; on Japan, Korea, Taiwan and Hong Kong in even-numbered years.

363.  *Southeast Asia*
   Fall. 4(3-0) Sophomores or approval of department.
   A geographical analysis of the major developmental (modernization) problems of Southeast Asia (Philippines, Indochina, Thailand, Burma, Malaysia, Singapore, Indonesia).

364.  *Middle East and North Africa*
   Winter. 4(3-0) Sophomores or approval of department.
   Socio-political and economic geography and physical environment of Southwest Asia and Northern Africa.

401.  *The Ghetto*
   Fall, Spring. 4(4-0) Juniors or approval of department. Interdepartmental with and administered by the Department of Urban and Metropolitan Studies.
   Analysis of the ghetto including its spatial organization, structure and distribution of non-white and ethnic populations in cities with emphasis on the United States.

402.  *The Geography of the City*
   Spring. 4(3-0) Interdepartmental with the Department of Urban and Metropolitan Studies.
   Spatial theories, concepts, and designs of internal urban economic, social, and political structures.

403.  *The American City and Its Region*
   Winter. 4(3-0)
   The regional system of cities in terms of size, spacing, and functional relationships.

404.  *Advanced Cultural Geography*
   Spring. 4(3-0) GEO 201 or approval of department.
   Geographical analysis of selected aspects of human culture area, landscape, spatial diffusion, cultural ecology, and environmental perception.

407.  *Michigan*
   Fall, Spring, Summer. 4(3-0) Sophomores or approval of department.
   Selected aspects of the physical and cultural geography of Michigan.

408.  *Canada*
   Spring. 4(3-0) Sophomores or approval of department.
   An analysis of the physical, economic and cultural patterns of Canada.

409.  *Geography of Transportation*
   Fall. 4(3-0)
   Analysis of spatial principles of transportation, including theories of interaction, network structures, and the role of transport in space-economy.

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

412.  *Geography of Agriculture*
   Winter. 4(3-0)
   Analysis of the nature and world distribution of agricultural activities and settlements.

413.  *Geography of Manufacturing*
   Winter. 4(3-0) GEO 213 or Juniors.
   Evaluation of the distribution of different types of manufacturing industries. Formulation of models of industries and analysis of the role of manufacturing in society, economics and development.

415.  *Field Techniques*
   Fall, Spring. 4(1-7) May reenroll for a maximum of 8 credits. Approval of department.
   Basic methods for making physical and cultural observations and measurements including map reading, photo interpretation, field sketch mapping, compass traverses, sampling, questionnaire design, interviewing, analysis and reporting. Requires work off campus.
416. Man's Geo-Political World  
Winter. 4(3-0) GEO 294 or Juniors.  
The organization and behavior of man in political  
space with emphasis on the United States.  

424. Advanced Remote Sensing  
Techniques  
Spring. 4(2-4) GEO 224.  
Extraction, analysis, and interpretation of in­  
formation obtained from remote sensors includ­  
ing conventional, infrared and radar imagery.  
Introduction to stereo-plotting devices, stressing  
theories of remote sensing and applications.  

425. Development of Geographic  
Thought  
Winter, Spring. 4(3-0) Approval of de­  
partment.  
Evolution of geographic thought from antiquity  
to the present emphasizing developments in  
20th century America. Survey of the theory and  
methodology of contemporary geography.  

426. Advanced Cartography  
Spring. 4(0-0) GEO 223.  
Development of advanced skills in the construc­  
tion of maps, including ink drafting, lettering sys­  
tems, map projections, scribing and photo repro­  
duction.  

427. Quantitative Methods in  
Geography  
Fall, Spring. 4(3-0) Approval of de­  
partment.  
Basic quantitative techniques used in the  
analysis and classification of geographic data.  

428. Computer Mapping in  
Geography  
Spring. 4(4-0) CPS 120.  
The preparation of computer maps and the appli­  
cation of the computer to the development and  
testing of models in geography.  

429. Landforms of North America  
Winter, Spring. 4(3-0) May reenroll for  
a maximum of 8 credits. GEO 296, GLG 201 or  
approval of department.  
Study of the surface features of eastern U.S.A.  
(winter term) and western U.S.A. (spring term).  

430. Climates of the World  
Spring. 4(3-0) GEO 206 or approval of  
department.  
Regional analysis of the world's weather and  
climate.  

431. Landform Analysis  
Fall. 4(3-0) GEO 206, GLG 201 or  
approval of department.  
A problem approach is utilized to explain classi­  
cal and contemporary interpretations of the na­  	ure of selected landforms, including treatment of  
related tools and techniques. Option for some  
field study.  

432. Biogeography  
Spring. 4(3-0) GEO 206 or approval of  
department.  
Patterns of vegetation, with emphasis on forests  
of eastern North America. Option for some field  
study.  

435. Land Use and Location Theory  
Spring. 4(3-0) GEO 213 or approval of  
department.  
Location principles and theories of economic  
activities, including methods of regional  
analysis.  

446. Production Cartography  
Winter. 4(1-5) GEO 223 or approval of  
department.  
Deals with the technical aspects of map and  
graphics production both as a sequence of oper­  
ations and as a series of problems of organiz­  
tions. Theoretical and applied aspects, process  
photography, typographgy, and proofing.  

451. Climatic Patterns and  
Atmospheric Circulation  
Winter. 4(3-0) GEO 206 or approval of  
department.  
Relationship between weather, climate, and  
upper air flow, with emphasis on this climatol­  
ogy of North America.  

454. Geography of Water  
Fall. 4(3-0) GEO 206 or GEO 213.  
Geographic aspects of global water resources,  
their utilization patterns, and the role of water in  
aricultural and industrial production.  

458. Geography for Teachers  
Winter. 4(3-0)  
Problems and practices of teaching geography  
in elementary and secondary schools.  

466. Social and Spatial Approaches  
to Community Service  
Spring. 3(3-0) GEO 201 or S W 205 or  
approval of department. Interdepartmental  
with the School of Social Work.  
Analysis of major themes in social service plan­  
ing: communities and neighborhoods, public  
policy administration, social service networks,  
location of public facilities, evaluation and ac­  
countability of service systems.  

470. Geography of Health and  
Disease  
Fall, Winter. 4(3-0)  
Socio-environmental concepts and the techni­  
quies applied to health problems: disease  
transmission cycles, community nutrition and  
health-care planning.  

480. Senior Seminar  
Spring. 3(2-0) Senior majors or app­  
approval of department.  
Current developments in geographic research  
and theory.  

810. Seminar in Historical  
Geography  
Winter. 3(3-0) Approval of depart­  
ment.  
Approaches in research in historical geography.  

811. Advanced Quantitative  
Methods in Geographic Research  
Winter. 4(3-0) Approval of depart­  
ment, GEO 427.  
Statistical and mathematical approaches to spa­  
tial distributions and areal data.  

812. Regional Seminar  
Fall, Winter, Spring, Summer. Vari­  
able credit. May reenroll for a maximum of 9  
credits. Approval of department.  
Selected research topics in regional geography.  

818. Readings in Geography  
Fall, Winter, Spring, Summer. Vari­  
able credit. May reenroll for a maximum of 15  
credits. Approval of department.  

825. History and Philosophy of  
Geography  
Fall. 3(3-0) Approval of department.  
Analysis of the monographic and serial litera­  
ture dealing with the theory and evolution of  
geographic science.  

826. Research Design in Geography  
Winter, Spring. 3(3-0) Approval of de­  
partment.  
Formalized approach to research and writing in  
geography: identification of geographic prob­  
lems and their relative importance, structuring  
and stating hypotheses, data acquisitions, and  
tests for validity.  

827. Contemporary Theory and  
Methodology in Geographic  
Research  
Spring. 3(3-0) Approval of depart­  
ment.  
Examination of the forward edges of geographic  
research, particularly with respect to its relation­  
to other disciplines, scientific methodology in  
general, and the evolution of geography as a  
professional scholarly discipline.  

828. Seminar in Recreation  
Geography  
Spring. 3(3-0) GEO 309 or approval of  
instructor.  
Selected current problems in recreation geogra­  
phy in the U.S. and abroad.  

834. Seminar in Physical Geography  
Winter, Spring. 3(3-0) May reenroll for  
a maximum of 9 credits. Approval of depart­  
ment.  
Analysis of classical and contemporary prob­  
lems in physical geography treated as follows:  
climatology (winter), biogeography (spring),  
geomorphology (spring).  

835. Seminar in Location Theory  
Fall. 3(3-0) Approval of depart­  
ment, GEO 435.  
Recent developments and research in location  
analysis and regional science.  

836. Population Geography Seminar  
Spring. 3(3-0) Approval of depart­  
ment.  
Studies of particular topics and problems in  
population geography.  

A-91
IDC. Interdisciplinary Seminar on Africa
For course description, see Interdisciplinary Courses.

846. Seminar in Cartography
Winter. 3(3-0) May reenroll for a maximum of 12 credits. Approval of department. Selected research topics in cartographic theory and map design.

850. Advanced Field Techniques
Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 6 credits. Instruction and practical training in the selection, data-gathering, on-site analysis, and presentation of geographic field problems.

855. Seminar in Geographic Education
Spring. 3(3-0) Approval of department. Treatment of selected topics in geographic education.

870. Seminar in Medical Geography
Winter. 3(0-0) Spatio-environmental analysis of selected health problems.

899. Master's Thesis Research
Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 15 credits. Approval of department.

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

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

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

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

908. Problems in Historical Geography
Fall, Winter, Spring. 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. 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. Doctoral Dissertation Research
Fall, Winter, Spring. Variable credit. Approval of department.

GEOLOGY GLG

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 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.

200L Laboratory--Geology of Man's Environment
Fall, Winter, Spring, Summer. 1(0-3) Credit will be given for only one of the following: GLG 200, GLG 201, GLG 306. 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 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 ocean. Man-sea interactions are emphasized, including resource utilization and pollution.

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

252. 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.

306. Solar System Geology
Winter. 4(4-0) AST 119 or AST 217 or AST 229; GLG 200 or GLG 201. 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 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 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 soil geologic maps and geologic cross sections studied in laboratory. Source of geologic literature and maps.

307. Geology Central Appalachians
Winter. 10(2-0) GLG 200, or GLG 201, or GLG 202, or concurrently. General geology of 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. 3(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.

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