825 Geoprocessing
Fall of odd years. 4(4-0)
Integration of digital remote sensing data, geographic information systems, spatial analysis, and expert systems in solving research problems. Class research project.

826 Seminar in Cartography and Geoprocessing
Spring. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. Review of research in cartography, geographic information systems, and remote sensing.

827 Digital Image Processing and Analysis
Fall. 4(2-4) P:M: (GEO 424)
Use of computer to classify and enhance satellite images and to extract information from them. Combining images from different sources. Accuracy assessment of resulting information.

832 Environmental and Natural Resource Law
Fall. 3(3-0) Interdepartmental with Resource Development; Agricultural Economics; Crop and Soil Sciences; Forestry. Administered by Department of Resource Development. RB: (RD 430)
Origin and development of environmental law. Theories of power, jurisdiction, sovereignty, property interests, pollution, and other bases for legal controls of natural resources. Common law and constitutional limitations on governmental powers.

835 Biogeography
Spring of odd years. 3(3-0)
Interdepartmental with Fisheries and Wildlife; Zoology; Plant Biology. Administered by Department of Fisheries and Wildlife. RB: Courses in evolution and ecology at undergraduate level.
Geographical distributions of plants and animals; biogeographic realms. Ecological and evolutionary mechanisms determining distributional patterns. Application of biogeography to conservation problems.

850 Seminar in Regional Geography
Spring. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. Review of research on contemporary geographic issues in different world regions.

854 Economics of Planning and Development
Spring. 3(3-0) Interdepartmental with Urban Planning. Administered by Department of Geography. RB: (UP 801)
The physical urban environment and local economic development.

865 Advanced Quantitative Methods in Geography
Spring. 4(0-0) RB: (GEO 465)

867 Methods and Modeling in Regional Science
Spring of even years. 3(3-0) Interdepartmental with Resource Development; Urban Planning. RB: (EC 820 and GEO 865) and (GEO 415 or RD 461)
Techniques for regional research: economic base analysis, input-output analysis, mathematical programming, and econometric and simulation analysis.

871 Seminar in Physical Geography
Fall. 3(3-0) RB: at least one course in physical geography
Research on topics in physical geography.

872 Seminar in Human Geography
Fall. 3(3-0) RB: at least one course in human geography
Research on topics in human geography.

873 Seminar in Human-Environment Geography
Spring. 3(3-0) RB: at least one course in human geography and one course in physical geography.
Research on topics in human-environment geography.

874 Seminar in Geographic Information Science
Spring. 3(3-0) RB: at least one course in geographic information science, cartography or remote sensing.
Geographic information science (GIS) applications to social and environmental problems. Theory and related issues.

880 Seminar in Advanced Physical Geography
Spring. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. SA: GEO 809
Advanced study of soils, geomorphology, climatology and/or plant geography.

886 Research Design in Geography
Spring. 3(3-0)
Research and writing in geography. Identification of geographic problems and their relative importance. Structuring and stating hypotheses. Data acquisition and tests for validity.

890 Advanced Readings in Geography
Fall, Spring, Summer. 1 to 8 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Approval of department.
Advanced independent readings.

892 Advanced Research in Geography
Fall, Spring. Summer. 1 to 4 credits. A student may earn a maximum of 12 credits in all enrollments for this course.
Advanced independent research.

899 Master's Thesis Research
Fall, Spring. Summer. 1 to 12 credits. A student may earn a maximum of 30 credits in all enrollments for this course. R: Open only to graduate students in Geography.
Master's thesis research.

906 Theory and Methods in Geography
Spring. 3(3-0) R: Open only to Ph.D. students in Geography.
Historical development of the discipline within social and intellectual contexts. Current methodological and philosophical approaches to geographic research.

999 Doctoral Dissertation Research
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 36 credits in all enrollments for this course.
Doctoral dissertation research.

GEOLOGICAL SCIENCES

Department of Geological Sciences
College of Natural Science

201 The Dynamic Earth
Fall, Spring. 4(3-2) Not open to students with credit in GLG 301.
Physical and chemical processes related to the past, present and future behavior of the earth system, and the energy systems that drive these processes. A study of the earth's materials, the earth's surface and the earth's interior.

302 Geology of Michigan
Spring. 3(3-0) P:M: (GLG 201 or GLG 301 or ISP 203)
Integration of the geological evolution of Michigan with its social and economic development.

303 Oceanography
Fall. 4(4-0) P:M: (CEM 141 or CEM 142 or CEM 151 or CEM 152 or CEM 181H or CEM 182H or LBS 171) and (PHY 183 or PHY 183B or PHY 193H or PHY 231 or PHY 231B or PHY 231C or LBS 271)
Physical, chemical, biological, and geological aspects of oceanography: ocean circulation, waves, tides, air-sea interactions, chemical properties of ocean water, ocean productivity, shoreline processes, and sediments.

304 Physical and Biological History of the Earth
Fall, Spring. 4(3-2) P:M: (GLG 201 or ISP 203) SA: GLG 202

306 Environmental Geomorphology
Spring. 3(3-0) Interdepartmental with Geography. Administered by Department of Geography. P:M: (CSS 210 or GEO 203 or GEO 206 or GEO 330 or GEO 333 or GEO 259 or GLG 201 or GLG 304 or ISP 201 or ISP 203 or ISS 310 or RD 201) and completion of Tier I writing requirement.
Relationships of running water, weathering, gravity, ice, waves, wind, and biota (including humans) to terrain and soils. Evolution of landscapes. Classical and modern interpretations.

319 Introduction to Earth System Science
Fall. 3(3-0) Interdepartmental with Entomology; Plant Biology; Zoology; Sociology. Administered by Department of Entomology. RB: Completion of one course in biological or physical science.
Systems approach to Earth as an integration of geochemical, geophysical, biological and social components. Global dynamics at a variety of spatial-temporal scales. Sustainability of the Earth system.
321 Mineralogy and Geochemistry
Spring. 4(3-2) P.M. (GLG 201 or concurrently) and (CEM 142 or CEM 152 or CEM 182H or LBS 172) and (MTH 132 or LBS 118)

335 Plants Through Time
Spring of odd years. 3(3-0) Interdepartmental with Plant Biology. Administered by Department of Plant Biology. P.M.: (BS 110 or PLB 105 or GLG 201 or LBS 144 or LBS 148H) R: Open only to juniors or seniors. SA: BOT 535
Evolutionary history of plants, development of ecosystems, and use of plant fossils in the reconstruction of ancient environments and climate.

351 Structural Geology
Fall. 4(3-2) P.M: (GLG 304 and GLG 361 or concurrently) and (MTH 114 or MTH 116 or LBS 117 or MTH 124 or MTH 126 MTH 132 or MTH 133 or LBS 118 or LBS 119) RB: Introductory physics
Mechanical behavior and kinematic history of the lithosphere. Stress and strain. Deformation features such as folds, faults and microstructure. Methods of analysis and interpretation. One weekend field trip required.

361 Petrology (W)
Fall. 4(3-2) P: (GLG 321) and completion of Tier I writing requirement. SA: GLG 461
Evolution, origin, occurrence and tectonic setting of igneous and metamorphic rocks. Phase relations of igneous and metamorphic systems. Studies of rocks in thin sections.

401 Plate Tectonics (W)
Spring. 4(3-2) P.M: (GLG 304) and (MTH 114 or MTH 116 or LBS 117 or MTH 124 or MTH 126 or MTH 132 or MTH 133 or LBS 118 or LBS 119) and (PHY 183 or PHY 183B or PHY 231 or PHY 231B or PHY 231C or LBS 271) and completion of Tier I writing requirement. R: Not open to graduate students in the Department of Geological Sciences. SA: GLG 371
Geophysical methods of studying the structure and dynamics of the earth and planets. Plate kinematics and global geodynamic processes, plate margin processes and evolution, marine geology.

411 Hydrogeology
Fall. 4(3-2) RB: (MTH 114 or MTH 116 or LBS 117 or MTH 124 or MTH 126 or MTH 132 or MTH 133 or LBS 118 or LBS 119) R: Not open to freshmen or sophomores.
Source, occurrence, and movement of groundwater emphasizing geologic factors and controls.

412 Glacial and Quaternary Geology
Spring. 4(3-2) Interdepartmental with Geography. RB: (GLG 201 or GLG 301 or GEO 306 or GEO 406) R: Not open to freshmen or sophomores.
Glacial and Quaternary geology with emphasis on North America and Europe. Laboratory focuses on glacial processes. One weekend field trip required.

419 Advanced Earth System Science
Spring. 3(2-5) Interdepartmental with Entomology; Plant Biology; Zoology; Sociology. Administered by Department of Entomology. P.M: (ENT 319) Systems science theory applied to analysis of the biological, geological, physical, and social causes and consequences of global changes. Issues of sustaining the Earth system.

421 Environmental Geochemistry
Spring. 4(3-2) RB: (GLG 201 or GLG 301) and (CEM 141 or CEM 151 or CEM 181H or LBS 165)
Natural and anthropogenic processes affecting environmental chemistry with emphasis on the water cycle. Chemical equilibria, kinetics, geochemical cycling, acid rain, carbon dioxide, heavy metals, toxic organics, global change and the greenhouse effect.

422 Aquatic and Marine Organic Geochemistry (W)
Fall. 3(3-0) P.M: (CEM 141 or CEM 142 or CEM 151 or CEM 152 or CEM 181H or CEM 182H or LBS 171) and completion of Tier I writing requirement. RB: (GLG 201 or GLG 304)
Organic geochemistry applied to global cycling of organic matter and diagenesis in aquatic and marine environments. Use of stable isotopes and molecular analyses to trace the fate of bulk organic matter and individual compounds in the environment.

426 Biogeochemistry
Summer. 3 credits. Given only at W.K. Kellogg Biological Station. Interdepartmental with Microbiology and Molecular Genetics; Crop and Soil Sciences; Zoology. Administered by Department of Microbiology and Molecular Genetics. RB: (BS 110 or LBS 144 or LBS 148H or BS 111 or LBS 145 or LBS 149H) and (CEM 143 or CEM 251) SA: MPH 426
Integration of the principles of ecology, microbiology, geochemistry, and environmental chemistry. Societal applications of research in aquatic and terrestrial habitats.

431 Sedimentology and Stratigraphy (W)
Spring. 4(3-2) P.M: (GLG 351) and completion of Tier I writing requirement. Sediments, sedimentary rocks, sedimentary processes, and depositional environments through geologic time. Facies events correlation. Fossils as tools in stratigraphy and environmental analysis. Biostratigraphy, paleoecology and taphonomy.

433 Vertebrate Paleontology
Fall of even years. 4(3-2) Interdepartmental with Zoology. R: Not open to freshmen or sophomores.
Vertebrate paleontology with emphasis on evolution and interrelationships of major groups. Modern techniques of identification and interpretation of fossils.

434 Evolutionary Paleobiology
Spring. 4(3-2) Interdepartmental with Zoology. RB: (BS 110 or GLG 202 or GLG 304 or LBS 144 or LBS 148H)
Patterns and processes of evolution known from the fossil record including speciation, phylogeny, extinction, heterochrony and biogeography.

470 Principles of Modern Geophysics
Fall of odd years. 3(3-0) P.M: (GLG 201) and (MTH 234 or concurrently or MTH 254H or concurrently or LBS 220 or concurrently) and (PHY 183 or PHY 183B or PHY 193H or PHY 233B or LBS 271) SA: GLG 472
Theory of solid-earth geophysics including geochronology, geothermics, geomagnetism and paleomagnetism, geodesy and gravity, rheology, and travel-time seismology.

471 Applied Geophysics
Spring. 4(3-2) P.M: (MTH 133 or concurrently or LBS 119 or concurrently) and (PHY 184 or concurrently or PHY 184B or concurrently or PHY 232 or concurrently or PHY 232B or concurrently or PHY 232C or concurrently or PHY 294H or concurrently or LBS 272 or concurrently) R: Not open to freshmen or sophomores.
Application of seismic, gravity, magnetic, resistivity, and electromagnetic methods to problems related to engineering studies, mineral and oil exploration, groundwater, subsurface mapping, pollution, and hazardous waste.

481 Reservoirs and Aquifers
Spring of even years. 3(3-0) P.M: (GLG 431 or concurrently)
Principles of the origin and evolution of porous media. Porosity and permeability of sediments and sedimentary rocks. Computing techniques for evaluating reservoirs and aquifers.

491 Field Geology - Summer Camp (W)
Summer. 6 credits. Given in Park City, Utah. P.M: (GLG 431) and completion of Tier I writing requirement. R: Open only to students in the Department of Geological Sciences. Approval of department.

499 Independent Study in Geological Sciences
Fall, Spring. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to juniors or seniors in the Department of Geological Sciences. Approval of department; application required.
Advanced individual study of special topics in the geological sciences.

801 Seminar in Geochemistry
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to graduate students in the Department of Geological Sciences.
Recent developments in geochemistry, including aqueous, biologic and minerologic aspects.

802 Seminar in Geophysics and Geodynamics
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. RB: (GLG 401 or GLG 470 or GLG 471) R: Open only to graduate students in the Department of Geological Sciences.
Applied, solid-earth, and theoretical geophysics, global and regional geodynamics. Plate tectonics, marine geophysics, and polar earth sciences.
### GERMAN—GRM

**Department of Linguistics and Germanic, Slavic, Asian and African Languages**

**College of Arts and Letters**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Semester(s)</th>
<th>Schedule</th>
<th>Requirements</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>101</td>
<td>Elementary German I</td>
<td>4</td>
<td>Fall, Spring, Summer</td>
<td>4(4-1)</td>
<td>No previous experience in German or designated score on German Placement Test</td>
<td>Students may earn a maximum of 4 credits in all enrollments for this course. R: Approval of department. Further study of German language, civilization and culture for beginning students. Work on all language skills with emphasis on speaking.</td>
</tr>
<tr>
<td>102</td>
<td>Elementary German II</td>
<td>4</td>
<td>Fall, Spring, Summer</td>
<td>4(4-1)</td>
<td>P: (GRM 101) or designated score on German placement test</td>
<td>Not open to students with credit in GRM 150. Further study of German language, civilization and culture for beginning students. Coursework includes readings, discussions and assignments based on materials dealing with the German economic system and Germany in world trade. Taught in German.</td>
</tr>
<tr>
<td>103</td>
<td>Self-Paced Elementary German I</td>
<td>4</td>
<td>Fall, Spring, Summer</td>
<td>2 to 4</td>
<td>P: (GRM 101) or designated score on German placement test. RB: Some German coursework in High School.</td>
<td>Students may earn a maximum of 4 credits in all enrollments for this course. RB: Some German coursework in High School. Further self-paced study of German language, civilization and culture for beginning students including web-based activities.</td>
</tr>
<tr>
<td>104</td>
<td>Self-Paced Elementary German II</td>
<td>4</td>
<td>Fall, Spring, Summer</td>
<td>2 to 4</td>
<td>P: (GRM 101) or designated score on German placement test. RB: Some German coursework in High School.</td>
<td>Students may earn a maximum of 4 credits in all enrollments for this course. RB: Some German coursework in High School. Further self-paced study of German language, civilization and culture for beginning students including web-based activities.</td>
</tr>
<tr>
<td>200</td>
<td>Second-Year German I with Review</td>
<td>4</td>
<td>Fall</td>
<td>4(4-1)</td>
<td>P: (GRM 102) or designated score on German placement test. Not open to students with credit in GRM 102 or GRM 201.</td>
<td>Rapid review and strengthening of vocabulary, grammar, and communication skills for incoming freshmen and transfer students. Reading, viewing, and discussion of a broad range of cultural texts and materials from the German-speaking world.</td>
</tr>
<tr>
<td>201</td>
<td>Second-Year German I</td>
<td>4</td>
<td>Fall</td>
<td>4(4-4)</td>
<td>P: (GRM 102) or designated score on German placement test. Not open to students with credit in GRM 200.</td>
<td>Intermediate-level development of all language skills. Reading, viewing, and discussion of a broad range of cultural materials from the German-speaking world.</td>
</tr>
<tr>
<td>202</td>
<td>Second-Year German II</td>
<td>4</td>
<td>Fall</td>
<td>4(4-4)</td>
<td>P: (GRM 201) or designated score on German placement test.</td>
<td>Further intermediate-level work on all language skills, based on topics such as popular music, literature, film, current events, and culture. Transition course to advanced work in German studies.</td>
</tr>
<tr>
<td>290</td>
<td>Independent Study</td>
<td>1 to 4</td>
<td>Fall</td>
<td></td>
<td></td>
<td>A student may earn a maximum of 8 credits in all enrollments for this course. R: Approval of department. Special projects arranged by an individual student and a faculty member in areas supplementing regular course offerings.</td>
</tr>
<tr>
<td>301</td>
<td>Advanced German Language and Culture I</td>
<td>3</td>
<td>Fall, Spring</td>
<td>3(3-0)</td>
<td>P: (GRM 202) or designated score on German placement test.</td>
<td>Work on advanced speaking, listening comprehension, reading, and writing skills through intensive work with authentic texts dealing with contemporary issues relating to the German-speaking world. Selected review of grammar and syntax.</td>
</tr>
<tr>
<td>302</td>
<td>Advanced German Language and Culture II</td>
<td>3</td>
<td>Fall, Spring</td>
<td>3(3-0)</td>
<td>P: (GRM 301)</td>
<td>Further work on advanced speaking, listening comprehension, reading and writing skills, through intensive work with original texts dealing with contemporary issues relating to the German-speaking world.</td>
</tr>
<tr>
<td>303</td>
<td>Advanced German Business Emphasis</td>
<td>3</td>
<td>Fall</td>
<td>3(3-0)</td>
<td>P: (GRM 202) or designated score on German placement test.</td>
<td>Not open to students with credit in GRM 102. Development of proficiency through readings, discussions, and assignments based on materials dealing with the German economic system and Germany in world trade. Taught in German.</td>
</tr>
<tr>
<td>311</td>
<td>Advanced German: Business Emphasis I</td>
<td>3</td>
<td>Fall</td>
<td>3(3-0)</td>
<td>P: (GRM 301)</td>
<td>Not open to freshmen. Further readings, discussions, and assignments based on materials dealing with key areas of German business such as management and corporate hierarchies. Taught in German. Research paper required.</td>
</tr>
<tr>
<td>312</td>
<td>Advanced German: Business Emphasis II</td>
<td>3</td>
<td>Spring</td>
<td>3(3-0)</td>
<td>P: (GRM 311)</td>
<td>Not open to freshmen.</td>
</tr>
<tr>
<td>330</td>
<td>German Life and Literature: Contemporary Period</td>
<td>3</td>
<td>Fall</td>
<td>3(3-0)</td>
<td>P: (GRM 202) or designated score on German placement test.</td>
<td>Not open to students with credit in GRM 102. Post-War World War II Germany through analysis of selected literary texts, documentary material, and film. Topics such as problems of recovery and prosperity, partition and re-unification, and Germany in Europe.</td>
</tr>
<tr>
<td>340</td>
<td>German Life and Literature: Historical Perspectives</td>
<td>3</td>
<td>Fall</td>
<td>3(3-0)</td>
<td>P: (GRM 202) or designated score on German placement test.</td>
<td>Not open to students with credit in GRM 102. Historical, social, and cultural developments in the German-speaking world as revealed in textual material in German, including literature, essays, and film. Focus on at least three historical epochs prior to 1945.</td>
</tr>
<tr>
<td>440</td>
<td>German Life and Literature: Cultural Differences</td>
<td>3</td>
<td>Fall</td>
<td>3(3-0)</td>
<td>A student may earn a maximum of 6 credits in all enrollments for this course.</td>
<td>Not open to students with credit in GRM 102. Values and beliefs of marginalized groups in German society including religious minorities and foreign workers, and of youth and women. German immigrants in the United States as seen through their writings. Influence of historical and cultural developments.</td>
</tr>
<tr>
<td>441</td>
<td>German Life and Literature: Mainstream Culture</td>
<td>3</td>
<td>Fall</td>
<td>3(3-0)</td>
<td>A student may earn a maximum of 6 credits in all enrollments for this course.</td>
<td>Not open to students with credit in GRM 102. Values and beliefs of mainstream German cultural and political figures, as seen through the writings of religious and political leaders, educators, writers, and philosophers. Influence of historical and cultural developments.</td>
</tr>
<tr>
<td>450</td>
<td>The Study of German Literature</td>
<td>3</td>
<td>Fall</td>
<td>3(3-0)</td>
<td>P: (GRM 340 and GRM 341)</td>
<td>Not open to students with credit in GRM 102.</td>
</tr>
<tr>
<td>461</td>
<td>Teaching German Language and Culture</td>
<td>2</td>
<td>Fall, Spring</td>
<td>2(2-0)</td>
<td>P: (GRM 340 or GRM 341)</td>
<td>Not open to students with a teacher certification option in German.</td>
</tr>
</tbody>
</table>

**Master's Thesis Research**

Fall, Spring, Summer. 1 to 10 credits. A student may earn a maximum of 36 credits in all enrollments for this course. R: Open only to master's students in the Department of Geological Sciences. Approval of department.

**Doctoral Dissertation Research**

Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 120 credits in all enrollments for this course. R: Open only to doctoral students in the Department of Geological Sciences. Approval of department.

**Doctoral dissertation research.**

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**Notes:**

- Fall, Spring, Summer.
- R: Registration restriction.
- P: Prerequisite.
- M: Corequisite.
- RB: Restricted to begin.
- RB: Restricted to some beginning.
- Spring of even years.
- HST: Honors.