<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
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<tbody>
<tr>
<td>GEOLOGY 1110</td>
<td>Physical And Environmental Geology (LEC 3.0)</td>
<td>3.0</td>
<td>Materials, structure, and surface features of the Earth and planets are studied in the context of the processes that continuously transform the Earth and affect management of Earth resources, hazards, engineering problems, and environmental challenges. Prerequisite: Entrance requirements. (Co-listed with Geo Eng 1150).</td>
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<tr>
<td>GEOLOGY 1111</td>
<td>Introduction to Physical Geology (LAB 1.0 and LEC 2.0)</td>
<td>1.0, 2.0</td>
<td>A study of Earth materials, surface features, internal structures and processes. Particular attention is paid to Earth resources, geological hazards, engineering and environmental problems. Prerequisite: Entrance requirements.</td>
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<tr>
<td>GEOLOGY 1119</td>
<td>Physical and Environmental Geology Laboratory (LAB 1.0)</td>
<td>1.0</td>
<td>Geology 1119 is designed to accompany Geology 1110 and consists of laboratory explorations of the study of common rocks and minerals, air photographs, maps, and case studies of geological problems related to management of Earth resources, hazards, and environmental challenges. Prerequisite: Preceded or accompanied by Geology 1110. (Co-listed with Geo Eng 1119).</td>
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<tr>
<td>GEOLOGY 1120</td>
<td>Evolution Of The Earth (LEC 3.0)</td>
<td>3.0</td>
<td>A survey of the Earth history from the coalescence of the solar system to the present and the events that have profoundly transformed the planet in the context of the dynamic feedback between physical and biological systems. A one day field trip is required. Prerequisites: Recommend Geo Eng 1150 or Geology 1110 or Bio Sci 1113 but not required.</td>
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<tr>
<td>GEOLOGY 1129</td>
<td>Evolution of the Earth Laboratory (LAB 1.0)</td>
<td>1.0</td>
<td>Geology 1129 is designed to accompany Geology 1120 and consists of laboratory explorations of fundamental concepts in geology and the diversity of the fossil record. Prerequisite: Preceded or accompanied by Geology 1120.</td>
</tr>
<tr>
<td>GEOLOGY 1141</td>
<td>Physical Oceanography (LEC 3.0)</td>
<td>3.0</td>
<td>An introduction to the study of the physical and geological processes in the world’s oceans including the importance of the oceans to the environment and to life on Earth. Prerequisites: GEOLOGY 1110 or GEOLOGY 1120 or equivalent.</td>
</tr>
<tr>
<td>GEOLOGY 2001</td>
<td>Special Topics (LEC 0.0-6.0)</td>
<td>0.0-6.0</td>
<td>This course is designed to give the department an opportunity to test a new course. Variable title.</td>
</tr>
<tr>
<td>GEOLOGY 2096</td>
<td>Field Geology (LEC 3.0)</td>
<td>3.0</td>
<td>Theory and practice in the qualitative and quantitative description of spatial relationships of major rock types, contacts, and structures through construction of geologic maps. Emphasis on developing fundamental field skills, including logistical planning, navigation, data collection and documentation, and professional protocol during site visits. Students will be charged a fee to cover the cost of field trip expenses. Prerequisites: GEOLOGY 1111, 1110, 1119, &amp; 1129.</td>
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<tr>
<td>GEOLOGY 2610</td>
<td>Mineralogy And Crystallography (LAB 1.0 and LEC 3.0)</td>
<td>1.0, 3.0</td>
<td>An introduction to the study of minerals, including their systematic classification, crystallography, morphology, chemistry, societal use, geologic occurrence, environmental application and impact, and identification by means of their physical and chemical properties. Prerequisites: Chem 1310 and Chem 1319.</td>
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<tr>
<td>GEOLOGY 2611</td>
<td>Physical Mineralogy And Petrology (LAB 1.0 and LEC 2.0)</td>
<td>1.0, 2.0</td>
<td>An introduction to the study of physical mineralogy and petrology, overviewing systematic determination of minerals and rocks by means of their physical properties. Includes the recognition of crystal forms and field relationships of rocks. Course designed for non-geology majors, credit will not count towards a geology-geophysics degree. Prerequisites: Chem 1310 and Chem 1319 or Chem 1351; Geo Eng 1150 or Geology 1110.</td>
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<tr>
<td>GEOLOGY 2620</td>
<td>Igneous And Metamorphic Petrology (LAB 1.0 and LEC 3.0)</td>
<td>1.0, 3.0</td>
<td>A comprehensive study of mesoscopic and microscopic characteristics of igneous and metamorphic rocks. Fundamental theories for their origin are presented. The class includes a trip to examine these rock types in the field. Prerequisite: Geology 2610.</td>
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<tr>
<td>GEOLOGY 2630</td>
<td>Geology And Earth History (LAB 1.0)</td>
<td>1.0</td>
<td>A one day field trip is required. Prerequisites: Geology 2620 or Geology 1110.</td>
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<tr>
<td>GEOLOGY 2650</td>
<td>Geology And Earth History (LAB 1.0)</td>
<td>1.0</td>
<td>Principles of physical stratigraphy, bio-stratigraphy and introductory sedimentation. Introduction to depositional systems, facies, unconformities, stratigraphic nomenclature and correlation. One field trip at student expense is required. Prerequisite: Geology 2620 or Geology 2611.</td>
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2016-2017
**GEOL329**  *Stratigraphy Lab*  (LAB 1.0)  
This course re-enforces the principles of stratigraphy and sedimentation through the use of "hands-on" laboratory procedures such as sieve and pipette analyses, correlation problems, fence diagrams and stratigraphic maps. One field trip at student expense is required. Prerequisite: Concurrent with Geology 3620.

**GEOL361**  *Systematic Paleontology*  (LAB 1.0 and LEC 2.0)  
Introduction to paleontological principles, biostratigraphy, paleoenvironments, and the study of fossil invertebrates, microfossils, plants and palynology. Emphasis of the course is on fossil morphology, classification, and environmental relationships. Prerequisites: Geology 1110 or Geology 1120 or Bio Sci 1113.

**GEOL3811**  *Fundamentals of Geographic Information Systems*  (LAB 1.0 and LEC 2.0)  
Introduction to the fundamental concepts and components of Geographic Information Systems. Techniques for acquiring, manipulating and analyzing digital terrain data for geological and geotechnical applications. (Co-listed with Geo Eng 3148).

**GEOL4000**  *Special Problems*  (IND 0.0-6.0)  
Problems or readings on specific subjects or projects in the department. Consent of instructor required.

**GEOL4001**  *Special Topics*  (LAB 1.0 and LEC 2.0)  
This course is designed to give the department an opportunity to test a new course. Variable title.

**GEOL4010**  *Seminar*  (RSD 0.0-6.0)  
Discussion of current topics. Required for two semesters during senior year. (Course cannot be used for graduate credit). Prerequisite: Senior standing. (Co-listed with Geo Eng 4010).

**GEOL4097**  *Advanced Field Geology*  (LEC 3.0)  
Advanced instruction in theory and practice of qualitative and quantitative description of spatial relationships of rock types in areas exhibiting complex deformation. Emphasis on experiential learning where students plan, implement, and reflect on outcomes for several scientific field campaigns in a manner consistent with professional scientific practices. Students will be charged a fee to cover the cost of field trip expenses. Prerequisites: GEOL3610, 2620, 3310, 3620, 3629, and 2096.

**GEOL4099**  *Undergraduate Research*  (IND 0.0-6.0)  
Designed for the undergraduate student who wishes to engage in research. Not for graduate credit. Not more than six (6) credit hours allowed for graduation credit. Subject and credit to be arranged with the instructor.

**GEOL4211**  *Electrical Methods in Geophysics*  (LEC 3.0)  
The theory and instrumentation for measurements of the electrical properties of the earth. Includes passive and active techniques, the advantages and disadvantages of the various techniques, and geologic interpretations of electrical soundings. Several weekends are spent making a variety of electrical surveys of local features. Prerequisites: Math 5325 and Geophys 3221.

**GEOL4310**  *Remote Sensing Technology*  (LAB 1.0 and LEC 2.0)  
Principles of digital image processing including image enhancement and multispectral classification. Emphasis upon design and implementation of remote sensing systems and analysis of remotely sensed data for geotechnical and environmental investigations. Prerequisite: Geo Eng 3148. (Co-listed with Geo Eng 5144).

**GEOL4411**  *Hydrogeology*  (LEC 3.0)  
This course discusses geologic aspects of major surface and subsurface hydrologic systems of North America. Chemical and physical relationships between groundwater and fractures, faults, karst, subsurface pressures, mineral deposits plus both contaminant and hydrocarbon migration are discussed. Prerequisites: Geo Eng 1150 or Geology 1110, Geology 3620 recommended.

**GEOL4421**  *Radioactive Waste Management and Remediation*  (LEC 3.0)  
Sources and classes of radioactive waste, long-term decay, spent fuel storage, transport, disposal options, regulatory control, materials issues, site selection and geologic characterization, containment, design and monitoring requirements, domestic and foreign waste disposal programs, economic and environmental issues; history of disposal actions, and conduct of remedial actions and cleanup. Prerequisite: Math 3304. (Co-listed with Nuc Eng 4367).

**GEOL4431**  *Methods of Karst Hydrogeology*  (LEC 3.0)  
Familiarize geoscientists with the origin and identification of karst features, discuss groundwater movement, engineering problems, water quality and supply in karst areas, and teach investigative techniques including fluorescent dye tracing. Several field trips at student expense will be required. Prerequisite: Geology 1110 or Geo Eng 1150; Geology 3620.

**GEOL4441**  *Applied Geochemistry*  (LAB 1.0 and LEC 2.0)  
Application of the principles of geochemistry and techniques of geochemical analysis in a student research project investigating geochemical processes (mineral deposits, environmental geochemistry, trace element migration, or water-rock interaction). Field trip fee required. Prerequisites: Geology 2610 and Geology 3410.

**GEOL4451**  *Aqueous Geochemistry*  (LEC 3.0)  
Studies of the interaction of water with minerals and organic materials at low temperatures; including processes affecting the migration of elements (alteration, precipitation, and adsorption), the influence of geochemical processes on water composition, weathering, soil formation, and pollution. Field trip fee required. Prerequisite: Geology 3410.

**GEOL4461**  *Isotope Geochemistry*  (LAB 1.0 and LEC 2.0)  
Introduction to the fundamentals of radiogenic and stable isotopes as used to understand geologic processes. The use of selected isotopic systems in petrology, ore petrogenesis, paleontology, and the global climate systems will be discussed. Prerequisites: Geology 2620, 3620, 3410.

**GEOL4521**  *Ore Microscopy*  (LAB 2.0 and LEC 1.0)  
A study of polished sections of minerals and ores under reflected light. Includes the preparation of polished sections, the identification of ore minerals, and the study of the textures, associations, and alterations of ore minerals. Prerequisite: Geology 2610.

**GEOL4631**  *Advanced Igneous and Metamorphic Petrology*  (LAB 1.0 and LEC 3.0)  
Processes governing the formation of igneous and metamorphic rocks as constrained by geochemical, isotopic, and thermodynamic data, with particular reference to the relationship between rock suites and tectonic setting. The laboratory will emphasize the description of rock suites in hand sample and thin section. A field trip at the student's expense is required. Prerequisite: Geology 2620.
GEOLOGY 4711 Paleoclimatology and Paleooeology (LEC 3.0)
This course will introduce students to the elements of climate, evidence of climate changes, proxy measurements and paleoclimate models. There is a review of Holocene climates and Archean to Pleistocene paleoclimates. Prerequisite: Geology 1110 or Geology 1120 or Geo Eng 1150.

GEOLOGY 4721 Meteorology and Climatology (LEC 3.0)
An introduction to the atmospheric and climatic systems of the Earth including weather, paleoclimatology, and global climate change. Prerequisites: GEOLOGY 1110 or GEOLOGY 1120 or equivalent.

GEOLOGY 4731 Astronomy and Planetary Science (LEC 3.0)
Basic principles of astronomy, the origin and evolution of the universe, stellar evolution, and the origin, composition, and processes operating on the planetary bodies in the solar system (besides the Earth). Prerequisite: Entrance requirements for the MST program in Earth Science.

GEOLOGY 4821 Applications Of Geographic Information Systems (LAB 1.0 and LEC 2.0)
Applications of Geographical Information Systems and remote sensing to environmental monitoring, mineral resource exploration, and geotechnical site evaluation. Prerequisite: Geo Eng 31+D151275 or consent of instructor. (Co-listed with Geo Eng 5146).

GEOLOGY 4831 Computational Geology (LAB 1.0 and LEC 2.0)
This course introduces the technology used for both surface and subsurface geologic mapping. It utilizes common systems and programs such as UNIX, Windows and industry-standard mapping applications. The goal of the course is to fully prepare students for their first professional assignment. Prerequisites: Geology 1110 or Geology 1120 or Geo Eng 1150.

GEOLOGY 4841 Geological Field Studies (LEC 3.0)
Intensive review of the scientific literature corresponding to a selected geographical region of geologic interest; followed by a 7 to 10 day long field trip to be held over spring break or after the end of the semester. Students will be expected to bear a portion of the field trip expenses. Repeatable for credit. Prerequisites: Geology 1110 or Geology 1120 or Geo Eng 1150.

GEOLOGY 5000 Special Problems (IND 0.0-6.0)
Problems or readings on specific subjects or projects in the department. Consent of instructor required.

GEOLOGY 5001 Special Topics (LEC 0.0 and LAB 0.0)
This course is designed to give the department an opportunity to test a new course. Variable title.

GEOLOGY 5010 Seminar (RSD 0.0-6.0)
Discussion of current topics.

GEOLOGY 5040 Oral Examination (IND 0.0)
After completion of all other program requirements, oral examinations for on-campus M.S./Ph.D. students may be processed during intersession. Off-campus M.S. students must be enrolled in oral examination and must have paid an oral examination fee at the time of the defense/ comprehensive examination (oral/ written). All other students must enroll for credit commensurate with uses made of facilities and/or faculties. In no case shall this be for less than three (3) semester hours for resident students.

GEOLOGY 5099 Research (IND 0.0-15)
Investigations of an advanced nature leading to the preparation of a thesis or dissertation.

GEOLOGY 5111 Advanced Physical Geology (LEC 3.0)
Examination of topics concerned with the physical properties of earth materials, processes affecting change of the surface and interior of the earth, and the driving forces causing these changes. Weekly critical assessment of literature, and an oral presentation and term paper required. Prerequisite: Consent of instructor.

GEOLOGY 5121 Advanced Historical Geology (LAB 1.0 and LEC 2.0)
Study of the physical and biological history of the Earth beginning with the origin of the solar system up to the present. Emphasis will be placed on processes that shaped the Earth and its ecosystems. Prerequisite: Entrance requirements for the MST program in Earth Science.

GEOLOGY 5311 Depositional Systems (LEC 3.0)
Development of three dimension depositional models using Walther's Law, Walther's Warning and seismic stratigraphy. Emphasis on overall geometries and internal porosity and permeability characteristics of aquifers and hydrocarbon reservoirs. Includes 3-D models for clastic, carbonate and evaporate sequences. Prerequisites: Geology 1110 or Geo Eng 1150; accompanied or preceded by both Geology 3310 and Geology 3620.

GEOLOGY 5411 Advanced Geochemistry (LEC 3.0)
A study of the absolute and relative abundance of elements and isotopes in the Earth, principles of element transport, formation of the Earth's crust, mineral deposits, and soils. Field trip fee required. Prerequisite: Geology 3410.

GEOLOGY 5511 Applied Petroleum Geology (LEC 1.0 and LAB 2.0)
The principles of petroleum geology are applied in solving hydrocarbon exploration and developmental problems. Geological and economical techniques for evaluating hydrocarbonbearing reservoirs are presented, with methods for decisionmaking under conditions of extreme uncertainty. Prerequisite: Geology 5411.

GEOLOGY 5513 Petroleum Geology (LAB 1.0 and LEC 2.0)
Principles of origin, migration, and accumulation of oil and gas. The laboratory introduces the procedures used for exploration, and development of hydrocarbon resources. Prerequisites: Geology 1110 or Geo Eng 1150; accompanied or preceded by both Geology 3310 and Geology 3620.

GEOLOGY 5521 Coal Petrology (LEC 3.0)
Formation, composition, and properties of coals. Discussion of the geology of selected coal deposits, the analysis of coal, and the optical identification of coal minerals. Prerequisite: Permission of instructor.

GEOLOGY 5611 Granites And Rhyolites (LAB 1.0 and LEC 3.0)
Processes governing the generation and crystallization of felsic magma will be covered, with specific reference to: 1) crust vs mantle sources, 2) melt migration and emplacement, 3) magma chamber dynamics, 4) the volcanic-plutonic connection, and 5) the relationship to tectonic setting. A field trip at the student's expense is required. Prerequisite: Geology 2620.

GEOLOGY 5631 Carbonate Petrology (LAB 1.0 and LEC 2.0)
Petrology, chemistry and sedimentology of carbonates and other associated chemical sedimentary rocks. Prerequisites: GEOLOGY 2620, 3620 and CHEM 1320 or equivalent; GEOLOGY 3410 recommended.

GEOLOGY 5641 Advanced Igneous Petrology (LAB 1.0 and LEC 2.0)
The genesis of eruptive rocks as evidenced by the physico-chemical conditions of formation of their constituent minerals. A critical examination of various magmatic processes. Use of advanced petrographic techniques. Prerequisites: GEOLOGY 4631.
GEOLOGY 5651 Granite and Rhyolite Petrogenesis (LAB 1.0 and LEC 3.0)
The origin of granites and rhyolites with respect to extreme fractionation, crustal anatexis, magma mixing, and tectonic setting will be explored through critical reading of the literature and examination of hand samples and thin sections from classic geologic terranes. A research paper is required as well as a field trip at the student's expense. Prerequisite: Geology 2620.

GEOLOGY 5661 Advanced Stratigraphy and Basin Evolution (LEC 3.0)
Advanced topics in sedimentary geology including: tectonic controls on sedimentary basin development, global sequence stratigraphy, regional facies and diagenetic patterns, basin hydrogeology, thermal evolution of basins and distribution of economic resources. This course should be preceded or accompanied by Geology 3410. May require one or two one-day field trips. Prerequisites: Geology 3620 and Geology 3310.

GEOLOGY 5671 Clay Mineralogy (LAB 1.0 and LEC 2.0)
Mineral structure, geochemical properties, occurrence, environment, and uses of clays. Determination of physical properties, optics, x-ray diffraction, and thermal features of clays. Field trip fee required. Prerequisites: Geology 2610 and 3410, or Chem 2310, or Civ Eng 5715, or Geo Eng 5172.

GEOLOGY 5679 Field and Laboratory Studies in Earth Science (LAB 3.0)
Hands-on laboratory and field experiences in the Earth Sciences. This course is designed to be taught in an intensive three week session during the summer on the S&T campus. Prerequisites: GEOLOGY 2096 or 5121 or equivalents.

GEOLOGY 5741 Micropaleontology (LAB 1.0 and LEC 2.0)
This course studies the fossil and soft-body characteristics of bacteria, protists, microinvertebrates and organic-walled microfossils (palynomorphs). Focused discussions on systematics, evolutionary histories, paleoecology, and geologic applications of the microfossil groups. Extraction of foraminifera and palynomorphs from rocks in lab. Prerequisite: Geology 3631.