Harold Hamm School of Geology and Geological Engineering (Geol and GeoE)

B.S. Geology (http://und-public.courseleaf.com/undergraduateacademicinformation/departmentalcoursesprograms/geologyandgeologicalengineering/geol-bs)

B.S. in Geological Engineering (http://und-public.courseleaf.com/undergraduateacademicinformation/departmentalcoursesprograms/geologyandgeologicalengineering/geol-bs-ge)

B.S. in Environmental Geoscience (http://und-public.courseleaf.com/undergraduateacademicinformation/departmentalcoursesprograms/geologyandgeologicalengineering/geol-bs-ge)


Minor in Geology (http://und-public.courseleaf.com/undergraduateacademicinformation/departmentalcoursesprograms/geologyandgeologicalengineering/geol-minor)

Geology Courses

GEOL 101. Introduction to Geology. 3 Credits.
Introduction to the dynamics of the Earth -- volcanoes, earthquakes, plate tectonics, streams, groundwater, glaciers, waves, wind, and landslides, with emphasis on the environmental applications of these processes. Introduction to the tools of the geologist -- minerals, rocks, maps, and aerial photographs. GEOL 101L may be taken concurrently. F.S,SS.

GEOL 101L. Introduction to Geology Laboratory. 1 Credit.
An introductory laboratory to complement GEOL 101. Field trip(s) included. Prerequisite or Corequisite: GEOL 101. F,SS.

GEOL 102. The Earth Through Time. 3 Credits.
The tracing of changes in the Earth and life through time, with emphasis on the record from North America. GEOL 102L may be taken concurrently. F.S.

GEOL 102L. The Earth Through Time Laboratory. 1 Credit.
An introductory laboratory to complement GEOL 102. Field trip included. Prerequisite or Corequisite: GEOL 102. F.

GEOL 103. Introduction to Environmental Issues. 3 Credits.
Introduction to Environmental Issues. A survey of environmental issues concerning society's interaction with Earth's natural systems and exploitation of Earth's resources. F.S.

GEOL 104. Geology of National Parks. 3 Credits.
An overview of the geology of U.S. National Parks. Unifying geological principles are emphasized. Major topics: sandstone parks, volcanic parks, hot springs and geothermal areas, caves and limestone parks, reefs and fossilized reefs, rivers and erosion, ice and glaciers, mountain building and mountain ranges. S.

GEOL 105. Selected Topics. 1-4 Credits.
A special topic course intended for non-geology majors. Subjects will include many issues of interest to non-geologists and non-scientists, such as earthquakes, evolution, gems, and the geology of National Parks. Repeatable when topics vary. Repeatable. On demand.

GEOL 106. Global Warming: The Facts and Myths. 3 Credits.
Global warming is the most debated current challenge to humans. A large, multifaceted and technically challenging topic. It has been diluted to popular slogans that at best capture some aspects of the issue and at the worst are over simplifications. Most of us who are directly affected by global warming do not understand the background, do not know what the assertions are based on, and can not evaluate the correctness of the arguments propagated in mass media such as newspapers and talk-radio. This class will provide students with a clear grasp of the science behind global warming discussion, the typical strategies (pros/cons) that are used in the popular media, and a good understanding of the science-based predictions of upcoming changes in the climate and environment. In addition to providing general scientific background to understand global warming and the science behind it, the class will visit the arguments that are used both for and against global warming. The graded written tests require students to address typical misinformation about global warming, show general knowledge of the scientific background, and recognize typical means to distort science in the mass media.

GEOL 111. Views of Earth and Planets. 3 Credits.
An introduction to Earth and the Solar System. Coverage includes: the planets and their moons, comets, asteroids, impact craters, meteorites, the sun, the solar system's origin, planetary atmospheres, the living Earth, the question of life elsewhere. F.S.

GEOL 111R. Views of the Earth and Planets Recitation. 1 Credit.
A recitation-discussion to complement GEOL 111. Corequisite: GEOL 111. S.

GEOE 203. Earth Dynamics. 3 Credits.
Introductory physical geology course that also includes elements of historical geology, geomorphology, geohazards, and ethics. Intended for engineering and geosciences majors. F.

GEOE 203L. Earth Dynamics Laboratory. 1 Credit.
Laboratory course to accompany Earth Dynamics lecture. The laboratory is delivered as on-campus and virtually using specific required products and digital material. F.

GEOL 205. Surviving on Planet Earth. 3 Credits.
This Essential Studies course stresses critical thinking in covering the basic strategies about humans succeeding on our planet including Earth's hazards (our restless Earth); the balance of life on Earth (evolution and extinction); water in our lives (too much and too little); energy (use and population demands); and global change (Earth as a unique, ongoing experiment). S.

GEOL 220. Computer Applications in Geology and Environmental Science. 2 Credits.
Introduction to the application of computers, software, and digital processing in the geological and environmental sciences. F.

GEOL 256. Critical Thinking in the Geosciences. 2 Credits.
An introduction to the study of geoscience and skills needed to successfully complete a geoscience degree. F.

GEOE 301. Petrophysics. 3 Credits.
Mineral and rock formation, identification and petrophysical properties, particularly with respect to porous rocks and their interactions with fluids. Prerequisite: GEOE 203. Corequisite: GEOE 301L. F.

GEOE 301L. Petrophysics Laboratory. 1 Credit.
Laboratory to accompany GEOE 301. Prerequisite: GEOE 203. Corequisite: GEOE 301. F.

GEOE 302. Reclamation Engineering. 3 Credits.
Principles of reclamation emphasizing: the need for reclamation; geology, geomorphology, geohazards, and ethics. Intended for engineering and geosciences majors. F.

GEOE 302L. Reclamation Engineering Laboratory. 1 Credit.
Laboratory to accompany GEOE 302. Prerequisite: GEOE 203. Corequisite: GEOE 302. F.

GEOE 303. Selected Topics in Geology. 1-4 Credits.
Each topic is concerned with a special aspect of geology. May be repeated up to a maximum of 8 hours. Prerequisite: Consent of the instructor. Repeatable to 8 credits. On demand.

GEOL 311. Geomorphology. 4 Credits.
Dynamics of weathering, mass movement, running water, groundwater, waves, wind and ice in the production of landforms. Includes field trips and laboratory. Prerequisites: GEOL 101 or GEOE 203; MATH 165, PHYS 211, CHEM 121 or consent of instructor. F.
GEOL 316. Earth Materials. 4 Credits.
We will organize the course into three Parts: Part I will provide the context in which Earth materials are studied, fundamental concepts that will be used subsequently including: how we study Earth materials, how Earth materials interact with other components of the Earth system, and a rationale for why Earth materials are important for the study of Earth (including processes and history) and the importance of Earth materials in our personal and societal lives. Part II will undertake a systematic look at Earth materials as they occur in different settings. We will identify and describe the key Earth materials, their properties, their distribution and occurrences, the processes that form them, and how scientists use these materials to interpret Earth. Part III will be an investigation of the practical applications of Earth materials to issues of societal importance (e.g., resources, hazards, engineering) and special applications that affect contemporary issues related to living on Earth. This course has both a lecture and a laboratory component. Prerequisites: GEOL 101, GEOL 101L, and CHEM 121 or equivalent. S.

GEOL 318. Mineralogy. 3 Credits.
Survey of the origin, distribution and uses of rock-forming minerals. Introduction to mineral structures, crystal chemistry, and crystallography. Laboratory identification of common minerals in hand sample and petrographic thin section. Introduction to the use of the polarizing microscope. Includes field trip. Prerequisites: GEOL 101 or GEOL 203, and CHEM 121 or consent of instructor. S.

GEOL 320. Petrology. 3 Credits.
Description, classification and origin of igneous, metamorphic, and sedimentary rocks. Field and laboratory study of rocks. Engineering properties of earth materials. Advanced aspects of optical mineralogy. Includes laboratory. Prerequisite: GEOL 318. F.

GEOL 321. Geochemistry. 3 Credits.
Application of the principles of chemistry to geologic and hydrogeologic problems. Origin and distribution of the chemical elements. Introduction to radiochemistry, isotopic geochronology, and stable-isotope geochemistry. Prerequisites: GEOL 318, CHEM 122, and MATH 165 or consent of instructor. S.

GEOL 322. Geology, Society, and the Environment. 3 Credits.
Relationship of geology to society; natural hazards; protection, reclamation, and restoration of our natural environment; application of geology to engineering, land planning, and resource management. Prerequisite: One introductory geology course or upper division standing; MATH 163 is recommended. S, even years.

GEOE 323. Engineering Geology. 2 Credits.
This course is to introduce the application of geological, hydrological and environmental principles to geotechnical/geological engineering design, construction and operation as well as various geohazards. Prerequisites: One introductory geology course and MATH 165. S.

GEOL 330. Structural Geology. 3 Credits.
Mechanics of rock deformation, analysis of rock structures, preparation and interpretation of geologic maps and cross sections showing structural and tectonic features. Includes laboratory. Prerequisites: GEOL 318, GEOL 320 and MATH 105. S.

GEOL 340. Digital Mapping Methods. 3 Credits.
This course integrates “hands-on” data acquisitions and map generation with an overview of the technology (GPS, lasers, and data management). Field projects focus on mapping methodology and laboratory projects focus on analysis and presentation. It is assumed that students have an undergraduate geology background and a basic knowledge of computer applications. Prerequisite: Junior Standing in geology.

GEOL 342. Conservation and Environmental Hydrology. 3 Credits.
Topics relating hydrology to the environment and water conservation, including the global and local hydrological cycle, flood occurrence and prediction, water pollution, erosion and sedimentation, wetlands, and water management. Prerequisites: Introductory geology course or upper division standing; MATH 103. S, odd years.

GEOL 356. Geoscience Lectures. 1 Credit.
Students attend and evaluate departmental lectures given by visiting scientists and engineers, faculty, and students. May be repeated once. May not be taken concurrently with GEOL 422. S/U grading. F,S.

GEOE 397. Cooperative Education. 1-8 Credits.
For qualified students majoring in geological engineering, geology, or environmental geology and technology. A practical work experience with an employer closely associated with the student’s academic area. Positions may require student relocation for one or more semesters. Arranged by mutual agreement among student, department, and employer. Special permission required. Repeatable to 24 credits. Repeatable to 24 credits. S/U grading. F,S,SS.

GEOL 407. Petroleum Geology. 3 Credits.
Origin, accumulation and geologic occurrence of petroleum and gas. Prerequisites: GEOL 101 or GEOL 203, and GEOL 102. F, odd years.

GEOL 410. Site Characterization. 3 Credits.
Purposes, techniques, and tools of site investigation. Covers geologic, hydrologic, and ecologic concerns. Hands-on application of principles, tools and techniques at real sites. Prerequisites: GEOL 220, GEOL 311, GEOL 414; BIOL 332, BIOL 332L. F.

GEOL 411. Sedimentology and Stratigraphy. 5 Credits.
Origin, transportation, deposition, and diagenesis of sediments; principles and applications of stratigraphy. Includes field trip and laboratory. Prerequisite: GEOL 320. S.

GEOL 414. Applied Geophysics. 3 Credits.
Principles of various geophysical methods and their application to geologic problems. Prerequisites: GEOL 101 or GEOL 203; MATH 165; and PHYS 211 or 251. F.

GEOL 415. Introduction to Paleontology. 4 Credits.
The principles of paleontology/paleobiology are presented using fossils to document the evolutionary, stratigraphic, and paleoecologic history of animal and plant life on Earth. Includes field trip and laboratory. Prerequisites: GEOL 102; BIOL 150 and BIOL 151 are recommended prerequisites. F, even years.

GEOL 417. Hydrogeology. 3 Credits.
Physical and chemical aspects of groundwater movement, supply, and contamination. Prerequisites: CHEM 121 or CHEM 221; MATH 166 or consent of instructor. F.

GEOL 418. Hydrogeological Methods. 2 Credits.
Field and laboratory methods used in hydrogeology; techniques of drilling, well and piezometer installation, determination of aquifer parameters, geophysical exploration, soil classification and analysis, ground water sampling and analysis. Includes field trip. Prerequisite: GEOL 417. F.

GEOL 419. Groundwater Monitoring and Remediation. 3 Credits.
Statistical methods for groundwater sampling and monitoring network design. Groundwater remediation and design; including strategies that remove contaminants for external treatment and strategies for in-situ contaminant treatment. Prerequisites: MATH 166, GEOL 417 and a statistics course (ECON 210, PSYC 241, MATH 321 or MATH 353) or consent of instructor. S.

GEOL 420. Geology Capstone. 3 Credits.
Geology capstone entailing information literacy and communication about Earth materials, processes and history. The course checks retention of earlier learning and insures review and significant addition to that learning. Prerequisite: GEOL 487. Corequisite: GEOL 494. F,S.

GEOL 421. Seminar I. 1 Credit.
Instruction and practice of oral and visual presentation in science and engineering. Includes preparation and delivery of artifact talks, chalk talks, and slide talks. Involves critical review of student presentations and departmental guest lectures. Prerequisite: GEOL 356. F,S.

GEOL 422. Seminar II. 1 Credit.
Continuation of GEOL 421 experience. Preparation and delivery of oral presentations in science and engineering, culminating in oral presentation of senior thesis (GEOL 490) or Engineering Design (485). Includes critical review of student presentations and departmental guest lectures. Prerequisites: GEOL 421, senior or graduate status in departmental major. F,S.

GEOE 425. Design Hydrology for Wetlands. 3 Credits.
Principles of chemistry, geology, hydraulics, and hydrology applied to natural and constructed wetlands and other small catchments. Prerequisites: CHEM 121 and either CE 306/ME 306 or GEOL 417. S.
GEOE 427. Groundwater Modeling. 3 Credits. Fundamentals of numerical modeling applied to groundwater flow. Spreadsheet calculations will be used to demonstrate the finite difference method applied to groundwater movement and storage. Simulation of practical groundwater problems will be performed with the U.S. Geological Survey's MODFLOW code. Prerequisites: GEOE 417 and MATH 265; some programming experience is recommended. On demand.

GEOE 455. Geomechanics. 3 Credits. The objective of this course is to train the students to use fundamental principles and field and lab techniques of Rock Mechanics to analyze real-world problems, identify the optimal methods, and solve the practical geological engineering problems with the combination of field and laboratory, analytical and experimental means. Emphases will be on the fundamental principles and their application to practical engineering problems, both surface and underground. Prerequisites: GEOE 423 or consent of instructor. F.

GEOE 484. Geological Engineering Design. 3 Credits. The first of a two-course sequence in geological engineering design. Define the design problem, establish design objectives, evaluate alternatives, specify constraints, develop a methodology, complete a formal design problem statement. Prerequisites: Advanced level standing in Geological Engineering and consent of advisor. F.

GEOE 485. Geological Engineering Design. 3 Credits. Continuation of GEOE 484 taken the preceding semester. Systematic study and design, with determination of feasibility, careful assessment of economic factors, safety, reliability, aesthetics, ethics, and social and environmental impact. Results presented in GEOL 422 Seminar. Prerequisite: GEOE 484. Corequisite: GEOL 422. S.

GEOE 487. Research I. 1 Credit. Identification and proposal of research project. Includes literature review, feasibility review, and formal project identification and written proposal. Selection of faculty research advisor within first month of semester. Prerequisite: Senior standing in departmental major. F.S.

GEOE 488. Research II. 2 Credits. Execution of research plan developed in GEOE 487. Prerequisite: GEOE 487.

GEOE 491. Geologic Problems. 1-4 Credits. Individualized or group study on selected geoscience topics. May be taken more than one semester to maximum of 8 hours. Prerequisite: Consent of instructor. Repeatable to 8 credits. F.S.SS.

GEOE 493. Selected Topics in Geological Engineering. 1-3 Credits. Detailed study of selected topics in Geological Engineering. Includes laboratory if applicable. Repeatable. Repeatable. On demand.

GEOE 494. Senior Thesis. 1 Credit. Written results of research conducted in Geol 489. The thesis document should conform to the format guidelines of a major English-language journal in which the thesis could be published. A copy is to be provided to the F.D. Holland, Jr. Geology Library. Prerequisite or Corequisite: GEOE 488. F.S.

GEOE Courses

GEOE 203. Earth Dynamics. 3 Credits. Introductory physical geology course that also includes elements of historical geology, geomorphology, geohazards, and ethics. Intended for engineering and geosciences majors. F.

GEOE 203L. Earth Dynamics Laboratory. 1 Credit. Laboratory course to accompany Earth Dynamics lecture. The laboratory is delivered as on-campus and virtually using specific required products and digital material. F.

GEOE 210. Earth Dynamics & Geophysics. 4 Credits. Introduction to geology with an emphasis on those aspects of the science that are essential for petroleum engineers. Topics covered include an introduction to geologic features and processes that are responsible for accumulations of petroleum products in the subsurface. F.

GEOE 301. Petrophysics. 3 Credits. Mineral and rock formation, identification and petrophysical properties, particularly with respect to porous rocks and their interactions with fluids. Prerequisite: GEOE 203. Corequisite: GEOE 301L. F.

GEOE 301L. Petrophysics Laboratory. 1 Credit. Laboratory to accompany GEOE 301. Prerequisite: GEOE 203. Corequisite: GEOE 301. F.

GEOE 302. Reclamation Engineering. 3 Credits. Principles of reclamation emphasizing the need for reclamation; geology and hydrogeology of disturbed landscapes, geological, hydrological, and ecological reclamation objectives; current reclamation practices; reclamation of abandoned mine lands; reclamation design; laws, regulations, permits, bonds, and public perception. Includes laboratory and field trip. Prerequisite: GEOE 101 or GEOE 203 or consent of instructor. S.

GEOE 323. Engineering Geology. 2 Credits. This course is to introduce the application of geological, hydrological and environmental principles to geotechnical/geological engineering design, construction and operation as well as various geohazards. Prerequisites: One introductory geology course and MATH 165. S.

GEOE 351. Petroleum Development Engr. 3 Credits.

GEOE 397. Cooperative Education. 1-8 Credits. For qualified students majoring in geological engineering, geology, or environmental geology and technology. A practical work experience with an employer closely associated with the student's academic area. Positions may require student relocation for one or more semesters. Arranged by mutual agreement among student, department, and employer. Special permission required. Repeatable to 24 credits. Repeatable to 24 credits. S/U grading. F.S.SS.

GEOE 412. Soil Mechanics. 3 Credits. To introduce the student to the fundamental knowledge of geomaterials and mechanical behavior of Soils to familiarize the student with the use of soil mechanics; to provide the student with a firm foundation for the continuation to more theoretical and applied aspects in pavement engineering, foundation engineering, dam engineering, geological engineering, Slope stability and earthquake engineering. Prerequisite: GEOE 323. Prerequisite or Corequisite: ENGR 203. F.

GEOE 417. Hydrogeology. 3 Credits. Physical and chemical aspects of groundwater movement, supply, and contamination. Prerequisites: CHEM 121 or CHEM 221; MATH 166 or consent of instructor. F.

GEOE 418. Hydrogeological Methods. 2 Credits. Field and laboratory methods used in hydrogeology; techniques of drilling, well and piezometer installation, determination of aquifer parameters, geophysical exploration, soil classification and analysis, ground water sampling and analysis. Includes field trip. Prerequisite: GEOE 417. F.

GEOE 419. Groundwater Monitoring and Remediation. 3 Credits. Statistical methods for groundwater sampling and monitoring network design. Groundwater remediation and design; including strategies that remove contaminants for external treatment and strategies for in-situ contaminant treatment. Prerequisites: MATH 166, GEOE 417 and a statistics course (ECON 210, PSY 241, MATH 251 or MATH 353) or consent of instructor. S.

GEOE 425. Design Hydrology for Wetlands. 3 Credits. Principles of chemistry, geology, hydrology, and hydrology applied to natural and constructed wetlands and other small catchments. Prerequisites: CHEM 121 and either CE 306/ME 306 or GEOE 417. S.

GEOE 427. Groundwater Modeling. 3 Credits. Fundamentals of numerical modeling applied to groundwater flow. Spreadsheet calculations will be used to demonstrate the finite difference method applied to groundwater movement and storage. Simulation of practical groundwater problems will be performed with the U.S. Geological Survey's MODFLOW code. Prerequisites: GEOE 417 and MATH 265; some programming experience is recommended. On demand.

GEOE 455. Geomechanics. 3 Credits. The objective of this course is to train the students to use fundamental principles and field and lab techniques of Rock Mechanics to analyze real-world problems, identify the optimal methods, and solve the practical geological engineering problems with the combination of field and laboratory, analytical and experimental means. Emphases will be on the fundamental principles and their application to practical engineering problems, both surface and underground. Prerequisites: GEOE 323 or consent of instructor. F.

GEOE 456. Geomaterials Stabilization. 3 Credits. Principles of stabilization emphasizing the need for stabilization; geotechnical and environmental principles to geotechnical/geological engineering design, construction and operation as well as various geohazards. Prerequisites: One introductory geology course and MATH 165. S.

GEOE 457. Soil Stabilization. 3 Credits. Principles of stabilization emphasizing the need for stabilization; geotechnical and environmental principles to geotechnical/geological engineering design, construction and operation as well as various geohazards. Prerequisites: One introductory geology course and MATH 165. S.

GEOE 458. Groundwater Flow. 3 Credits. Fundamentals of numerical modeling applied to groundwater flow. Spreadsheet calculations will be used to demonstrate the finite difference method applied to groundwater movement and storage. Simulation of practical groundwater problems will be performed with the U.S. Geological Survey's MODFLOW code. Prerequisites: GEOE 417 and MATH 265; some programming experience is recommended. On demand.
GEOL 101. Introduction to Geology. 3 Credits.
Introduction to the dynamics of the Earth -- volcanoes, earthquakes, plate tectonics, streams, groundwater, glaciers, waves, wind, and landslides, with emphasis on the environmental applications of these processes. Introduction to the tools of the geologist -- minerals, rocks, maps, and aerial photographs. GEOL 101L may be taken concurrently. F,S,SS.

GEOL 101L. Introduction to Geology Laboratory. 1 Credit.
An introductory laboratory to complement GEOL 101. Field trip(s) included. Prerequisite or Corequisite: GEOL 101. F,SS.

GEOL 102. The Earth Through Time. 3 Credits.
The tracing of changes in the Earth and life through time, with emphasis on the record from North America. GEOL 102L may be taken concurrently. F,S.

GEOL 102L. The Earth Through Time Laboratory. 1 Credit.
An introductory laboratory to complement GEOL 102. Field trip included. Prerequisite or Corequisite: GEOL 102. F,S.

GEOL 103. Introduction to Environmental Issues. 3 Credits.
Introduction to Environmental Issues. A survey of environmental issues concerning society's interaction with Earth's natural systems and exploitation of Earth's resources. F,S.

GEOL 104. Geology of National Parks. 3 Credits.
An overview of the geology of U.S. National Parks. Unifying geological principles are emphasized. Major topics: sandstone parks, volcanic parks, hot springs and geothermal areas, caves and limestone parks, reefs and fossilized springs and geothermal areas, caves and limestone parks, reefs and fossilized ranges. S.

GEOL 105. Selected Topics. 1-4 Credits.
A special topic course intended for non-geology majors. Subjects will include many issues of interest to non-geologists and non-scientists, such as earthquakes, evolution, gems, and the geology of National Parks. Repeatable when topics vary. Repeatable. On demand.

GEOL 106. Global Warming: The Facts and Myths. 3 Credits.
Global warming is the most debated current challenge to humans. A large, multifaceted and technically challenging topic, it has been diluted to popular slogans that at best capture some aspects of the issue and at the worst are over simplifications. Most of us who are directly affected by global warming do not understand the background, do not know what the assertions are based on, and cannot evaluate the correctness of the arguments propagated in mass media such as newspapers and talk-radio. This class will provide students with a clear grasp of the science behind global warming discussion, the typical strategies (pros/cons) that are used in the popular media, and a good understanding of the science-based predictions of upcoming changes in the climate and environment. In addition to providing general scientific background to understand global warming and the science behind it, the class will visit the arguments that are used both for and against global warming. The graded written tests require students to address typical misinformation about global warming, show general knowledge of the scientific background, and recognize typical means to distort science in the mass media. S.

GEOL 111. Views of Earth and Planets. 3 Credits.
An introduction to Earth and the Solar System. Coverage includes: the planets and their moons, comets, asteroids, impact craters, meteorites, the sun, the solar system's origin, planetary atmospheres, the living Earth, the question of life elsewhere. F,S.

GEOL 111R. Views of the Earth and Planets Recitation. 1 Credit.
A recitation-discussion to complement GEOL 111. Corequisite: GEOL 111. S.

GEOL 205. Surviving on Planet Earth. 3 Credits.
This Essential Studies course stresses critical thinking in covering the basic strategies about humans succeeding on our planet including Earth's hazards (our restless Earth); the balance of life on Earth (evolution and extinction); water in our lives (too much and too little); energy (use and population demands); and global change (Earth as a unique, ongoing experiment). S.

GEOL 220. Computer Applications in Geology and Environmental Science. 2 Credits.
Introduction to the application of computers, software, and digital processing in the geological and environmental sciences. F.

GEOL 256. Critical Thinking in the Geosciences. 2 Credits.
An introduction to the study of geoscience and skills needed to successfully complete a geoscience degree. F.

GEOL 303. Selected Topics in Geology. 1-4 Credits.
Each topic is concerned with a special aspect of geology. May be repeated up to a maximum of 8 hours. Prerequisite: Consent of the instructor. Repeatable to 8 credits. On demand.

GEOL 311. Geomorphology. 4 Credits.
Dynamics of weathering, mass movement, running water, groundwater, waves, wind and ice in the production of landforms. Includes field trips and laboratory. Prerequisites: GEOL 101 or GEOL 203; MATH 165, PHYS 211, CHEM 121 or consent of instructor. F.

GEOL 316. Earth Materials. 4 Credits.
We will organize the course into three Parts: Part I will provide the context in which Earth materials are studied, fundamental concepts that will be used subsequently including: how we study Earth materials, how Earth materials interact with other components of the Earth system, and a rationale for why Earth materials are important for the study of Earth (including processes and history) and the importance of Earth materials in our personal and societal lives. Part II will undertake a systematic look at Earth materials as they occur in different settings. We will identify and describe the key Earth materials, their properties, their distribution and occurrences, the processes that form them, and how scientists use these materials to interpret Earth. Part III will be an investigation of the practical applications of Earth materials to issues of societal importance (e.g., resources, hazards, engineering) and special applications that affect contemporary issues related to living on Earth. This course has both a lecture and a laboratory component. Prerequisites: GEOL 101, GEOL 101L, and CHEM 121 or equivalent. S.

GEOL 318. Mineralogy. 3 Credits.
Survey of the origin, distribution and uses of rock-forming minerals. Introduction to mineral structures, crystal chemistry, and crystallography. Laboratory identification of common minerals in hand sample and petrographic thin section. Introduction to the use of the polarizing microscope. Includes field trip. Prerequisites: GEOL 101 or GEOL 203, and CHEM 121 or consent of instructor. S.

GEOL 320. Petrology. 3 Credits.
Description, classification and origin of igneous, metamorphic, and sedimentary rocks. Field and laboratory study of rocks. Engineering properties of earth materials. Advanced aspects of optical mineralogy. Includes laboratory. Prerequisite: GEOL 318. F.

GEOL 321. Geochemistry. 3 Credits.
Application of the principles of chemistry to geologic and hydrogeologic problems. Origin and distribution of the chemical elements. Introduction to radiochemistry, isotopic geochronology, and stable-isotope geochemistry. Prerequisites: GEOL 318, CHEM 122, and MATH 165 or consent of instructor. S.

GEOL 322. Geology, Society, and the Environment. 3 Credits.
Relationship of geology to society; natural hazards; protection, reclamation, and restoration of our natural environment; application of geology to engineering, land planning, and resource management. Prerequisite: One introductory geology course or upper division standing; MATH 103 is recommended. S, even years.

GEOL 330. Structural Geology. 3 Credits.
Mechanics of rock deformation, analysis of rock structures, preparation and interpretation of geologic maps and cross sections showing structural and tectonic features. Includes laboratory. Prerequisites: GEOL 318, GEOL 320 and MATH 105. S.
GEOL 340. Digital Mapping Methods. 3 Credits.
This course integrates "hands-on" data acquisitions and map generation with an overview of the technology (GPS, lasers, and data management). Field projects focus on mapping methodology and laboratory projects focus on analysis and presentation. It is assumed that students have an undergraduate geology background and a basic knowledge of computer applications.
Prerequisite: Junior Standing in geology.

GEOL 342. Conservation and Environmental Hydrology. 3 Credits.
Topics relating hydrology to the environment and water conservation, including the global and local hydrological cycle, flood occurrence and prediction, water pollution, erosion and sedimentation, wetlands, and water management.
Prerequisites: Introductory geology course or upper division standing; MATH 103. S, odd years.

GEOL 356. Geoscience Lectures. 1 Credit.
Students attend and evaluate departmental lectures given by visiting scientists and engineers, faculty, and students. May be repeated once. May not be taken concurrently with GEOL 422. S/U grading. F,S.

GEOL 407. Petroleum Geology. 3 Credits.
Origin, accumulation and geologic occurrence of petroleum and gas.
Prerequisites: GEOL 101 or GEOE 203, and GEOL 102. F, odd years.

GEOL 410. Site Characterization. 3 Credits.
Purposes, techniques, and tools of site investigation. Covers geologic, hydrologic, and ecologic concerns. Hands-on application of principles, tools and techniques at real sites.
Prerequisites: GEOL 220, GEOL 311, GEOL 414; BIOL 332, BIOL 332L. F.

GEOL 411. Sedimentology and Stratigraphy. 5 Credits.
Origin, transportation, deposition, and diagenesis of sediments; principles and applications of stratigraphy. Includes field trip and laboratory.
Prerequisite: GEOL 320. S.

GEOL 414. Applied Geophysics. 3 Credits.
Principles of various geophysical methods and their application to geologic problems.
Prerequisites: GEOL 101 or GEOE 203; MATH 165; and PHYS 211 or 251. F.

GEOL 415. Introduction to Paleontology. 4 Credits.
The principles of paleontology/paleobiology are presented using fossils to document the evolutionary, stratigraphic, and paleoecologic history of animal and plant life on Earth. Includes field trip and laboratory.
Prerequisites: GEOL 102; BIOL 150 and BIOL 151 are recommended prerequisites. F, even years.

GEOL 420. Geology Capstone. 3 Credits.
Geology capstone entails information literacy and communication about Earth materials, processes and history. The course checks retention of earlier learning and insures review and significant addition to that learning.
Prerequisite: GEOL 487. Corequisite: GEOL 494. F,S.

GEOL 421. Seminar I. 1 Credit.
Instruction and practice of oral and visual presentation in science and engineering. Includes preparation and delivery of artifact talks, chalk talks, and slide talks. Involves critical review of student presentations and departmental guest lectures.
Prerequisite: GEOL 356. F,S.

GEOL 422. Seminar II. 1 Credit.
Continuation of GEOL 421 experience. Preparation and delivery of oral presentations in science and engineering, culminating in oral presentation of senior thesis (Geol 490) or Engineering Design (485). Includes critical review of student presentations and departmental guest lectures.
Prerequisites: GEOL 421, senior or graduate status in departmental major. F,S.

GEOL 487. Research I. 1 Credit.
Identification and proposal of research project. Includes literature review, feasibility review, and formal project identification and written proposal.
Selection of faculty research adviser within first month of semester.
Prerequisite: Senior standing in departmental major. F,S.

GEOL 488. Research II. 2 Credits.
Execution of research plan developed in GEOL 487. Prerequisite: GEOL 487.

GEOL 491. Geologic Problems. 1-4 Credits.
Individualized or group study on selected geoscience topics. May be taken more than one semester to maximum of 8 hours.
Prerequisite: Consent of instructor. Repeatable to 8 credits. F,S,SS.