

# Geological Engineering (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. S.

### **GEOE 301L. Petrophysics Laboratory. 1 Credit.**

Laboratory to accompany GEOE 301, or PTRE 301. Prerequisite or Corequisite: GEOE 301 or PTRE 301. S, odd years.

### **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: GEOL 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. Prerequisite: One introductory geology course and MATH 165. S.

### **GEOE 397. Cooperative Education. 1-2 Credits.**

For qualified students majoring in geological engineering or environmental geoscience. 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. Repeatable to 6 credits. Prerequisite: Consent of advisor required. Repeatable to 24.00 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. Prerequisite: MATH 165. 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. Prerequisite: MATH 165. S.

### **GEOE 420. Geological Modeling and Numerical Simulation of Reservoirs. 3 Credits.**

This technical elective course targets senior or graduate student who has desire to pursue fossil energy industry or a transition from fossil energy to renewable energy as a future career or related. The course introduces workflow designs and software application from geological modeling to numerical simulation for hydrocarbon or geothermal energy, so that engineering student can communicate knowledgeably about geologic processes to reservoir fluid flow process that formed and continued to shape the rock formation and reservoir. Prerequisite: GEOE 301 and GEOL 407. F.

### **GEOE 421. Cold Region Hydrologic Modeling. 3 Credits.**

This course aims to describe and explain the governing physical principles, processes and recent advances in cold region hydrology and physically based numerical simulation with special reference to northern prairie region. In addition, the students will learn the incorporation of physically based process into a numerical model using the cold region hydrologic model platform (CRHM). The CRHM allows the compilation of various modules (each module represent a process) to build a model to simulate watershed processes in a specific basin. Prerequisite: GEOL 101, GEOE 203, or MATH 165. F.

### **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. Prerequisite: 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. Prerequisite: GEOE 417 and MATH 265; some programming experience is recommended. On demand.

### **GEOE 454. Unsaturated Soil Mechanics. 3 Credits.**

This course is designed to introduce the students the unsaturated soil mechanics based on three fundamental perspectives: mechanics, hydrology and thermodynamics. This course is designed for undergraduate seniors and graduate students with general background in geological engineering, geotechnical engineering, civil engineering, and environmental engineering. Prerequisite: CE 412, GEOE 412, or GEOE 323. S.

### **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. Prerequisite: GEOE 323 and GEOE 412/CE 412 or consent of instructor. F.

### **GEOE 455L. Geomechanics Laboratory. 1 Credit.**

Laboratory to accompany GEOE 455. Prerequisite: GEOE 323 or consent of instructor. Prerequisite or Corequisite: GEOE 455 or consent of instructor. F.

### **GEOE 456. Geomaterials Stabilization. 3 Credits.**

The course is to highlight the need for geomaterial improvement and stabilization in engineering. To provide an understanding for the different principles, analysis, design procedures and applications for geomaterial stabilization and ground improvement. Prerequisite: GEOE 412 or CE 412. 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, determine a methodology, complete a formal design problem statement. Prerequisite: 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 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 555. Advanced Rock Mechanics. 3 Credits.**

Fundamentals of rock mechanics, elasticity theory of rock, failure criterion of rocks, laboratory and field testing methods, field instrumentation, the applications of rock mechanics in mining, tunneling and rock slopes engineering, and the applications of numerical methods in rock mechanics. Prerequisite: GEOE 323 and ENGR 203. F.

**GEOE 591. Advanced Subsurface Energy Recovery in Engineering. 3 Credits.**

This course describes technologies that can be applied to further recover from the subsurface energy resource in EOR/EGR and EGS, include renewable geothermal resource, hydrogen storage, CCUS, and hydrocarbons - oil/gas, that cannot be produced by primary or second extraction. Development of these processes requires significant technological advances in our understanding of subsurface mining from energy reservoirs and may be the stimulus for future technological development. Prerequisite: Background/knowledge of Multivariable Calculus, Introductory Chemistry, and Petrophysics. S.

**GEOE 599. Doctoral Research. 1-15 Credits.**

Research contributing to the discovery and dissemination of knowledge and/or technology in Geological Engineering and contributing to the student's doctoral dissertation. Prerequisite: Admission to the PhD program in Geological Engineering. Repeatable to 15.00 credits. F,S,SS.

**GEOE 996. Continuing Enrollment. 1-12 Credits.**

Repeatable. S/U grading.

**GEOE 998. Thesis. 1-9 Credits.**

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**GEOE 999. Dissertation. 1-18 Credits.**

PhD student doctoral dissertation. Prerequisite: Admission to the PhD program in Geological Engineering. Repeatable to 18.00 credits. S/U grading. F,S,SS.