

# GEOLOGICAL ENGINEERING (G L E)

## G L E 1 – COOPERATIVE EDUCATION PROGRAM

1 credit.

Work experience which combines classroom theory with practical knowledge of operations to provide students with a background upon which to base a professional career in industry.

**Requisites:** Sophomore standing

**Course Designation:** Workplace – Workplace Experience Course

**Repeatable for Credit:** Yes, unlimited number of completions

**Last Taught:** Fall 2023

**Learning Outcomes:** 1. Identify and respond appropriately to real-life engineering ethics cases relevant to co-op work Audience: Undergraduate

2. Synthesize and apply appropriate technical education to real world technical work Audience: Undergraduate

3. Communicate effectively in writing and speaking with a range of audiences in the workplace, including those without disciplinary expertise Audience: Undergraduate

4. Develop professional and transferable habits like time management skills, collaborative problem-solving skills, and research skills for learning new information Audience: Undergraduate

## G L E 171 – INTRODUCTION TO GEOLOGICAL ENGINEERING

1 credit.

Comprehensive introduction to engineering applications of earth sciences. Exploitation and management of geologic resources; mitigation of geologic hazards such as landslides and earthquakes; abatement of environmental problems such as land and water pollution; design of surface and underground excavations; principal methods of geological engineering.

**Requisites:** None

**Repeatable for Credit:** No

**Last Taught:** Spring 2022

## G L E/CIV ENGR 291 – PROBLEM SOLVING USING COMPUTER TOOLS

4 credits.

Introduction to engineering computations with emphasis on computer tools and computer based measurement, data collection, and processing. Tools will include computer aided design, spreadsheets, other engineering computation tools, and hardware and software for laboratory and spatial measurements.

**Requisites:** MATH 222 or member of Engineering Guest Students

**Repeatable for Credit:** No

**Last Taught:** Spring 2024

## G L E/CIV ENGR 330 – SOIL MECHANICS

3 credits.

Basic principles of soil mechanics and fundamentals of application in engineering practice; soil composition and texture; classification; permeability and seepage; consolidation; settlement; shear strength; lateral earth pressures and retaining structures, shallow and deep foundations, slope stability; subsurface exploration; laboratory characterization of physical and engineering properties of soils.

**Requisites:** E M A 303 or M E 306, graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Grad 50% – Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2024

## G L E/GEOSCI 350 – INTRODUCTION TO GEOPHYSICS: THE DYNAMIC EARTH

3 credits.

Methods of geophysics applied to earth structure and plate tectonics. Principles of seismology, gravity, geodesy, magnetism and heat flow.

**Requisites:** MATH 217, 221, graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Level – Intermediate

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Grad 50% – Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2024

## G L E/GEOSCI 360 – PRINCIPLES OF MINERALOGY

3 credits.

Minerals, their physical and chemical properties, crystallography, and geologic significance.

**Requisites:** (GEOSCI 100 or ENVIR ST/GEOSCI 106) and (CHEM 103, 109, 115, or concurrent enrollment), graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Breadth – Physical Sci. Counts toward the Natural Sci req

Level – Intermediate

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Grad 50% – Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2023

## G L E/GEOSCI 370 – ELEMENTARY PETROLOGY

3 credits.

Igneous and metamorphic rocks, studied in hand sample and thin section.

**Requisites:** G L E/GEOSCI 360, graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Breadth – Physical Sci. Counts toward the Natural Sci req

Level – Intermediate

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Grad 50% – Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2024

**G L E/ENVIR ST/F&W ECOL/GEOG/GEOSCI/LAND ARC 371 – INTRODUCTION TO ENVIRONMENTAL REMOTE SENSING**  
3 credits.

Introduction to the Earth as viewed from above, focusing on use of aerial photography and satellite imagery to study the environment. Includes physical processes of electromagnetic radiation, data types and sensing capabilities, methods for interpretation, analysis and mapping, and applications.

**Requisites:** (Sophomore standing and MATH 113, 114, or 171), graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S

**Repeatable for Credit:** No

**Last Taught:** Spring 2024

**G L E/ENVIR ST/F&W ECOL/GEOG/GEOSCI/LAND ARC 372 – INTERMEDIATE ENVIRONMENTAL REMOTE SENSING**  
3 credits.

Examines intermediate-level concepts in information extraction, data processing and radiative transfer relevant to remote sensing of the environment. Includes transforms, image correction, classification algorithms and change detection, with emphasis on applications for land use planning and natural resource management.

**Requisites:** LAND ARC/ENVIR ST/F&W ECOL/G L E/GEOG/GEOSCI 371, graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S

**Repeatable for Credit:** No

**Last Taught:** Spring 2015

**G L E 401 – SPECIAL TOPICS IN GEOLOGICAL ENGINEERING**  
1-3 credits.

Various topics in the field of geological engineering.

**Requisites:** None

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** Yes, unlimited number of completions

**Last Taught:** Spring 2023

**G L E/CIV ENGR 421 – ENVIRONMENTAL SUSTAINABILITY ENGINEERING**  
3 credits.

Uses the three paradigms of sustainability (environmental, social, and economic) for strategic environmental initiatives in an engineering setting. Proactive environmental management opportunities, including practices of pollution prevention, industrial ecology, and design for the environment. A systems approach to manufacturing, examining the life cycle of products, incorporating total cost accounting, extended producer responsibility, and design for end-of-life.

**Requisites:** (MATH 217 or 221) and (CHEM 104 or 109), or graduate/professional standing or member of Engineering Guest Students

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2023

**G L E/CIV ENGR 430 – INTRODUCTION TO SLOPE STABILITY AND EARTH RETENTION**  
1 credit.

Introduction to theory and approaches commonly used in geotechnical engineering practice for design and analysis of slopes and earth retaining structures.

**Requisites:** CIV ENGR/G L E 330, graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2024

**Learning Outcomes:** 1. Calculate the factor of safety of natural or engineered slopes Audience: Both Grad Undergrad

2. Design simple earth retaining structures Audience: Both Grad Undergrad

3. Perform additional design strategies to design complex slope or retaining structures Audience: Graduate

4. Lead a team of undergraduate students for the final design project exercise Audience: Graduate

**G L E/GEOSCI 431 – SEDIMENTARY & STRATIGRAPHY LAB**  
1 credit.

Covers Sedimentology and Stratigraphy; emphasizes qualitative and quantitative description and interpretation of sediments and sedimentary deposits.

**Requisites:** GEOSCI 204 or G L E/GEOSCI 360, graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2023

**G L E/CIV ENGR 432 – INTRODUCTION TO SHALLOW AND DEEP FOUNDATION SYSTEMS**

1 credit.

Introduction to theory and approaches commonly used in geotechnical engineering practice for design and analysis of slopes and earth retaining structures.

**Requisites:** CIV ENGR/G L E 330, graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2024

**Learning Outcomes:** 1. Apply methods and requirements of a subsurface investigation program Audience: Both Grad Undergrad

2. Collect sufficient information to design basic shallow or deep foundation systems Audience: Both Grad Undergrad

3. Fulfill the design criteria for different structures and facilities Audience: Both Grad Undergrad

4. Design shallow and deep foundation structures Audience: Both Grad Undergrad

5. Perform additional design strategies to design the foundation of a soil retaining structure Audience: Graduate

**G L E/CIV ENGR 434 – INTRODUCTION TO UNDERGROUND OPENINGS ENGINEERING**

1 credit.

Subsurface stress; rock failure criteria; openings in competent rock; openings in layered rocks; plastic behavior around openings in weak rock; stereographic projections and stereonet; block theory; rock bolts; stabilization methods and design.

**Requisites:** CIV ENGR/G L E 330, GEOSCI/CIV ENGR/G L E/ M S & E 474 or concurrent enrollment, graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2024

**Learning Outcomes:** 1. Predict stress concentrations around underground openings Audience: Both Grad Undergrad

2. Identify weak points around underground openings in conjunction with the rock mass type information Audience: Both Grad Undergrad

3. Design openings to minimize hazard Audience: Both Grad Undergrad

4. Design reinforcement strategies Audience: Both Grad Undergrad

5. Perform advanced design strategies Audience: Graduate

**G L E/CIV ENGR/ENVIR ST/GEOSCI 444 – PRACTICAL APPLICATIONS OF GPS SURVEYING**

2 credits.

Global positioning system surveying for field applications. Signals. Coordinate systems. Datums. Cartographic projections. Satellite orbits. Choosing hardware. Strategies for data collection and analysis. Assessing uncertainty. Geocoding satellite images. Integrating data with Geographic Information Systems. Emerging technologies.

**Requisites:** MATH 211, 217, 221, or graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2023

**G L E/GEOSCI 455 – STRUCTURAL GEOLOGY**

4 credits.

Principles of rock deformation, structures in layered rocks, structural analysis, intrusive structures. Lab: three-dimensional problems involving structural concepts; field trip.

**Requisites:** GEOSCI 202, 204, and (G L E/GEOSCI 370 or concurrent enrollment), graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2024

**G L E/CIV ENGR/GEOSCI/M S & E 474 – ROCK MECHANICS**

3 credits.

Classification of rock masses, stress and strain in rock, linear and non-linear behavior of rock, failure mechanisms, state of stress in rock masses, lab testing, geological and engineering applications.

**Requisites:** E M A 201, PHYSICS 201, 207, or 247, or graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Breadth – Physical Sci. Counts toward the Natural Sci req

Level – Advanced

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Grad 50% – Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2024

**Learning Outcomes:** 1. Measure basic index properties for rock mass classification Audience: Both Grad Undergrad

2. Describe stress and strain in continuums Audience: Both Grad Undergrad

3. Describe the factors which control the mechanical behavior of rocks Audience: Both Grad Undergrad

4. Apply basic concepts of rock mechanics and rock physics to analyze basic geomechanical engineering problems Audience: Both Grad Undergrad

5. Prepare rock samples for mechanical testing, conduct experiment, and analyze experimental data to obtain rock strength properties Audience: Both Grad Undergrad

6. Describe analytically time-dependent rock behaviors Audience: Graduate

**G L E 479 – GEOLOGICAL ENGINEERING DESIGN**

4 credits.

A practical problem in an area of geological engineering (such as development of a geologic resource or design of a structure in soil and/or rock) is selected, and then the principles and processes of design and analysis are applied to the solution of the problem.

**Requisites:** Senior standing and CIV ENGR/G L E 421, 530, 532, 635, 735, GEOSCI/G L E 629, CIV ENGR 414, 514, or (CIV ENGR/G L E 430, 432, and 434)

**Repeatable for Credit:** No

**Last Taught:** Spring 2024

**Learning Outcomes:** 1. Integrate and apply the knowledge gained in prior coursework into a simulated real-world design environment Audience: Undergraduate

2. Explain basic concepts in management, business, and public policy Audience: Undergraduate

3. Explain the importance of professional licensure Audience: Undergraduate

4. Identify common failure mechanisms of a component, process, or system and their causes and prevention Audience: Undergraduate

**G L E 489 – HONORS IN RESEARCH**

1-3 credits.

Undergraduate honors research projects supervised by faculty members.

**Requisites:** Consent of instructor

**Course Designation:** Level – Advanced

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Grad 50% – Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2023

**G L E/CIV ENGR 511 – MIXING AND TRANSPORT IN THE ENVIRONMENT**

3 credits.

Application of fluid mechanics to understand the mixing and transport of contaminants, pollutants, and other solutes in the environment. Introduction to chemical and biochemical transformation processes as well as boundary interactions at the air-water and sediment-water interfaces. Transport phenomena: diffusive processes, advective processes, turbulent diffusion, and shear flow dispersion. Introduction to both analytical and computational solutions with applications to mixing and transport in rivers, lakes, the atmosphere, and coastal waters.

**Requisites:** (CIV ENGR/G L E 291, COMP SCI 220, or E C E 203) and (CIV ENGR 310 or M E 363), graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Grad 50% – Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** Yes, unlimited number of completions

**Last Taught:** Spring 2024

**G L E/CIV ENGR 520 – REACTIVE PROCESSES FOR SUSTAINABLE ENERGY AND RESOURCE PRODUCTION**

3 credits.

Key scientific concepts related to fossil and renewable energy resources. Apply the fundamentals of thermodynamics and chemical kinetics at solid interfaces to better understand the science behind using fossil and renewable energy resources. Evaluate the impacts of existing and emerging energy technologies on the environment.

**Requisites:** Senior standing, (MATH 211, 217, or 221), (CHEM 103, 104, or 109), and CIV ENGR 320, graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**G L E/CIV ENGR 530 – SEEPAGE AND SLOPES**

3 credits.

Practical aspects of seepage effects and ground water flow. Stability of natural and man-made slopes under various loading conditions. Design and construction of earth dams and embankments. Flow net and its use; wells; filters; total and effective stress methods of slope analysis; selection of pertinent soil parameters.

**Requisites:** CIV ENGR/G L E 330, graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2023

**Learning Outcomes:** 1. Characterize and classify slope failure Audience: Both Grad Undergrad

2. Identify stability risk factors in generalized slope design Audience: Both Grad Undergrad

3. Apply soil and rock mechanics and strength principles in the context of slope stability investigation and design Audience: Both Grad Undergrad

4. Determine strength parameters of soil materials under saturated and unsaturated conditions Audience: Both Grad Undergrad

5. Understand pore fluid pressure in underground environments and its effect on manmade structures integrated within the soil as well as the failure potential of differing geometries Audience: Both Grad Undergrad

6. Design slope remedial plans for earth structures subjected to varying physical properties, overburden and pore pressures, and restrictive geometries Audience: Both Grad Undergrad

7. Act as leaders of the small groups they have been assigned for the mini design project Audience: Graduate

**G L E/CIV ENGR 532 – FOUNDATIONS**

3 credits.

Shallow and deep foundations. Analysis and design of footings, mats, piers and piles, and related fill and excavation operations. Consolidation settlement, time rate of settlement, stress distribution, elastic (immediate) settlement, load bearing capacity; methods to reduce settlements and increase shear strength; the selection of a foundation system.

**Requisites:** CIV ENGR/G L E 330, graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2022

**Learning Outcomes:** 1. Provide examples of when and where to consider shallow foundation systems in lieu of deep foundation systems and where stone columns or rammed aggregate piers are appropriate Audience: Both Grad Undergrad

2. Scope and Prepare a Foundation Investigation, including the equipment and standards used for subsurface exploration and the advantages/disadvantages therein Audience: Both Grad Undergrad

3. Calculate Allowable Bearing Pressure using (a) presumptive values, (b) the bearing capacity equation and (c) in situ approaches Audience: Both Grad Undergrad

4. Design a safe spread foundation system where structural capacity exceeds demand Audience: Both Grad Undergrad

5. Design a drilled shaft and a driven pile for axial loading considering vertical loading and a settlement estimate Audience: Both Grad Undergrad

6. Prepare a bid sheet, plan set, and set of specifications for a successful foundation design Audience: Both Grad Undergrad

7. Use soil moduli in the application of a laterally loaded deep-foundation system using an appropriate software program with a hand-calculated backcheck Audience: Graduate

**G L E/CIV ENGR 534 – NONDESTRUCTIVE EVALUATION**

3 credits.

Practical aspects of nondestructive evaluation (NDE) techniques for identifying physical properties and damage within civil and geologic materials and structures. Data analyses and data science for wave propagation, arrival picking, distributed fiber optic sensing, and visualization tools such as augmented/mixed/virtual reality.

**Requisites:** E M A 201, PHYSICS 201, 207, or member of Engineering Guest Students

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Learning Outcomes:** 1. Describe multiple nondestructive evaluation (NDE) testing methods and their applications Audience: Both Grad Undergrad

2. Characterize flaws within Civil and Geological Engineering materials Audience: Both Grad Undergrad

3. Determine source locations of flaws or damage within a structure based on NDE data Audience: Both Grad Undergrad

4. Characterize both active and passive elastic wave observations in rock Audience: Both Grad Undergrad

5. Apply seismological principles to observed acoustic emissions for determining source locations of microcracks and infer the mechanism of failure Audience: Both Grad Undergrad

6. Analyze fiber optic distributed acoustic sensing (DAS) to find earthquake events within timeseries data Audience: Both Grad Undergrad

7. Apply artificial intelligence techniques to analyze fiber optic sensing data Audience: Graduate

**G L E/CIV ENGR 535 – WIND ENERGY BALANCE-OF-PLANT DESIGN**

3 credits.

Wind Energy Development and Balance-of-Plant Design. Up-front coverage includes the science and mechanics of wind energy including turbine basics, wind resource assessment, energy production, and economic return. Balance-of-plant design aspects include site layout and micro-siting, foundation systems, collector systems and interconnection, site civil and electrical infrastructure, and structural tower analysis. Development includes environmental due diligence and permitting, stakeholder engagement, energy policy and markets, and levelized cost of energy (LCOE).

**Requisites:** PHYSICS 201, 207, 247, E M A 201, graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2024

**G L E/GEOSCI 537 – QUANTITATIVE METHODS FOR GEOSCIENCE**

3 credits.

MATLAB is a powerful, high-level programming language and integrated development environment (IDE) that is used across a broad variety of scientific disciplines for tasks including data visualization, modeling, and application development. Focus on the active use of MATLAB for developing practical programming and data analysis skills that can be applied across a range of geoscience- relevant problems. Applications will include: data visualization and publishable figure development; automation of data processing; statistical and time-series analysis; image processing and mapping; and optimization. Additional topics may be guided by student interest.

**Requisites:** MATH 222, graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2023

**G L E/GEOSCI 594 – INTRODUCTION TO APPLIED GEOPHYSICS**

3 credits.

Survey of applied geophysics, including seismic refraction, seismic reflection, electrical resistivity, gravity, and magnetics methods. Basic physics of each method and modeling techniques and field procedures.

**Requisites:** MATH 222 and (PHYSICS 202, 208, 248, or E M A 202), graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2023

**G L E/GEOSCI 595 – FIELD METHODS IN APPLIED AND ENGINEERING GEOPHYSICS**

1 credit.

The application of geophysical field methods for delineating near-surface features and/or structures as applied to engineering, environmental and exploration problems.

**Requisites:** GEOSCI/G L E 594 or concurrent enrollment, graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2023

**G L E/GEOSCI 596 – GEOMECHANICS**

3 credits.

Observation, description, and prediction of deformation of geomechanical systems at depth, and the forces (stress) causing those deformations, relevant for petroleum/geothermal reservoirs and studies of earthquake mechanics. Emphasis on computational exercises using datasets from the petroleum industry and earthquake catalogues, as well as prediction of ground deformation.

**Requisites:** GEOSCI/CIV ENGR/G L E/M S & E 474, graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2022

**Learning Outcomes:** 1. Conduct a borehole geomechanical analysis

Audience: Both Grad Undergrad

2. Design casing plans for drilling Audience: Both Grad Undergrad

3. Use borehole data and earthquake focal mechanisms to gain information about in-situ stress and strain Audience: Both Grad Undergrad

4. Describe modern challenges in developing subsurface energy resources Audience: Both Grad Undergrad

5. Use modern software to find crustal deformation models that match observed ground deformation Audience: Graduate

**G L E/CIV ENGR 612 – ECOHYDROLOGY**

3 credits.

Mutual interactions between the hydrologic cycle and ecosystems, including hydrologic mechanisms that underlie ecological patterns and processes, movement of water and energy through the soil-plant-atmosphere continuum, application and development of models for simulating ecohydrologic processes, and case studies on ecohydrologic function and ecosystem services of varied environments.

**Requisites:** CIV ENGR 311, GEOSCI/G L E 627, graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2024

**G L E/GEOSCI 627 – HYDROGEOLOGY**

3-4 credits.

Mathematical treatment of the physical principles governing the flow of groundwater; emphasis on well hydraulics and flow system analysis.

**Requisites:** (GEOSCI 100, 109, 110, ATM OCN/GEOSCI 105, 140, ENVIR ST/GEOSCI 106, or ASTRON/GEOSCI 160) and (MATH 217 or 221), graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2023

**G L E/GEOSCI 629 – CONTAMINANT HYDROGEOLOGY**

3 credits.

Physical and chemical processes governing the transport of solutes in groundwater; application of hydrogeologic and geochemical theory and practice to the protection of aquifers from contamination.

**Requisites:** G L E/GEOSCI 627 and MATH 222, graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2024

**G L E/CIV ENGR 635 – REMEDIATION GEOTECHNICS**

3 credits.

Geotechnical practice for remediation of sites containing contaminated soil and groundwater is discussed. Topics include non-invasive and invasive subsurface exploration techniques, methods to monitor for the presence of contaminants in the saturated and unsaturated zones, and geotechnically-oriented remedial action technologies.

**Requisites:** CIV ENGR/G L E 330, graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2023

**G L E 699 – INDEPENDENT STUDY**

1-3 credits.

**Requisites:** Consent of instructor

**Course Designation:** Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** Yes, unlimited number of completions

**Last Taught:** Spring 2024

**G L E/GEOSCI 724 – GROUNDWATER FLOW MODELING**

3 credits.

An introduction to the principles of modeling groundwater flow systems, with emphasis on regional flow system analysis. Conceptual understanding of governing equations, and the use of finite difference techniques to solve such equations are stressed. Develop codes and become introduced to packaged models, including those developed by the U. S. Geological Survey. Knowledge of hydrogeology [such as G L E/GEOSCI 627 or 629] required.

**Requisites:** Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Spring 2023**G L E/CIV ENGR 730 – ENGINEERING PROPERTIES OF SOILS**

3 credits.

Determination and interpretation of soil properties for engineering purposes; physio-chemical properties of soil-water systems, permeability and capillarity, compression characteristics of soils, measurement of soil properties in the triaxial test, properties of frozen soils and permafrost.

**Requisites:** Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Spring 2022**Learning Outcomes:** 1. Describe the physicochemical characteristics of soils and their importance to the engineering behavior of soils Audience: Graduate

2. Define the factors which control the hydraulic and mechanical behavior of soils Audience: Graduate

3. Evaluate how engineering classification of soils capture fundamental responses Audience: Graduate

4. Run and interpret laboratory tests used to characterize how physical and chemical properties of particles affect the behavior of soil masses, including hydraulic properties and the stiffness and shear strength properties Audience: Graduate

5. Explain models that describe the behavior and properties of soils Audience: Graduate

**G L E/CIV ENGR 732 – UNSATURATED SOIL GEOENGINEERING**

3 credits.

Engineering principles of unsaturated soils as they apply to geotechnical and geoenvironmental systems. Effect of soil water suction and stress on hydraulic conductivity, shear strength, and compressibility of soils in the context of geoengineering problems of flow and stability. Knowledge of Soil Mechanics [such as CIV ENGR/G L E 330] is required.

**Requisites:** Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Spring 2023**Learning Outcomes:** 1. Define properties of unsaturated soils Audience: Graduate

2. Use principles of interfacial physics, hydrology, and soil mechanics to interpret unsaturated soil behavior Audience: Graduate

3. Use results from measurement methods to characterize unsaturated soil properties Audience: Graduate

**G L E/CIV ENGR 733 – PHYSICOCHEMICAL BASIS OF SOIL BEHAVIOR**

3 credits.

Applications of physiochemical, mineralogical and environmental considerations to the engineering behavior of soils. Soil composition, formation, fabric, pore fluid chemistry and interaction of phases. The particulate nature of soils and the fabric-engineering property (volume change, strength, deformation and conduction) relationships. Knowledge of Soil Mechanics [such as CIV ENGR/G L E 330] is required.

**Requisites:** Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Fall 2023**Learning Outcomes:** 1. Characterize properties of soils that consist partly or wholly of clay Audience: Graduate

2. Define the composition and fabric of natural soils, their surface and pore-fluid chemistry, and the physical and chemical factors that govern fine-grained soil behavior Audience: Graduate

**G L E/CIV ENGR 735 – SOIL DYNAMICS**

3 credits.

Geotechnical considerations of earthquake engineering and foundation vibrations. Seismic surveying; ground motion during earthquakes; determination of soil properties for ground response analysis; dynamic properties of soils; soil structure interaction effects; soil liquefaction; dynamic analysis of earth dams; settlements resulting from earthquakes, lateral earth pressures during earthquakes; foundation vibrations. Knowledge of Soil Mechanics [such as CIV ENGR/G L E 330] and Foundations [such as G L E 452 or CIV ENGR/G L E 532] is required.

**Requisites:** Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Spring 2018

**G L E/GEOSCI 747 – TECTONOPHYSICS**

3 credits.

Elasticity and flexure of the earth's lithosphere, heat conduction, mantle convection, earthquake mechanisms, rock rheology, and fluid migration in the earth's crust; integration of geophysical observations, laboratory experiments, and theoretical models.

**Requisites:** Graduate/professional standing

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2022

**G L E/GEOSCI 757 – ADVANCED ROCK MECHANICS**

3 credits.

Experimental rock mechanics, rock mechanics apparatus design, static and dynamic rock friction, rate and state friction, crack phenomena and rock fracture mechanics, earthquake energy budget, elastic/viscoelastic/plastic behavior of rocks, engineering and geological applications. Knowledge of introductory rock mechanics [such as M S E/GEOSCI/CIV ENGR/G L E/ M S & E 474] required.

**Requisites:** Graduate/professional standing

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2021

**Learning Outcomes:** 1. Analyze technical construction of rock mechanics apparatuses Audience: Graduate

2. Design and fabricate load cells and displacement sensors Audience: Graduate

3. Measure dynamic rock frictional properties for fault instability analysis Audience: Graduate

**G L E 790 – MASTER'S RESEARCH OR THESIS**

1-9 credits.

Under faculty supervision.

**Requisites:** Declared in Geological Engineering MS

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** Yes, unlimited number of completions

**Last Taught:** Spring 2024

**G L E 801 – SPECIAL TOPICS IN GEOLOGICAL ENGINEERING**

1-3 credits.

Topics vary.

**Requisites:** Graduate/professional standing

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** Yes, unlimited number of completions

**Last Taught:** Fall 2020

**G L E 890 – PRE-DISSERTATOR'S RESEARCH**

1-9 credits.

Under faculty supervision.

**Requisites:** Declared in Geological Engineering PHD

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** Yes, unlimited number of completions

**Last Taught:** Spring 2024

**G L E 900 – SEMINAR**

1 credit.

Topics vary.

**Requisites:** Graduate/professional standing

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** Yes, unlimited number of completions

**Last Taught:** Spring 2024

**G L E 990 – RESEARCH AND THESIS**

1-9 credits.

Under faculty supervision.

**Requisites:** Declared in Geological Engineering PHD

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** Yes, unlimited number of completions

**Last Taught:** Summer 2023

**G L E 999 – INDEPENDENT WORK**

1-3 credits.

Under faculty supervision.

**Requisites:** Consent of instructor

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** Yes, unlimited number of completions

**Last Taught:** Summer 2023