GEOLOGICAL ENGINEERING

Emphasis areas at the bachelor of science level in environmental protection and hazardous waste management, groundwater hydrology and contaminant transport, engineering geology and geotechnics, petroleum, energy and natural resources, and quarry engineering.

Geological engineers apply their skills in geology and engineering to projects that protect and preserve the earth and the environment in which we live. Do you like working outdoors? Do you enjoy solving problems using your skills and creativity? Do you like helping people and the environment? Then you may be a good candidate for geological engineering!

Geological engineers work on a variety of projects that involve the earth and its resources. For example, a geological engineer may work on protecting infrastructure like bridges, buildings and utilities from earthquake or landslide damage, designing tunnels through soil and rock, and evaluating natural hazards from slope failure, flooding, failure of dams or levees, and sea level rise. Geological engineers may also be involved in the design of a project to protect wetlands, clean up contaminated soil and groundwater, or develop and maintain safe drinking water supplies. Geological engineers use a wide variety of tools, including soil and rock samples, near-surface geophysics, and remote sensing methods such as unmanned aerial vehicles and satellites, to assess natural hazards and protect the environment. Geological engineers also help develop renewable energy resources – even in space – to conserve traditional sources of energy. Geological engineers work with the environment to improve conditions for everyone and the world around us.

The curriculum for geological engineers includes familiar engineering subjects like math, chemistry, physics, and mechanics. In addition, geological engineers learn about the earth, how its soils, rocks and fluids interact with life, and how to engage natural processes sustainably. Our courses often include field work. When they are seniors, geological engineering students bring all their knowledge together to design real-world solutions that help people and society.

Because responsible use of the Earth's resources is an ever-growing task, geological engineers are needed more and more in a wide variety of areas, including industry, government, and research. Scholarships are available, as well as a wide range of experiential learning opportunities such as summer internships, cooperative work projects, student design teams, and international experiences. Especially in challenging times, many paths to rewarding permanent employment start with a Missouri S&T geological engineering BS degree.

Mission Statement

It is the mission of the geological engineering program to teach integrated concepts of geology and engineering in such a manner that graduates will become competent, ethical, professional geological engineers. The program is designed to provide background in geological and engineering sciences in lower-level courses, which then support the applied analysis and design concepts taught in the upper levels. Students are expected to gain the ability to identify problems resulting from the interaction of human activities with the geologic environment, and solve them through thorough analysis and competent design. The curriculum blends theoretical concepts with practical application and experiential learning. It combines discussion and project-oriented work with real-world issues to help the student understand and fulfill the engineers' responsibilities to client and society.

Program Educational Objectives

Graduates will serve public and private interests as future professional geological engineers practicing in the State of Missouri, the nation, and international situations; they will ultimately achieve the status of licensed engineers.

Program Outcomes

Students graduating from the Geological Engineering B.S. Program should have:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics;
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors;
3. an ability to communicate effectively with a range of audiences;
4. an ability to recognize their ethical and professional responsibilities in engineering situations and to make informed judgments which consider the impact of engineering solutions in global, economic, environmental, and societal contexts;
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative environment, establish goals, plan tasks, and meet objectives;
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions; and
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Bachelor of Science Geological Engineering

For the bachelor of science degree in geological engineering a minimum of 124 credit hours is required. These requirements are in addition to credit received for algebra, trigonometry, and basic ROTC courses. The student must maintain at least two grade points per credit hour (grade of C) for all courses taken in geological engineering. Geological engineering students must take the Fundamentals of Engineering Examination prior to graduation. A passing grade is not required; however, passing this examination is the first step toward becoming a registered professional engineer. This requirement is part of the Missouri S&T assessment process. Additionally, students who complete the geological engineering BS have met all of the requirements to take the Fundamentals of Geology exam, which is the first step towards becoming a registered professional geologist. Geological engineering students are encouraged, but not required, to take the Fundamentals of Geology exam, as professional registration as both an engineer and a geologist is professionally advantageous.

The geological engineering program at Missouri S&T is characterized by comprehensive understanding of the principles of engineering and geology and innovative application of these principles. We focus

on solving the problems and meeting the needs of people and the environment related to geological materials, structures, or events. Geological engineering is an interdisciplinary field where differing components of science, engineering, and human professions are emphasized in research, analysis, synthesis, and design. Learning occurs in the classroom, laboratory, field, online, and combined modes.

Freshman Year

First Semester	Credits	Second Semester	Credits
CHEM 1100	1	ENGLISH 1120	3
CHEM 1305	4	GEOLOGY 2611	3
CHEM 1319	1	MATH 1215	4
FR ENG 1100	1	MECH ENG 1720	3
GEO ENG 1150	3	PHYSICS 1135	4
HISTORY 1200, or 1300, or 1310, or POL SCI 1200	3		
MATH 1214 or 1211[1]	4		
	17		**17**

Sophomore Year

First Semester	Credits	Second Semester	Credits
General Education Elective[2]	3	CIV ENG 2200	3
GEO ENG 2110	1	GEO ENG 3175	3
GEO ENG 3148	3	GEOLOGY 3620	3
MATH 2222	4	MATH 3304	3
PHYSICS 2135	4	PHILOS 3225	3
	15		**15**

Junior Year

First Semester	Credits	Second Semester	Credits
CIV ENG 2210	3	CIV ENG 3330	3
General Education Elective[2]	3	CIV ENG 3715 or MIN ENG 5823	3
GEO ENG 5331	3	GEO ENG 5174	3
GEOLOGY 3310	3	Technical Elective[3]	3
GEOLOGY 3319	1	Technical Elective[3]	3
MECH ENG 2350	2		
	15		**15**

Senior Year

First Semester	Credits	Second Semester	Credits
ENGLISH 3560[5]	3	Eng Econ Elective[8]	3
Field Technical Elective[6]	3	General Education Elective[2]	3
GEO ENG 5441	3	GEO ENG 5090	3
GEO ENG 5443	3	Geo Eng Elective[7]	3
Geophysics Elective[4]	3	Statistics Elective[9]	3
	15		**15**

Total Credits: 124

1. MATH 1211 may be substituted for MATH 1214.
2. General Education Requirement: General education electives must fulfill the Missouri S&T general education requirements applicable to the student's catalog year.
3. Technical Elective: Select from advanced courses in engineering as approved by advisor.
4. Geophysics Elective: Select from GEO ENG 5736, GEO ENG 5761, or GEO ENG 5782.
5. General Education Requirement - discipline specific requirement
6. Field Technical Elective: Select from: GEO ENG 5736, GEOLOGY 5679, or other field-based elective approved by advisor. GEO ENG 5736 may be used to satisfy both the Geophysics elective requirement and the Field Technical elective requirement; if this is done, an additional engineering technical elective must be taken to maintain the total number of credit hours in the degree.
7. Geological Engineering Elective: Select from GEO ENG 5381, GEO ENG 5471, GEO ENG 5556, MIN ENG 5823, PET ENG 3520, CIV ENG 3715, CIV ENG 4729, or CIV ENG 5715.
8. Engineering Economics Elective: Select from ENG MGT 5210, MIN ENG 3512, or PET ENG 4590 or both ENG MGT 1100 and ENG MGT 1210.
9. Statistics Elective: Select one course from GEO ENG 4115 or STAT 3113 or STAT 3115.

Geological Engineering Focus Areas

The student uses the following course lists as guidance to satisfy the various elective requirements (chemistry/geochemistry, technical, geophysics, and geological engineering) while focusing preparation for their chosen career specialty. Other courses can be substituted with advisor approval.

Engineering Geology and Geotechnics

CIV ENG 3715	Fundamentals of Geotechnical Engineering	3
CIV ENG 4729	Foundation Engineering	3
GEO ENG 5146	Applications Of Geographic Information Systems	3
GEO ENG 5471	Rock Engineering	3
MIN ENG 5823	Rock Mechanics	3

Environmental and Engineering Geophysics

GEO ENG 5144	Remote Sensing Technology	3
GEO ENG 5736	Geophysical Field Methods	3
GEO ENG 5761	Transportation Applications of Geophysics	3
GEO ENG 5782	Environmental and Engineering Geophysics	3
GEOPHYS 4241	Electrical Methods In Geophysics	3
GEOPHYS 4261	Geophysical Instrumentation	1
GEOPHYS 5231	Seismic Data Processing	3

Groundwater Hydrology and Environmental Protection

CIV ENG 5640	Environmental Law And Regulations	3
GEO ENG 4276	Environmental Aspects Of Mining	
GEO ENG 5233	Risk Assessment In Environmental Studies	3
GEO ENG 5235	Environmental Geological Engineering	3
GEO ENG 5237	Geological Aspects Of Hazardous Waste Management	3
GEO ENG 5320	Groundwater Modeling	3
GEO ENG 5381	Intermediate Subsurface Hydrology And Contaminant Transport Mechs	3
PET ENG 3330	Formation Evaluation	3

Quarry and Mine Engineering

CIV ENG 3116	Construction Materials, Properties And Testing	3
GEO ENG 4276	Environmental Aspects Of Mining	3
GEO ENG 5471	Rock Engineering	3
GEO ENG 5575	Aggregates And Quarrying	3
MIN ENG 3913	Mineral Identification and Exploration	3
MIN ENG 5612	Principles of Explosives Engineering	3
MIN ENG 5822	Strata Control	3
MIN ENG 5823	Rock Mechanics	3
MIN ENG 5912	Mine Power and Drainage	3

Renewable and Conventional Energy Resources

GEO ENG 5146	Applications Of Geographic Information Systems	3
GEO ENG 5556	Renewable Energy Systems	3

GEOLOGY 5511	Applied Petroleum Geology	3
MIN ENG 5322	Coal Mining Methods	3
MIN ENG 5422	Coal Preparation	3
MIN ENG 5823	Rock Mechanics	3
PET ENG 3330	Formation Evaluation	3
PET ENG 3520	Petroleum Reservoir Engineering	3
PET ENG 4520	Well Test Analysis	3

Accelerated BS/MS Option (Graduate Pathway)

Students nearing completion of a BS in geological engineering can share up to nine 5000- or 6000-level credit hours toward their BS degree and a MS degree in geological engineering simultaneously, if they satisfy the following criteria:

- Have completed 64 credit hours of course work, including:
  - All chemistry and mathematics requirements, and
  - 21 credit hours of geological engineering courses with a minimum GPA of 3.20 in the geological engineering courses.
- Complete an application listing the courses to be shared, with approval from the undergraduate advisor and a recommendation from the geological engineering faculty member who agrees to serve as their MS advisor. The shared courses may not be undergraduate research, special problems, or transfer courses. Applications are due within one semester of completing the last shared course.
- Follow all geological engineering non-thesis MS program requirements (see the Graduate Catalog).

All other MS degree requirements remain the same. The program may be combined with existing honors research, emphasis areas, and certificate options. An additional six credit hours of coursework for graduate credit (beyond the shared BS/MS credits) can be taken while in the undergraduate program by applying for dual undergraduate/graduate enrollment. Taking additional courses for graduate credit as a dual enrolled student will require formal application to the graduate program. Upon application, acceptance to the geological engineering MS degree program from this option is automatic as long as the student remains in good standing (GPA above 3.0 and B's or better in all graduate courses within the program). To remain in this option, the student must meet geological engineering graduate academic performance requirements and maintain continuous enrollment at Missouri S&T. If the student exits the program before completion of the MS degree, or fails to maintain continuous enrollment at Missouri S&T, the shared-credit courses may not apply toward graduate requirements in the event of future readmission.

It is the student's responsibility to check how dual-enrollment status and graduate coursework would affect scholarships and other financial aid. Graduate students are not eligible for Federal Pell Grants, though they are eligible for Federal Financial Aid, as well as fellowships and teaching/research assistantships. International students are responsible for checking with the International Affairs Office during completion of an accelerated BS/MS to ensure immigration status is properly maintained throughout the program.

This option reduces the cost and the time required to earn a MS. See the Graduate Pathway section of this catalog, and the Geological Engineering Masters section of the Graduate Catalog, for additional details.

Geological Engineering Minor

A minor in geological engineering enhances the academic credentials of a student in any science or engineering discipline and broadens their employment opportunities. It requires 15 hours of Missouri S&T credit per the following curriculum, in approximate recommended order.

GEO ENG 1150	Physical and Environmental Geology [1]	3
GEO ENG 3175	Geomorphology And Terrain Analysis	3
GEO ENG 5331	Subsurface Hydrology	3
GEO ENG 5441	Engineering Geology And Geotechnics	3
GEO ENG Elective [2]		3
Total Credits		**15**

[1] GEOLOGY 1110 may be substituted for geology and geophysics majors.
[2] To be selected with geological engineering advisor approval.

Neil L Anderson, Professor Emeritus[1,2]
PHD University of Calgary

Jeffrey D Cawlfield, Professor Emeritus[2,1]
PHD University of California-Berkeley

Leslie Sour Gertsch, Associate Professor
PHD Colorado School of Mines

Katherine R Grote, Associate Professor[2]
PHD University of California-Berkeley

Norbert H Maerz, Professor Emeritus[1,2]
PHD University of Waterloo

Jeremy Maurer, Associate Professor
PHD Stanford University

Taghi Sherizadeh, Associate Professor
PHD University of Arizona

GEO ENG 1001 Special Topics (LEC 0.0-6.0)
This course is designed to give the department an opportunity to test a new course. Variable title.

GEO ENG 1150 Physical and Environmental Geology (LAB 1.0 and LEC 2.0)
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 Geology 1110).

GEO ENG 1175 Geological Engineering in Popular Media (LAB 2.0 and LEC 1.0)
Examination of the issues and topics related to geological engineering as presented in movies, television programs, and other communications media.

GEO ENG 1605 Mathematical Concepts for Military Engineers (LEC 2.0)
Review of fundamental concepts in Algebra, Trigonometry and Calculus for students in Geological Engineering. Designed as a bridging course for Military Reserve officers enrolled in the On-Line Certificate in Military Geological Engineering. Prerequisite: Permission of instructor. This course was designed for military officers registered in either the GE DL MS Degree Program or the GE FLW MS Degree Program.

GEO ENG 1810 Humanitarian Engineering and Science Colloquium (RSD 0.50)
Course introduces Humanitarian Engineering & Science Minor students to topics such as impact of Western interventions on developing cultures, ethics and engineering, frugal engineering, the role of civic engagement in corporate culture, responsible behavior in outreach programs, and others. Cannot be used for credit towards Geological Engineering B.S. Prerequisites: Open to undergraduate students pursuing the Humanitarian Engineering and Science Minor.

GEO ENG 1880 Civic Engagement (IND 0.50)
Course provides a formal independent study framework so that Humanitarian Engineering & Science Minor students and other students have the opportunity to achieve formal recognition of experiential service learning that may occur during participation in extracurricular programs. Cannot be used for credit towards Geological Engineering B.S. Prerequisites: Open to undergraduate students pursuing the Humanitarian Engineering and Science Minor and other students.

GEO ENG 2000 Special Problems (IND 0.0-6.0)
Problems or readings on specific subjects or projects in the department. Consent of instructor required.

GEO ENG 2001 Special Topics (LEC 1.0-6.0)
This course is designed to give the department an opportunity to test a new course. Variable title.

GEO ENG 2002 Cooperative Work Training (IND 1.0-3.0)
On the job experience gained through cooperative education with industry, with credit arranged through departmental cooperative advisor. Grade received depends on quality of reports submitted and work supervisor's evaluation.

GEO ENG 2110 Principles Of Geological Engineering (LEC 1.0)
Introduce GE students to the GE program. Topics include career paths, professional development, licensure, life long learning, engineering ethics, societal issues, engineering law, international engineering, and GE program outcomes and objectives. Discussion of the teaching and research of the faculty. Prerequisite: Sophomore standing in the GE program.

GEO ENG 2407 Geology and Engineering of Ancient and Modern Peru (LEC 1.0)
A study of the geological engineering of the Cuzco-Machu Picchu corridor, including the interrelations of geology, climate, archeology, and history. A technical report and a week-long field trip to Peru during Spring Break are required.

GEO ENG 2536 Basic Weather (LAB 1.0 and LEC 2.0)
A course to study basic concepts of atmospheric science such as air masses, frontal weather patterns and weather forecasting. The course also will include topics on climate and severe weather. Prerequisites: Physics 1135, Geo Eng 1150.

GEO ENG 2605 Statics and Mechanics of Geologic Materials (LEC 3.0)
Fundamental statics of rigid bodies and mechanics of deformable bodies for entering graduate students, focusing on behavior of rock and soil in engineering situations. Not for students intending to register as professional engineers. Designed for military officers registered in GE DL MS Degree Program or GE FLW MS Degree Program. Prerequisite: Permission of instructor.

GEO ENG 3001 Special Topics (LAB 0.0 and LEC 0.0)
This course is designed to give the department an opportunity to test a new course. Variable title.

GEO ENG 3002 Cooperative Work Training (IND 1.0-3.0)
On the job experience gained through cooperative education with industry, with credit arranged through departmental cooperative advisor. Grade received depends on quality of reports submitted and work supervisor's evaluation.

GEO ENG 3148 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 Geology 3811).

GEO ENG 3175 Geomorphology And Terrain Analysis (LAB 1.0 and LEC 2.0)
Study of geomorphic processes, landform development, and surficial materials. Stresses evaluation of the engineering properties of terrain for site selection and design of engineered structures. Prerequisite: Geo Eng 1150.

GEO ENG 3249 Fundamentals Of Computer Applications In Geological Engineering (LAB 1.0 and LEC 2.0)
Applications of existing and available software packages utilizing a variety of hardware systems for geological engineering purposes. Emphasis on practical utilization of software and network operations for graphical analysis of geologic data, mapping of surface and subsurface configurations and modeling of geologic processes. Prerequisites: Geo Eng 1150.

GEO ENG 4000 Special Problems (IND 0.0-6.0)
Problems or readings on specific subjects or projects in the department. Consent of instructor required.

GEO ENG 4001 Special Topics (LAB 0.0 and LEC 0.0)
This course is designed to give the department an opportunity to test a new course. Variable title.

GEO ENG 4010 Current Topics and Professionalism (RSD 0.50)
Discussion of current topics, professionalism, and ethics. Required for two semesters during senior year. (Course cannot be used for graduate credit). Prerequisite: Senior standing.

GEO ENG 4099 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.

GEO ENG 4115 Statistical Methods in Geology and Engineering (LEC 3.0)
Statistical methods in engineering and geological applications including site investigations and environmental data analyses. Introduction to spatial correlation analysis and geostatistical techniques such as kriging for resource evaluation and estimation.

GEO ENG 4276 Environmental Aspects Of Mining (LEC 3.0)
Permitting: the legal environment of reclamation and environmental impact assessment; post-mining land-use selection and mine planning for optimum reclamation of all mines: metal, nonmetal, and coal; unit operations of reclamation; drainage, backfill, soil replacement, revegetation, maintenance, etc. Prerequisites: Co-requisites: MIN ENG 4933 or GEO ENG 5441 or ENV ENG 5619. (Co-listed with MIN ENG 4742).

GEO ENG 4321 Drone Mapping and Photogrammetry (LAB 1.0 and LEC 2.0)
The course will start with an overview of the basic knowledge required for passing the FAA Part 107 Remote Pilots Knowledge Test for small UAS operators, including UAS mapping technology and its rules and regulations, airspace classification, and reading aeronautical charts. The principles of UAS data collection are explained along with hands-on practice in flight planning and execution, as well as processing collected imagery. Prerequisites: Basic computer knowledge. Either Civ Eng 2401 or Geo Eng 3148 or equivalent. (Co-listed with Civ Eng 4321, Geology 4321, Geophys 4321, Min Eng 4321).

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

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

GEO ENG 5085 Internship (IND 0.0-15)
Students working toward a doctor of engineering degree will select, with the advice of their committees, appropriate problems for preparation of a dissertation. The problem selected and internship plan must conform to the purpose of providing a high level engineering experience consistent with the intent of the doctor of engineering degree.

GEO ENG 5090 Geological Engineering Design (LAB 1.0 and LEC 2.0)
Geological engineering design is an open-ended project course requiring the collection of data, analysis and synthesis of that data and design of a socially acceptable, economical solution to the selected problem. Oral and written reports are required. Prerequisite: To be taken in the semester before graduation.

GEO ENG 5099 Research (IND 0.0-15)
Investigations of an advanced nature leading to the preparation of a thesis or dissertation. Consent of instructor required.

GEO ENG 5144 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: Geology 1110. (Co-listed with Geology 4310).

GEO ENG 5146 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 3175 or consent of instructor. (Co-listed with Geology 4821).

GEO ENG 5153 Regional Geological Engineering Problems In North America (LEC 3.0)
A physiographic approach to engineering materials and problems. Course emphasizes the distribution and engineering characteristics of soil and rock to construction and site problems and includes aggregates, foundations, excavations, surface and ground water, slope stability and arctic conditions.

GEO ENG 5172 Soil Science In Engineering Practice (LEC 3.0)
A study of the ways in which soils and geologic conditions influence engineered projects. Soil formation, soil chemistry and properties to include composition, organic component, ion exchange and water relationships as well as erosion control and revegetation will be covered. Prerequisite: Geo Eng 3175.

GEO ENG 5173 Geologic Field Methods (LAB 3.0)
Field practice in geologic mapping and interpretation in the Western United States using topographic base maps and aerial photos. Emphasizes the description and interpretation of stratigraphic sections, sedimentary and tectonic structures. Prerequisite: Two courses in either Geology or Geological Engineering.

GEO ENG 5174 Geological Engineering Field Methods (LAB 3.0)
Instruction in methods of field investigation required for geological engineering studies. Course will include procedures for qualitative and quantitative data collection for characterizing surficial geologic conditions, groundwater and surface water investigations, and other engineering activities. Written reports and field trip required.

GEO ENG 5211 Introduction to International Engineering and Design Lab (LAB 1.0)
The lab for multi-disciplinary design will be as follows: Students will develop a work plan to address design objectives and other considerations including scheduling, budgeting, environmental impacts, and life cycle design. Prerequisites: Senior standing, instructor approval, accompanied by GEO ENG 5247.

GEO ENG 5233 Risk Assessment In Environmental Studies (LEC 3.0)
This course will present the concepts required to assess the human health and environmental risks resulting from contaminants in soil and groundwater. Course topics include evaluation of data sets, exposure calculation, chemical fate and transport, and development of conceptual site models.

GEO ENG 5235 Environmental Geological Engineering (LEC 3.0)
Introduction to engineering geologic mapping for site selection for solid waste disposal facilities; landfill site selection, design, permitting, construction, operation, and closeout/reclamation. Prerequisites: Geo Eng 3175, accompanied or preceded by Civ Eng 3715.

GEO ENG 5237 Geological Aspects Of Hazardous Waste Management (LEC 3.0)
Nature and classification of hazardous wastes; federal and state regulation for treatment and disposal; geological characterization of facility sites; design of impoundments, storage and containment facilities; ground water monitoring and protection; site permitting and licensing planning. Prerequisite: Geo Eng 3175.

GEO ENG 5239 Groundwater Remediation (LEC 3.0)
A survey of conventional and innovative techniques for remediation of contaminated groundwater. Topics include groundwater cleanup standards, physico-chemical properties of groundwater and contaminants, fate and transport of contaminants in the subsurface, hydrogeologic site characterization, and selection process of a remedial technology. Various computer programs developed to assist in preliminary selection and design of remediation technologies will be used. Prerequisite: Geo Eng 5331.

GEO ENG 5247 Introduction to International Engineering and Design (LEC 2.0)
A multi-disciplinary design course focused on sustainable design and technology transfer to developing countries. Students will develop a work plan to address design objectives and other considerations including scheduling, budgeting, environmental impacts, and life cycle design. Prerequisites: Senior standing, instructor approval, accompanied by Geo Eng 5211.

GEO ENG 5276 Sustainability in Mining (LEC 3.0)
Sustainability implications of mining. Topics include mine permitting, environmental impact assessment, mine reclamation and habitat restoration, sustainability implications of mine planning and design, environmental management systems, sustainability reporting, community development, and handling mine-influenced water. Prerequisites: Preceded or accompanied by Min Eng 5933 or Geo Eng 5441 or Env Eng 5619. (Co-listed with Min Eng 5742).

GEO ENG 5315 Advanced Statistical Methods in Geology and Engineering (LEC 3.0)
Application of statistical methods to study of geologic materials and practices, with emphasis on reliable interpretation of laboratory and field data for water, hydrocarbon, and mineral exploration, research, and engineering as well as other aspects of geological engineering. Prerequisites: Geo Eng 4115 or Stat 3113 or Stat 3117.

GEO ENG 5320 Groundwater Modeling (LEC 3.0)
This course is an introduction to advanced modeling techniques for understanding flow and transport in porous media under different hydrologic conditions. Emphasis is placed on both theoretical and practical modeling considerations. Computer demonstrations are incorporated. Practical applications are emphasized. Prerequisite: Civ Eng 3330 or Geo Eng 5331.

GEO ENG 5331 Subsurface Hydrology (LAB 1.0 and LEC 2.0)
Introduction to the theory and engineering concepts of the movement of subsurface fluids. Hydraulic characteristics of earth materials, aquifer characterization, and flow prediction. Engineering problems related to subsurface fluids. Prerequisites: Geo Eng 1150 or Geology 1110; Math 1212 or Math 1214; Physics 1135 or Physics 1145.

GEO ENG 5332 Fundamentals of Groundwater Hydrology (LEC 3.0)
Focus on fundamental analysis and survey of groundwater hydrology with emphasis on practical geo-environmental and subsurface hydrology issues of interest to working professionals. Topics will include general hydrology, surface and subsurface intercconnection, basic groundwater flow and well test analysis, and a brief intro to contaminant transport. Prerequisites: Graduate standing.

GEO ENG 5381 Intermediate Subsurface Hydrology And Contaminant Transport Mechs (LAB 1.0 and LEC 2.0)
A study of the physical/chemical properties of rocks and sediments in the subsurface environment. Emphasis is put on waterrock properties such as permeability, capillarity, and mechanical dispersion. Both microscopic and macroscopic approaches are used. Prerequisites: Geo Eng 5331, Geo Eng 5332, or Geol 4411.

GEO ENG 5415 Soil Mechanics for Geoprofessionals (LEC 3.0)
The basic principles of soil mechanics necessary for professionals to practice in the field of geoconstruction. Topics related to the practical aspects of engineering include: soil classification, index properties, water flow through soils, compaction, compressibility, and shear strength. These basic principles will be applied to real world problems.

GEO ENG 5432 Potential Field Theory (LEC 3.0)
The mathematics and physics of gravitational, magnetic, and electrical fields of the earth as derived from potential functions, with applications to practical problems. The theorems of Laplace, Poisson, Gauss, and Green and their applications to geophysics are presented. Prerequisites: Math 5325 (also may be taken as a co-requisite). (Co-listed with Geophys 5432 and Geology 5432).

GEO ENG 5441 Engineering Geology And Geotechnics (LEC 3.0)
Study of procedures and techniques used to evaluate geologic factors for site selection and the design of engineered structures. Prerequisite: Geo Eng 3175.

GEO ENG 5443 Subsurface Exploration (LAB 1.0 and LEC 2.0)
Lectures and field and laboratory exercises in the use of geologic and geophysical techniques for evaluation of subsurface geology and resources. Prerequisite: Geo Eng 1150.

GEO ENG 5471 Rock Engineering (LEC 3.0)
Data requirements for design; engineering properties of rock; characterization of fractures and rock masses; stereonet analysis of discontinuities; graphic analysis of failure; ground stress distribution; tunnel construction methods; ground support principles; selection of tunneling equipment; and specifications for underground construction. Prerequisite: Geo Eng 3175.

GEO ENG 5556 Renewable Energy Systems (LEC 3.0)
Introduction to the theory and performance prediction of typical renewable energy systems such as, but not limited to, those based on energy from the sun, wind and water, and geothermal. The use of environmental data, including stochastic modeling, for renewable energy system (including wind turbine, photovoltaic, and geothermal) design is addressed. Prerequisites: Math 3304, Physics 2135, and preceded or accompanied by Geo Eng 4115 or any Probability and Statistics class. Junior or senior standing is required.

GEO ENG 5575 Aggregates And Quarrying (LEC 3.0)
Properties and uses of aggregates. Finding aggregate deposits and methods of extraction. Aggregate processing. Aggregate testing. Economics and politics of aggregates. Special topics in aggregates and quarrying. Prerequisites: Geo Eng 1150, Geo Eng 3175.

GEO ENG 5642 Military Geology (LEC 3.0)
This course will familiarize geologists, geophysicists, civil and geological engineers with the fundamental principles of physical geology, geohydrology and geomorphology as applied to military problems, such as development of fortitications, core infrastructure, water resources and combat engineering requirements. Prerequisite: Geo Eng 3175 or graduate standing.

GEO ENG 5736 Geophysical Field Methods (LAB 1.0 and LEC 2.0)
Imaging of selected subsurface features and engineering structures using various geophysical tools. Special emphasis is placed on ground penetrating radar and surface wave techniques. One field trip at student expense required. Prerequisite: Junior level standing or higher. (Co-listed with Geophys 5736).

GEO ENG 5761 Transportation Applications of Geophysics (LAB 1.0 and LEC 2.0)
Overview of geophysical and non-destructive test methods that are commonly used to investigate transportation structures and their foundations. Emphasis is placed on bridge system substructure, bridge system superstructure, pavement, roadway subsidence, subsurface characterization and vibration measurements. Prerequisite: Junior level standing or higher. (Co-listed with Geophys 5761 and Civ Eng 5750).

GEO ENG 5782 Environmental and Engineering Geophysics (LAB 1.0 and LEC 2.0)
An introduction to the theory and application of the gravity, magnetic, resistivity, self-potential, induced polarization and electromagnetic methods as applied to the solution of engineering and environmental problems. Prerequisite: Math 2222. (Co-listed with Geophys 5782).

GEO ENG 5810 Fundamentals of Space Resources (LEC 3.0)
Introduction to the science of the mineral resources of space and to the engineering of extracting them for human use. (Co-listed with Aero Eng 5810).