

# 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.**

The geological engineering program is offered under the department of geosciences and geological and petroleum engineering.

Geological engineering - we care about the earth! We care for the earth, its resources and its inhabitants.

Geological engineers apply their engineering skills to projects which 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 be involved in the design of a project to protect wetlands. A geological engineer may be involved in the cleanup of lead contaminated soil which threatens peoples' homes. Geological engineers may develop safe drinking water supplies in parts of the world where infant mortality is many times higher than it is in the United States. Geological engineers work on protecting infrastructure like bridges, buildings and utilities from earthquake damage. Geological engineers evaluate the use of naturally-occurring materials like clay to prevent the spread of subsurface contamination. Geological engineers are interested in the development of renewable energy resources 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 the familiar engineering subjects like math, chemistry, physics and mechanics. However, geological engineers also take courses that are focused on the earth - its soil, rock and fluids; these courses frequently include field work! Of course, geological engineers also are well-trained in engineering design and such design courses typical focus on projects that help people and society through careful consideration of where, when, and how the earth's resources are utilized.

Because the use and conservation of the earth's resources is an ever-growing concern and responsibility, there is an increasing need for geological engineers in a wide variety of areas including industry, government agencies, and research applications. Scholarships are available as are summer internships and, ultimately, challenging and rewarding permanent employment.

## 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 graduate as competent, ethical, professional geological engineers. The program is designed to provide background in geological and engineering sciences courses in the lower division which support the applied analysis and design concepts courses taught in the upper division. It is expected that the students will have gained the ability to identify and, through analysis and design, solve problems resulting from the interaction of man's activities with the geologic environment. The curriculum is intended to blend theoretical concepts with practical application, so as to offer the student a well-rounded education, and

to include sufficient discussion and project oriented work with real-world issues to provide the student with a thorough awareness of the graduate's responsibility to society. Since geological engineering students are oriented toward careers in environmental protection, social awareness and the engineer's responsibility to both client and society is strongly emphasized throughout the curriculum, particularly in the senior seminar and design courses.

## Program Objectives and Outcomes

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

Outcome Group 1: General engineering and science competence. Graduates will be well trained in the fundamentals of general engineering, mathematics, and the sciences; with particular focus on geology and engineering applications.

Outcomes:

1. Students will have a fundamental knowledge of basic mathematical principles particular to geological engineering, and to prepare them to write the Fundamentals of Engineering Exams.
2. Students will have a fundamental knowledge of basic science principles particular to geological engineering, and to prepare them to write the Fundamentals of Engineering Exams.
3. Students will have a fundamental knowledge of general engineering mechanics particular to geological engineering (including design, statics, mechanics of materials), and to prepare them to write the Fundamentals of Engineering Exam.
4. Students will have a fundamental knowledge of basic geology topics particular to geological engineering (geological processes, identification of rocks and minerals, visualize and solve problems in 3 and 4 D, and to apply principles of geology and geophysics).
5. Students will have the ability to apply mathematics including differential equations, calculus based physics and chemistry to geological engineering.

Outcome Group 2: Geological engineering competence. Graduates will acquire a broad knowledge of geological engineering principles and practices and understand what practicing geological engineers do.

1. Students will have a fundamental knowledge of principles associated with geological engineering and closely related disciplines, and to design solutions to geological engineering and geomechanics problems.
2. Students will have an applied specific knowledge of aspects of geological engineering and closely related disciplines, including specialization in one or more emphasis area of geological engineering.
3. Students will learn the importance of professional licensure and the appropriate path to professional licensure.
4. Students will learn practical professional skills required of practicing engineers.
5. Students will learn what some practicing professionals in our field do as a part of their job.

6. Students will gain exposure to international engineering situations.

Outcome Group 3: Problem solving skills. Graduates will have the ability to use mathematics and scientific principles and analytical and other problem-solving skills necessary to systematically solve problems within the environmental, economic, social, political, and professional constraints of society and the geological engineering community, by themselves and in teams.

Outcomes:

1. Students will be able to conduct experiments, design projects, and analyze and interpret data.
2. Students will be able to design components and integrated systems to solve a typical geological problem associated with subsurface conditions or the environment.
3. Students will be able to successfully work in design teams.
4. Students will have the ability to function on multidisciplinary teams.
5. Students will have an appreciation for the inherent uncertainty and variability of naturally occurring materials and the risks and difficulties of decision making and engineering design within such a framework, especially with respect to the economic and optimum use of resources.
6. Students will have the ability to understand how to use non-invasive imaging technologies for geotechnical, environmental, hydrologic, and structural investigations.
7. Students will have the ability to use state-of-the-practice computer software.
8. Students will have the ability to use state-of-the-practice accepted field methods and equipment.
9. Students will have the confidence to provide leadership and communicate effectively in a multidisciplinary team in order to analyze and interpret data, transmit results, make proposals, and prepare reports.

Outcome Group 4: Social skills. Graduates will possess the highest level of personal and professional ethics, have a broad based knowledgeable of humanities and social sciences, and have the communication and personal skills necessary to be leaders and effective members of multidisciplinary teams.

Outcomes:

1. Students will have knowledge of, and appreciation for, historical and contemporary issues and the impact of such issues, by taking non-technical classes as part of an engineering education.
2. Students will have broad knowledge of environmental, economic, social, political and professional issues relevant to the practice of engineering in today's world.
3. Students will be able to communicate effectively.
4. Students will understand how to development personal and professional ethics and professional responsibility.
5. Students will be encouraged to join a professional society.
6. Students will be encouraged to participate in extra-curricular activities.
7. Students will be encouraged to become leaders.

Outcome Group 5: Life-long learning skills. Graduates will have the skills and motivation to continue learning throughout their careers.

Outcome:

1. Students will understand the need for and attain the skills to develop life-long learning.

## Bachelor of Science Geological Engineering

Entering freshmen desiring to study geological engineering will be admitted to the Freshman Engineering Program. They will, however, be permitted, if they wish, to state a geological engineering preference, which will be used as a consideration for available freshman departmental scholarships. The focus of the Freshman Engineering program is on enhanced advising and career counseling, with the goal of providing to the student the information necessary to make an informed decision regarding the choice of a major.

For the bachelor of science degree in geological engineering a minimum of 128 credit hours is required. These requirements are in addition to credit received for algebra, trigonometry, and basic ROTC courses. A student must maintain at least two grade points per credit hour for all courses taken in the student's major department, and an average of at least two grade points per credit hour must be maintained in geological engineering.

The geological engineering curriculum contains a required number of hours in humanities and social sciences as specified by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology. Each student's program of study must contain a minimum of 18 credit hours of course work from the humanities and the social sciences areas and should be chosen according to the following rules:

1. All students are required to take one American history course and one economics course. The history course is to be selected from HISTORY 1200, HISTORY 1300, HISTORY 1310, or POL SCI 1200. The economics course may be either ECON 1100 or ECON 1200. Some disciplines require one humanities course to be selected from the approved lists for art, English, foreign languages, music, philosophy, speech and media studies, or theater.
2. Of the remaining hours, six credit hours must be taken in humanities or social sciences at the 100 level or above and must be selected from the approved lists. Each of these courses must have as a prerequisite one of the humanities or social sciences courses already taken. Foreign language courses numbered 70 to 80 can be considered to be one of these courses. (Students may receive humanities credit for foreign language courses in their native tongue only if the course is at the 300 level.)
3. Some departments list specific requirements; e.g. a psychology course, a literature course, and /or a second semester of economics. Selections should be made to ensure that these requirements are met.
4. Skill courses are not allowed to meet humanities and social sciences requirements except in foreign languages. Students who select the foreign language option are urged to take more than one course.
5. Special topics, special problems courses and honors seminars are allowed only by petition to and approval by the student's program head.

The geological engineering program at Missouri S&T is characterized by its focus on the scientific basics of engineering and its innovative application; indeed, the underlying theme of this educational program is the application of the scientific basics to engineering practice through attention to problems and needs of the public. The necessary interrelations among the various topics, the engineering disciplines, and

the other professions as they naturally come together in the solution of real world problems are emphasized as research, analysis, synthesis, and design are presented and discussed through classroom and laboratory instruction.

Freshman Year			
First Semester	Credits	Second Semester	Credits
MATH 1214	4	MATH 1215	4
CHEM 1310	4	Chemistry/Geochemistry Elective <sup>b</sup>	3
CHEM 1100	1	MECH ENG 1720	3
CHEM 1319	1	PHYSICS 1135	4
ENGLISH 1120	3	H/SS Elective <sup>a</sup>	3
FR ENG 1100	1		
H/SS Elective <sup>a</sup>	3		
	17		17
Sophomore Year			
First Semester	Credits	Second Semester	Credits
MATH 2222	4	MATH 3304	3
PHYSICS 2135	4	CIV ENG 2200	3
GEO ENG 3148	3	GEO ENG 2110	1
GEO ENG 1150	3	GEOLOGY 2611	3
GEO ENG 1120	1	GEO ENG 3175	3
		Humanities/Soc Sci Elective <sup>a</sup>	3
	15		16
Junior Year			
First Semester	Credits	Second Semester	Credits
MECH ENG 2350	2	CIV ENG 3330	3
CIV ENG 2210	3	GEO ENG 4115	3
GEOLOGY 3310	3	GEO ENG 5443	3
Economics Elective <sup>j</sup>	3	Technical Communications Elective <sup>d</sup>	3
Hum/Soc Sc Elective <sup>a</sup>	3	Humanities/Soc. Sci Elective <sup>a</sup>	3
Earth Energy Elective <sup>c</sup>	3		
	17		15
Senior Year			
First Semester	Credits	Second Semester	Credits
Geophysics Elective <sup>i</sup>	3	GEO ENG 5174	3
GEO ENG 4010	0.5	GEO ENG 4010	0.5
GEO ENG 5331	3	Earth Mechanics Elective <sup>e</sup>	3
GEO ENG 5441	3	Eng Econ Elective <sup>f</sup>	3
GEO ENG 5090 or 5092 <sup>h</sup>	3	Technical Electives <sup>g</sup>	6
CIV ENG 3715 or MIN ENG 4823	3		
	15.5		15.5

Total Credits: 128

- a The sequence of course selection must provide both breadth and depth of content and must be selected from the list of approved humanities/social science electives available from your advisor. A total of 18 hours of humanities and social science credit is required.
- b The chemistry/geochemistry elective must be selected from chemistry, geochemistry or biology courses as approved by your advisor.
- c Students should select GEO ENG 5556, or other earth energy electives such as PET ENG 3330, PET ENG 2510, or GEOLOGY 5513.

- d The Technical Communications elective can be selected from ENGLISH 1160, ENGLISH 3560, SP&M S 1185, or the complete four-course sequence in Advanced ROTC (MIL ARMY 3250, MIL ARMY 3500, MIL ARMY 4250, and MIL ARMY 4500 or AERO ENG 5758, AERO ENG 351, AERO ENG 4790, and AERO ENG 5481).
- e To be selected from GEO ENG 5471, GEO ENG 5381, MIN ENG 4823, PET ENG 2510, PET ENG 3520, CIV ENG 3715, CIV ENG 4729, or CIV ENG 5715.
- f To be selected from ENG MGT 5210, MIN ENG 3512, or PET ENG 4590 or both ENG MGT 1100 and ENG MGT 1210.
- g To be selected from advanced courses in geological, mining, petroleum or civil engineering, geology or other courses with approval of your advisor. Must contain design content and must be approved by your advisor.
- h Students may take GEO ENG 5090 or GEO ENG 5092 for senior design credit.
- i The Geophysics elective can be selected from GEO ENG 5736, GEO ENG 5761, or GEO ENG 5782.
- j The Economics Elective must be selected from Econ 1100 or Econ 1200.

All GE students must take the Fundamentals of Engineering Examination prior to graduation. A passing grade is not required; however, it is the first step toward becoming a registered professional engineer. This requirement is part of the Missouri S&T assessment process. Students must sign a release form giving the University access to their Fundamentals of Engineering Examination score.

Geological engineering students must earn the grade of “C” or better in all geological engineering courses to receive credit toward graduation. The total number of credit hours required for a degree in Geological Engineering is 128. The assumption is made that a student admitted to the Department has completed 34 hours toward graduation to fulfill the requirements of the Freshman Engineering program.

## Geological Engineering Emphasis Areas

Electives are selected by the student with advisor approval. Some appropriate electives are listed for each emphasis area.

### Environmental Protection and Hazardous Waste Management

GEO ENG 5235	Environmental Geological Engineering	3
GEO ENG 5237	Geological Aspects Of Hazardous Waste Management	3
GEO ENG 5381	Intermediate Subsurface Hydrology And Contaminant Transport Mechs	3
GEO ENG 5331	Subsurface Hydrology	3
GEO ENG 4115	Statistical Methods in Geology and Engineering	3
GEO ENG 4276	Environmental Aspects Of Mining	3
GEO ENG 5233	Risk Assessment In Environmental Studies	3
CIV ENG 3715	Fundamentals of Geotechnical Engineering	3

### Groundwater Hydrology and Contaminant Transport

GEO ENG 5381	Intermediate Subsurface Hydrology And Contaminant Transport Mechs	3
GEO ENG 5233	Risk Assessment In Environmental Studies	3
GEO ENG 5174	Geological Engineering Field Methods	3
GEO ENG 5331	Subsurface Hydrology	3
GEO ENG 4115	Statistical Methods in Geology and Engineering	3
GEO ENG 5441	Engineering Geology And Geotechnics	3

CIV ENG 3715	Fundamentals of Geotechnical Engineering	3
PET ENG 3330	Well Logging	3

## Engineering Geology and Geotechnics

GEO ENG 5471	Rock Engineering	3
CIV ENG 3715	Fundamentals of Geotechnical Engineering	3
MIN ENG 4823	Rock Mechanics	3
CIV ENG 4729	Foundation Engineering	3
MIN ENG 308		
GEO ENG 5146	Applications Of Geographic Information Systems	3
GEO ENG 5441	Engineering Geology And Geotechnics	3
GEO ENG 4115	Statistical Methods in Geology and Engineering	3

## Petroleum, Energy and Natural Resources

PET ENG 3520	Petroleum Reservoir Engineering	3
MIN ENG 4823	Rock Mechanics	3
GEO ENG 5146	Applications Of Geographic Information Systems	3
GEO ENG 5381	Intermediate Subsurface Hydrology And Contaminant Transport Mechs	3
GEOLOGY 5511	Applied Petroleum Geology	3
PET ENG 2510	Properties Of Hydrocarbon Fluids	3
PET ENG 1110	Introduction to Petroleum Engineering	1
PET ENG 3330	Well Logging	3
PET ENG 4520	Well Test Analysis	3

## Quarry Engineering

MIN ENG 4823	Rock Mechanics	3
GEO ENG 5575	Aggregates And Quarrying	3
CIV ENG 3116	Construction Materials, Properties And Testing	3
GEO ENG 5471	Rock Engineering	3
GEO ENG 4276	Environmental Aspects Of Mining	3
MIN ENG 3913	Mineral Identification and Exploration	3
MIN ENG 5612	Principles of Explosives Engineering	3
MIN ENG 308		3
MIN ENG 5822	Strata Control	3

## Minor in Geological Engineering

Geological engineering offers employment opportunities for a broad spectrum of disciplines including civil, mining, nuclear, and petroleum engineering as well as for geologists and geophysicists. A minor in geological engineering or engineering geology, therefore, enhances the academic credentials of a student and broadens employment choices. A minor in geological engineering requires 15 hours of Missouri S&T credit to include the following:

GEO ENG 1150	Physical and Environmental Geology <sup>1</sup>	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 <sup>2</sup>		3
Total Credits		15

<sup>1</sup> GEOLOGY 1110 may be substituted for geology and geophysics majors.

<sup>2</sup> To be selected with geological engineering advisor approval.

## Minor in Humanitarian Engineering and Science

Humanitarian engineering may be described as a multi-disciplinary approach to improve the well-being of underserved or developing

communities and/or populations. The purpose of the minor is to provide the opportunity to all Missouri S&T students to:

- Potentially participate in activities designed to improve the well-being of underserved or developing communities/populations
- Address quality of life issues, local leadership partnerships, resource allocation, the natural world, and climate and risk
- Obtain a degree that explicitly requires experiential service learning

The Humanitarian Engineering and Science Minor requires the completion of a minimum of 15 hours of courses as described below:

A minimum of three semesters (for a minimum total of 1.5 SCH):

GEO ENG 1810	Humanitarian Engineering and Science Colloquium
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A minimum of three semesters (for a minimum total of 1.5 SCH):

GEO ENG 1880	Civic Engagement
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Three hours of ethics-related coursework to be selected from:

PHILOS 3223	Bioethics
PHILOS 3225	Engineering Ethics
PHILOS 3235	Business Ethics

Nine hours of electives to be selected from:

ARCH ENG 5642	Sustainability, Population, Energy, Water, and Materials (co-listed with CIV ENG 5642 and ENV ENG 5642)
BIO SCI 2372	Issues in Public Health
BUS 3115	Introduction to Teambuilding and Leadership
ECON 4440	Environmental And Natural Resource Economics
ECON 4641	Foundations of Sustainability
ECON 4642	Introduction to Global Eco- and Social-preneurship and Innovation
ECON 4730	Economic Development
ENG MGT 4330	Human Factors
ENGLISH 3228	The American Experience
GEO ENG 5331	Subsurface Hydrology
GEO ENG 5211	Introduction to International Engineering and Design Lab
GEO ENG 5247	Introduction to International Engineering and Design
GEO ENG 5092	International Engineering and Design
HISTORY 3510	Twentieth Century Technology And Society
MKT 3210	Consumer Behavior
MKT 4150	Customer Focus and Satisfaction
POL SCI 2500	International Relations
POL SCI 3510	
PSYCH 4600	Social Psychology
PSYCH 4710	Human Factors
PSYCH 4730	Environmental Psychology
PSYCH 4992	Cross-Cultural Psychology
SP&M S 3235	Intercultural Communication
SP&M S 3250	Interpersonal Communication

Foreign language - a maximum of 4 SCH may be applied to the Humanitarian Engineering and Science Minor electives requirement.

**Neil L Anderson, Professor**<sup>1,2</sup>  
PHD University of Calgary

**Kwame Awuah-Offei, Associate Professor**  
PHD University of Missouri-Rolla

**James L Bunch, Lecturer**  
MASTER Missouri University of Science

**Jeffrey D Cawfield, Professor**<sup>1,2</sup>  
PHD University of California-Berkeley

**Leslie Sour Gertsch**, Associate Professor  
PHD Colorado School of Mines

**Katherine R Grote**, Associate Professor  
PHD University of California, Berkeley

**Joe D Guggenberger**, Assistant Professor  
PHD Missouri University of Science and Technology

**James E Kaufmann**, Lecturer  
MASTER University of Missouri-Rolla

**Norbert H Maerz**, Associate Professor<sup>1,2</sup>  
PHD University of Waterloo

**J David Rogers**, Associate Professor<sup>1,2</sup>  
PHD University of California-Berkeley

**James E Vandike**, Lecturer  
MASTER South Dakota School of Mines & Technology

**Emitt Cleveland Witt**, Adjunct Assistant Professor  
PHD Missouri University of Science & Technology

**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 1119 Physical and Environmental Geology Laboratory** (LAB 1.0)  
Geology 1119 is designed to accompany Geology 1110 and consists of laboratory explorations of the study of common rocks and minerals, air photographs, maps, and case studies of geological problems related to management of Earth resources, hazards, and environmental challenges. Prerequisite: Preceded or accompanied by Geology 1110. (Co-listed with Geology 1119).

**GEO ENG 1150 Physical and Environmental Geology** (LEC 3.0)  
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.

**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 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 personal computers and network operations for graphical analysis of geologic data, mapping of surface and subsurface configurations and modeling of geologic processes. Prerequisites: Geo Eng 1150, Comp Sci 1970, 1980.

**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** (LEC 0.0 and LAB 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 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** (LEC 0.0 and LAB 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** (LEC 2.0 and LAB 1.0)

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 5092 International Engineering and Design** (LEC 3.0)

A multi-disciplinary engineering course focused on sustainable design and technology transfer to developing countries. Course includes elements of traditional capstone design classes. Experiential learning through competitions and/or field work is a major component of the class. Prerequisites: Senior standing, instructor approval, Geo Eng 5211, Geo Eng 5247. (Co-listed with Met Eng 4510 and Cer Eng 4510).

**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** (LEC 2.0 and LAB 1.0)

Principles of digital image processing including image enhancement and multispectral classification. Emphasis upon design and implementation of remote sensing systems and analysis of remotely sensed data for geotechnical and environmental investigations. Prerequisite: Geo Eng 3148. (Co-listed with Geology 4310).

**GEO ENG 5146 Applications Of Geographic Information Systems** (LEC 2.0 and LAB 1.0)

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 Advanced Environmental Aspects Of Mining** (LEC 3.0)

Applied and fundamental research issues pertaining to: 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. Course project.

**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 3111 or Stat 3113 or Stat 3115 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** (LEC 3.0)

Introduction to the theory and engineering concepts of the movement of subsurface fluids. Properties of water and other subsurface fluids. Hydraulic characteristics of earth materials. Engineering problems related to subsurface fluids. Prerequisites: Geo Eng 1150, Math 3304.

**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 interconnection, basic groundwater flow and well test analysis, and a brief intro to contaminant transport.

**GEO ENG 5381 Intermediate Subsurface Hydrology And Contaminant Transport Mechs** (LEC 3.0)

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: Civ Eng 3330 & Geo Eng 5331.

**GEO ENG 5415 Soil Mechanics for Geoprosessionals** (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 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 fortifications, core infrastructure, water resources and combat engineering requirements. Prerequisite: Geo Eng 3175 or graduate standing.

***GEO ENG 5736 Geophysical Field Methods*** (LEC 2.0 and LAB 1.0)

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*** (LEC 2.0 and LAB 1.0)

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).