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 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 and inclusive 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

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. 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 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 2000 level or above and must meet requirements as specified under “Engineering Degree Requirements” published in the current undergraduate catalog. Each of these courses must have as a prerequisite one of the humanities or social sciences courses already taken. Foreign language courses numbered 1180 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 3000 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. Special topics, special problems courses and honors seminars are offered 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

<table>
<thead>
<tr>
<th>First Semester</th>
<th>Credits</th>
<th>Second Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 1214</td>
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<td>MATH 1215</td>
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<td>PHYS 1315</td>
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<td>CHEM 1100</td>
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<td>GEO 1150</td>
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<tr>
<td>ENGLISH 1120</td>
<td>3</td>
<td>Humanities/Soc Sci Elective</td>
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<td>FR ENG 1100</td>
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<td><strong>Total Credits:</strong></td>
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### Sophomore Year

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<tbody>
<tr>
<td>MATH 2222</td>
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<td>MATH 3304</td>
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<tr>
<td>PHYSICS 2135</td>
<td>4</td>
<td>CIV ENG 2200</td>
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<td>GEO ENG 3148</td>
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<td>GEO ENG 2110</td>
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### Junior Year

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</thead>
<tbody>
<tr>
<td>MATH ENG 2350</td>
<td>2</td>
<td>CIV ENG 3330</td>
<td>3</td>
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<tr>
<td>CIV ENG 2210</td>
<td>3</td>
<td>GEO ENG 5443</td>
<td>3</td>
</tr>
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<td>GEO ENG 5331</td>
<td>3</td>
<td>ENGLISH 3560</td>
<td>3</td>
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<tr>
<td>Economics Elective&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3</td>
<td>Humanities/Soc Sci Elective&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3</td>
</tr>
<tr>
<td>GEOLOGY 3310</td>
<td>3</td>
<td>Chemistry/Geochemistry Elective&lt;sup&gt;c&lt;/sup&gt;</td>
<td>3</td>
</tr>
<tr>
<td>Humanities/Soc Sci Elective&lt;sup&gt;a&lt;/sup&gt;</td>
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<tr>
<td>GEOLOGY 3319</td>
<td>1</td>
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### Senior Year

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<tbody>
<tr>
<td>Geophysics Elective&lt;sup&gt;d&lt;/sup&gt;</td>
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<td>GEO ENG 5174</td>
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<td>GEO ENG 4010</td>
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<tr>
<td>GEO ENG 5441</td>
<td>3</td>
<td>Earth Mechanics Elective&lt;sup&gt;e&lt;/sup&gt;</td>
<td>3</td>
</tr>
<tr>
<td>GEO ENG 5090 or 5092&lt;sup&gt;f&lt;/sup&gt;</td>
<td>3</td>
<td>Technical Electives&lt;sup&gt;g&lt;/sup&gt;</td>
<td>6</td>
</tr>
<tr>
<td>CIV ENG 3715 or MIN ENG 5823</td>
<td>3</td>
<td>Eng Econ Elective&lt;sup&gt;h&lt;/sup&gt;</td>
<td>3</td>
</tr>
<tr>
<td>GEO ENG 4115</td>
<td>3</td>
<td></td>
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<tr>
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<td><strong>Total Credits:</strong></td>
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<table>
<thead>
<tr>
<th>Credits</th>
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<tbody>
<tr>
<td>15.5</td>
<td>15.5</td>
</tr>
</tbody>
</table>

### Total Credits: 128

- a The sequence of course selection must provide both breadth and depth of content and must meet requirements as specified under “Engineering Degree Requirements” published in the current undergraduate catalog. A total of 18 hours of humanities and social science credit is required.
- b The Economics Elective must be selected from ECON 1100 or ECON 1200.
- c The chemistry/geochemistry elective must be selected from chemistry, geochemistry or biology courses as approved by your advisor.
- d The Geophysics elective can be selected from GEO ENG 5736, GEO ENG 5761, or GEO ENG 5782.
- e Students may take GEO ENG 5090 or GEO ENG 5092 for senior design credit.
- f To be selected from GEO ENG 5471, GEO ENG 5381, GEO ENG 5556, MIN ENG 5823, PET ENG 2510, PET ENG 3520, CIV ENG 3715, CIV ENG 4729, or CIV ENG 5715.
- 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 To be selected from ENG MGT 5210, MIN ENG 3512, or PET ENG 4590 or both ENG MGT 1100 and ENG MGT 1210.

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.

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.

### Engineering Geology and Geotechnics

- **GEO ENG 5471**: Rock Engineering 3
- **CIV ENG 3715**: Fundamentals of Geotechnical Engineering 3
- **CIV ENG 4729**: Foundation Engineering 3
- **MIN ENG 5823**: Rock Mechanics 3
- **GEO ENG 5140**: Applications Of Geographic Information Systems 3
- **GEO ENG 5441**: Engineering Geology And Geotechnics 3

### Groundwater Hydrology and Environmental Protection

- **GEO ENG 5381**: Intermediate Subsurface Hydrology And Contaminant Transport Mechs 3
- **GEO ENG 5233**: Risk Assessment In Environmental Studies 3
- **GEO ENG 5235**: Environmental Geological Engineering 3
- **GEO ENG 5230**: Groundwater Modeling 3
- **GEO ENG 5237**: Geological Aspects Of Hazardous Waste Management 3
- **CIV ENG 5640**: Environmental Law And Regulations 3
- **GEO ENG 4276**: Environmental Aspects Of Mining 3
- **PET ENG 3330**: Well Logging 3

### Dual Professional Registration as a Geologist

- **GEOL 2096**: Field Geology 3
- **GEOL 3620**: Stratigraphy And Sedimentation 3
- **GEOL 4097**: Advanced Field Geology 3
- **GEOL 4841**: Geological Field Studies 3
- **GEOL 3410**: Introduction To Geochemistry 3
- **GEOL 4310**: Remote Sensing Technology 3
- **GEOL 4431**: Methods Of Karst Hydrogeology 3

### Environmental and Engineering Geophysics

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

### Renewable and Conventional Energy Resources

- **GEO ENG 5556**: Renewable Energy Systems 3
- **PET ENG 3520**: Petroleum Reservoir Engineering 3
- **GEO ENG 5146**: Applications Of Geographic Information Systems 3
- **MIN ENG 5823**: Rock Mechanics 3
- **GEO ENG 5381**: Intermediate Subsurface Hydrology And Contaminant Transport Mechs 3
- **GEOL 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 and Mining Engineering

- **GEO ENG 5575**: Aggregates And Quarrying 3
- **MIN ENG 5823**: Rock Mechanics 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 5822**: Strata Control 3

### Accelerated BS/MS Geological Engineering Program Option for Geological Engineering Majors

Geological Engineering undergraduates at Missouri S&T may opt to apply for an accelerated BS/MS program where a student can achieve both the BS and MS degrees in Geological Engineering faster than if pursuing the degrees separately. The degrees awarded will be a BS & MS in Geological Engineering.

The benefits for undergraduate students admitted to the program are:

- Undergraduate and graduate courses may be chosen with greater flexibility.
- Up to six hours of 5000-level or above Geo Eng coursework may apply to both the BS and MS requirements.
- The classes taken for shared BS/MS credit may be taken at the lower undergraduate tuition rate.
- The GRE is not required for admission.
- Other graduate courses can be taken anytime after entering the program as a dual enrolled student.
- Work on a thesis project may begin before the BS requirements are completed.

To be eligible for the accelerated BS/MS Geo Eng program, a Geo Eng undergraduate must be at or beyond the junior level standing with a minimum of 48 credit hours, have successfully completed the Chemistry and Math requirements, and have completed 18 credit hours of Geo Eng courses at Missouri S&T with at least a 3.2 GPA in the Geo Eng courses. To be admitted, the student must complete the program application and must have the recommendation of a Geo Eng faculty member. All other MS degree requirements remain the same. The program may be combined with existing honors research, emphasis areas, and certificate options. Admitted students will have both undergraduate and graduate records in the Registrar’s Office.

The Accelerated Program application must be completed within one semester after all shared-credit courses are completed. Courses taken for shared credit will be identified on the application form. These courses will also be listed on the student’s Graduate Form 1 to be submitted after the student enters the graduate program. The six hours of shared-credit coursework, to be taken as undergraduate credit, must be approved by the academic advisor and may not be undergraduate research, special problems, or transfer courses. 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. Acceptance to the Geo Eng MS degree program from the Accelerated Program is automatic so 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 the Accelerated Program, the student must meet Geological Engineering graduate student academic
performance requirements and must maintain continuous enrollment at Missouri S&T. If the student exits the program before completion of the MS degree requirements, 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. It is international student’s responsibility to check with the International Affairs Office during completion of an accelerated BS/MS to ensure immigration status is properly maintained throughout the program.

### 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 geophysists. 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:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEO ENG 1150</td>
<td>Physical and Environmental Geology(^1)</td>
<td>3</td>
</tr>
<tr>
<td>GEO ENG 3175</td>
<td>Geomorphology And Terrain Analysis</td>
<td>3</td>
</tr>
<tr>
<td>GEO ENG 5331</td>
<td>Subsurface Hydrology</td>
<td>3</td>
</tr>
<tr>
<td>GEO ENG 5441</td>
<td>Engineering Geology And Geotechnics</td>
<td>3</td>
</tr>
<tr>
<td>GEO ENG Elective (^2)</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

Total Credits 15

\(^1\) GEOLOGY 1110 may be substituted for geology and geophysics majors.

\(^2\) 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 coursework as described below:

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

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEO ENG 1810</td>
<td>Humanitarian Engineering and Science Colloquium</td>
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</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEO ENG 1880</td>
<td>Civic Engagement</td>
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Three hours of ethics-related coursework to be selected from:

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<tr>
<td>PHILOS 3223</td>
<td>Bioethics</td>
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<tr>
<td>PHILOS 3225</td>
<td>Engineering Ethics</td>
<td></td>
</tr>
<tr>
<td>PHILOS 3235</td>
<td>Business Ethics</td>
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</table>

Nine hours of electives to be selected from:

<table>
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<th>Credit</th>
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<tbody>
<tr>
<td>ARCH ENG 5642</td>
<td>Sustainability, Population, Energy, Water, and Materials (co-listed with CIV ENG 5642 and ENV ENG 5642)</td>
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</tr>
<tr>
<td>BIO SCI 2372</td>
<td>Issues in Public Health</td>
<td></td>
</tr>
<tr>
<td>BUS 3115</td>
<td>Introduction to Teambuilding and Leadership</td>
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</tr>
<tr>
<td>ECON 4440</td>
<td>Environmental And Natural Resource Economics</td>
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</tr>
<tr>
<td>ECON 4641</td>
<td>Foundations of Sustainability</td>
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<tr>
<td>ECON 4642</td>
<td>Introduction to Global Eco- and Social-preneurship and Innovation</td>
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<td>ECON 4730</td>
<td>Economic Development</td>
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<tr>
<td>ENG MGT 4330</td>
<td>Human Factors</td>
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<tr>
<td>ENGLISH 3228</td>
<td>The American Experience</td>
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<tr>
<td>GEO ENG 5331</td>
<td>Subsurface Hydrology</td>
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<tr>
<td>GEO ENG 5211</td>
<td>Introduction to International Engineering and Design Lab</td>
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<td>GEO ENG 5247</td>
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<tr>
<td>HISTORY 3510</td>
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<td>MKT 3210</td>
<td>Consumer Behavior</td>
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<td>MKT 4150</td>
<td>Customer Focus and Satisfaction</td>
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<td>POL SCI 2500</td>
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<td>POL SCI 3510</td>
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<td>PSYCH 4600</td>
<td>Social Psychology</td>
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<td>PSYCH 4710</td>
<td>Human Factors</td>
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<td>SP&amp;M S 3235</td>
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<td>Interpersonal Communication</td>
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Foreign language - a maximum of 4 SCH may be applied to the Humanitarian Engineering and Science Minor electives requirement.

- Neil L Anderson, Professor\(^1,2\)
  PHD University of Calgary
- James L Bunch, Lecturer
  MASTER Missouri University of Science
- Jeffrey D Cawlfield, Professor\(^1,2\)
  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
- James E Kaufmann, Lecturer
  MASTER University of Missouri-Rolla
- Norbert H Maerz, Associate Professor\(^1,2\)
  PHD University of Waterloo
- J David Rogers, Associate Professor\(^1,2\)
  PHD University of California-Berkeley

**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.

**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 2011 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 2020 Special Problems** (IND 0.0-6.0)
Problems or readings on specific subjects or projects in the department. Consent of instructor required.

**GEO ENG 2110 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 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 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** (LEC 2.0 and LAB 1.0)
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 (LAB 3.0)
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 (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: Geog 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. (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 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. Hydraulic characteristics of earth materials, aquifer characterization, and flow prediction. Engineering problems related to subsurface fluids. Prerequisites: Geo Eng 1150 or equivalent, Math 1215.

**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 Geoprofessionals** (LEC 3.0)
The basic principles of soil mechanics necessary for professionals to practice in the field of geotechnics. 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)

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 (LEC 2.0 and LAB 1.0)
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).