

GEOTECHNICS

The geological engineering program at Missouri University of Science and Technology offers an on-line masters of engineering degree in geotechnics. This web-based degree is designed for working professionals, whose upward mobility requires an advanced degree, but who do not wish to take an extended leave of absence to physically attend college. The program is an interdisciplinary master's degree program without a required research component. Courses in geological, civil, and mining engineering can be applied to the degree. The program is offered using distance-education methods and therefore there is no formal residency requirement.

Entrance Requirements

This program is open to graduates holding a B.S. degree in engineering or geology or other hard sciences. (For graduates of a non-engineering B.S. some bridging courses may be required). Prerequisite requirements include at least one introductory course in physical geology and one introductory course in rock mechanics or soil mechanics or equivalent. GRE scores are not required. For international students, minimum English testing scores are TOEFL 79, or IELTS 6.5, or PTE 53.

Contact information e-mail gtech@mst.edu or visit our website at <http://gtech.mst.edu/>.

Course Requirements

This web-based degree is designed for working professionals whose upward mobility requires an advanced degree, but who do not wish to take an extended leave of absence to physically attend college. It requires 30 credit hours of graduate credit in 4000, 5000, and 6000 level courses, and a practice-oriented report instead of a research project. The following five core courses (15 credit hours) are mandatory:

GEO ENG 5381	Intermediate Subsurface Hydrology And Contaminant Transport Mechs	3
GEO ENG 5441	Engineering Geology And Geotechnics	3
GEO ENG 5471	Rock Engineering	3
GEO ENG 6400	Practice Oriented Project	3
CIV ENG 5715	Intermediate Soil Mechanics	3

Of the additional 15 credit hours of course work, up to 9 credit hours of graduate credit (minimum grade B) can be transferred from another university with advisor approval if not used toward another degree. The balance of the credit hours must be Missouri S&T graduate courses. At least 15 credit hours must be geological engineering courses, and at least 9 credit hours must be from 6000-level courses.

Jeffrey D Cawfield, Professor^{1,2}

PHD University of California-Berkeley

Probabilistic modeling and geo-statistics, ground-water and contaminant transport analysis, and computer applications in geological engineering.

Leslie Sour Gertsch, Associate Professor

PHD Colorado School of Mines

Rock mechanics, mechanical mining and excavating, mine design and rock fragmentation.

Katherine R Grote, Associate Professor²

PHD University of California-Berkeley

Application of geophysical techniques for hydrological site characterization with emphasis on vadose zone processes, investigation of agriculture practices for improved water management.

Jeremy Maurer, Assistant Professor

PHD Stanford University

Geophysics, earthquakes, induced seismicity, remote sensing, big Earth data.

J David Rogers, Hasselmann Professor^{1,2}

PHD University of California-Berkeley

Seismic hazards, geotechnical engineering, dam safety and earth structures.

Taghi Sherizadeh, Assistant Professor

PHD University of Arizona

Computational mechanics, numerical, statistical, and probabilistic modeling in rock mechanics.

Ryan G Smith, Assistant Professor

PHD Stanford University

Geophysics, remote sensing hydrology, GIS and data analytics.

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 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 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 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 (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; Math 1215 or Math 1221.

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. 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 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 (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.

GEO ENG 6000 Special Problems (IND 0.0-6.0)

Problems or readings on specific subjects or projects in the department. Consent of instructor required.

GEO ENG 6001 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 6010 Seminar (RSD 1.0)

Discussion of current topics. Prerequisite: Graduate student.

GEO ENG 6040 Oral Examination (IND 0.0)

After completion of all other program requirements, oral examinations for on-campus M.S./Ph.D. students may be processed during intersession. Off-campus M.S. students must be enrolled in oral examination and must have paid an oral examination fee at the time of the defense/comprehensive examination (oral/ written). All other students must enroll for credit commensurate with uses made of facilities and/or faculties. In no case shall this be for less than three (3) semester hours for resident students.

GEO ENG 6050 Continuous Registration (IND 1.0)

Doctoral candidates who have completed all requirements for the degree except the dissertation, and are away from the campus must continue to enroll for at least one hour of credit each registration period until the degree is completed. Failure to do so may invalidate the candidacy. Billing will be automatic as will registration upon payment.

GEO ENG 6085 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 6099 Research (IND 0.0-15)

Investigations of an advanced nature leading to the preparation of a thesis or dissertation.

GEO ENG 6146 Advanced Remote Sensing And Image Processing (LAB 1.0 and LEC 2.0)

Quantitative methods of utilizing remote sensing technology for terrain analysis. Digital image processing of landsat and/or aircraft scanner data for mineral resource studies and geological engineering applications. Prerequisite: Geo Eng 5146. (Co-listed with Geology 6341).

GEO ENG 6235 Advanced Concepts Of Environmental Geological Engineering (LEC 3.0)

Application of the principles of geology to the solution of engineering problems in environmental protection and remediation. Topics will include the study of geologic processes and the evaluation of geologic materials as they affect the potential for groundwater contamination, susceptibility of soils to erosion, characterization of the geologic environment for site suitability and the analysis of the criteria necessary for the selection of technologies for minimizing environmental impact. Prerequisite: Graduate level course in environmental geologic studies.

GEO ENG 6237 Advanced Geological & Geotechnical Design For Hazardous Waste Mgt (LEC 3.0)

Geological and geotechnical design factors for hazardous waste management facilities and remedial actions (cleanup) of uncontrolled hazardous waste sites. Prerequisite: Geo Eng 5237 or consent of instructor.

GEO ENG 6331 Advanced Subsurface Hydrology (LEC 3.0)

Advanced treatment of selected topics in subsurface hydrology, including groundwater contamination, contaminant transport, land disposal of wastes, aquifer test analysis, injection well technology, etc. Applied hydrogeologic site analysis and flow and transport modeling through solution of selected case examples. Prerequisite: Geo Eng 5331 or equivalent.

GEO ENG 6332 Numerical Methods In Subsurface Flow (LEC 3.0)

Development of governing balance equations, constitutive laws and mathematical models of groundwater flow and contaminant transport in porous media. Solution of mathematical models by finite difference and finite element methods for various boundary and initial conditions. Prerequisites: Geo Eng 5331, Comp Sci 1970.

GEO ENG 6400 Practice Oriented Project (IND 3.0)

This class will consist of a single term project. Students will, in consultation with the instructor, pick a topic relevant to their studies, and produce a comprehensive, in depth, professionally written report, including a literature review on the state of the practice on that topic. Prerequisites: Limited to students enrolled in the Masters of Engineering (M.E.) in Geotechnics Program.

GEO ENG 6407 Inca Civilization Geotechnical Engineering Practices (LEC 3.0)

An in-depth study of geotechnical engineering practices in the mountains of Peru, including the Cuzco-Machu Picchu corridor, with emphasis on the inter-relationships between tectonics, geology, geomorphology, climate, hydrology, agriculture, quarrying, construction practices, irrigation, culture and history. A week-long field trip to Peru during Spring Break is required at student's expense. Prerequisite: Geo Eng 1150 or Civ Eng 3715 or Geo Eng 5471 or equivalent; Graduate standing. (Co-listed with Civ Eng 6760).

GEO ENG 6441 Geotechnical Construction Practice (LEC 3.0)

Advanced level lecture topics on procedures used for site characterization, standards for earthquake grading and construction, including embankments, building pads, retention structures, roads, levees, and earthen dams. Specific emphasis on preparation of documents involved in such work and engineer's responsibilities. Prerequisite: Geo Eng 5441.

GEO ENG 6477 Discontinuous Rock (LEC 3.0)

Nature and properties of discontinuous rock masses, genesis and properties of joints, role of joints in rock shear strength, slope of stability of jointed rock, fracture flow hydrogeology. Modeling of the mechanical behavior of fractured rock. Prerequisite: Min Eng 4823 or Geo Eng 5471.

GEO ENG 6625 Applications in Geological Engineering (LEC 3.0)

Content is focused on practical aspects of geological engineering. Geotechnical, environmental and geohydrologic case studies are presented to illustrate concepts and relate theory to applications.

GEO ENG 6736 Advanced Geophysical Methods (LAB 2.0 and LEC 1.0)

Geophysical field data will be acquired at selected study sites with the objective of imaging the shallow subsurface and/or built structures.

Registrants will process and interpret the acquired non-invasive imaging data using ground truth as a constraint. Prerequisite: Graduate Standing.

GEO ENG 6782 Surface Waves (MASW) and Ground Penetrating Radar (GPR)

(LAB 1.0 and LEC 2.0)

Geological engineering applications of surface wave and ground penetrating radar methods are emphasized. Field data will be acquired, processed and interpreted. Prerequisites: Geo Eng 1150 or Civ Eng 3715 or equivalent, and graduate standing.

GEO ENG 6784 Advanced Engineering And Environmental Geophysics (LEC

3.0)

An introduction to the theory and application of the gravity, magnetic, resistivity, self-potential induced polarization, seismic, electromagnetic and GPR methods as applied to the solution of engineering and environmental problems. Prerequisite: Admittance into USAES-S&T Co-operative Degree Program. (Co-listed with Geophys 5251).
