

Geology and Geological Engineering



M.S. and Ph.D.

Contact Information

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Geology Faculty

Professors Duke, Paterson; Associate Professor Uzunlar; Assistant Professor Terry; Professors Emeritus Fox, Lisenbee, Redden.

Geological Engineering Faculty

Professors Davis, Stetler, Assistant Professors Sawyer, Katzenstein; Professor Emeritus Rahn

Geology and Geological Engineering

The Department of Geology and Geological Engineering offers advanced study leading to an M.S. degree in geology and geological engineering or a Ph.D. degree in geology and geological engineering. Students must elect to pursue either a Geology Specialization or a Geological Engineering Specialization, each of which has different background requirements and program requirements. The available course work and current faculty expertise support the

following areas of concentration. Students take a core of required courses supplemented by electives determined by the student's committee based on the intended field of study:

1. Energy and Mineral Resources
2. Environmental/Exploration Geophysics
3. Ground Water / Environmental Studies
4. Mineral Deposits/Mineralogy/Petrology
5. Sedimentation/Stratigraphy
6. Paleontology*
7. Structural Geology/Tectonics
8. Geomechanics/Engineering geology

* Ph.D. only. Students concentrating in Paleontology at the Master's level should apply for the separate M.S. in Paleontology.

Background Requirements for M.S. and Ph.D.

The Graduate Record Examination (GRE) is required of all applicants except School of Mines graduates. The TOEFL exam is required for students whose native language is not English.

Geology Specialization

1. All incoming students are expected to present a full year each of college-level Calculus, Physics, and Chemistry as part of their undergraduate record. Deficiencies in these areas must be remedied by taking the necessary course work prior to or in the first year of enrollment in the graduate program.
2. All incoming students are expected to have completed courses in, or to develop proficiency in, the following areas. Additional subjects may be required by the student's graduate committee depending on the student's area of concentration. The student and the graduate committee will arrange in writing how these requirements can best be met.

- Physical Geology
- Mineralogy
- Stratigraphy and Sedimentation
- Petrology

- Structural Geology
- Field Geology

Geological Engineering Specialization

1. All incoming students are expected to present three semesters of Calculus and one semester of Differential Equations, as well as two semesters each of Physics and Chemistry, as part of their undergraduate record. Deficiencies in these areas must be remedied by taking the necessary course work prior to or in the first year of enrollment in the graduate program.

2. All incoming students are expected to have completed courses in, or to develop proficiency in, the following areas. Additional subjects may be required by the student's graduate committee depending on the student's area of concentration. The student and the graduate committee will arrange in writing how these requirements can best be met.

- Physical Geology or Geology for Engineers
- Mineralogy
- Stratigraphy and Sedimentation
- Structural Geology
- Statics
- Mechanics of Materials
- Fluid Mechanics

Master's Program

The M.S. degree program consists of research and study in various fields depending on the student's interests. The M.S. thesis option requires 32 credits, including six to eight (6-8) credits of thesis research and twenty-four to twenty-six (24-26) credits of course work. The non-thesis option includes 32 credits of course work and is reserved for students who have had extensive professional experience after the B.S. degree. Candidates for the M.S. degree must fulfill all degree requirements of the graduate office and also the program requirements. Each student must elect a specialization in Geology or in Geological Engineering.

Geology Specialization Requirements

Core Courses:

- GEOL 604 Advanced Field Geology
- GEOL 633 Sedimentation

One course from:

- GEOL 517 Geospatial Databases
- GEOL 519 Advanced Geospatial Analysis
- GEOE 766 Digital Modeling of Ground-Water
- MEM 533 Comp Apps in Geoscience Modeling

One course from:

- GEOL 621 Advanced Structural Geology
- GEOL 622 Geotectonics

One course from:

- GEOE 552 Geochemical Exploration
- GEOE 626 Environmental Geophysics
- GEOE 641 Geochemistry
- GEOE 664 Advanced Ground Water

Geological Engineering Specialization Requirements

Core Courses:

- GEOL 633 Sedimentation
- GEOE 766 Digital Modeling of Ground Water

Geological Engineering students focus on one of three areas. Typical course work recommended for focus is shown below.

Ground Water and Environmental Focus

- GEOE 641 Geochemistry
- GEOE 664 Advanced Ground Water
- CEE 634 Surface Water Hydrology
- GEOE 682 Fluvial Processes

Geomechanics Focus

- GEOE 668 Eng. Geology of Surficial Deposits
- CEE 643 Advanced Soil Mechanics I
- CEE 646 Stability of Soil and Rock Slopes
- CEE 647 Earth Structures
- MEM 533 Comp Apps in Geoscience Modeling

Energy and Mineral Resources Focus	
GEOE 531	Principles of Well Logging
GEOE 552	Geochemical Exploration
GEOE 525	Engineering Geophysics II
GEOE 641	Geochemistry
GEOE 661	Petroleum Geology
GEOL 652	Problems in Ore Deposits

Doctor of Philosophy Program

Admission to the Ph.D. program in Geology and Geological Engineering is normally limited to qualified students who have already earned an M.S. degree in geology, geological engineering, paleontology, or a related field. Students holding an M.S. but with extensive undergraduate deficiencies may be placed into the M.S. program in Geology and Geological Engineering until these deficiencies are remedied. Students with a B.S. degree who apply to the Ph.D. program will be admitted to the M.S. program in Geology and Geological Engineering until they have accumulated sufficient course credits for an M.S. degree. Students placed into the M.S. under one of these two circumstances will be admitted to the Ph.D. program after passing the qualifying exam.

Qualifying Exam

All Ph.D. students are expected to take a qualifying exam to demonstrate their potential for independent research. Students entering with a B.S. degree will take the examination in the semester immediately following the completion of 24 credits of graduate course work. Students placed in the M.S. due to undergraduate deficiencies must take it in the semester immediately following the completion of the deficiencies. Students entering with a completed M.S. degree will take it before the end of their second semester in residence.

To pass the qualifying exam, the student must 1) complete all undergraduate deficiency requirements, 2) submit a valid Ph.D. Program of Study to the department chair; 3) complete a literature search and paper on a topic related to the student's area of concentration; and 4) present and defend the paper in an oral examination by the department faculty. The paper should reflect a

sustained effort during the student's first year and culminate in an analysis of potential significant research problems. The identified problems need not match the eventual dissertation topic.

Curriculum

A minimum of eighty (80) credit hours are required beyond the B.S. degree. At least fifty (50) of these credits must be for course work. Up to twenty-four (24) course credits and six (6) research credits from the M.S. degree can be applied toward the total required credits if the student's committee agrees.

The student's committee will work with the student to devise a program of courses appropriate to the student's area of study. It is recommended that at least ten (10) credits are related to the student's research specialty and that six (6) to twelve (12) hours of course work be taken outside the department. Students must choose between the Geology Specialization and the Geological Engineering Specialization.

Geology Specialization

Core Courses:

GEOL 633	Sedimentation
GEOL 604	Advanced Field Geology
GEOL 808	Fundamental Problems in Geol/GeoE

One course from:

GEOL 517	Geospatial Databases
GEOL 519	Advanced Geospatial Analysis
GEOE 766	Digital Modeling of Ground Water
MEM 533	Computer Applications in Geoscience Modeling

One course from:

GEOL 621	Advanced Structural Geology
GEOL 622	Geotectonics

One course from:

GEOE 626	Environmental Geophysics
GEOE 641	Geochemistry
GEOE 664	Advanced Ground Water
GEOL 652	Problems in Ore Deposits

Geological Engineering Specialization

All Ph.D. students in the Geological Engineering specialization are expected to focus in one of the three areas of groundwater/environmental, geomechanics, or energy/mineral resources. Recommended courses for each focus are listed below.

Required of all GEOE students:

GEOE 766	Digital Modeling of Ground Water
GEOL 633	Sedimentation
GEOL 808	Fundamental Problems in Geol/GeoE

Ground Water and Environmental Focus:

GEOE 766	Digital Modeling of Ground Water
GEOL 633	Sedimentation
GEOL 808	Fundamental Problems in Geol/GeoE

Ground Water and Environmental Focus:

GEOE 664	Advanced Ground Water
GEOE 641	Geochemistry
GEOE 663	Ground-Water Geochemistry
CEE 634	Surface Water Hydrology
CEE 523	Environmental Systems Analysis
GEOL 517	Geospatial Databases
GEOL 519	Advanced Geospatial Analysis
CEE 730	Statistical Methods in Water Resources
CEE 731	Topics in Water Quality Assessment
CEE 526	Environmental Engineering Physical/Chemical Process Design
CEE 621	Env. Contaminant Fate and Transport
CHEM 480	Toxicology

Geomechanics Focus:

GEOE 668	Eng. Geology of Surficial Deposits
CEE 647	Earth Structures
CEE 646	Stability of Soil and Rock Slopes
CEE 643	Advanced Soil Mechanics I
MEM 550	Rock Slope Engineering
MINE 512	Rock Mechanics III
GEOE 664	Advanced Ground Water

CEE 645	Advanced Foundations
CEE 647	Earth and Earth Retaining Structures
CEE 784	Modeling and Comp in Civil Engr

Energy and Mineral Resources Focus:

GEOE 525	Engineering Geophysics II
GEOE 531	Principles of Well Logging
GEOE 552	Geochemical Exploration
GEOE 661	Petroleum Geology
GEOL 652	Problems in Ore Deposits ⁴
GEOL 513	Ore Microscopy
GEOE 626	Environmental Geophysics
GEOE 641	Geochemistry
MEM 533	Comp App in Geoscience Modeling
GEOE 665	Bioremediation of Hazardous Materials
GEOE 663	Ground-Water Geochemistry
CEE 725	Treatment, Disposal, and Management of Hazardous Waste
GEOL 650	Seminar in Ore Deposits
CEE 784	Modeling and Comp in Civil Engr

Dissertation Proposal Defense

The dissertation proposal is part of the comprehensive examination. All Ph.D. students are required to prepare a research proposal for the work to be accomplished for the dissertation. The proposal is due one month prior to the comprehensive examination, so that the candidate's committee may review the proposal to assure that it is defensible. If not, then the student will have an opportunity to resubmit, although this may alter the final date of the comprehensive examination.

Comprehensive Examination: Summary of Rules and Organizations

When the student's program of course work has been substantially completed and dissertation proposal prepared, he/she will undertake the comprehensive examination for admission to candidacy. This examination should normally occur after the student has spent four semesters in the Ph.D. program, but must take place at least four months prior to the final defense. The comprehensive examination will consist of written

and oral examinations covering the student's field of study and related subjects. It will be prepared by the student's advisory committee, with potential suggestions from any faculty member from whom the student has taken a graduate course. The oral examination is open to any faculty member, but must include the candidate's full committee.

If the student has not completed all requirements for the Ph.D. degree by the fifth year following the comprehensive examination, his/her active status will be automatically terminated and the comprehensive examination must be repeated.

1. No later than two (2) months prior to the examination date the student must make a request to the student's committee to take the Comprehensive Examination. The dissertation research proposal must be submitted at least one month prior to the examination date.
2. The examination will consist of four parts, all of which must be completed within one working week. The examination may be scheduled for spring and fall semesters only, but not during the week of final examinations or the last week of classes.
3. The written examinations will be graded prior to the oral examination.
4. The oral examination will last three hours. It will begin with an oral presentation of the dissertation proposal by the student, who will then undergo an oral examination by the committee that may include questions concerning the proposal, the written exam topics, and any relevant subject area related to the student's research.
5. The written examination will consist of three parts: one general, and two specific topics.

Each part of the written examination will be three (3) hours in length.

General (written)	25%
Specific Topic (written)	25%
Specific Topic (written)	25%
Oral Examination	25%

Geology Specialization:

The General part will include General Geology. Specific topics will be chosen from the following list:

- Structural geology
- Sedimentation/stratigraphy
- Paleontology
- Igneous/metamorphic petrology
- Economic geology/mineral exploration
- Crystal chemistry/mineralogy
- Geomorphology
- Geophysics
- Glacial and Pleistocene Geology

Geological Engineering Specialization:

The General part will include Geological Engineering, General Geology, and Fundamentals of Engineering. Specific topics will be chosen from the following list:

- Ground Water
- Engineering Geology
- Petroleum Engineering
- Minerals
- Hydrology and Hydraulic Engineering
- Geophysical Exploration
- Geochemistry
- Geomorphology
- Rock Mechanics
- Geotechnical Engineering

A student may substitute successful completion of the Fundamentals of Engineering (F.E.) examination for one of these three (3) parts. A student also may propose hybrid fields with other disciplines if approved by his or her graduate committee.