Geography

Degrees Offered

- Master of Arts
- Doctor of Philosophy

Nature of the Program

The graduate program in geography at West Virginia University provides students with the opportunity to study for a master of arts or a doctor of philosophy degree with an area of emphasis in one or more of the following fields:

- Geographic information science
- Environmental geography
- Human geography

Research

Students who are interested in pursuing research in an area other than these may do so provided the research area matches the interest of a faculty member in the department who agrees to supervise the student’s program. Students who wish to focus their research on a particular region are encouraged to do so. The Graduate Program in Geography at WVU has strong links with the University’s Regional Research Institute, the State GIS Technical Center, the Geology Program, the Water Research Institute, the International Studies Program, the West Virginia Geological and Economic Survey, the Center for Women’s Studies, and the Center for Black Culture and Research.

Computing Facilities

The geography program has extensive computing facilities housed in a new 98,000 square foot building dedicated exclusively to geography and geology. The new building has five computer laboratories dedicated to teaching and research. The department has ESRI ArcGIS, ERDAS Imagine, and ENVI site licenses. In addition, the department supports SAS, SAS-Graph, JMP, Surface III, Oracle, and extensive database and statistical packages. The department’s geovisualization research group operates an immersive four-wall 3-D display environment or CAVE. The remote sensing program operates an ASD full-range portable spectroradiometer.

FACULTY

CHAIR

- J. Steven Kite - Ph.D. (University of Wisconsin)

ASSOCIATE CHAIR FOR GEOGRAPHY

- Amy Hessl - Ph.D. (University of Arizona)

PROFESSORS

- Gregory A. Elmes - Ph.D. (Pennsylvania State University)
  GISc, Spatial Modeling, Crime Mapping
- Trevor M. Harris - Ph.D. (University of Hull)
  Eberly Professor, GISc, Virtual Reality and GIS, Participatory GIS, Spatial Humanities
- Randall Jackson - Ph.D. (University of Illinois)
  Director of Regional Research Institute, Regional Economic Geography, Regional Economic Health and Performance, Regional Science
- Ann M. Oberhauser - Ph.D. (Clark University)
  Director of Women's Studies, Economic Geography, Regional Development, Gender Geography, Political Economy, Appalachia
- Timothy A. Warner - Ph.D. (Purdue University)
  Remote Sensing

PROFESSOR EMERITUS

- Kenneth C. Martis - Ph.D. (University of Michigan)
  Political and Electoral Geography, Historical Geography

ASSOCIATE PROFESSORS

- Amy Hessl - Ph.D. (University of Arizona)
  Biogeography, Forest Ecosystems
• J. Steven Kite - Ph.D. (University of Wisconsin-Madison)
  Geomorphology, Quaternary Studies, Geoarchaeology
• Brent McCusker - Ph.D. (Michigan State University)
  Uneven Development, Political Ecology, Africa

ASSOCIATE PROFESSOR EMERITUS
• Robert Q. Hanham - Ph.D. (Ohio State University)
  Political Economy of Uneven Development, Labor Geography

ASSISTANT PROFESSORS
• Jamison Conley - Ph.D. (Pennsylvania State University)
  GISc, Geocomputation, Medical Geography
• Karen Culcasi - Ph.D. (Syracuse University)
  Geopolitics, Identity, Middle East, Cartography
• Eungul Lee - Ph.D. (University of Colorado)
  Climatology, Vegetation-atmosphere Interactions, Asian Monsoon
• Brenden McNeil - Ph.D. (Syracuse University)
  GIS, Remote Sensing, Ecosystem Ecology
• Jeremia Njeru - Ph.D. (University of Wisconsin-Milwaukee)
  Urban Development and Environmental Change, Urban Political Ecology
• Bradley Wilson - Ph.D. (Rutgers University)
  Social Movements, Globalization, Environmental Justice, Latin America

CLINICAL ASSISTANT PROFESSOR
• Rick Landenberger - PhD. (West Virginia University)
  Remote Sensing, Ecology, Educational Outreach

POST DOCTORAL RESEARCHERS
• Jonathan Hall - Ph.D. (Ohio State University)
  Ecology, Biogeography
• Maria Alejandra Perez - Ph.D. (University of Michigan)
  Human Geography, Science and Society

Admission/Application Requirements

Master of arts applicants must submit GRE scores, a personal two-page statement defining the applicant’s interest in geography and career intentions, and two letters of recommendation from people who are familiar with the student’s undergraduate training. Ph.D. applicants should send three letters of recommendation, GRE scores, and a personal two-page statement defining the applicant’s interest in geography and career intentions. This material should be forwarded directly to:

Coordinator of the Geography Graduate Program
West Virginia University 330 Brooks Hall
P.O. Box 6300
Morgantown, WV 26506

Priority will be given to applications for fall admission and teaching assistantships received by January 15. To apply for fall admission without financial assistance, application material should preferably be received by April 1.

International students should submit their materials at least three months in advance of all deadlines. Prospective students must have an overall undergraduate GPA of 3.0 and a 3.0 GPA for undergraduate geography courses. Prospective doctoral students should have a cumulative GPA of at least 3.3. Students with degrees in other disciplines are encouraged to apply although they may be asked to make up deficiencies in geography during the first year in the program.

Research Assistantships

Research assistantships must be applied for through the faculty member whose research is providing the funding. The geography faculty are engaged in numerous funded research projects, many of which provide graduate students with opportunities for obtaining research skills and experience as well as employment and tuition aid. Furthermore, the professional contacts made in the course of faculty research frequently provide graduate students with opportunities for career development.
Master of Arts

The M.A. degree program in geography was designated a program of excellence by the West Virginia University Board of Governors in 1998, 2003, and 2008. This award is given to superlative degree programs in recognition of their contribution to higher education in West Virginia and national recognition.

Degree Requirements

The program is designed so that full-time students should satisfy all program requirements within two years. Students are expected to be well-grounded in one or more of the program’s three areas of specialization (environmental geography, geographic information science, and space, place, and development). Students will be awarded an M.A. after fulfilling the following requirements:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>GEOG 601</td>
<td>Geographic Traditions</td>
<td>3</td>
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<tr>
<td>GEOG 594</td>
<td>SEM: Geographical Data Analysis</td>
<td>3</td>
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<tr>
<td>GEOG 603</td>
<td>Qualitative Research - Geography</td>
<td>3</td>
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<tr>
<td>GEOG 701</td>
<td>Advanced Research Methods</td>
<td>3</td>
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<tr>
<td>GEOG 600</td>
<td>Geography Research Colloquium</td>
<td>4</td>
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<tr>
<td>GEOG 780</td>
<td>Non-Thesis Project</td>
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<tr>
<td>GEOG 797</td>
<td>Research</td>
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</tbody>
</table>

Geography Courses: 9

Thesis/Research Project: 3-6

Additional Hours: 8

Total Hours: 30-33

- Obtain thirty hours of graduate credit
- Complete the course GEOG 601
- Complete either GEOG 603 or GEOG 701
- Complete GEOG 600 for four semesters (four credit hours)
- Complete nine hours of geography graduate courses (400 level and above) but excluding GEOG 689–695 and GEOG 697–699 (Note: With the approval of the graduate committee, courses from other programs may also be used to fulfill this requirement.)

A. Thesis Option

Complete and successfully defend a written research thesis (GEOG 697, six credit hours)

B. Professional Masters Option

Complete a one-semester project (three credit hours) and an additional graduate course (400 level and above, three credit hours, but excluding 691 and 791 courses)

The First Year for all M.A. Students

Each incoming student is interviewed before the fall semester to identify the student’s interests and any academic deficiencies that require remedial work before graduate studies continue. All students are initially supervised by the Graduate Committee.

Once the student develops a more clearly defined research interest, no later than the middle of the spring semester, the student should request a faculty member to be their advisor. The student should discuss with the advisor whether to pursue the thesis or professional master’s option. The student and the advisor together select an advisory committee. A minimum of two of the three committee members (including the advisor) must be geography faculty members at WVU. Students may change advisor or committee members after consultation with the advisor and the Graduate Committee. The progress of every student is reviewed toward the end of the spring semester. In cases where a student is performing significantly below expectations, the student may be required to leave the program.

The M.A. Thesis Option

The M.A. thesis is an independent research project undertaken by the student. The thesis research should adhere to the following:

- Demonstrate knowledge of the literature in the student’s chosen field
- Use data and methods appropriate to the research
- Draw conclusions from the research endeavor

M.A. thesis option students develop a thesis proposal toward the end of the first year and during the first summer. The first step is to develop a written thesis proposal. This must be completed to the satisfaction of the student’s advisor and thesis committee no later than October 1 of the student’s second
year. This is followed by an oral presentation to all students and faculty in the geography program no later than October 31 (unless there are scheduling conflicts). Presentations must be advertised within the department. Students should aim to complete the thesis proposal process well before the October deadline in order to ensure progress towards graduation the following semester. Students not able to meet this schedule should seek a meeting with their advisor to resolve the issue prior to the deadline dates.

The defense of the thesis takes place when the advisor and the committee agree that a defendable copy of the thesis is complete. The defense date must be advertised at least two weeks in advance. Only in exceptional circumstances will the thesis committee waive the two-week requirement for advertising thesis proposals and defenses. The thesis examination is graded on a pass/provisional pass/fail basis. To pass the examination, there can be no more than one unsatisfactory grade from the committee members. A student who fails may submit another thesis or a revised version upon the approval of the student’s committee. No student may be re-examined more than once. A student who is given a provisional pass will generally be required to make minor revisions or corrections to the thesis.

Thesis proposals and defenses are not normally scheduled between June 15 and August 15.

The Professional Master’s Option

Overview
The professional master’s option consists of an additional graduate course and a three-credit-hour project (GEOG 780). The professional master’s option is designed for students interested in a more focused project than the traditional research thesis option. It is not recommended for students considering entering a Ph.D. program. The thesis project has strict deadlines and must be completed in one semester and after the completion of GEOG 601 and either GEOG 603 or GEOG 701.

Deadlines and Timetable

Students planning on selecting the professional masters’ option must make a written request to the Geography Graduate Committee no later than two weeks before the start of the semester in which the project is undertaken. The request should be endorsed by the student’s advisor. Only after the written request has been received will the geography graduate director issue a permit for the course. It is strongly recommended that the project topic be selected prior to the beginning of the semester.

A written project plan is to be submitted to the advisor and committee no later than three weeks after the start of the semester. The project plan includes an objective, methods, and timetable. No public presentation of the proposal is required.

The student is required to have meetings with the advisor and the committee in weeks seven and eleven to present progress reports.

The project must be completed and successfully defended by the end of the semester in which the project was undertaken. If the student completes the project, passes the defense, and submits the project to the library by the end of the semester, the student will be given a grade of S (satisfactory) for the GEOG 780 course.

If the student completes the project and fails the defense or if the project is not completed and defended by the end of the semester, the student will be given a grade of U for the GEOG 780 course.

Students who receive a grade of U may reapply to do a different project the following semester. Students cannot reapply more than once.

The Graduate Committee may grant an extension to the one semester deadline under exceptional circumstances.

Project Topic and Defense

The choice of a project topic is to be determined by close interaction and agreement between the student, advisor, and committee. The project may comprise a wide range of activities, but is usually either (a) an applied problem-solving exercise with minimal literature review, (b) an empirical test of an idea from the literature with minimal literature review, or (c) a literature review or development of a conceptual idea using the literature.

The project is defended in a public presentation at the end of the project semester, but no later than the university deadline for a thesis defense. The defense time and location must be published in the department no less than two weeks in advance. The standard for passing will be that the majority of the advisory committee (two or more of the three members) evaluate the work as substantially meeting the goals identified in the written research plan.

Most projects are expected to be in written form (fifteen to twenty pages). Other forms of presentation may be acceptable such as maps, software, video, land-use plan, image classification, field-trip guide, work of art, etc.; however, a written document explaining the project is still required.
### Doctor of Philosophy

Prospective doctor of philosophy students must have a master’s degree. Students with degrees in other disciplines are encouraged to apply, but they may be asked to make up deficiencies in geography during their first year in the program. Incoming geography students may also be asked to make up deficiencies if any are found during the student’s entry interview with faculty. This interview is immediately prior to the first semester of the program.

Students are expected to be well-grounded both in one of the program’s areas of emphases and in the history and philosophy of geography.

Students will be awarded a Ph.D. after obtaining twenty-eight hours of graduate credit, completing certain required courses, passing comprehensive examinations, and writing a dissertation. These steps are discussed in more detail below.

### Coursework

The courses GEOG 600 and either GEOG 701 or GEOG 603 (three hours) are required as well as three general electives and two method electives. An additional eleven hours of other courses, which may include seminars and directed study courses, must also be completed. A limited number of the required courses may be waived if the student has already completed an equivalent course and can demonstrate proficiency with the material.

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<tr>
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<tr>
<td>GEOG 601</td>
<td>Geographic Traditions</td>
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<td>Methods Course:</td>
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<td>GEOG 603</td>
<td>Qualitative Research-Geography</td>
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<td>GEOG 701</td>
<td>Advanced Research Methods</td>
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<td>Geography Courses</td>
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<tr>
<td>Methods Elective:</td>
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<tr>
<td>GEOG 550</td>
<td>Geographic Information Science</td>
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<td>GEOG 603</td>
<td>Qualitative Research-Geography</td>
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<td>GEOG 630</td>
<td>Sem:Land Use and Cover Change</td>
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<td>GEOG 651</td>
<td>GIS:Technical Issues</td>
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<td>GEOG 655</td>
<td>Remote Sensing Principles</td>
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<td>GEOG 753</td>
<td>Exploratory Spatial Data Analy</td>
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<td>Seminar Course:</td>
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<td>GEOG 607</td>
<td>Geography of Fire</td>
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<td>GEOG 612</td>
<td>Gender, Society and Space</td>
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<td>GEOG 615</td>
<td>Development Geography</td>
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<td>GEOG 621</td>
<td>Advanced Fluvial Geomorphology</td>
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<td>GEOG 694</td>
<td>Seminar</td>
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<tr>
<td>GEOG 600</td>
<td>Geography Research Colloquium</td>
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**Total Hours**: 22

### Examinations and Dissertation

The student is required to pass an oral and three written comprehensive examinations no later than the fourth semester. The student will be examined on two areas of specialization and the student’s dissertation research topic. Upon successful completion of the comprehensive examination and no later than the end of the fifth semester, the student will be expected to defend a dissertation research proposal. The award of the Ph.D. is granted upon the successful defense of the dissertation itself.

### Assistantships

The Geography Graduate Program has a number of teaching and research assistantships available each year, which are allocated to qualified students on a competitive basis. These awards include a full university tuition waiver. Teaching assistantships are awarded annually and for no more than four semesters for M.A. students and six semesters for Ph.D. students. Ph.D. teaching assistants who meet all comprehensive exam and dissertation proposal deadlines, have made excellent progress towards the completion of their dissertation research, and have applied for at least one external research grant may request an additional year of funding. Assistantships are reconfirmed each year based on performance in the previous year with respect to both assistantship duties and academic progress. Additionally, meritorious tuition waivers are offered on a competitive basis to outstanding students who do not receive assistantships. Requests for teaching assistantships and tuition waivers should be sent directly to the Coordinator of Graduate Studies in Geography by January 1. International students should submit their materials at least three months in advance of this deadline.
GEOGRAPHY COURSES

GEOG 517. Climatological Analysis. 3 Hours.
PR: GEOG 207 or Consent. Statistical analysis and interpretation of climatological data and application to physical and human problems across the globe using user-friendly and programmable tools. (Also listed as GEOG 317).

GEOG 525. Problems in Geomorphology. 0-4 Hours.
(Also listed as GEOL 525.).

GEOG 550. Geographic Information Science. 4 Hours.
PR: Instructor’s permission. Principles and practice of geographical information science. Geospatial data handling for research, planning and decision-making. Spatial analysis, information production, and display.

GEOG 553. Environmental Impact Assessmnt. 3 Hours.
Study of the process and methods, including GIS, by which the environmental consequences of development actions are assessed and evaluated in advance of their occurrence.

GEOG 591A-Z. Advanced Topics. 1-6 Hours.
PR: Consent. Investigation of advanced topics not covered in regularly scheduled courses.

GEOG 594A-Z. Seminar. 1-6 Hours.
Special seminars arranged for advanced graduate students.

GEOG 600. Geography Research Colloquium. 1 Hour.
PR: Consent. Lectures and presentation on recent and current research by resident and visiting scholars.

GEOG 601. Geographic Traditions. 3 Hours.
PR: Consent. Review of the major approaches in geographic scholarship.

GEOG 602. Geographic Research-Design. 3 Hours.
PR: GEOG 300 and GEOG 601. Choosing, preparing, and developing research problems of geographic interest. Emphasizes proposal writing and research design alternatives.

GEOG 603. Qualitative Research-Geography. 3 Hours.
PR: GEOG 602 or consent. Analysis of qualitative research in geography and related fields. Examine methodological approaches and techniques that explore and interpret issues in the development of geographical research projects.

GEOG 607. Geography of Fire. 3 Hours.
PR: Graduate standing. Course explores spatial science and human environment relations through a review of fire ecology literature. This is a seminar-style course with weekly readings, discussion, and a term project required by each student.

GEOG 612. Gender, Society and Space. 3 Hours.
PR: GEOG 601 or Consent. Examines how gender and feminist perspectives are an integral part of how space is used, distributed, and perceived in society. Overviews of major developments in the field including diversity and difference, representation, identity, and nature.

GEOG 615. Development Geography. 3 Hours.
PR: Consent. An analysis of the concept and practice of development. Alternative people-centered approaches to social change are investigated.

GEOG 621. Advanced Fluvial Geomorphology. 4 Hours.
PR: GEOL 321 or GEOG 321 or Consent. Analysis of stream processes, landforms, deposits, including paleohydrology and Appalachian surficial geology. Required weekend field trips at student’s expense. (Also listed as GEOL 621.).

GEOG 622. Surficial and Glacial Geology. 4 Hours.
PR: GEOL 321 or GEOG 321 or Consent. Analysis of late Cenozoic landscapes, especially those caused by glaciers or otherwise influenced by global climate change. Required weekend field trips at student’s expense. (Also listed as GEOL 622.).

GEOG 630. Sem:Land Use and Cover Change. 3 Hours.
Review, discussion, and critique of major scientific approaches to the study of land use and cover change. All world regions and biomes covered. Includes theoretical and technical discussions of change, human dimensions, and policy issues.

GEOG 640. Geopolitical Perspectives. 3 Hours.
This course uses geopolitical perspectives to critically examine the linkages between power and places. Seminal literatures in the sub-field of geopolitics are read and critiqued, including critical geopolitics, feminist geopolitics and post-colonial theory.

GEOG 651. GIS:Technical Issues. 3 Hours.
PR: GEOG 350. Current issues in GIS research. Technical aspects of GIS operations, algorithms, theory of geographical data structures, and error handlings. Labs focus on tools, data structures, database languages and macros. (2 hr. lec., 1 hr. lab.).

GEOG 654. Environmental GIS Modeling. 3 Hours.
Provides background and hands-on experience needed to answer scientific questions about the environment within a raster-based GIS Framework. Students should have introductory level GIS background.

GEOG 655. Remote Sensing Principles. 3 Hours.
Mapping of earth features using aerial and satellite-borne sensors, image enhancement, geo-referencing, and classification. (Also listed as GEOL 655.).
GEOG 689. Geog Grad Student Internship. 1-6 Hours.
PR: Consent. Internship in the private or public sector designed for practical application of geographic training.

GEOG 691A-Z. Advanced Topics. 1-6 Hours.
PR: Consent. Investigation of advanced topics not covered in regularly scheduled courses.

GEOG 692A-Z. Directed Study. 1-6 Hours.
Directed study, reading, and/or research.

GEOG 693A-Z. Special Topics. 1-6 Hours.
A study of contemporary topics selected from recent developments in the field.

GEOG 694A-Z. Seminar. 1-6 Hours.
Special seminars arranged for advanced graduate students.

GEOG 695. Independent Study. 1-6 Hours.
Faculty supervised study of topics not available through regular course offerings.

GEOG 696. Grad Sem:Gender,Society,Space. 1 Hour.
PR: Consent. Each graduate student will present at least one seminar to the assembled faculty and graduate student body of his her program.

GEOG 697. Research. 1-15 Hours.
PR: Consent. Research activities leading to thesis, problem report, research paper or equivalent scholarly project, or a dissertation. (Grading may be S/ U.).

GEOG 698. Thesis. 1-6 Hours.
PR: Consent. This is an optional course for programs that wish to provide formal supervision during the writing of student reports (698), or dissertations (798). Grading is normal.

GEOG 699. Graduate Colloquium. 1-6 Hours.
PR: Consent. For graduate students not seeking coursework credit but who wish to meet residency requirements, use of the University’s facilities, and participate in its academic and cultural programs. Note: Graduate students who are not actively involved in coursework or research are entitled, through enrollment in their department’s 699/799 Graduate Colloquium to consult with graduate faculty, participate in both formal and informal academic activities sponsored by their program, and retain all of the rights and privileges of duly enrolled students. Grading is P/F; colloquium credit may not be counted against credit requirements for masters programs. Registration for one credit of 699/799 graduate colloquium satisfies the University requirement of registration in the semester in which graduation occurs.

GEOG 701. Advanced Research Methods. 3 Hours.
PR: GEOG 601. Review of quantitative and qualitative methods used in geographic research.

GEOG 711. Regional Development. 3 Hours.
PR: Consent. Review of contemporary geographic theories of uneven spatial development of capitalism.

GEOG 752. Adv/Geographic/Informtn/Science. 3 Hours.
PR: GEOG 452 or GEOG 651 or Consent. Functional strengths and weaknesses of GIS. Related geographical information, science technologies, GPS, remote sensing, multimedia, spatial statistics, and expert systems. Multi- dimensionality (4-D GIS), temporality, social implications of GIS.

GEOG 753. Exploratory Spatial Data Analy. 3 Hours.
Develop expertise in spatial analytical techniques for use in geographical data analysis and GIS.

GEOG 755. Advanced Remote Sensing. 0-3 Hours.
PR: GEOG 655 or GEOL 655 or consent. Collection, processing, and classification of remotely sensed data, including optical, thermal, radar, and topographic information. (2 hour lecture, 1 hour laboratory.) (Also listed as GEOL 755.).

GEOG 780. Non-Thesis Project. 3 Hours.
Research activities leading to a non-thesis project report.

GEOG 791A-Z. Advanced Topics. 1-6 Hours.
PR: Consent. Investigation of advanced topics not covered in regularly scheduled courses.

GEOG 792A-Z. Directed Study. 1-6 Hours.
Directed study, reading, and/or research.

GEOG 793A-Z. Special Topics. 1-6 Hours.
A study of contemporary topics selected from recent developments in the field.

GEOG 794A-Z. Seminar. 1-6 Hours.
Special seminars arranged for advanced graduate students.

GEOG 795. Independent Study. 1-9 Hours.
Faculty supervised study of topics not available through regular course offerings.

GEOG 796. Grad Sem:Modeling With GIS. 1 Hour.
PR: Consent. Each graduate student will present at least one seminar to the assembled faculty and graduate student body of his or her program.
GEOG 797. Research. 1-15 Hours.  
PR: Consent. Research activities leading to thesis, problem report, research paper or equivalent scholarly project, or a dissertation. (Grading may be S/U.).

GEOG 930. Professional Development. 1-6 Hours.  
Professional Development courses provide skill renewal or enhancement in a professional field or content area (e.g., education, community health, geology). These tuition waived, continuing education courses are graded on a pass/fail grading scale and do not apply as graduate credit toward a degree program.

GEOLOGY COURSES

GEOL 510. Computer Aided Subsurface Intrp. 3 Hours.  
PR: GEOL 311 and GEOL 341. Develop subsurface interpretations from integrated geological, geophysical and engineering databases in a computer workstation environment. Construct maps and 3D visualizations of subsurface structure, seismic horizons, layer properties, etc., for prospect location and subsurface assessment.

GEOL 511. Sedimentary Geology in Ireland. 2 Hours.  
PR: GEOL 311. Field course to study the sedimentary rock of Dingle, Ireland- their origin, classification, and economic importance. (Course is an extended field trip during spring break. Student is responsible for all expenses.).

GEOL 511A. Sedimentary Geol-Ireland:Trvl. 1 Hour.  
Travel portion of GEOL 511. See GEOL 511 for description.

GEOL 525. Problems in Geomorphology. 0-4 Hours.

GEOL 543. Tectonics. 3 Hours.  
PR: GEOL 341 and GEOL 311; undergraduates need Consent. Investigation of patterns and processes of large-scale deformation mechanisms that shape the earth. Focuses on the structural evolution and modeling process of various plate boundaries.

GEOL 554. Environmntl/Explratn-Geophys 2. 3 Hours.  
PR: PHYS 102 and (MATH 156 or GEOL 351) or Consent. Basic and applied studies of reflection and refraction seismology and ground penetrating radar methods will be covered with an emphasis on the use of computers in the modeling and interpretation of seismic data.

GEOL 556. 3-D Seismic Visualization. 3 Hours.  
This course focuses on the application of 3-D seismic data visualization and interpretation technologies to the characterization of subsurface structure, facies, and reservoirs, with particular reference to hydrocarbon exploration and CO2 sequestration.

GEOL 558. Seismic Attribute. 3 Hours.  
PR: GEOL 341 and GEOL 311 and MATH 155. The effective seismic attribute technologies and attribute interpretation workflows, their application to the characterization of subsurface structures, facies, and reservoir properties, with particular reference to hydrocarbon exploration and C)2 sequestration.

GEOL 562. Quantitative Hydrogeology. 3 Hours.  
PR: MATH 156 or GEOL 351 and GEOL 463 or Consent. Mathematical and computer analysis of groundwater flow, aquifer systems, radial-flow solutions; well/aquifer test methods; superposition, boundaries; dispersive/advevctive transport.

GEOL 564. Environmental Hydrogeology. 4 Hours.  
PR: GEOL 101 and GEOL 102 and GEOL 463 and (PR or CONC: GEOL 562). Seminar reviewing groundwater occurrence, flow, quality, and exploration in various geologic terrains; groundwater pollution and dewatering; and groundwater technology. Includes topical literature review.

GEOL 579. Applied Petroleum Geoscience. 3 Hours.  
Students work in teams to conduct integrated characterization of a petroleum reservoir, develop numerical simulation, consider technical options, perform economic analyses and make a final report to the company/organization.

GEOL 580. Organic Contaminant GeoChem. 3 Hours.  
This course focuses on fundamental chemical properties and structures of organic contaminants that control their functionality, fate, and transport in the environment. Natural organic matter and inorganic phases are discussed relative to contaminant mobility.

GEOL 585. Optical Mineralogy & Petrology. 3 Hours.  
PR: GEOL 285. Introduction to the optical properties of minerals and the use of the petrographic microscope. Interpretation of sedimentary, igneous, and metamorphic rocks based on microscopic examination of thin sections. (Offered alternate years.).

GEOL 586. Advanced Isotope Geochemistry. 3 Hours.  
PR: GEOL 486. Advance the understanding of isotopic systems by comprehensive discussion of selected research publications. Laboratory exercises will provide hands-on training in stable isotope measurement techniques. Study topics will focus on use of isotopes to address research questions in variety of fields, including geology, biology, forensics, environmental sciences and energy.

GEOL 588. Aqueous Geochemistry. 3 Hours.  
PR: GEOL 101 and CHEM 112 or CHEM 116, or Consent. Review of basic chemical principles as they apply to aqueous geochemical environments. Properties of water and the types, sources, and controls of the common and environmentally significant chemical species dissolved in water.

GEOL 591A-Z. Advanced Topics. 1-6 Hours.  
PR: Consent. Investigation of advanced topics not covered in regularly scheduled courses.
**GEOL 593A-Z. Special Topics. 1-6 Hours.**
A study of contemporary topics selected from recent developments in the field.

**GEOL 594A-Z. Seminar. 1-6 Hours.**
Special seminars arranged for advanced graduate students.

**GEOL 610. Advanced Stratigraphy. 3 Hours.**

**GEOL 611. Carbonate Sedimentology. 4 Hours.**

**GEOL 615. Stratigraphy of Porous Media. 3 Hours.**
PR: GEOL 311. Advanced discussion of the deposition of clastic sediments, chemistry of carbonates, sequence stratigraphy, porosity development in sandstones and limestones, flow of oil through rock.

**GEOL 616. Advanced Sedimentation. 4 Hours.**
PR: GEOL 311 or Consent. (Required field trips at student’s expense.) Origin of sedimentary rocks; principles involved in interpretation of ancient geography, climates, animals, and plants. Emphasis on detrital sediments and rocks.

**GEOL 619. Advanced Petroleum Geology. 3 Hours.**
Petroleum source rocks, thermal and biogenic maturity, primary and secondary migration of oil, porosity development in reservoirs, permeability. (Required weekend field trip.)

**GEOL 621. Advanced Fluvial Geomorphology. 4 Hours.**
PR: GEOL 321 or GEOG 321 or Consent. Analysis of stream processes, landforms, deposits, including paleohydrology and Appalachian surficial geology. (Required weekend field trips at student’s expense; also listed as GEOG 521.)

**GEOL 622. Surficial/ Glacial Geology. 4 Hours.**
PR: GEOL 321 or GEOG 321 or Consent. Analysis of late Cenozoic landscapes, especially those caused by glaciers or otherwise influenced by global climate change. (Required weekend field trips at student’s expense; also listed as GEOG 522.)

**GEOL 632. Palaeoecology. 3 Hours.**
PR: GEOL 331 and GEOL 311 or Consent. Methods of palaeoecologic analysis in sedimentary geology. Topics include trace fossil analysis, shell biogeochemistry, community palaeoecology, biofacies analysis of basins, and Precambrian palaeoecology.

**GEOL 642. Advanced Structural Geology. 3 Hours.**
PR: GEOL 341. Theoretical and observational aspects of the development of geological structures. Problems ranging from the microstructural to the orogenic scale will be addressed.

**GEOL 645. Basin Structures. 4 Hours.**
PR: GEOL 341 and GEOL 311 or equivalent. The origin, development, and distribution of basins and the structure found within basins throughout the world are studied. The distribution of energy-related minerals related to basins and structural accumulations is emphasized.

**GEOL 655. Remote Sensing Principles. 3 Hours.**
Mapping of earth features using aerial and satellite-borne sensors, image enhancement, geo-referencing, and classification. (Also listed as GEOG 655.)

**GEOL 659. Quantive Methods in GeoScience. 3 Hours.**
PR: STAT 312 or STAT 511 or Consent. Brief review and introduction to multivariate quantitative techniques as applied to geology and geography.

**GEOL 665. Groundwater Modeling. 4 Hours.**
PR: GEOL 562 or Consent. Theory and application of groundwater flow modeling, focusing on MODFLOW; numerical methods; discretization and boundaries; parameterization and calibration; problems and case histories.

**GEOL 666. Karst Geology. 3 Hours.**
PR: Consent. Review of karst terrain hydrogeology and geomorphology, emphasizing origins and nature of caves, sinkholes and other karst landforms, environmental problems of karst, and its water and mineral/ petroleum resources.

**GEOL 680. Masters Project Research. 1-5 Hours.**
Planning and presentation of a professional project, including proposal, work plan execution, and project report. Status reports and timeline planning. Must be taken in two consecutive semesters, totaling to 6 credits.

**GEOL 687. Physical Geochemistry. 3 Hours.**

**GEOL 690. Teaching Practicum. 1-3 Hours.**
PR: Consent. Supervised practice in college teaching of geology. Note: This course is intended to insure that graduate assistants are adequately prepared and supervised when they are given college teaching responsibility. It also provides a mechanism for students not on assistantships to gain teaching experience. (Grading will be P/F.)

**GEOL 691A-Z. Advanced Topics. 1-6 Hours.**
PR: Consent. Investigation of advanced topics not covered in regularly scheduled courses.
GEOL 692A-Z. Directed Study. 1-6 Hours.
Directed study, reading, and/or research.

GEOL 693A-Z. Special Topics. 1-6 Hours.
A study of contemporary topics selected from recent developments in the field.

GEOL 694A-Z. Seminar. 1-6 Hours.
Special seminars arranged for advanced graduate students.

GEOL 695. Independent Study. 1-6 Hours.
Faculty supervised study of topics not available through regular course offerings.

GEOL 697. Research. 1-15 Hours.
PR: Consent. Research activities leading to thesis, problem report, research paper or equivalent scholarly project, or a dissertation. (Grading may be S/U).

GEOL 698. Thesis. 1-6 Hours.
PR: Consent. This is an optional course for programs that wish to provide formal supervision during the writing of student reports (698), or dissertations (798). Grading is normal.

GEOL 699. Graduate Colloquium. 1-6 Hours.
PR: Consent. For graduate students not seeking course work credit, but who wish to meet residence requirements, use the University facilities and participate in its academic and cultural programs. NOTE: Graduate students not actively involved in course work or research or enrolled, through enrollment in his/her departments Graduate Colloquium, to consult with graduate faculty, participate in both formal and informal academic activities sponsored by his/her program and retain all of the rights and privileges of duly enrolled students. Grading is P/F; colloquium credit may not be counted against credit requirements for master’s programs.

GEOL 755. Advanced Remote Sensing. 3 Hours.
PR: GEOG 655 or GEOL 655 or consent. Collection, processing and classification of remotely sensed data, including optical, thermal, radar, and topographic information. (2 hour lecture, 1 hour laboratory.) (Also listed as GEOG 755.).

GEOL 790. Teaching Practicum. 1-3 Hours.
PR: Consent. Supervised practice in college teaching of geology. Note: This course is intended to insure that graduate assistants are adequately prepared and supervised when they are given college teaching responsibility. It will also present a mechanism for students not on assistantships to gain teaching experience. (Grading will be P/F.).

GEOL 791A-Z. Advanced Topics. 1-6 Hours.
PR: Consent. Investigation of advanced topics not covered in regularly scheduled courses.

GEOL 794A-Z. Seminar. 1-6 Hours.
Special seminars arranged for advanced graduate students.

GEOL 795. Independent Study. 1-9 Hours.
Faculty supervised study of topics not available through regular course offerings.

GEOL 796. Graduate Seminar. 1 Hour.
PR: Consent. Each graduate student will present at least one seminar to the assembled faculty and graduate student body of his or her program.

GEOL 798. Dissertation. 1-6 Hours.
PR: Consent. This is an optional course for programs that wish to provide formal supervision during the writing of student reports (698), or dissertations (798). Grading is normal.

GEOL 799. Graduate Colloquium. 1-6 Hours.
PR: Consent. For graduate students not seeking coursework credit but who wish to meet residency requirements, use of the University’s facilities, and participate in its academic and cultural programs. Note: Graduate students who are not actively involved in coursework or research are entitled, through enrollment in their department’s 699/799 Graduate Colloquium to consult with graduate faculty, participate in both formal and informal academic activities sponsored by their program, and retain all of the rights and privileges of duly enrolled students. Grading is P/F; colloquium credit may not be counted against credit requirements for masters programs. Registration for one credit of 699/799 graduate colloquium satisfies the University requirement of registration in the semester in which graduation occurs.

GEOL 930. Professional Development. 1-6 Hours.
Professional development courses provide skill renewal or enhancement in a professional field or content area (e.g., education, community health, geology). These tuition-waived continuing education courses are graded on a pass/fail grading scale and do not apply as graduate credit toward a degree program.