

GEOGRAPHY AND THE ENVIRONMENT

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Why study geography at the University of Denver?

Consider these advantages:

- Engaged and research-active faculty
- Small classes and personal attention
- State-of-the-art geospatial technology laboratories
- Strong and exciting field orientation
- Excellent location for applied research in physical and human geography

Situated at the foot of the Rocky Mountains in the dynamic city of Denver, the University of Denver is an ideal laboratory for physical and human geographers, as well as those studying human-environment interaction and geographic information science.

Since it was founded in 1945, the University of Denver's department of geography has offered excellent opportunities for graduate students in teaching, research, academia, government and the private sector.

We have state-of-the-art facilities and resources:

- Fully networked labs with frequent upgrades in hardware, specialized equipment and software
- Four Geographic Information Science (GIS) labs which include most industry standard GIS software (All ESRI products, ERDAS Imagine, E-cognition, ENVI, Web Mapping and Geovisualization products)
- USDA-approved soil and sediment lab and the Hoyt Mineral Collection
- Multimedia teaching classrooms
- National and international field trips
- The Mount Evans field station (elevation 10,600 feet), is just 45 minutes from campus

Come visit our facilities, meet our faculty and students and see the advantages for yourself.

The Department of Geography and the Environment at the University of Denver offers programs leading to the MA in Geography, MS in Geographic Information Science (GISc) (on-campus and online programs) and PhD in Geography. Areas of teaching and research include biogeography, climatology, computer-assisted cartography, cultural geography, development, economic geography, environmental geology, geographic information science, geovisualization, geomorphology, global change, hydrology, land use/land cover analysis, Latin America, natural resources, paleoenvironmental change, political ecology, Quaternary studies, remote sensing, soils, spatial analysis, sustainability, transportation, and urban geography and planning. With 12 tenure-line faculty and five full-time teaching faculty, our faculty is very active in research, publishing numerous journal articles and presenting many conference papers every year. Our faculty members also are known for their excellence as instructors, with several faculty having earned major teaching awards.

Doctor of Philosophy in Geography

Degree and GPA Requirements

Bachelor's degree: All graduate applicants must hold an earned baccalaureate from a regionally accredited college or university or the recognized equivalent from an international institution.

Master's degree: This program requires a master's degree as well as the baccalaureate.

University GPA requirement: The minimum grade point average for admission consideration for graduate study at the University of Denver must meet one of the following criteria:

- A cumulative 2.5 on a 4.0 scale for the baccalaureate degree.
- A cumulative 2.5 on a 4.0 scale for the last 60 semester credits or 90 quarter credits (approximately two years of work) for the baccalaureate degree.

- An earned master's degree or higher from a regionally accredited institution or the recognized equivalent from an international institution supersedes the minimum GPA requirement for the baccalaureate.
- A cumulative GPA of 3.0 on a 4.0 scale for all graduate coursework completed for applicants who have not earned a master's degree or higher.

English Language Proficiency Test Score Requirements

The minimum TOEFL/IELTS/C1 Advanced/Duolingo English Test score requirements for this degree program are:

- Minimum TOEFL Score (Internet-based test): 80
- Minimum IELTS Score: 6.5
- Minimum C1 Advanced Score: 176
- Minimum Duolingo English Test Score: 115

Master of Arts in Geography

Degree and GPA Requirements

Bachelor's degree: All graduate applicants must hold an earned baccalaureate from a regionally accredited college or university or the recognized equivalent from an international institution.

University GPA requirement: The minimum grade point average for admission consideration for graduate study at the University of Denver must meet one of the following criteria:

- A cumulative 2.5 on a 4.0 scale for the baccalaureate degree.
- A cumulative 2.5 on a 4.0 scale for the last 60 semester credits or 90 quarter credits (approximately two years of work) for the baccalaureate degree.
- An earned master's degree or higher from a regionally accredited institution or the recognized equivalent from an international institution supersedes the minimum GPA requirement for the baccalaureate.
- A cumulative GPA of 3.0 on a 4.0 scale for all graduate coursework completed for applicants who have not earned a master's degree or higher.

English Language Proficiency Test Score Requirements

The minimum TOEFL/IELTS/C1 Advanced/Duolingo English Test score requirements for this degree program are:

- Minimum TOEFL Score (Internet-based test): 80
- Minimum IELTS Score: 6.5
- Minimum C1 Advanced Score: 176
- Minimum Duolingo English Test Score: 115

Master of Science in Geographic Information Science

Degree and GPA Requirements

Bachelor's degree: All graduate applicants must hold an earned baccalaureate from a regionally accredited college or university or the recognized equivalent from an international institution.

University GPA requirement: The minimum grade point average for admission consideration for graduate study at the University of Denver must meet one of the following criteria:

- A cumulative 2.5 on a 4.0 scale for the baccalaureate degree.
- A cumulative 2.5 on a 4.0 scale for the last 60 semester credits or 90 quarter credits (approximately two years of work) for the baccalaureate degree.
- An earned master's degree or higher from a regionally accredited institution or the recognized equivalent from an international institution supersedes the minimum GPA requirement for the baccalaureate.
- A cumulative GPA of 3.0 on a 4.0 scale for all graduate coursework completed for applicants who have not earned a master's degree or higher.

English Language Proficiency Test Score Requirements

The minimum TOEFL/IELTS/C1 Advanced/Duolingo English Test score requirements for this degree program are:

- Minimum TOEFL Score (Internet-based test): 80
- Minimum IELTS Score: 6.5

- Minimum C1 Advanced Score: 176
- Minimum Duolingo English Test Score: 115

Master of Science in Geographic Information Science (Online Program)

Degree and GPA Requirements

Bachelor's degree: All graduate applicants must hold an earned baccalaureate from a regionally accredited college or university or the recognized equivalent from an international institution.

University GPA requirement: The minimum grade point average for admission consideration for graduate study at the University of Denver must meet one of the following criteria:

- A cumulative 2.5 on a 4.0 scale for the baccalaureate degree.
- A cumulative 2.5 on a 4.0 scale for the last 60 semester credits or 90 quarter credits (approximately two years of work) for the baccalaureate degree.
- An earned master's degree or higher from a regionally accredited institution or the recognized equivalent from an international institution supersedes the minimum GPA requirement for the baccalaureate.
- A cumulative GPA of 3.0 on a 4.0 scale for all graduate coursework completed for applicants who have not earned a master's degree or higher.

English Language Proficiency Test Score Requirements

The minimum TOEFL/IELTS/C1 Advanced/Duolingo English Test score requirements for this degree program are:

- Minimum TOEFL Score (Internet-based test): 80
- Minimum IELTS Score: 6.5
- Minimum C1 Advanced Score: 176
- Minimum Duolingo English Test Score: 115

Doctoral Program

Doctor of Philosophy in Geography

Degree Requirements

Coursework Requirements

A minimum of 117 quarter hours of credit is required for the doctoral degree, up to 45 hours of which may be transferred from an earned master's degree from a regionally accredited university.

Minimum number of credits required for the degree: 117 credits

Code	Title	Credits
Core coursework requirements		12
Complete the following courses or work with your advisor if the equivalent of the following courses were taken as part of your MA or MS program.		
GEOG 3000	Advanced Geographic Statistics	
GEOG 4000	Fundamental Geographic Perspectives	
GEOG 4020	Geographic Research Design	
GEOG 4900	Graduate Colloquium in Geog	
Geography courses		32
Complete at least 32 additional credits in geography courses (at least 3000 or higher level) directed toward the dissertation research		
Cognate courses		12
Complete at least 12 additional credits in cognate coursework in a related field		
Additional coursework		0-16
Complete 2 graduate seminar courses and 2 research tools to reach the number of minimum credits required for the degree		
Transfer Credit		0-45
A maximum of 45 credits may be accepted as transferred in from a MA or MS program, including credits substituting core coursework requirements		
Total Credits		117

Non-coursework requirements:

- Two Research Tools Requirement
- PhD Research Proposal Presentation
- Comprehensive Examination
- Dissertation
- Oral Defense

Two Research Tools Requirement

The options to meet the tool requirement include languages, geographic information systems, computer cartography, remote sensing and geographic statistics.

PhD Research Proposal Presentation

Each student is required to prepare and present a dissertation proposal and have it formally approved by the student's faculty committee. This should be completed by the end of the second year for a full-time PhD student.

Comprehensive Exam

This exam, which includes both written and oral parts, is designed to evaluate the student's work at the University of Denver.

This exam is usually scheduled after all substantive course work has been completed and the dissertation proposal has been approved. It must be taken at least three quarters prior to expected graduation. Students should consult with their adviser and committee members to achieve a greater understanding of what will be on the exam. The written portion of the exam can be taken in one of two formats: a written examination conducted in the department usually taken over two days, lasting four hours each day, or a take-home examination in which the student has five days to complete the exam. An oral examination is held two weeks after the written exam has been completed. A candidate who fails one or all parts of the comprehensive exam may petition the department for re-examination. Re-examination, if granted by the department, may not be scheduled until the succeeding quarter and cannot be retaken more than once.

Dissertation and Oral Defense

Upon completion of course work, approved proposal, comprehensive exam and the dissertation, each student will undergo a final oral defense. An oral defense may not be scheduled until at least the second quarter following the quarter in which the comprehensive exam was successfully completed (the summer may count as a quarter, though no examinations should be scheduled during the summer). The final oral defense is to be conducted at least two weeks before the end of the quarter in which the degree is to be awarded. This defense is usually about two hours in length, and is composed of a 20–25 minute presentation by the student followed by questions from the committee. The examining committee is comprised of at least four members: an advisor and three other committee members. The advisor must be a full-time tenure-line faculty member in the Department of Geography & the Environment with a research record and interest appropriate to the student's proposed research area of specialization. All members of the committee must be full-time appointed faculty at DU and have research records appropriate to the student's area of specialization. Faculty from appropriately-related units who hold the terminal degree in their field may serve on the committee as long as the candidate's graduate unit has the majority representation and a two-thirds majority of the committee hold the earned doctorate. There is also a non-voting Oral Defense Committee Chair who must be a tenured faculty member from another department at the University of Denver serving as the university representative for the final oral defense.

For doctoral programs, research areas are limited to the fields of biogeography, climatology, cultural geography, economic geography, geographic information science, geomorphology, global change, human environment interaction, Latin America, paleoenvironmental change, Quaternary studies, transportation geography and urban geography in accordance with current faculty expertise.

Master's Programs

Master of Arts in Geography**Requirements for students with prior degrees in geography:**

For the MA degree, 45 quarter hours of course work and a thesis are required. Students can specialize in subfields within physical geography, human geography or human-environment interaction (please see the Department of Geography and the Environment Graduate Student Handbook for detailed information).

Degree requirements**Coursework requirements**

Minimum number of credits required for degree: 45 credits

Code	Title	Credits
Core coursework requirements:		
GEOG 3000	Advanced Geographic Statistics	4
GEOG 4000	Fundamental Geographic Perspectives	4
GEOG 4020	Geographic Research Design	4
GEOG 4900	Graduate Colloquium in Geog	0
Additional transfer, departmental, and other university courses		0-33

Total Credits 45

Note: Students must take a minimum of 33 credits in GEOG courses

Non-coursework requirements:

- Research proposal presentation
- Thesis
- Final Oral Defense

Research Proposal Presentation

Each student is required to prepare and present a thesis proposal and have it formally approved by the student's faculty committee.

Thesis Requirement

Original research of a geographic topic is required, the scope of which is determined by the thesis committee. The thesis should be of publishable quality.

Final Oral Defense

Upon completion of required course work, proposal approval and the thesis, each student will undergo a final oral defense. This defense is usually about two hours in length. The defense will address both course work and the thesis research. The final oral defense is to be conducted at least two weeks before the end of the quarter in which the degree is to be awarded. The oral defense committee is comprised of at least three members: an advisor and two other committee members. The advisor must be a full-time tenure-line faculty member in the Department of Geography & the Environment with a research record and interest appropriate to the student's proposed research area of specialization. All members of the committee must be full-time appointed faculty at DU and have research records appropriate to the student's area of specialization. DU faculty from appropriately-related units who hold the terminal degree in their field may serve on the committee as long as the candidate's graduate unit has the majority representation. There is also a non-voting Oral Defense Committee Chair who must be a tenure-line faculty member from another department at the University of Denver serving as the university representative for the final oral defense.

Master of Science in Geographic Information Science

Degree requirements

Coursework requirements

Minimum number of credits required for degree: 48 credits

Code	Title	Credits
Core coursework requirements		28
GEOG 3000	Advanced Geographic Statistics	
GEOG 3010 or GEOG 3120	Geographic Information Analysis Environmental/GIS Modeling	
GEOG 3140	GIS Database Design	
GEOG 3150 or GEOG 4170	GIS Project Management Geospatial Analysis and Project Management	
GEOG 3200	Remote Sensing	
GEOG 4020	Geographic Research Design	
GEOG 4900	Graduate Colloquium in Geog	
GEOG 4993	Capstone or Project	
Electives		8-20

A minimum of 8 quarter hours of electives must be taken in geography from any of the GEOG courses at 3000 level or above. It is strongly recommended that students take GEOG 4000 Fundamental Geographic Perspectives as one of their elective courses.

Total Credits 48

Note: At least 24 quarter hours must be completed in courses taken within the Department of Geography & the Environment at the University of Denver. No more than 24 credits will be accepted in transfer from the GIS certificate program.

Non-coursework requirements:

- Capstone project
- Capstone project presentation

Capstone Project

Students will be required to produce a final project of professional quality demonstrating their ability to apply geographic information science to their chosen area of specialization. The project is done for, and with, a company, agency, nongovernmental organization or faculty member who is referred

to as the client. The project must be used by the client and may be predominantly technical in nature or may include a research component. The project must demonstrate a mastery of one or more of the several geospatial technologies. It must require the student to engage in all facets of a project, from design to implementation. At the completion of the project, students will present their work to their peers.

Master of Science in Geographic Information Science (Online Program)

This option is designed for people wishing to complete the degree via an online format.

Degree requirements

Coursework requirements

Minimum number of credits required for degree: 48 credits

Code	Title	Credits
Core coursework requirements		20
Complete all of the following courses:		
GEOG 3000	Advanced Geographic Statistics	
GEOG 3010	Geographic Information Analysis	
GEOG 3140	GIS Database Design	
GEOG 3150 or GEOG 4170	GIS Project Management Geospatial Analysis and Project Management	
GEOG 3200 or GIS 4700	Remote Sensing (Remote Sensing is elective in GIS certificate program) Remote Sensing I	
Geography/GIS Elective Courses		20
Complete a minimum of five elective courses from any College of Professional Studies GIS certificate program course and not already used to meet a required course, or choose from the courses below.		
GEOG 3040	GPS for Resource Mapping	
GEOG 3410	Urban Applications in GIS	
GEOG 3130	GIS Programming with Python	
Acceptable College of Professional Studies GIS certificate electives can be found within that section this Bulletin. ¹		
Capstone courses		8
Complete both of the following courses:		
GEOG 4020	Geographic Research Design	
GEOG 4993	Capstone or Project	
Total Credits		48

Note: At least 24 credits counted towards the degree must be taken within the Department of Geography & the Environment at the University of Denver. No more than 24 credits will be accepted in transfer from the GIS certificate program.

Non-coursework requirements:

- Capstone project

¹ College of Professional Studies Geographic Information Systems Certificate Programs (<http://bulletin.du.edu/graduate/schoolscollegesanddivisions/professionalstudies/geographicinformationsystems/>)

GEOG 3000 Advanced Geographic Statistics (4 Credits)

The second in a sequence of two courses that address general statistical applications particular to geography, environmental science and other disciplines dealing with a spatial dimension in the data they work with. The focus of this second course is on the more advanced multivariate statistical techniques. The course has a strong applied orientation as particular attention is given to which technique is the most appropriate to use for a given type of problem and how to interpret and apply the resulting statistics. Extensive use is made of computer statistics packages. Homework exercises involving such statistical techniques as multiple correlation and regression analysis, principle components analysis, discriminate analysis and canonical correlation. Prerequisite: GEOG 2000.

GEOG 3010 Geographic Information Analysis (4 Credits)

Reviews many basic statistical methods and applies them to various spatial datasets. In addition, several spatial statistical methods are applied to spatial datasets. This course is an in-depth study of the interface between GIS, spatial data, and statistical analysis. Preferred prerequisite: GEOG 2000. Prerequisite: GEOG 2100.

GEOG 3030 Advanced Field Methods (4 Credits)

Various field methods used by researchers in physical geography; techniques include field mapping, laboratory analyses, geologic field methods. Prerequisite: GEOG 1201 or equivalent.

GEOG 3040 GPS for Resource Mapping (4 Credits)

This course is an introduction to GPS (Global Positioning Systems) concepts, techniques, and applications as they relate to GIS data collection. Lectures focus on satellite surveying, GPS technology, error sources, program planning, data collection design, and Quality Control and Quality Assurance issues for data collection programs. Hands-on lab exercises include navigation, mission planning for a GPS survey, designing a field data collection plan and associated data dictionary, field data collection, differential correction, and data integration into a GIS and map production.

GEOG 3100 Geospatial Data (4 Credits)

This graduate-level course is designed to provide graduate students from a broad range of disciplines with the skills to carry out applied research tasks and projects requiring the integration of geographic information system technologies and geospatial data. Students are introduced to a collection of techniques and data sources with a focus on acquiring and integrating data. Legal, ethical, and institutional problems related to data acquisition for geospatial information systems are also discussed.

GEOG 3120 Environmental/GIS Modeling (4 Credits)

Facing challenges brought by the dramatically changing global environment, environmental modeling is increasingly used to support geographical and environmental decision making (e.g., spatial conservation prioritization). Environmental modeling is concerned with the characterization, modeling and simulation of environmental phenomena and processes using conceptual and mathematical models. Environmental phenomena and processes taking place in the geographic space are regulated by spatial principles. They also interact with other phenomena or processes in the attribute space. For example, species distribution is not only constrained by spatial factors such as proximity to other species, but also influenced by environmental factors such as terrain and climatic conditions. Due to its superior capabilities of handling spatial data and modeling spatial and attribute relationships, geographic information system (GIS) provides the ideal tools for environmental modeling. This upper-level undergraduate/graduate-level course surveys the concepts and techniques of GIS supported environmental modeling in three general categories: 1) Modeling in the spatial domain where the focus is on modeling spatial principles (e.g., spatial autocorrelation); 2) Modeling in the attribute domain where the emphasis is on environmental correlations (e.g., environmental niche modeling); 3) Modeling in the combined spatial and attribute domain where both spatial principles and environmental correlations are exploited (e.g., geographically weighted regression). Throughout this course, several real-world applications are used to demonstrate the ideas, concepts, and techniques of GIS supported environmental modeling, including crime spatial pattern modeling, species distribution modeling, and soil-landscape modeling and mapping. Prerequisites: GEOG 2000 and GEOG 2100.

GEOG 3130 GIS Programming with Python (4 Credits)

This advanced course explores the more technical aspects of GIS functions and data structures. Students have hands-on access to both raster (grid-cell) and vector-based software packages in the form of lab exercises that culminate in a small student-designed GIS project. Prerequisite: GEOG 2100.

GEOG 3140 GIS Database Design (4 Credits)

Designing databases to provide a foundation for GIS functions and applications, including investigating techniques used for designing databases in non-spatial environments and learning the applicability to GIS problems. Building on concepts and techniques introduced in the first half to extend traditional techniques and methodologies to model the requirements of spatial problems. Students learn to translate the conceptual spatial model into a physical implementation specific to GIS products. Prerequisite: GEOG 2100 or GEOG 3100.

GEOG 3150 GIS Project Management (4 Credits)

This course provides graduate students seeking a career in GIS, or anyone managing a GIS project, with the knowledge, skill and abilities to take a GIS project or program past the design and implementation phase and into day-to-day operation. Students evaluate and analyze the role of GIS in an organization's overall information system strategy and communicate the importance of geography in an information system. Data sharing in the organization is examined to determine the benefits and costs of distributing data creation and maintenance activities throughout an organization. Finally, the role of GIS professionals and the skill sets required to manage GIS effectively are examined. Students review case studies of successful and not-so-successful GIS projects in North America. GIS management issues are addressed by a series of case studies focusing on various management aspects. Students are also expected to visit operational GIS programs in the metropolitan area and interview GIS managers. Students prepare case study evaluations for review in the classroom. Required for all MSGIS students because of the critical importance of GIS project management.

GEOG 3165 Geospatial Artificial Intelligence (4 Credits)

Geospatial Artificial Intelligence (GeoAI) combines geospatial data with artificial intelligence (AI) techniques to analyze, interpret, and model spatial patterns and processes. This interdisciplinary field integrates machine learning and deep learning with geographic information systems (GIS) and remote sensing technologies to extract meaningful insights from geospatial data. GeoAI enables more accurate mapping, modeling and prediction of geographic phenomena to support decision-making, and has been widely adopted in various domains, including environmental monitoring, disaster response, agriculture, urban planning, energy, transportation, etc. In this course, students will dive into the core principles and building blocks of GeoAI with a strong emphasis on real-world applications. Key topics include the use of machine learning and deep learning methods to analyze geospatial data such as satellite imagery and LiDAR point cloud data for image classification, object detection and feature extraction. Example applications include leveraging GeoAI models for land cover mapping, electric power lines identification, flood mapping, fire damage assessment, landslide susceptibility evaluation, etc. Students will also explore advanced GeoAI topics such as geo-foundation models and the most recent ChatGPT-like tools that are developed to automate spatial analysis and map-making workflows. Hands-on exercises, assignments and student projects in this class will involve using GIS tools (e.g., ArcGIS Pro), and AI frameworks to fine-tune existing, or develop and train new, GeoAI models and apply them for various case studies, such as detecting wind turbines, monitoring floods, and analyzing wildfire damages. Through this course, students gain experiences on using GeoAI methods to improve geospatial data analysis to support decision-making in application scenarios such as resource management and disaster response. Prerequisites: GEOG 3130 AND (GEOG 2100 or GEOG 3100 or GEOG 4110) or instructor's permission.

GEOG 3190 Lidar: Theory and Applications (4 Credits)

Overview: Lidar (Light Detection and Ranging) is an active remote sensing system that uses laser pulses to measure the distance between the sensor and a surface or objects. Lidar has become an established method for collecting very dense and accurate elevation values, as well as for characterizing the three-dimensional structure of vegetation and urban land cover. In this course, we will build an understanding of the physical principles behind lidar, develop experience working with Lidar datasets, and survey a wide array of lidar applications for mapping and natural resource management. The course will culminate with a student-directed final project. Prerequisites: GEOG 2100 or GEOG 3200.

GEOG 3200 Remote Sensing (4 Credits)

This course acquaints students with the basic techniques of the collection, processing and interpretation of information about the character of the earth's surface from remote locations. Students become familiar with the use of the visible, infrared, thermal and microwave portions of the electromagnetic spectrum as a means of determining land cover and/or land use. Both manual and computer-assisted techniques are discussed and include hands-on applications.

GEOG 3230 Advanced Remote Sensing (4 Credits)

This course will build on the basic remote sensing concepts presented in GEOG 3200. Students will explore more in-depth concepts relevant to satellite and airborne remote sensing, including radiative transfer and information extraction. In addition, students will be introduced to two cutting-edge sources of data about the Earth's surface: hyperspectral and lidar (Light Detection and Ranging) sensors. Students will study specific applications of advanced digital image processing techniques for environmental monitoring, natural resource management, and land-use planning. Finally, students will integrate remote sensing and other spatial datasets in the context of Geographic Information System (GIS) analysis. Prerequisite: GEOG 3200.

GEOG 3300 Cultural Geography (4 Credits)

Themes and methods of cultural geography including cultural area, landscape, history and ecology.

GEOG 3310 Culture/Nature/Economics-Human Ecology (4 Credits)

Cultural adaptation, livelihood strategies and environmental modification among subsistence and peasant societies: responses of such groups to technological change and economic integration.

GEOG 3330 Political Geography (4 Credits)**GEOG 3340 Geographies of Migration (4 Credits)**

This course explores contemporary movement of people across international borders and the social, cultural, political, economic, and environmental repercussions of such movements. The class looks at the global flow of people across national boundaries and the ways in which these dispersed peoples build and maintain social networks across national borders. While doing so, we address the role of globalization in international migration processes. What motivates people to move long distances, often across several international borders and at considerable financial and psychological cost? How do migrants change—and how in turn do they bring change, social as well as economic, to new destinations as well as places left behind? This course examines politics and patterns of migration, transnational migration, and immigration to the United States.

GEOG 3350 Qualitative Methods in Geography (4 Credits)

This course focuses upon qualitative methods in the production of geographic knowledge. Qualitative methods are widely employed by geographers to understand patterns and underlying processes of human and human-environment issues in society. The course is designed to expose participants to the theories, purpose, scope, and procedures of qualitative research. Specific topics include: epistemological theories (ways of knowing); ethics and power in research; research design; data collection techniques in interviewing, participant observation and landscape interpretation, discourse and archive analysis, and case studies; data analysis; and writing and disseminating qualitative findings.

GEOG 3400 Urban Landscapes (4 Credits)

Urbanization as a process; national urban systems; internal spatial structure of cities; role of transportation in urban development; location of residential, commercial and industrial activities; agglomeration economies; residential congregation and segregation; environmental justice; urban growth and growth coalitions; decentralization and urban sprawl; edge cities; impacts on the urban environment; world cities; globalization.

GEOG 3410 Urban Applications in GIS (4 Credits)

This course uses the tools of geographic information systems (GIS) to explore concepts of traditional urban geography, including defining cities/metropolis, internal urban structures, urban systems, industrial location, social and residential patterns, urban form, environmental problems, and urban planning. The course allows students to practice fundamental skills in GIS (e.g., working with attribute tables, spatial analysis, spatial queries) and cartography (map design, color theory, display of information). Depending on the quarter, students pursue individual projects of interest or client-based projects. Prerequisite: GEOG 2100 or GEOG 3100 or equivalent.

GEOG 3420 Urban and Regional Planning (4 Credits)

Historical evolution of planning theory and practices; comprehensive planning process; legal, political, economic, social, environmental aspects of urban planning; urban design; urban renewal and community development; transportation planning; economic development planning; growth management; environmental and energy planning; planning for metropolitan regions; national planning.

GEOG 3425 Urban Sustainability (4 Credits)

The 21st century is being called the 'century of the city.' Now more than ever, humans across the globe call the city their home. Many of the world's most pressing crises are manifest in cities, including: greenhouse gas emissions, land degradation, high mass production and consumption, widespread poverty and hunger, and expanding socio-economic disparities. As 'sustainability' becomes part of mainstream discourse, this course explores what sustainability means for urban contexts around the globe. Arguably, the city has the potential to be the most efficient, equitable, and environmental form of modern human settlement. Covering all dimensions of sustainability from a social science perspective, this course focuses on theoretical groundings, practices of urban sustainability, and new research agendas. Major topics include cities and nature; planning and land use; urban form; community and neighborhoods; transportation systems and accessibility; livelihood and urban economies; and social justice and the city.

GEOG 3440 Urban Transportation Planning (4 Credits)

A specialized course in the urban planning sequence focusing on issues, practices and policies of urban transportation planning. Recommended for anyone interested in timely transportation topics, such as the feasibility and impacts of light rail transit, the planning and implementation of highway projects, and the role of freight and passenger transportation companies in transportation planning.

GEOG 3445 Sustainability and Transportation (4 Credits)

Sustainable transportation aims at promoting better and healthier ways of meeting individual and community needs while reducing the social and environmental impacts of current mobility practices. Given the importance of transport for economic growth, the uncertainties surrounding the availability and price of future sources of energy for transport use, as well as the social and environmental externalities of currently-utilized transport modes, it is imperative that more sustainable ways of providing transportation be developed and utilized.

GEOG 3500 Reconstructing Quaternary Environments (4 Credits)

Nature, magnitude, sequence and causes of Pleistocene and Holocene climatic changes; effects of climatic change on plant/animal distributions and human populations; paleoclimatic research methods. Laboratory and field trips. Prerequisites: GEOG core, ENVI 3000.

GEOG 3510 Biogeography (4 Credits)

Biogeography focuses on present and past distributions of plants and animals. In this course we consider a number of themes central to biogeography, including plate tectonics and biogeography, the effects of climate change of plant and animal distributions, biogeographic realms, island biogeography, biodiversity, human impacts on plants and animals, and the origins of agriculture.

GEOG 3520 Geography of Soils (4 Credits)

Spatial variation in soil characteristics; soil processes, soil morphology, their application in soil studies. Prerequisite: GEOG 1201-1203 Environmental Systems or instructor's permission.

GEOG 3550 Topics in Physical Geography (1-5 Credits)

Investigations into various aspects of physical environment.

GEOG 3560 Fluvial Geomorphology (4 Credits)

Examines how water and sediment interact at Earth's surface to create a variety of landforms ranging from small rills to continental-scale river systems. Introduces fundamental fluvial processes or channel hydraulics and sediment transport. Examines common fluvial landforms including alluvial streams, bedrock streams, floodplains and alluvial fans. Combines traditional lectures and in-class discussions with numerous field excursions to rivers in the Rocky Mountains and Great Plains. Prerequisite: GEOG 1203, GEOG 1218, or GEOG 1266.

GEOG 3600 Meteorology (4 Credits)

The basic theory and skills of weather forecasting. Topics include thorough coverage of atmosphere dynamics and thermodynamics, the evolution of various weather types, the mechanics of storm systems (cyclones, severe storms, hurricanes), creation and interpretation of weather maps, and forecasting techniques.

GEOG 3610 Climatology (4 Credits)

Climatology is the study of the processes that result in spatial and temporal variation of weather. This course introduces the student to the processes responsible for the transfer of matter and energy between the Earth's surface and the atmosphere and the average weather conditions that result. In addition, topics of global concern, such as greenhouse effect, El Nino, urban heat islands and acid rain, are discussed. Laboratory exercises provide an opportunity to investigate climate variation and climatic change through the use of a variety of computer simulations. Prerequisites: GEOG 1201, GEOG 1216, & GEOG 1264.

GEOG 3620 Applied Climatology (4 Credits)

Climatic impact on environmental systems and human behavior; techniques to investigate climatic characteristics of environmental extremes (floods, blizzards), urban climatology and socioeconomic impacts of climate. Prerequisite: GEOG 1201. Recommended Prerequisite: GEOG 3600 or GEOG 3610.

GEOG 3630 Dendroclimatology (2-4 Credits)

Systematic variations in tree ring width and/or density can be used to reconstruct changes in precipitation or temperature well before humans were around to record the variability. This class utilizes hands on methods to introduce the fundamental principles of dendroclimatology. Through readings and lectures, students will learn how tree ring growth can be correlated to climate change. Students will then undertake several research projects to reconstruct past climate variability in the Denver metro area using tree rings. Prerequisite: permission of instructor.

GEOG 3640 Climate Change and Society (4 Credits)

The science of anthropogenic climate change will be presented with an emphasis on critical evaluation of the evidence of climate change and future scenarios and migration strategies. Students will be introduced to the latest climate change research, including the Intergovernmental Panel on Climate Change report, and the most recent literature from the field. The societal and cultural implications of climate change will also be discussed. Prerequisites: GEOG 1201, GEOG 1216, or GEOG 1264.

GEOG 3701 Topics in Geographic Information Science (1-4 Credits)

Topics vary by instructor.

GEOG 3720 Mountain Environments and Sustainability (4 Credits)

Mountain Environments and Sustainability explores the unique physical and cultural aspects of high relief and/or high altitude environments. Covering one quarter of the Earth's land surface, mountains directly or indirectly impact the lives of millions of people. We examine the significance of mountains to climate, water resources, and human activities, and discuss the sustainability of these environments and communities in light of rapid changes in many mountain regions resulting from anthropogenic factors and global change. GEOG 1201, 1202, and 1203 or instructor approval.

GEOG 3750 Topics in Human-Environment Interactions (1-4 Credits)

This course investigates various aspects of the relationships between human societies and the natural environment.

GEOG 3755 Geography of Health (4 Credits)

The geography of health is a thriving area of study that considers the impact of natural, built, and social environments on human health. This course introduces students to three geographical contributions to health studies. First, it emphasizes the importance of ecological approaches to health, which consider interactions between humans and their environments, including topics such as how climate change might influence disease distributions, and how the built environment can influence patterns of physical activity. A second focus is social theory, exploring how aspects such as race, socioeconomic status, and identity play a critical role in influencing human health. A third section of the course considers how spatial methods (cartography, GIS, and spatial statistics) can help answer health-related questions.

GEOG 3800 Geography of Colorado (4 Credits)

This course focuses on the physical and human geography of Colorado, a state that includes the western Great Plains, the southern Rocky Mountains, and the eastern Colorado Plateau. Colorado's varied natural landscapes provide equally varied settings for human settlement and resource use.

Recommended Prerequisites: GEOG 1201, GEOG 1202, and GEOG 1203.

GEOG 3820 Kiwis and Kauris: Sustainability in New Zealand (4 Credits)

With its tourist tagline of "100% Pure New Zealand," New Zealand prides itself as a world leader in sustainability, with great efforts made towards sustainable use of resources and renewable energy, conservation of indigenous species, and integration of indigenous Maori understandings of the land into sustainability approaches. At the same time, New Zealand faces significant sustainability challenges, particularly related to climate change, invasive species, continued reliance on extractive industries, and histories of oppression/exploitation of native peoples. This class uses a field-based case study approach to unpick some of these complex issues, as we visit local sites and explore topics such as preserving native species, sustainable resource use, ecotourism, and indigeneity.

GEOG 3840 Water Resource Analysis (4 Credits)

The focus of this course is on complex policy, economic and local, national and international, and political issues surrounding resource use in the western U.S. Issues include exploitation of nonrenewable and renewable energy and mineral resources; and flexible responses to changing public policy.

GEOG 3870 Water Resources & Sustainability (4 Credits)

In this course, we look at water as both a local and global resource and examine what sustainability means for human and ecological realms. After an overview of the physical processes that drive the hydrologic cycle, surface and groundwater hydrology, we examine how we humans have harnessed water for our use and how we both alter and treat its quality. We examine the legal aspects of water allocation in the U.S. and the groups and agencies that are most involved in managing and overseeing water issues. Finally, we examine the most pressing water "issues" related to wildlife, development, scarcity and conflict. We look forward to imagining the power of both the individual and the collective in meeting our future, global water needs.

GEOG 3890 Ecological Economics (4 Credits)

Ecological Economics is an emerging transdisciplinary endeavor that reintegrates the natural and social sciences toward the goal of developing a united understanding of natural and human-dominated ecosystems and designing a sustainable and desirable future for humans on a materially finite planet. In this course we start with a basic overview and summary of the neo-classical economic perspective with a particular focus on the recognized market failures of public goods, common property, and externalities. We begin with a reconceptualization of economic theory by imposing scientific constraints (e.g. conservation of mass and energy, the laws of thermodynamics, evolutionary theory, etc.). Using the ideas developed in this reconceptualization of economic theory we explore the implications for international trade and myriad public policies associated with the ethical, environmental, and economic aspects of sustainability.

GEOG 3910 Geomorphology (4 Credits)

An advanced course that examines how Earth's landforms are created by a range of physical processes. Most landforms can be viewed as a result of some combination of erosion, transport and deposition of rock, soil and sediment. The most common agents causing these geomorphic processes are water, wind, ice and waves. This course examines the processes responsible for eroding, transporting and depositing earth materials and compares these processes with the resulting landforms. Prerequisites: GEOG 1202 or GEOG 1217 or instructor's permission.

GEOG 3920 Remote Sensing Seminar (4 Credits)

Special topics in advanced remote sensing.

GEOG 3930 Cultural Geography Seminar (4 Credits)

Topics, methods and current research in cultural geography.

GEOG 3940 Urban Geography Seminar (4 Credits)

International comparison of economic and social, positive and negative aspects of urban systems.

GEOG 3950 Physical Geography Seminar (2-4 Credits)**GEOG 3955 Pollen Analysis Seminar (3 Credits)**

Pollen grains preserved in sediment provide long-term records of vegetation conditions. Changing proportions of pollen types may reflect climatic fluctuation or human impacts. We review important recent research in pollen analysis (palynology), pollen sampling, laboratory techniques and pollen identification. Students are responsible for counting a number of samples and contributing data for a pollen diagram.

GEOG 3990 Undergraduate Research Seminar (1 Credit)

This course is designed to prepare students who will participate in faculty-supervised summer research projects. Students are introduced to research design, use of the scientific method, research expectations and reporting of results. Preparation of formal research proposal with adviser.

GEOG 3991 Independent Study (1-5 Credits)**GEOG 3995 Independent Research (1-5 Credits)****GEOG 4000 Fundamental Geographic Perspectives (4 Credits)**

A foundation course for persons in the community, without a degree in geography, who want to pursue an education in or make use of computer-based geographic technology but who need a foundation in geographic concepts and perspectives.

GEOG 4020 Geographic Research Design (4 Credits)

This class prepares you to undertake creative geographic research leading to the generation of new knowledge. You will produce a NSF-style proposal by the end of the class. In this class, we focus on your idea generation and proposal writing rather than philosophy or specific methods. Specific objectives of the course include providing you the following skills: 1. The ability to create and communicate scholarly work in writing and orally 2. The ability to critique your own work and the work of other in a constructive fashion 3. Incorporation of the core ideas of geography and your field into your research 4. An understanding and appreciation of the various research methods in geography and other cognate disciplines. This understanding includes a discussion of ethics in research. 5. Ability to write an effective vita, statement of area of specialization, literature review, problem statement, and research proposal.

GEOG 4110 Geospatial Data (4 Credits)

This graduate-level course is designed to provide graduate students from a broad range of disciplines with the skills to carry out applied research tasks and projects requiring the integration of geographic information system technologies and geospatial data. Students are introduced to a collection of techniques and data sources with a focus on acquiring and integrating data. Legal, ethical, and institutional problems related to data acquisition for geospatial information systems are also discussed.

GEOG 4135 Advanced GIS Programming with Python (4 Credits)

This advanced course in Geographic Information Science (GIS) focuses on developing Python scripts for data manipulation, geospatial analysis, and thematic mapping. Students will explore advanced spatial data structures, 3D and temporal geospatial data, database operations, and spatial analysis, applying these techniques to solve real-world geospatial problems. Through practical exercises, assignments, and a capstone project, students will gain hands-on experience with Python and advanced GIS tools. These activities will equip students with the skills to design, implement, and present customized and automated solutions for geospatial challenges. Graduate students will engage in additional tasks, including researching real-world applications, presenting conceptual tool designs, and completing more advanced or detailed components of assignments.

GEOG 4140 GIS Database Design (4 Credits)

Designing databases to provide a foundation for GIS functions and applications, including investigating techniques used for designing databases in non-spatial environments and learning the applicability to GIS problems. Building on concepts and techniques introduced in the first half to extend traditional techniques and methodologies to model the requirements of spatial problems. Students learn to translate the conceptual spatial model into a physical implementation specific to GIS products.

GEOG 4150 GIS Project Management (4 Credits)

This course provides graduate students seeking a career in GIS, or anyone managing a GIS project, with the knowledge, skill and abilities to take a GIS project or program past the design and implementation phase and into day-to-day operation. Students evaluate and analyze the role of GIS in an organization's overall information system strategy and communicate the importance of geography in an information system. Data sharing in the organization is examined to determine the benefits and costs of distributing data creation and maintenance activities throughout an organization. Finally, the role of GIS professionals and the skill sets required to manage GIS effectively are examined. Students review case studies of successful and not-so-successful GIS projects in North America. GIS management issues are addressed by a series of case studies focusing on various management aspects. Students are also expected to visit operational GIS programs in the metropolitan area and interview GIS managers. Students prepare case study evaluations for review in the classroom. Required for all MSGIS students because of the critical importance of GIS project management.

GEOG 4170 Geospatial Analysis and Project Management (4 Credits)

This course provides an opportunity for students to apply geospatial data analysis to real-world applications. Students will work as a team to develop a project that requires GIS analysis and/or application development, design a project work flow and management plan, and implement a solution. Students will demonstrate competence in GIS techniques, geospatial data analysis, and project management at a professional level. This course may substitute for GEOG 3150 - GIS Project Management. Prerequisites: Completion of a minimum of two GISc courses.

GEOG 4400 Urban Landscapes (4 Credits)

Urbanization as a process; national urban systems; internal spatial structure of cities; role of transportation in urban development; location of residential, commercial and industrial activities; agglomeration economies; residential congregation and segregation; environmental justice; urban growth and growth coalitions; decentralization and urban sprawl; edge cities; impacts on the urban environment; world cities; globalization.

GEOG 4420 Urban and Regional Planning (4 Credits)

The field of urban and regional planning is concerned with the future of cities, neighborhoods, metropolitan areas, and extended regions. How do local governments (cities, counties) and metropolitan planning organizations (regional planning agencies, councils of governments) work with community stakeholders (neighborhood associations, chambers of commerce, businesses, citizens, non-governmental organizations) to formulate plans that will guide the future development of a city and its region? Cities and their regions face numerous challenges including population and employment growth or decline, economic development, neighborhood vitality, housing availability and affordability, urban design, land use, transportation, sustainability, access to parks and open space, air quality, floodplain management, water resources, and social equity among many others. How places address these challenges is critical to the future health and livability of our cities, neighborhoods, metropolitan areas, and extended regions. This course will have a community-engaged service learning component. Community-engaged scholarship and teaching comprise intellectually and methodologically rigorous work that is grounded in the norms of democratic education: inclusiveness, participation, task sharing, reciprocity in public problem solving, and an equality of respect for the knowledge and experience that everyone involved contributes to education and community building. The specific service learning project for the class will be to assist the Metropolitan Denver Nature Alliance (Metro DNA) with its goal to increase the community's engagement with nearby nature by reviewing, analyzing, and collecting data from park/ open space plans of cities and counties in the Denver metropolitan area. Cross-listed with GEOG 3420.

GEOG 4425 Urban Sustainability (4 Credits)

The 21st century is being called the 'century of the city'. Now more than ever, humans across the globe call the city their home. Many of the world's most pressing crises are manifest in cities, including: greenhouse gas emissions, land degradation, high mass production and consumption, widespread poverty and hunger, and expanding socio-economic disparities. As 'sustainability' becomes part of mainstream discourse, this course will explore what sustainability means for urban contexts around the globe. Arguably, the city has the potential to be the most efficient, equitable, and environmental form of modern human settlement. Covering all dimensions of sustainability from a social science perspective, this course will focus on theoretical groundings, practices of urban sustainability, and new research agendas. Major topics include: cities and nature; planning and land use; urban form; community and neighborhoods; transportation systems and accessibility; livelihood and urban economies; and social justice and the city.

GEOG 4440 Urban Transportation Planning (4 Credits)

A specialized course in the urban planning sequence focusing on issues, practices and policies of urban transportation planning. Recommended for anyone interested in timely transportation topics, such as the feasibility and impacts of light rail transit, the planning and implementation of highway projects, and the role of freight and passenger transportation companies in transportation planning.

GEOG 4445 Sustainability and Transportation (4 Credits)

Sustainable transportation aims at promoting better and healthier ways of meeting individual and community needs while reducing the social and environmental impacts of current and future mobility practices. Given the importance of transport for economic growth, the uncertainties surrounding the availability and price of future sources of energy for transport use, as well as the social and environmental externalities of currently-utilized transport modes, it is imperative that more sustainable ways of providing transportation be developed and utilized.

GEOG 4460 Air Transportation, High-Speed Rail and Tourism (4 Credits)

This course delves into the world of commercial air passenger transportation, studying the foundations of the industry, its role in the travel and tourism, and strategies for the future. Foundational topics include the history and geography of air transportation, air travel and tourism, the geography of tourism, airline corporate cultures, the role of government, aviation law, regulation, deregulation, and globalization. Study of the principal elements of airline economics, finance, planning, management, operations, pricing, promotion, cost containment, marketing, and policy provide the opportunity for consideration of strategic options within the contemporary airline industry. Further discussion focuses on the planning and management of airport and airway system infrastructure, the issue of sustainable air transportation, and the role of the airline industry within the context of intermodalism. Cross listed with GEOG 3460.

GEOG 4701 Topics in Geography (4 Credits)

Topics vary by instructor.

GEOG 4810 Geography of Latin America (4 Credits)

In this course, we examine how past and present cultural preferences and political economies effect changes in Latin American landscapes. Cross listed with GEOG 2810.

GEOG 4825 Geographies of International Development in Africa (4 Credits)

What are the historical roots of (under)development in sub-Saharan Africa? How is sub-Saharan Africa typically depicted in the media? How can we explain the fact that the Niger Delta provides the bulk of Nigeria's revenue, and yet, it remains the poorest part of the country? Is climate change the major cause of persistent food insecurity in the drylands of Ethiopia and Burkina Faso? How can we make sense of the uneven geography of poverty in Ghana? What explains urban food insecurity in Cape Town, or land struggles in rural South Africa? What are the social processes underlying the spatial disparity in health status in Malawi, or gender differences in HIV rates in Nyanza province, Kenya? And why do land users often resist state conservation efforts in Tanzania? These are some of the critical questions explored in this course. The primary aim is to provide a critical introduction to the geography of sub-Saharan Africa. We will begin by exploring how "the Africa story" is told by the media, scholars and policymakers. Attention will then shift to understanding the key historical processes that shape (under)development in the region. We will cover a broad range of topics, including governance, colonial history, debt and structural adjustment, foreign aid, food and agriculture, gender, climate change, land grabbing, health, population growth, migration, remittances, and resource extraction. We cannot possibly cover all these topics in greater detail; indeed, some are too vast and complex. We will however use specific case studies to illustrate and discuss each of the topics.

GEOG 4835 Biogeographies of Conservation: Safari landscapes and protected areas (Tanzania) (4 Credits)

This course introduces students to the landscapes, biodiversity, societies, and human-environment interactions in Tanzania mainland through an intensive and immersive field study and travel experience. This field intensive class equals 4 academic credits. Over a period of 9 days we will visit the greater Serengeti ecosystem, Tanzania where we will examine and compare geography, cultures, history, archaeology, ecology, biodiversity, and sustainability issues. The environment in this part of East Africa offers unique challenges for wildlife and societies. By understanding the locations and patterns of human and animal activity there, students can better appreciate the circumstances affecting individuals and countries other than our own. Through observations, lectures, discussions, readings, assignments and immersion, the course will stress the development of in-situ critical thinking skills and the promotion of environmental sustainability, cultural diversity, and global awareness.

GEOG 4880 Geographies of South Africa (4 Credits)

This travel course is designed to give students a first-hand look at the physical and cultural landscapes of South Africa. We will study the varied natural landscapes that produce the commodities (e.g., gold, diamonds, wine, and agriculture) that have attracted the interest of outsiders for centuries and that have influenced the cultural landscapes particular to South Africa. A systematic presentation of the geology of South Africa, and its human history, will unfold throughout our travels.

GEOG 4900 Graduate Colloquium in Geog (0 Credits)

Solid foundation in history and philosophy of the discipline of geography; basis for further exploration of major research specialization.

GEOG 4930 Nicaragua: Development Dilemmas (4 Credits)

This class takes students to post-revolutionary Nicaragua to examine the consequences of recent land grabs by foreigners and transnational companies. Students learn to operate in a country with minimal "western" infrastructure. They learn to examine developing landscapes (that is, resorts and tourism infrastructure) with new eyes and from the perspective of locals who have been left out of the development loop. By the end of the class, students begin to understand the "development game", begin to question the role of tourism in developing economies, begin to know how to interact with other cultures, and finally learn to question the landscapes we "see" and begin to peel back the layers to understand the social and physical evolution of the landscape before their eyes. This class takes an experiential approach and requires students to participate in a service learning experience. Service learning is defined as a course-based, credit bearing educational experience in which faculty, students, and community members participate in an organized service activity that addresses a self-identified community need. We work with several community-based and non-governmental organizations to ensure a good fit between community needs and student expertise.

GEOG 4950 Advanced Field Research (1-17 Credits)**GEOG 4991 Independent Study (1-5 Credits)****GEOG 4993 Capstone or Project (1-4 Credits)**

Includes technical design and development for MA geotechnical track project and MS-GIS capstone project.

GEOG 4995 Independent Research (1-5 Credits)

Includes field research for doctoral dissertation.

GEOG 4999 Geographic Internship (0-5 Credits)

Supervised internship in a government office at local, state or federal level or within private sector. Prerequisite: Permission of instructor.

GEOG 5991 Independent Study (1-5 Credits)**GEOG 5995 Independent Research (1-10 Credits)**

Geography Courses

GEOG 3000 Advanced Geographic Statistics (4 Credits)

The second in a sequence of two courses that address general statistical applications particular to geography, environmental science and other disciplines dealing with a spatial dimension in the data they work with. The focus of this second course is on the more advanced multivariate statistical techniques. The course has a strong applied orientation as particular attention is given to which technique is the most appropriate to use for a given type of problem and how to interpret and apply the resulting statistics. Extensive use is made of computer statistics packages. Homework exercises involving such statistical techniques as multiple correlation and regression analysis, principle components analysis, discriminate analysis and canonical correlation. Prerequisite: GEOG 2000.

GEOG 3010 Geographic Information Analysis (4 Credits)

Reviews many basic statistical methods and applies them to various spatial datasets. In addition, several spatial statistical methods are applied to spatial datasets. This course is an in-depth study of the interface between GIS, spatial data, and statistical analysis. Preferred prerequisite: GEOG 2000. Prerequisite: GEOG 2100.

GEOG 3030 Advanced Field Methods (4 Credits)

Various field methods used by researchers in physical geography; techniques include field mapping, laboratory analyses, geologic field methods. Prerequisite: GEOG 1201 or equivalent.

GEOG 3040 GPS for Resource Mapping (4 Credits)

This course is an introduction to GPS (Global Positioning Systems) concepts, techniques, and applications as they relate to GIS data collection. Lectures focus on satellite surveying, GPS technology, error sources, program planning, data collection design, and Quality Control and Quality Assurance issues for data collection programs. Hands-on lab exercises include navigation, mission planning for a GPS survey, designing a field data collection plan and associated data dictionary, field data collection, differential correction, and data integration into a GIS and map production.

GEOG 3100 Geospatial Data (4 Credits)

This graduate-level course is designed to provide graduate students from a broad range of disciplines with the skills to carry out applied research tasks and projects requiring the integration of geographic information system technologies and geospatial data. Students are introduced to a collection of techniques and data sources with a focus on acquiring and integrating data. Legal, ethical, and institutional problems related to data acquisition for geospatial information systems are also discussed.

GEOG 3120 Environmental/GIS Modeling (4 Credits)

Facing challenges brought by the dramatically changing global environment, environmental modeling is increasingly used to support geographical and environmental decision making (e.g., spatial conservation prioritization). Environmental modeling is concerned with the characterization, modeling and simulation of environmental phenomena and processes using conceptual and mathematical models. Environmental phenomena and processes taking place in the geographic space are regulated by spatial principles. They also interact with other phenomena or processes in the attribute space. For example, species distribution is not only constrained by spatial factors such as proximity to other species, but also influenced by environmental factors such as terrain and climatic conditions. Due to its superior capabilities of handling spatial data and modeling spatial and attribute relationships, geographic information system (GIS) provides the ideal tools for environmental modeling. This upper-level undergraduate/graduate-level course surveys the concepts and techniques of GIS supported environmental modeling in three general categories: 1) Modeling in the spatial domain where the focus is on modeling spatial principles (e.g., spatial autocorrelation); 2) Modeling in the attribute domain where the emphasis is on environmental correlations (e.g., environmental niche modeling); 3) Modeling in the combined spatial and attribute domain where both spatial principles and environmental correlations are exploited (e.g., geographically weighted regression). Throughout this course, several real-world applications are used to demonstrate the ideas, concepts, and techniques of GIS supported environmental modeling, including crime spatial pattern modeling, species distribution modeling, and soil-landscape modeling and mapping. Prerequisites: GEOG 2000 and GEOG 2100.

GEOG 3130 GIS Programming with Python (4 Credits)

This advanced course explores the more technical aspects of GIS functions and data structures. Students have hands-on access to both raster (grid-cell) and vector-based software packages in the form of lab exercises that culminate in a small student-designed GIS project. Prerequisite: GEOG 2100.

GEOG 3140 GIS Database Design (4 Credits)

Designing databases to provide a foundation for GIS functions and applications, including investigating techniques used for designing databases in non-spatial environments and learning the applicability to GIS problems. Building on concepts and techniques introduced in the first half to extend traditional techniques and methodologies to model the requirements of spatial problems. Students learn to translate the conceptual spatial model into a physical implementation specific to GIS products. Prerequisite: GEOG 2100 or GEOG 3100.

GEOG 3150 GIS Project Management (4 Credits)

This course provides graduate students seeking a career in GIS, or anyone managing a GIS project, with the knowledge, skill and abilities to take a GIS project or program past the design and implementation phase and into day-to-day operation. Students evaluate and analyze the role of GIS in an organization's overall information system strategy and communicate the importance of geography in an information system. Data sharing in the organization is examined to determine the benefits and costs of distributing data creation and maintenance activities throughout an organization. Finally, the role of GIS professionals and the skill sets required to manage GIS effectively are examined. Students review case studies of successful and not-so-successful GIS projects in North America. GIS management issues are addressed by a series of case studies focusing on various management aspects. Students are also expected to visit operational GIS programs in the metropolitan area and interview GIS managers. Students prepare case study evaluations for review in the classroom. Required for all MSGIS students because of the critical importance of GIS project management.

GEOG 3165 Geospatial Artificial Intelligence (4 Credits)

Geospatial Artificial Intelligence (GeoAI) combines geospatial data with artificial intelligence (AI) techniques to analyze, interpret, and model spatial patterns and processes. This interdisciplinary field integrates machine learning and deep learning with geographic information systems (GIS) and remote sensing technologies to extract meaningful insights from geospatial data. GeoAI enables more accurate mapping, modeling and prediction of geographic phenomena to support decision-making, and has been widely adopted in various domains, including environmental monitoring, disaster response, agriculture, urban planning, energy, transportation, etc. In this course, students will dive into the core principles and building blocks of GeoAI with a strong emphasis on real-world applications. Key topics include the use of machine learning and deep learning methods to analyze geospatial data such as satellite imagery and LiDAR point cloud data for image classification, object detection and feature extraction. Example applications include leveraging GeoAI models for land cover mapping, electric power lines identification, flood mapping, fire damage assessment, landslide susceptibility evaluation, etc. Students will also explore advanced GeoAI topics such as geo-foundation models and the most recent ChatGPT-like tools that are developed to automate spatial analysis and map-making workflows. Hands-on exercises, assignments and student projects in this class will involve using GIS tools (e.g., ArcGIS Pro), and AI frameworks to fine-tune existing, or develop and train new, GeoAI models and apply them for various case studies, such as detecting wind turbines, monitoring floods, and analyzing wildfire damages. Through this course, students gain experiences on using GeoAI methods to improve geospatial data analysis to support decision-making in application scenarios such as resource management and disaster response. Prerequisites: GEOG 3130 AND (GEOG 2100 or GEOG 3100 or GEOG 4110) or instructor's permission.

GEOG 3190 Lidar: Theory and Applications (4 Credits)

Overview: Lidar (Light Detection and Ranging) is an active remote sensing system that uses laser pulses to measure the distance between the sensor and a surface or objects. Lidar has become an established method for collecting very dense and accurate elevation values, as well as for characterizing the three-dimensional structure of vegetation and urban land cover. In this course, we will build an understanding of the physical principles behind lidar, develop experience working with Lidar datasets, and survey a wide array of lidar applications for mapping and natural resource management. The course will cumulate with a student-directed final projects. Prerequisites: GEOG 2100 or GEOG 3200.

GEOG 3200 Remote Sensing (4 Credits)

This course acquaints students with the basic techniques of the collection, processing and interpretation of information about the character of the earth's surface from remote locations. Students become familiar with the use of the visible, infrared, thermal and microwave portions of the electromagnetic spectrum as a means of determining land cover and/or land use. Both manual and computer-assisted techniques are discussed and include hands-on applications.

GEOG 3230 Advanced Remote Sensing (4 Credits)

This course will build on the basic remote sensing concepts presented in GEOG 3200. Students will explore more in-depth concepts relevant to satellite and airborne remote sensing, including radiative transfer and information extraction. In addition, students will be introduced to two cutting-edge sources of data about the Earth's surface: hyperspectral and lidar (Light Detection and Ranging) sensors. Students will study specific applications of advanced digital image processing techniques for environmental monitoring, natural resource management, and land-use planning. Finally, students will integrate remote sensing and other spatial datasets in the context of Geographic Information System (GIS) analysis. Prerequisite: GEOG 3200.

GEOG 3300 Cultural Geography (4 Credits)

Themes and methods of cultural geography including cultural area, landscape, history and ecology.

GEOG 3310 Culture/Nature/Economics-Human Ecology (4 Credits)

Cultural adaptation, livelihood strategies and environmental modification among subsistence and peasant societies: responses of such groups to technological change and economic integration.

GEOG 3330 Political Geography (4 Credits)**GEOG 3340 Geographies of Migration (4 Credits)**

This course explores contemporary movement of people across international borders and the social, cultural, political, economic, and environmental repercussions of such movements. The class looks at the global flow of people across national boundaries and the ways in which these dispersed peoples build and maintain social networks across national borders. While doing so, we address the role of globalization in international migration processes. What motivates people to move long distances, often across several international borders and at considerable financial and psychological cost? How do migrants change—and how in turn do they bring change, social as well as economic, to new destinations as well as places left behind? This course examines politics and patterns of migration, transnational migration, and immigration to the United States.

GEOG 3350 Qualitative Methods in Geography (4 Credits)

This course focuses upon qualitative methods in the production of geographic knowledge. Qualitative methods are widely employed by geographers to understand patterns and underlying processes of human and human-environment issues in society. The course is designed to expose participants to the theories, purpose, scope, and procedures of qualitative research. Specific topics include: epistemological theories (ways of knowing); ethics and power in research; research design; data collection techniques in interviewing, participant observation and landscape interpretation, discourse and archive analysis, and case studies; data analysis; and writing and disseminating qualitative findings.

GEOG 3400 Urban Landscapes (4 Credits)

Urbanization as a process; national urban systems; internal spatial structure of cities; role of transportation in urban development; location of residential, commercial and industrial activities; agglomeration economies; residential congregation and segregation; environmental justice; urban growth and growth coalitions; decentralization and urban sprawl; edge cities; impacts on the urban environment; world cities; globalization.

GEOG 3410 Urban Applications in GIS (4 Credits)

This course uses the tools of geographic information systems (GIS) to explore concepts of traditional urban geography, including defining cities/metropolis, internal urban structures, urban systems, industrial location, social and residential patterns, urban form, environmental problems, and urban planning. The course allows students to practice fundamental skills in GIS (e.g., working with attribute tables, spatial analysis, spatial queries) and cartography (map design, color theory, display of information). Depending on the quarter, students pursue individual projects of interest or client-based projects. Prerequisite: GEOG 2100 or GEOG 3100 or equivalent.

GEOG 3420 Urban and Regional Planning (4 Credits)

Historical evolution of planning theory and practices; comprehensive planning process; legal, political, economic, social, environmental aspects of urban planning; urban design; urban renewal and community development; transportation planning; economic development planning; growth management; environmental and energy planning; planning for metropolitan regions; national planning.

GEOG 3425 Urban Sustainability (4 Credits)

The 21st century is being called the 'century of the city.' Now more than ever, humans across the globe call the city their home. Many of the world's most pressing crises are manifest in cities, including: greenhouse gas emissions, land degradation, high mass production and consumption, widespread poverty and hunger, and expanding socio-economic disparities. As 'sustainability' becomes part of mainstream discourse, this course explores what sustainability means for urban contexts around the globe. Arguably, the city has the potential to be the most efficient, equitable, and environmental form of modern human settlement. Covering all dimensions of sustainability from a social science perspective, this course focuses on theoretical groundings, practices of urban sustainability, and new research agendas. Major topics include cities and nature; planning and land use; urban form; community and neighborhoods; transportation systems and accessibility; livelihood and urban economies; and social justice and the city.

GEOG 3440 Urban Transportation Planning (4 Credits)

A specialized course in the urban planning sequence focusing on issues, practices and policies of urban transportation planning. Recommended for anyone interested in timely transportation topics, such as the feasibility and impacts of light rail transit, the planning and implementation of highway projects, and the role of freight and passenger transportation companies in transportation planning.

GEOG 3445 Sustainability and Transportation (4 Credits)

Sustainable transportation aims at promoting better and healthier ways of meeting individual and community needs while reducing the social and environmental impacts of current mobility practices. Given the importance of transport for economic growth, the uncertainties surrounding the availability and price of future sources of energy for transport use, as well as the social and environmental externalities of currently-utilized transport modes, it is imperative that more sustainable ways of providing transportation be developed and utilized.

GEOG 3500 Reconstructing Quaternary Environments (4 Credits)

Nature, magnitude, sequence and causes of Pleistocene and Holocene climatic changes; effects of climatic change on plant/animal distributions and human populations; paleoclimatic research methods. Laboratory and field trips. Prerequisites: GEOG core, ENVI 3000.

GEOG 3510 Biogeography (4 Credits)

Biogeography focuses on present and past distributions of plants and animals. In this course we consider a number of themes central to biogeography, including plate tectonics and biogeography, the effects of climate change of plant and animal distributions, biogeographic realms, island biogeography, biodiversity, human impacts on plants and animals, and the origins of agriculture.

GEOG 3520 Geography of Soils (4 Credits)

Spatial variation in soil characteristics; soil processes, soil morphology, their application in soil studies. Prerequisite: GEOG 1201-1203 Environmental Systems or instructor's permission.

GEOG 3550 Topics in Physical Geography (1-5 Credits)

Investigations into various aspects of physical environment.

GEOG 3560 Fluvial Geomorphology (4 Credits)

Examines how water and sediment interact at Earth's surface to create a variety of landforms ranging from small rills to continental-scale river systems. Introduces fundamental fluvial processes or channel hydraulics and sediment transport. Examines common fluvial landforms including alluvial streams, bedrock streams, floodplains and alluvial fans. Combines traditional lectures and in-class discussions with numerous field excursions to rivers in the Rocky Mountains and Great Plains. Prerequisite: GEOG 1203, GEOG 1218, or GEOG 1266.

GEOG 3600 Meteorology (4 Credits)

The basic theory and skills of weather forecasting. Topics include thorough coverage of atmosphere dynamics and thermodynamics, the evolution of various weather types, the mechanics of storm systems (cyclones, severe storms, hurricanes), creation and interpretation of weather maps, and forecasting techniques.

GEOG 3610 Climatology (4 Credits)

Climatology is the study of the processes that result in spatial and temporal variation of weather. This course introduces the student to the processes responsible for the transfer of matter and energy between the Earth's surface and the atmosphere and the average weather conditions that result. In addition, topics of global concern, such as greenhouse effect, El Nino, urban heat islands and acid rain, are discussed. Laboratory exercises provide an opportunity to investigate climate variation and climatic change through the use of a variety of computer simulations. Prerequisites: GEOG 1201, GEOG 1216, & GEOG 1264.

GEOG 3620 Applied Climatology (4 Credits)

Climatic impact on environmental systems and human behavior; techniques to investigate climatic characteristics of environmental extremes (floods, blizzards), urban climatology and socioeconomic impacts of climate. Prerequisite: GEOG 1201. Recommended Prerequisite: GEOG 3600 or GEOG 3610.

GEOG 3630 Dendroclimatology (2-4 Credits)

Systematic variations in tree ring width and/or density can be used to reconstruct changes in precipitation or temperature well before humans were around to record the variability. This class utilizes hands on methods to introduce the fundamental principles of dendroclimatology. Through readings and lectures, students will learn how tree ring growth can be correlated to climate change. Students will then undertake several research projects to reconstruct past climate variability in the Denver metro area using tree rings. Prerequisite: permission of instructor.

GEOG 3640 Climate Change and Society (4 Credits)

The science of anthropogenic climate change will be presented with an emphasis on critical evaluation of the evidence of climate change and future scenarios and migration strategies. Students will be introduced to the latest climate change research, including the Intergovernmental Panel on Climate Change report, and the most recent literature from the field. The societal and cultural implications of climate change will also be discussed. Prerequisites: GEOG 1201, GEOG 1216, or GEOG 1264.

GEOG 3701 Topics in Geographic Information Science (1-4 Credits)

Topics vary by instructor.

GEOG 3720 Mountain Environments and Sustainability (4 Credits)

Mountain Environments and Sustainability explores the unique physical and cultural aspects of high relief and/or high altitude environments. Covering one quarter of the Earth's land surface, mountains directly or indirectly impact the lives of millions of people. We examine the significance of mountains to climate, water resources, and human activities, and discuss the sustainability of these environments and communities in light of rapid changes in many mountain regions resulting from anthropogenic factors and global change. GEOG 1201, 1202, and 1203 or instructor approval.

GEOG 3750 Topics in Human-Environment Interactions (1-4 Credits)

This course investigates various aspects of the relationships between human societies and the natural environment.

GEOG 3755 Geography of Health (4 Credits)

The geography of health is a thriving area of study that considers the impact of natural, built, and social environments on human health. This course introduces students to three geographical contributions to health studies. First, it emphasizes the importance of ecological approaches to health, which consider interactions between humans and their environments, including topics such as how climate change might influence disease distributions, and how the built environment can influence patterns of physical activity. A second focus is social theory, exploring how aspects such as race, socioeconomic status, and identity play a critical role in influencing human health. A third section of the course considers how spatial methods (cartography, GIS, and spatial statistics) can help answer health-related questions.

GEOG 3800 Geography of Colorado (4 Credits)

This course focuses on the physical and human geography of Colorado, a state that includes the western Great Plains, the southern Rocky Mountains, and the eastern Colorado Plateau. Colorado's varied natural landscapes provide equally varied settings for human settlement and resource use. Recommended Prerequisites: GEOG 1201, GEOG 1202, and GEOG 1203.

GEOG 3820 Kiwis and Kauris: Sustainability in New Zealand (4 Credits)

With its tourist tagline of "100% Pure New Zealand," New Zealand prides itself as a world leader in sustainability, with great efforts made towards sustainable use of resources and renewable energy, conservation of indigenous species, and integration of indigenous Maori understandings of the land into sustainability approaches. At the same time, New Zealand faces significant sustainability challenges, particularly related to climate change, invasive species, continued reliance on extractive industries, and histories of oppression/exploitation of native peoples. This class uses a field-based case study approach to unpick some of these complex issues, as we visit local sites and explore topics such as preserving native species, sustainable resource use, ecotourism, and indigeneity.

GEOG 3840 Water Resource Analysis (4 Credits)

The focus of this course is on complex policy, economic and local, national and international, and political issues surrounding resource use in the western U.S. Issues include exploitation of nonrenewable and renewable energy and mineral resources; and flexible responses to changing public policy.

GEOG 3870 Water Resources & Sustainability (4 Credits)

In this course, we look at water as both a local and global resource and examine what sustainability means for human and ecological realms. After an overview of the physical processes that drive the hydrologic cycle, surface and groundwater hydrology, we examine how we humans have harnessed water for our use and how we both alter and treat its quality. We examine the legal aspects of water allocation in the U.S. and the groups and agencies that are most involved in managing and overseeing water issues. Finally, we examine the most pressing water "issues" related to wildlife, development, scarcity and conflict. We look forward to imagining the power of both the individual and the collective in meeting our future, global water needs.

GEOG 3890 Ecological Economics (4 Credits)

Ecological Economics is an emerging transdisciplinary endeavor that reintegrates the natural and social sciences toward the goal of developing a united understanding of natural and human-dominated ecosystems and designing a sustainable and desirable future for humans on a materially finite planet. In this course we start with a basic overview and summary of the neo-classical economic perspective with a particular focus on the recognized market failures of public goods, common property, and externalities. We begin with a reconceptualization of economic theory by imposing scientific constraints (e.g. conservation of mass and energy, the laws of thermodynamics, evolutionary theory, etc.). Using the ideas developed in this reconceptualization of economic theory we explore the implications for international trade and myriad public policies associated with the ethical, environmental, and economic aspects of sustainability.

GEOG 3910 Geomorphology (4 Credits)

An advanced course that examines how Earth's landforms are created by a range of physical processes. Most landforms can be viewed as a result of some combination of erosion, transport and deposition of rock, soil and sediment. The most common agents causing these geomorphic processes are water, wind, ice and waves. This course examines the processes responsible for eroding, transporting and depositing earth materials and compares these processes with the resulting landforms. Prerequisites: GEOG 1202 or GEOG 1217 or instructor's permission.

GEOG 3920 Remote Sensing Seminar (4 Credits)

Special topics in advanced remote sensing.

GEOG 3930 Cultural Geography Seminar (4 Credits)

Topics, methods and current research in cultural geography.

GEOG 3940 Urban Geography Seminar (4 Credits)

International comparison of economic and social, positive and negative aspects of urban systems.

GEOG 3950 Physical Geography Seminar (2-4 Credits)**GEOG 3955 Pollen Analysis Seminar (3 Credits)**

Pollen grains preserved in sediment provide long-term records of vegetation conditions. Changing proportions of pollen types may reflect climatic fluctuation or human impacts. We review important recent research in pollen analysis (palynology), pollen sampling, laboratory techniques and pollen identification. Students are responsible for counting a number of samples and contributing data for a pollen diagram.

GEOG 3990 Undergraduate Research Seminar (1 Credit)

This course is designed to prepare students who will participate in faculty-supervised summer research projects. Students are introduced to research design, use of the scientific method, research expectations and reporting of results. Preparation of formal research proposal with adviser.

GEOG 3991 Independent Study (1-5 Credits)**GEOG 3995 Independent Research (1-5 Credits)****GEOG 4000 Fundamental Geographic Perspectives (4 Credits)**

A foundation course for persons in the community, without a degree in geography, who want to pursue an education in or make use of computer-based geographic technology but who need a foundation in geographic concepts and perspectives.

GEOG 4020 Geographic Research Design (4 Credits)

This class prepares you to undertake creative geographic research leading to the generation of new knowledge. You will produce a NSF-style proposal by the end of the class. In this class, we focus on your idea generation and proposal writing rather than philosophy or specific methods. Specific objectives of the course include providing you the following skills: 1. The ability to create and communicate scholarly work in writing and orally 2. The ability to critique your own work and the work of other in a constructive fashion 3. Incorporation of the core ideas of geography and your field into your research 4. An understanding and appreciation of the various research methods in geography and other cognate disciplines. This understanding includes a discussion of ethics in research. 5. Ability to write an effective vita, statement of area of specialization, literature review, problem statement, and research proposal.

GEOG 4110 Geospatial Data (4 Credits)

This graduate-level course is designed to provide graduate students from a broad range of disciplines with the skills to carry out applied research tasks and projects requiring the integration of geographic information system technologies and geospatial data. Students are introduced to a collection of techniques and data sources with a focus on acquiring and integrating data. Legal, ethical, and institutional problems related to data acquisition for geospatial information systems are also discussed.

GEOG 4135 Advanced GIS Programming with Python (4 Credits)

This advanced course in Geographic Information Science (GIS) focuses on developing Python scripts for data manipulation, geospatial analysis, and thematic mapping. Students will explore advanced spatial data structures, 3D and temporal geospatial data, database operations, and spatial analysis, applying these techniques to solve real-world geospatial problems. Through practical exercises, assignments, and a capstone project, students will gain hands-on experience with Python and advanced GIS tools. These activities will equip students with the skills to design, implement, and present customized and automated solutions for geospatial challenges. Graduate students will engage in additional tasks, including researching real-world applications, presenting conceptual tool designs, and completing more advanced or detailed components of assignments.

GEOG 4140 GIS Database Design (4 Credits)

Designing databases to provide a foundation for GIS functions and applications, including investigating techniques used for designing databases in non-spatial environments and learning the applicability to GIS problems. Building on concepts and techniques introduced in the first half to extend traditional techniques and methodologies to model the requirements of spatial problems. Students learn to translate the conceptual spatial model into a physical implementation specific to GIS products.

GEOG 4150 GIS Project Management (4 Credits)

This course provides graduate students seeking a career in GIS, or anyone managing a GIS project, with the knowledge, skill and abilities to take a GIS project or program past the design and implementation phase and into day-to-day operation. Students evaluate and analyze the role of GIS in an organization's overall information system strategy and communicate the importance of geography in an information system. Data sharing in the organization is examined to determine the benefits and costs of distributing data creation and maintenance activities throughout an organization. Finally, the role of GIS professionals and the skill sets required to manage GIS effectively are examined. Students review case studies of successful and not-so-successful GIS projects in North America. GIS management issues are addressed by a series of case studies focusing on various management aspects. Students are also expected to visit operational GIS programs in the metropolitan area and interview GIS managers. Students prepare case study evaluations for review in the classroom. Required for all MSGIS students because of the critical importance of GIS project management.

GEOG 4170 Geospatial Analysis and Project Management (4 Credits)

This course provides an opportunity for students to apply geospatial data analysis to real-world applications. Students will work as a team to develop a project that requires GIS analysis and/or application development, design a project work flow and management plan, and implement a solution. Students will demonstrate competence in GIS techniques, geospatial data analysis, and project management at a professional level. This course may substitute for GEOG 3150 - GIS Project Management. Prerequisites: Completion of a minimum of two GISc courses.

GEOG 4400 Urban Landscapes (4 Credits)

Urbanization as a process; national urban systems; internal spatial structure of cities; role of transportation in urban development; location of residential, commercial and industrial activities; agglomeration economies; residential congregation and segregation; environmental justice; urban growth and growth coalitions; decentralization and urban sprawl; edge cities; impacts on the urban environment; world cities; globalization.

GEOG 4420 Urban and Regional Planning (4 Credits)

The field of urban and regional planning is concerned with the future of cities, neighborhoods, metropolitan areas, and extended regions. How do local governments (cities, counties) and metropolitan planning organizations (regional planning agencies, councils of governments) work with community stakeholders (neighborhood associations, chambers of commerce, businesses, citizens, non-governmental organizations) to formulate plans that will guide the future development of a city and its region? Cities and their regions face numerous challenges including population and employment growth or decline, economic development, neighborhood vitality, housing availability and affordability, urban design, land use, transportation, sustainability, access to parks and open space, air quality, floodplain management, water resources, and social equity among many others. How places address these challenges is critical to the future health and livability of our cities, neighborhoods, metropolitan areas, and extended regions. This course will have a community-engaged service learning component. Community-engaged scholarship and teaching comprise intellectually and methodologically rigorous work that is grounded in the norms of democratic education: inclusiveness, participation, task sharing, reciprocity in public problem solving, and an equality of respect for the knowledge and experience that everyone involved contributes to education and community building. The specific service learning project for the class will be to assist the Metropolitan Denver Nature Alliance (Metro DNA) with its goal to increase the community's engagement with nearby nature by reviewing, analyzing, and collecting data from park/ open space plans of cities and counties in the Denver metropolitan area. Cross-listed with GEOG 3420.

GEOG 4425 Urban Sustainability (4 Credits)

The 21st century is being called the 'century of the city'. Now more than ever, humans across the globe call the city their home. Many of the world's most pressing crises are manifest in cities, including: greenhouse gas emissions, land degradation, high mass production and consumption, widespread poverty and hunger, and expanding socio-economic disparities. As 'sustainability' becomes part of mainstream discourse, this course will explore what sustainability means for urban contexts around the globe. Arguably, the city has the potential to be the most efficient, equitable, and environmental form of modern human settlement. Covering all dimensions of sustainability from a social science perspective, this course will focus on theoretical groundings, practices of urban sustainability, and new research agendas. Major topics include: cities and nature; planning and land use; urban form; community and neighborhoods; transportation systems and accessibility; livelihood and urban economies; and social justice and the city.

GEOG 4440 Urban Transportation Planning (4 Credits)

A specialized course in the urban planning sequence focusing on issues, practices and policies of urban transportation planning. Recommended for anyone interested in timely transportation topics, such as the feasibility and impacts of light rail transit, the planning and implementation of highway projects, and the role of freight and passenger transportation companies in transportation planning.

GEOG 4445 Sustainability and Transportation (4 Credits)

Sustainable transportation aims at promoting better and healthier ways of meeting individual and community needs while reducing the social and environmental impacts of current and future mobility practices. Given the importance of transport for economic growth, the uncertainties surrounding the availability and price of future sources of energy for transport use, as well as the social and environmental externalities of currently-utilized transport modes, it is imperative that more sustainable ways of providing transportation be developed and utilized.

GEOG 4460 Air Transportation, High-Speed Rail and Tourism (4 Credits)

This course delves into the world of commercial air passenger transportation, studying the foundations of the industry, its role in the travel and tourism, and strategies for the future. Foundational topics include the history and geography of air transportation, air travel and tourism, the geography of tourism, airline corporate cultures, the role of government, aviation law, regulation, deregulation, and globalization. Study of the principal elements of airline economics, finance, planning, management, operations, pricing, promotion, cost containment, marketing, and policy provide the opportunity for consideration of strategic options within the contemporary airline industry. Further discussion focuses on the planning and management of airport and airway system infrastructure, the issue of sustainable air transportation, and the role of the airline industry within the context of intermodalism. Cross listed with GEOG 3460.

GEOG 4701 Topics in Geography (4 Credits)

Topics vary by instructor.

GEOG 4810 Geography of Latin America (4 Credits)

In this course, we examine how past and present cultural preferences and political economies effect changes in Latin American landscapes. Cross listed with GEOG 2810.

GEOG 4825 Geographies of International Development in Africa (4 Credits)

What are the historical roots of (under)development in sub-Saharan Africa? How is sub-Saharan Africa typically depicted in the media? How can we explain the fact that the Niger Delta provides the bulk of Nigeria's revenue, and yet, it remains the poorest part of the country? Is climate change the major cause of persistent food insecurity in the drylands of Ethiopia and Burkina Faso? How can we make sense of the uneven geography of poverty in Ghana? What explains urban food insecurity in Cape Town, or land struggles in rural South Africa? What are the social processes underlying the spatial disparity in health status in Malawi, or gender differences in HIV rates in Nyanza province, Kenya? And why do land users often resist state conservation efforts in Tanzania? These are some of the critical questions explored in this course. The primary aim is to provide a critical introduction to the geography of sub-Saharan Africa. We will begin by exploring how "the Africa story" is told by the media, scholars and policymakers. Attention will then shift to understanding the key historical processes that shape (under)development in the region. We will cover a broad range of topics, including governance, colonial history, debt and structural adjustment, foreign aid, food and agriculture, gender, climate change, land grabbing, health, population growth, migration, remittances, and resource extraction. We cannot possibly cover all these topics in greater detail; indeed, some are too vast and complex. We will however use specific case studies to illustrate and discuss each of the topics.

GEOG 4835 Biogeographies of Conservation: Safari landscapes and protected areas (Tanzania) (4 Credits)

This course introduces students to the landscapes, biodiversity, societies, and human-environment interactions in Tanzania mainland through an intensive and immersive field study and travel experience. This field intensive class equals 4 academic credits. Over a period of 9 days we will visit the greater Serengeti ecosystem, Tanzania where we will examine and compare geography, cultures, history, archaeology, ecology, biodiversity, and sustainability issues. The environment in this part of East Africa offers unique challenges for wildlife and societies. By understanding the locations and patterns of human and animal activity there, students can better appreciate the circumstances affecting individuals and countries other than our own. Through observations, lectures, discussions, readings, assignments and immersion, the course will stress the development of in-situ critical thinking skills and the promotion of environmental sustainability, cultural diversity, and global awareness.

GEOG 4880 Geographies of South Africa (4 Credits)

This travel course is designed to give students a first-hand look at the physical and cultural landscapes of South Africa. We will study the varied natural landscapes that produce the commodities (e.g., gold, diamonds, wine, and agriculture) that have attracted the interest of outsiders for centuries and that have influenced the cultural landscapes particular to South Africa. A systematic presentation of the geology of South Africa, and its human history, will unfold throughout our travels.

GEOG 4900 Graduate Colloquium in Geog (0 Credits)

Solid foundation in history and philosophy of the discipline of geography; basis for further exploration of major research specialization.

GEOG 4930 Nicaragua: Development Dilemmas (4 Credits)

This class takes students to post-revolutionary Nicaragua to examine the consequences of recent land grabs by foreigners and transnational companies. Students learn to operate in a country with minimal "western" infrastructure. They learn to examine developing landscapes (that is, resorts and tourism infrastructure) with new eyes and from the perspective of locals who have been left out of the development loop. By the end of the class, students begin to understand the "development game", begin to question the role of tourism in developing economies, begin to know how to interact with other cultures, and finally learn to question the landscapes we "see" and begin to peel back the layers to understand the social and physical evolution of the landscape before their eyes. This class takes an experiential approach and requires students to participate in a service learning experience. Service learning is defined as a course-based, credit bearing educational experience in which faculty, students, and community members participate in an organized service activity that addresses a self-identified community need. We work with several community-based and non-governmental organizations to ensure a good fit between community needs and student expertise.

GEOG 4950 Advanced Field Research (1-17 Credits)**GEOG 4991 Independent Study (1-5 Credits)****GEOG 4993 Capstone or Project (1-4 Credits)**

Includes technical design and development for MA geotechnical track project and MS-GIS capstone project.

GEOG 4995 Independent Research (1-5 Credits)

Includes field research for doctoral dissertation.

GEOG 4999 Geographic Internship (0-5 Credits)

Supervised internship in a government office at local, state or federal level or within private sector. Prerequisite: Permission of instructor.

GEOG 5991 Independent Study (1-5 Credits)**GEOG 5995 Independent Research (1-10 Credits)****Geology Courses****GEOL 3100 Environmental Geology (4 Credits)**

Environmental geology examines geologic hazards, both natural and those attributable to human impacts on the environment from urban and regional development. Specific topics may include disposal of municipal solid waste and radioactive waste; flood, earthquake, volcanic hazards; groundwater pollution and withdrawal; mass-wasting phenomena; and energy-related issues. Prerequisite: GEOL 1010, GEOG 1203 or instructor's permission.

GEOL 3200 Sedimentology/Stratigraphy (4 Credits)

This course reviews the origin, geologic history, and depositional environments of sediments and sedimentary rocks. Course work concentrates on the identification of sedimentary rocks and depositional environments by first-hand observations of rocks in the Denver area. Prerequisite: GEOL 1010, GEOG 1203 or instructor's permission.

GEOL 3540 Hydrology (4 Credits)

This course provides an overview of the hydrologic cycle with emphasis placed on the study of applied hydrology. Discussions include the fundamental characteristics of precipitation, runoff processes, calculation of flood hazards, aquifers (porosity and permeability), the geologic settings of groundwater, the basic physics of groundwater flow, and water supply and use. Prerequisite: GEOL 1010, GEOG 1203 or instructor's permission. Recommended prerequisite: one introductory statistics course.

GEOL 3900 Geomorphology Seminar (1-5 Credits)

Hill slopes comprise the vast majority of the Earth's land surface. It is upon these surfaces that nearly all of the human population must exist and, hopefully, flourish. Hill slopes assume various forms, and their shape influences their utility for various human endeavors. Numerous geomorphic processes operate upon hill slopes to determine their form, and human activities strongly influence the frequency and magnitude of these geomorphic processes. Consequently, hill slopes are an interface between the Earth and the human population. Prerequisite: GEOL 3010 or permission of instructor.

GEOL 3991 Independent Study (1-5 Credits)