

# GEOSCIENCES (GEOS)

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## GEOS 100. DISCOVERING GEOLOGY. 5 Credits.

**Notes:** satisfies lab science requirement at most universities; weekly laboratories required.

**Satisfies:** a BACR for natural sciences.

This course explores the interactions between human beings and their geological environment. The earth is a dynamic planet affected by sudden, violent events such as volcanic eruptions, earthquakes and floods, as well as by slower processes operating over long time spans that create, move, and destroy continents and oceans. Other topics include study of energy, mineral and water resources and their importance to modern society. Topics are presented at a level intended for nonscience majors.

## GEOS 111. THE EARTH'S INTERIOR. 5 Credits.

**Notes:** required weekly laboratories and one field trip may be required.

**Satisfies:** the completion of GEOS 111 counts as one course for the BACR in natural science; the completion of GEOS 111 and GEOS 112 counts as two courses for the BACR for natural science.

Introduction to physical geology for students interested in earth and environmental science. This course covers the origin of the earth, its internal structure and minerals, rocks and volcanoes. Earthquakes, mountains and continental drift are discussed in the context of plate tectonics. The formation of mineral deposits is also covered.

## GEOS 112. THE EARTH'S SURFACE. 5 Credits.

**Notes:** weekly laboratories are required and one field trip may be required.

**Satisfies:** the completion of GEOS 111 counts as one course for the BACR in natural science; the completion of GEOS 111 and GEOS 112 counts as two courses for the BACR for natural science.

Introduction to surficial processes. This course emphasizes quantitative and qualitative analyses of processes that shape the earth's surface including weathering and erosion, sediments and sedimentary rocks, and the development of landforms by gravity, wind, water, and glacial ice. Concepts related to geologic time and absolute/relative dating are also explored. Class requires analytical thinking and quantitative literacy.

## GEOS 113. THE EARTH'S CLIMATE AND WEATHER. 5 Credits.

**Notes:** this course requires four hours of lecture and three hours of lab per week.

**Satisfies:** a BACR for natural sciences.

This course explores Earth's atmosphere, covering the subjects of energy balance, atmospheric moisture, and global atmospheric and oceanic circulation. We then analyze various atmospheric disturbances such as thunderstorms, tornadoes, and hurricanes. We spend the last few weeks studying climate, weather patterns and trends over a much longer period. This investigation looks at modern climate types and vegetation patterns, paleoclimatology, and the current threat of global climate change.

## GEOS 115. EARTH SCIENCE FOR TEACHERS. 5 Credits.

**Notes:** for students planning to teach elementary school, these inquiry-based earth science investigations support science instruction outlined in the Next Generation Science Standards.

**Pre-requisites:** MTHD 104 or equivalent (pre-university basic skills in mathematics.)

**Satisfies:** a BACR for natural sciences.

This class presents a content-rich, inquiry-based approach to some foundational topics in geology and meteorology, presented as an active process, in which students become participants in learning science.

## GEOS 196. EXPERIMENTAL COURSE. 1-5 Credits.

Experimental.

## GEOS 200. GLOBALIZATION AND THE ENVIRONMENT. 5 Credits.

**Satisfies:** a BACR for social sciences.

An introduction to the study of spatial variations among human cultures and the patterns of interaction between humans and the natural environment. Special emphasis is placed on the social and spatial dynamics of globalization and its myriad impacts on the environment.

## GEOS 201. RESEARCH METHODS. 5 Credits.

**Pre-requisites:** sophomore standing.

This course presents the fundamentals of research methods, design, and performance in geography and environmental studies.

## GEOS 203. FUNDAMENTALS OF SURFACE HYDROLOGY. 5 Credits.

**Cross-listed:** PLAN 203.

**Satisfies:** a BACR for natural science.

This course is an introduction to surface hydrology. Hydrological process and the techniques used to measure them are the primary focus of this course.

## GEOS 204. HOT EARTH: PEOPLE AND CLIMATE CHANGE. 5 Credits.

**Satisfies:** a BACR for natural sciences.

An introduction to the earth-atmosphere system. The course surveys the physical nature of the atmosphere including weather elements, weather systems and climate. The course addresses the social and environmental issues related to natural and human induced changes in the composition of the atmosphere.

## GEOS 222. THE EARTH THROUGH TIME. 5 Credits.

**Pre-requisites:** GEOS 100.

Introduction to earth history for students majoring in geology, earth science or environmental science. This course covers the evolution of the earth from its creation to the present. Topics focus on tectonic history, the evolution and diversity of life, and the effects of biological change on the environment throughout geologic time. Participation in weekly laboratories and field trips required.

## GEOS 226. INTRODUCTION TO GIS SOFTWARE DESIGN. 2 Credits.

This course provides hands-on experience and teaches students technical proficiency using GIS software through demonstration and laboratory exercises.

## GEOS 227. CRITICAL CARTOGRAPHIES. 5 Credits.

**Satisfies:** a BACR for humanities and arts.

The focus of this course is mastering and critically evaluating the historic and contemporary uses of maps as both scientific and artistic representations of geographic reality, environmental as well as cultural. Special attention is directed toward maps as communication devices. The course is of value for those wishing to move on to geographic information systems (GIS) courses as well as general background for geography, social science, humanities, and education majors.

## GEOS 230. WORLD GEOGRAPHY. 5 Credits.

**Satisfies:** a university graduation requirement—global studies.

A survey of world geographical relationships. Includes an examination of the distribution of selected physical and human phenomena and the processes responsible for the distributions and the varying interrelationships from place to place between humans and the environment.

**GEOS 235. ENERGY/WATER NEXUS. 4 Credits.****Cross-listed:** SUST 235.**Satisfies:** a BACR for social sciences.

Energy and water are intrinsically linked. Each is needed to extract, harness, and transport the other and modern society demands that both are readily available. This class will review water availability, use, classifications and spatiotemporal considerations. Students will learn about the history and current state of technology of energy systems. The water energy nexus and how it prevails in different systems will be discussed throughout the course.

**GEOS 239. TOPICS. 1 Credit.**

Topics in Geosciences.

**GEOS 250. GLOBAL ECONOMIC DEVELOPMENT. 3 Credits.**

This course is a survey of the patterns, structures and locational principles of economic activity, including world regional and historical economic development, natural resources, agriculture, manufacturing, transportation, communications and the distribution of service sectors. Particular emphasis will be placed on the process of globalization, free trade and the increasing significance of space and place in the 21st century global economy.

**GEOS 296. EXPERIMENTAL COURSE. 1-5 Credits.**

Experimental.

**GEOS 300. EARTH SYSTEMS PROCESSES. 5 Credits.****Pre-requisites:** GEOS 113 or permission of the instructor.

Systematic study of physical events and processes within the human environment including elements of landforms, soils, vegetation, and oceans.

**GEOS 301. HUMAN GEOGRAPHY. 5 Credits.****Pre-requisites:** ENGL 201.

A study of humans, focused on their interaction with the physical and cultural environments of the earth.

**GEOS 302. CULTURE, POWER, NATURE: THE HUMAN-ANIMAL NEXUS. 5 Credits.****Pre-requisites:** ENGL 201.

An introduction to the ways that humans and animals have shared the earth across space and time, with an emphasis on the ways different cultural groups interact with, make use of, assign economic values to, develop cultural perspectives about, impact the habitats of, form friendships with, attempt to protect, or potentially cause the extinction of, various animal species. The class explores the nexus of humans, animals, and cultural systems of power, privilege, oppression and colonization.

**GEOS 305. INTRODUCTION TO OCEANOGRAPHY. 5 Credits.****Pre-requisites:** mathematics clearance.

An introduction to the nature, occurrence, distribution and interrelationships of phenomena in the oceans, the basins and margins.

**GEOS 306. WILDFIRE ACTIVITY MAPPING. 5 Credits.****Pre-requisites:** GEOS 113, GEOS 323, or permission of the instructor.

This course is an introduction to historical and active wildfire mapping. This course covers various wildfire data sources, methods for mapping historical versus active fires, and limitations of current GIS workflows in the field. This course is project-based and considered an upper-level GIS elective.

**GEOS 311. EARTH MATERIALS. 4 Credits.****Pre-requisites:** GEOS 100, CHEM 171 or HONS 171, and CHEM 171L.

This course is an introduction to the materials that comprise the solid earth, including minerals, igneous, sedimentary and metamorphic rocks. The course includes discussions of their occurrence, associations and uses. Methods of identification are stressed during laboratory exercises.

**GEOS 312. FUNDAMENTALS OF SOIL SCIENCE. 4 Credits.****Cross-listed:** BIOL 312, PLAN 312.**Pre-requisites:** MTHD 104 or completion of the Quantitative and Symbolic Reasoning requirement.

A general introduction to physical, chemical and biological properties of soils.

**GEOS 313. IGNEOUS AND METAMORPHIC PETROLOGY. 4 Credits.****Pre-requisites:** GEOS 311.

A comprehensive study of the classification, description, and origin of igneous and metamorphic rocks. Students will learn about the use of minerals in helping to interpret the geologic and tectonic significance of the rocks in which they are found. The course builds on skills learned in GEOS 311 and stresses hand sample and thin section descriptive techniques. Weekly laboratories as well as one weekend field trip are required.

**GEOS 314. WEATHER FORECASTING. 5 Credits.****Pre-requisites:** GEOS 204 or 10 credits of upper division science or permission of the instructor.

Includes the principles of meteorology, description and use of instruments, weather and climate controls. Students will gain experience using contemporary data from NOAA/NWS and elsewhere for analyses in weather forecasting.

**GEOS 315. WATER RESOURCES. 4 Credits.****Cross-listed:** PLAN 315.**Pre-requisites:** completion of the Quantitative and Symbolic Reasoning requirement.**Satisfies:** a university graduation requirement—global studies.

A comprehensive examination of water resources. This class examines the role of the hydrologic cycle and the geography of freshwater in human-environment interactions with an emphasis on national and international water resource issues.

**GEOS 317. RESOURCES AND CONSERVATION. 5 Credits.****Cross-listed:** PLAN 317.**Pre-requisites:** successful completion of at least one natural science BACR and ENGL 201.**Satisfies:** a university graduation requirement—global studies.

Studies the nature and distribution of natural resources, and problems and principles of their use and conservation.

**GEOS 320. ENVIRONMENTAL GEOLOGY. 4 Credits.****Pre-requisites:** two of the following: GEOS 100, GEOS 111, GEOS 112, GEOS 113.

Relationship of human activities with earth materials and processes, water quality, atmospheric composition, waste disposal, natural resources, the importance of an interdisciplinary approach to environmental problems. Field trips emphasize local environmental problems. Laboratory.

**GEOS 321. GEOGRAPHIC INFORMATION SYSTEMS I: SPATIAL ANALYSIS FOR SOCIAL SCIENCES. 5 Credits.****Notes:** this course satisfies a core requirement in the geosciences curriculum as well as the GIS and Remote Sensing certificates.**Pre-requisites:** GEOS 111 or GEOS 112 or GEOS 113 or junior standing. Introduction to Geographic Information Systems (GIS) with an emphasis on its applications in the Social Sciences, including census data, demographic analysis, social justice, and related mapping of social phenomena. Course includes hands-on GIS work in the lab.

**GEOS 323. GEOGRAPHIC INFORMATION SYSTEMS I: SPATIAL ANALYSIS FOR ENVIRONMENTAL SCIENCES. 5 Credits.****Cross-listed:** ENVS 323.**Notes:** includes hands-on GIS work in the lab.**Pre-requisites:** GEOS 111 or GEOS 112 or GEOS 113 or junior standing. Introduction to Geographic Information Systems (GIS) with an emphasis on its applications in the environmental sciences. This course can be taken to satisfy a core requirement for the Geosciences BS and BA, and Certificates in GIS and Remote Sensing.**GEOS 325. WETLAND SCIENCE I. 4 Credits.****Cross-listed:** BIOL 325, PLAN 325.**Pre-requisites:** completion of at least one Natural Science BACR course. An introduction to the fundamental processes that form and sustain wetlands. Emphasizes the distinctive hydrology, soils, and vegetation of wetlands and field experience in delineation. Examines issues of regulation. Focus is on Pacific Northwest wetlands.**GEOS 329. REMOTE SENSING WITH SATELLITE IMAGERY. 5 Credits.****Pre-requisites:** GEOS 321 or GEOS 323.

Today, there is a wealth of both historic and newly online airborne and spaceborne imagery. This course concentrates on examining the various types of aerial and satellite sensing platforms and datasets and investigates how existing and future systems will be used for the extraction of features for analysis.

**GEOS 330. GEOGRAPHY OF THE PACIFIC NORTHWEST. 4 Credits.****Pre-requisites:** junior standing.

An introduction to regional geographic studies on a local scale. A survey and appraisal of the interrelated elements of the economy, resources, population and physical environment as they affect the growth and development of the region.

**GEOS 332. LANDSCAPES OF THE PAST. 5 Credits.****Pre-requisites:** junior standing.

Investigations of ancient and historic landscapes address the complexities of how humans have shaped and been shaped by their environment. Landscape archaeology is a multidisciplinary approach that interprets the natural and cultural environments of the past through geoarchaeological and geoscience techniques. This course covers these principles and provides students with fundamental skills in surveying, spatial analysis, remote sensing, and the creation of augmented reality 3D visualizations.

**GEOS 333. REMOTE SENSING WITH LIDAR. 5 Credits.****Pre-requisites:** GEOS 321 and GEOS 323.

Recent technological advances in geophysical survey equipment and Light Detection and Ranging (LiDAR) have produced high-resolution remote sensing datasets ideal for investigating the Earth's surface. These require unique computational analysis techniques and are increasingly important for understanding the interface of human impacts to the natural environment. This class provides an overview of these techniques and concentrates on building skills in analysis of datasets produced by LiDAR.

**GEOS 335. REMOTE SENSING WITH DRONES. 5 Credits.****Pre-requisites:** GEOS 321 or GEOS 323.

The increasing ubiquity of unmanned aerial vehicles(UAVS)/drones in remote sensing investigations has led to a need for understanding not only the sensor platforms, but how to analyze and investigate the datasets generated by these machines. This course provides an overview of the different types of data that can be gathered by drones and how to investigate them using GIS, photogrammetry, and other geospatial software programs.

**GEOS 352. ENVIRONMENTAL JUSTICE. 5 Credits.****Pre-requisites:** junior standing or permission of instructor.**Satisfies:** a university graduation requirement–diversity.

This course examines the breadth of research in situated within the interdisciplinary field of environmental justice with a particular focus on the nexus between the process of urbanization and the natural environment. Emphasis will be placed on the spatial expression of socio-environmental inequalities (based on class, race, ethnicity, gender, sexuality, etc.), as they get written into, or reflected by, the myriad urban landscapes of the world.

**GEOS 355. THE GEOGRAPHY OF THEME PARKS. 2 Credits.****Pre-requisites:** ENGL 201.

Examination of the geographic history and characteristics of the theme park as a 'serious' part of the built environment. We consider the environmental, economic, political, cultural, architectural, and technological impacts of theme parks on urban and suburban space around the world.

**GEOS 357. THE GEOGRAPHY OF CHILDHOOD. 3 Credits.****Pre-requisites:** ENGL 201.

Examination of the geographic aspects of childhood across space and time. Focus on how cultures in different places and at different times have created, maintained, and controlled spaces for children, including where children are born, who cares for infants, the conditions of schooling, leisure spaces provided, and the 'virtual geographies' of television and the internet.

**GEOS 359. POLITICAL GEOGRAPHY. 5 Credits.****Pre-requisites:** sophomore standing or permission of instructor.**Satisfies:** a university graduation requirement–global studies.

The course identifies and critically evaluates the geographic distribution of political actions and outcomes in the context of globalization. Topics include state, regional, national and international electoral politics, international war and conflict, access to natural resources, nationalism, democratization, terrorism, processes of militarization, and the politics of identity.

**GEOS 360. GEOLOGIC HAZARDS. 4 Credits.****Pre-requisites:** GEOS 100 or GEOS 113 or GEOS 115.

Introduction to geologic hazards affecting humankind; emphasis on earthquakes, volcanism, floods and landslides. Applications to geological site engineering and city/regional planning.

**GEOS 365. URBAN GEOGRAPHY: ORIGINS, FORMS AND FUNCTIONS. 5 Credits.****Pre-requisites:** sophomore standing or permission of instructor.**Satisfies:** a university graduation requirement–diversity.

This course explores the complexity of the city in a global context, and the ensemble of economic, political, social, and environmental forces that are constituted in and reverberate through and across particular urban landscapes. Topical issues addressed include the evolution of urban spatial forms, policy and governance, and the city as an increasingly globalizing entity. Emphasis will be placed on contemporary urban problems (widening inequality, deepening poverty and social marginalization).

**GEOS 392. SEMINAR IN HISTORY AND PHILOSOPHY OF GEOGRAPHY. 2 Credits.****Pre-requisites:** junior standing or permission of the instructor.

The development of geographic thought from early to contemporary time.

**GEOS 396. EXPERIMENTAL COURSE. 1-5 Credits.**

Experimental.

**GEOS 408. INVERTEBRATE PALEONTOLOGY. 4 Credits.**

**Pre-requisites:** GEOS 100, GEOS 222, or permission of the instructor. Principles of paleontology including methods of description and analyses of invertebrate fossils. Emphasis on principles of morphology and evolutionary development of invertebrates and the use of invertebrate fossils in biostratigraphy and paleoecology. Laboratory.

**GEOS 410. GEOMORPHOLOGY. 5 Credits.**

**Pre-requisites:** GEOS 100 or GEOS 113 or permission of the instructor. This course treats the development of the surface features of the earth caused by mountain-building, weathering, erosion and deposition.

**GEOS 411. SEDIMENTOLOGY AND STRATIGRAPHY. 4 Credits.**

**Pre-requisites:** GEOS 222 and GEOS 311. Study of the origin of sediments and sedimentary rocks for advanced geology majors. Description and interpretation of facies and environments of deposition and classification of clastic and chemical sedimentary rocks is emphasized. Stratigraphic principles, nomenclature and correlation is also treated. Lecture and weekly laboratory.

**GEOS 412. ADVANCED & APPLIED OPTICAL MINERALOGY. 4 Credits.**

**Notes:** this course requires three hours of lecture and three hours of lab per week.

**Pre-requisites:** GEOS 313.

This course builds on GEOS 311 and GEOS 313 to describe the external morphology of well-formed crystals using crystallographic techniques. In addition, the techniques of optical mineralogy using a petrographic microscope are introduced as a tool for identifying rock-forming (silicate) minerals in professional settings.

**GEOS 413. RIVERS AND FLOODS. 5 Credits.**

**Pre-requisites:** junior standing or request of instructor.

The course explores the processes and forms of channelized surface flow, i.e. rivers. This course emphasizes quantitative geographic evaluation and interpretation of fluvial processes, as well as the links between these processes and ecology, resource management, and policy.

**GEOS 414. METEOROLOGY. 5 Credits.**

**Pre-requisites:** junior standing or permission of instructor.

This course begins with a discussion on energy, mass, and our atmosphere. Next, we examine the relationships between the atmosphere and the hydrosphere. The third section covers atmospheric circulation, pressure, air masses, and fronts. We finish by covering midlatitude cyclones and various atmospheric disturbances.

**GEOS 420. DIGITAL GEOARCHAEOLOGY. 5 Credits.**

**Notes:** the course will satisfy an elective in the GIS certificate.

**Pre-requisites:** GEOS 321.

GIS has become an indispensable tool for archaeological investigations of the past and is used to both find archaeological sites and contextualize their location compared to the cultural and natural landscape. This course provides an overview of digital geoarchaeology, the intersection of archaeological research, geoscience techniques, and computational skills through a specific training in the application of geospatial technology to the analysis of archaeological sites and historic landscapes.

**GEOS 421. DENDROCHRONOLOGY. 5 Credits.**

**Pre-requisites:** junior standing or permission of instructor.

This course introduces students to the science of tree ring analysis known as dendrochronology. This sub discipline of physical geography is the application and study of tree rings as indicators of environmental phenomena in the surrounding environment. In this course students will gain exposure to the fundamentals of tree-ring science, the history of the discipline, and various uses of tree rings in scientific research.

**GEOS 426. CRITICAL GIS. 5 Credits.**

**Notes:** Lecture and laboratory. May be stacked with GEOS 528.

**Pre-requisites:** sophomore standing.

The course covers the scope and breadth of Critical GIS (Geographic Information Science), which refers to the examination of GIS technology through the lens of critical social theory.

**GEOS 427. DESKTOP MAPPING. 3 Credits.**

Advanced production of maps and related graphics using computer techniques. Emphasis is placed on the design and creation of thematic maps. Lecture and laboratory.

**GEOS 428. GEOGRAPHIC INFORMATION SYSTEMS II. 5 Credits.**

**Pre-requisites:** GEOS 426.

Advanced course in geographic information systems and their applications. Through detailed examination of conceptual issues and in-depth laboratory work, students develop and implement a project that involves the computer analysis of spatial data. Lecture and laboratory.

**GEOS 429. GEOGRAPHIC INFORMATION SYSTEMS III. 5 Credits.**

**Pre-requisites:** GEOS 428 or permission of the instructor.

Advanced course in geographic information systems and their applications. Each student will be responsible for designing and carrying out a GIS project using real world data. Course required for certification in GIS.

**GEOS 430. STRUCTURAL GEOLOGY. 4 Credits.**

**Notes:** Designed to be taken in series with GEOS 431. Weekly laboratory exercises.

**Pre-requisites:** GEOS 100.

Analysis of the kinematics and mechanics of rock deformation and an introduction to geologic structures. Laboratory introduces the solution of structural geology problems, the map-based interpretation of geologic structures and the creation of geologic cross sections.

**GEOS 431. FIELD METHODS AND REGIONAL GEOLOGY. 4 Credits.**

**Notes:** Continuation of an introduction to geologic structures from GEOS 430. Weekly field trips and laboratory exercises required.

**Pre-requisites:** GEOS 100.

An exploration of the regional geosciences with context to tectonic setting. Introduction to the field study of geologic problems with weekly field trips that emphasize the collection and analysis of geologic field data to solve complex geologic problems.

**GEOS 432. SOCIAL AND ENVIRONMENTAL JUSTICE SEMINAR. 3 Credits.**

**Notes:** an introduction to the material for those who plan to attend graduate school.

**Pre-requisites:** junior standing or permission of instructor.

This course explores the concept of "social justice" as it has been examined by social scientists in general and geographers in particular. Our primary concern will be placed on the spatial expression of socio-economic inequalities, as they get written into, or reflected by, the myriad socio-cultural landscapes of the world. Particular emphasis will be placed on contemporary problems.

**GEOS 435. INTRODUCTION TO QGIS. 4 Credits.**

**Notes:** elective to help satisfy the GIS Certificate in Geosciences.

**Pre-requisites:** junior or senior standing.

Covers basic QGIS functions for geospatial data collection, analysis, and presentation with an emphasis on spatial analysis for geoscience applications. Students collect and process data and build spatial models of earth systems. Course covers advanced quantitative methods for creating, processing, and analyzing raster-based datasets in QGIS. This course emphasizes independent project design and quantitative analysis.

**GEOS 441. DISASTERS. 5 Credits.**

**Pre-requisites:** GEOS 113 and GEOS 200, or permission of instructor. This course examines the complexity of both natural and technological disasters by exploring various social, political, and economic aspects regarding human exposure and vulnerability to various hazards. Concepts of sustainability and risk are weighed and considered. The course then shifts to the physical sciences to investigate the mechanisms and processes associated with natural events.

**GEOS 449. ADVANCED SPATIAL ANALYSIS. 5 Credits.**

**Cross-listed:** ENVS 449.

**Pre-requisites:** GEOS 323 or ENVS 323, or GEOS 321.

This is an advanced course where students learn to build Geographic Information System models for environmental applications. In the course, students design, collect data, process data and build several spatial models of increasing complexity. Students will learn advanced techniques in Geographic Information Systems including raster processing, analysis methods and layout design and document their projects in a report form and create production quality maps.

**GEOS 450. RESOURCES AND MANAGEMENT. 5 Credits.**

**Pre-requisites:** GEOS 113 or GEOS 200 or permission of the instructor.

The course covers the breadth of scholarship in natural and/or cultural resource management. It also immerses students in active projects with community organizations, non-profits, and or NGOs, etc. situated in the broader Inland Northwest region.

**GEOS 455. GEOLOGY FIELD TRIP. 4 Credits.**

**Notes:** Course fee. This course is not offered every year.

**Pre-requisites:** GEOS 100 or permission of the instructor.

This course is a week-long field study of the rocks and landforms of a geologically interesting region. Geologic evolution and structural geology of the region will be discussed. Regions vary depending on instructor. A field trip will be held during the week of spring break.

**GEOS 458. DIGITAL CULTURAL RESOURCE MANAGEMENT. 5 Credits.**

**Pre-requisites:** GEOS 321 or GEOS 323.

Cultural resource management (CRM) both within the United States and abroad has focused on inventorying and evaluating archaeological and cultural heritage sites. GIS is increasingly used by both CRM firms and government agencies to model potential site locations, to manage known sites, and to assist in public education of the past and its importance to the present. This course focuses on the unique abilities of GIS as a tool for CRM and public archaeology/heritage programs.

**GEOS 460. GEOSTATISTICS. 4 Credits.**

**Pre-requisites:** GEOS 321 or GEOS 323, Math Proficiency, or permission of the instructor.

Introduction of geostatistics using spatial data. Basic statistics will be applied to real-world problems using software such as R, ArcGIS, and Microsoft Excel.

**GEOS 462. PRINCIPLES OF GEOCHEMISTRY. 4 Credits.**

**Pre-requisites:** GEOS 311 and GEOS 313, or permission of the instructor.

Abundance of elements in the solar system. Origin, chemical evolution, and composition of the earth; distribution and migration of chemical elements; differentiation history of the earth into crust, mantle and core. Origin and evolution of the hydrosphere and atmosphere. Chemical processes involved in weathering of rocks, chemical sedimentation and diagenesis.

**GEOS 466. ISOTOPIC TRACERS IN THE ENVIRONMENT. 4 Credits.**

**Pre-requisites:**  $\geq$ C in CHEM 173 and CHEM 173L.

This course focuses on the principles and application of radioactive, cosmogenic and stable isotopes as environmental tracers in soil, water, atmosphere and biological materials. Topics include the variations in isotopic composition of natural materials and the processes behind these variations (e.g., fractionation, radioactive decay, mineral dissolution).

**GEOS 470. GROUNDWATER HYDROLOGY. 4 Credits.**

**Pre-requisites:** GEOS 100, Quantitative and Symbolic Reasoning proficiency, or permission of the instructor.

This class introduces students to basic quantification of the relationship between groundwater and geologic materials, emphasizing the principles governing groundwater flow. Lectures and the weekly labs will apply professional techniques in real-life community-based projects.

**GEOS 471. GIS PROGRAMMING. 5 Credits.**

**Pre-requisites:** GEOS 428 or permission of instructor.

This is an advanced GIS course that focuses on the computer programming languages utilized within GIS software. A variety of GIS-related programming languages, methods and techniques are surveyed. Students gain direct experience developing algorithms, reading existing code and writing their own programs in a selected programming language. This is a lab-intensive class; prior computer programming experience recommended but not required.

**GEOS 475. ENGINEERING GEOLOGY OF SOILS: INTRODUCTION TO GEOTECHNICAL ENGINEERING. 4 Credits.**

**Pre-requisites:** GEOS 100, or permission of instructor.

Introduction to theory and lab practice in geotechnical engineering. Content includes engineering properties of soil and rock; ASTM standard laboratory tests for particle size distribution, liquidity/plasticity, compaction, shear strength, permeability, consolidation, CBR, and others; as well as Unified Soil Classification System.

**GEOS 485. GEOTECHNICAL ENGINEERING OF SOILS AND FOUNDATIONS. 4 Credits.**

**Pre-requisites:** GEOS 475.

This course uses the principles of rock and soil mechanics to evaluate the stability of natural and engineered slopes, aid in design of earthworks and foundations, and plan the construction of dams, levees, aqueducts and other waterworks.

**GEOS 490. THE GEOSCIENTIST'S CAPSTONE. 5 Credits.**

**Pre-requisites:** senior standing or permission of the instructor.

**Satisfies:** a university graduation requirement—senior capstone.

This course is a departmental capstone highlighting original geoscience research projects designed by students, integrating both physical and human geoscience topics. Students have the opportunity to apply geoscience skills they have gained to a topic of significance to current understanding of human-environment interactions. The course culminates in a geoscience conference where students plan, develop, and display their final projects.

**GEOS 490A. SENIOR CAPSTONE: WATER AND THE WEST, WATER RESOURCES IN ARID LANDS. 4 Credits.**

**Pre-requisites:** junior or senior standing.

**Satisfies:** a university graduation requirement—senior capstone.

This course focuses on the global controls on aridity and the relationship between human activities and water resources in the largely arid western United States. Topics include topographic and meteorological controls on the distribution and quantity of water, the history of conflict over scarce water resources, and construction of dams, aqueducts, and other engineered structures to solve water scarcity problems. Case studies involve examples from the western United States and other countries.

**GEOS 490B. CAPSTONE: ENVIRONMENTAL GEOCHEMISTRY. 4 Credits.****Cross-listed:** ENVS 490.**Pre-requisites:** CHEM 172 and CHEM 172L or permission of instructor.**Satisfies:** a university graduation requirement—senior capstone.

Application of principles of geochemistry to environmental problems, including air and water pollution, water-rock interactions, weathering and soil formation. Origin, distribution and transport of inorganic contaminants in air, water, soils, sediments and plants. The behavior of trace elements in near surface environments.

**GEOS 490G. SENIOR CAPSTONE: GEOLOGY FIELD CAMP. 7-10 Credits.****Notes:** course fee is to be determined. Field work is expected everyday of class.**Pre-requisites:** junior or senior standing and permission of the instructor.**Satisfies:** a university graduation requirement—senior capstone.

This course applies geologic principles to the solution of field problems in the Rocky Mountain fold and thrust belt. This four-week course of study includes geologic mapping, description of stratigraphic relationships, structural analysis, and GPS data collection. Maps, cross sections, and a formal report of the field study are required. Location of the camp can vary.

**GEOS 491. SENIOR THESIS. 1-4 Credits.****Notes:** Students should complete a GEOS 499 project with the professor prior to beginning a Senior Thesis. This course may be repeated to complete the required 4 total credits.**Pre-requisites:** senior standing and permission of the instructor.**Satisfies:** a university graduation requirement—senior capstone.

Directed research on a geoscience problem and organization of the results for oral and written presentation. End of program assessment, Senior Thesis, that meets the Department of Geosciences standards is required.

**GEOS 493. GIS PORTFOLIO. 2 Credits.****Pre-requisites:** GEOS 429 or permission of the instructor.

Exit synthesis for the certificate in GIS or related GIS studies. Students will produce two versions of a GIS portfolio highlighting their GIS work, one in hard copy and one on the web using appropriate web publishing and map serving software.

**GEOS 496. EXPERIMENTAL COURSE. 1-5 Credits.**

Experimental.

**GEOS 497. WORKSHOP, SHORT COURSE, CONFERENCE, SEMINAR. 1-5 Credits.**

Students will attend, participate, and ask questions during seminars and special events. This course will also focus on preparations for employment and graduate school including CV or Resume reviews and writing cover letters.

**GEOS 498. SEMINAR. 1-5 Credits.**

Seminar.

**GEOS 499. DIRECTED STUDY. 1-15 Credits.****Pre-requisites:** permission of the instructor, department chair and college dean.**GEOS 505. SPATIAL THEORY. 5 Credits.**

This seminar focuses on the development and evolution of spatial theory both within and beyond the discipline of geography. Working from a global perspective, students explore and critically compare seminal theoretical contributions and their broader social contexts that underscore specific moments in the history of geographical studies. We investigate the ways in which contemporary western geographic thought is inseparable from the interconnected global networks within which it emerged.

**GEOS 521. GIS FOR SOCIAL SCIENCES. 5 Credits.**

This course emphasizes the application of Geographic Information Systems in the Social Sciences, including census data, demographic analysis, social justice and related mapping of social phenomena. Course includes hands-on GIS work in the lab.

**GEOS 522. RESEARCH DESIGN. 3 Credits.**

Provides for the continued development of a practical toolkit with which to conduct applied social science research. Addresses research design elements necessary in areas such needs assessments and program evaluations through techniques such as participatory research, action research, evaluation, assessment and surveying. The course covers development of research proposals for independent, grant funded or contract designs.

**GEOS 523. GIS FOR ENVIRONMENTAL SCIENCE. 3 Credits.**

This course emphasizes the application of Geographic Information Systems in the Environmental Sciences, including mapping and analysis of topographical, hydrological, geological, biological, and other environmental data. The course includes hands-on GIS work in the lab.

**GEOS 524. GIS FOR PUBLIC HEALTH. 5 Credits.**

This course introduces students to Geographic Information Systems (GIS) applications in the field of public health. Students learn basic digital mapping and spatial analysis concepts and techniques that can be applied toward the study of the health and wellness of populations. Students gain hands-on experience working with GIS software in a laboratory setting.

**GEOS 525. DATA ANALYSIS AND VISUALIZATION. 3 Credits.**

This course introduces students to data analysis and data visualization. In particular, students will learn basic data analysis approaches, explore their use and apply them to qualitative and quantitative data sets. In addition students will synthesize the results of their data analysis into a variety of data visualization formats.

**GEOS 527. DESKTOP MAPPING. 3 Credits.**

This course explores the various ways that spatial information is communicated through cartographic and related methods. The course covers both contemporary theories of cartographic visualization and applied digital design strategies. Includes hands-on lab work using GIS and related mapping software.

**GEOS 528. GEOGRAPHIC INFORMATION SYSTEMS I. 5 Credits.**

Introductory survey of geographic information systems. Focus is on (1) computer techniques for the input, storage, manipulation, analysis and output of spatial data and (2) the social and administrative creation and dissemination of geographic information.

**GEOS 531. ADVANCED FIELD METHODS AND REGIONAL GEOLOGY. 4 Credits.**

**Pre-requisites:** GEOS 430 and GEOS 323 (or equivalent with instructor permission).

Field analysis of geologic problems with weekly field trips that emphasize the collection and analysis of geologic field data to solve structural problems. Weekly field trips and laboratory exercises required. Weekly field trips will be summarized in reports and at the 500-level require presentation of field data in an ArcGIS form (geodatabase with layers and orientation symbols) with applicable metadata.

**GEOS 533. TOPICS IN ENVIRONMENTAL JUSTICE. 5 Credits.**

**Notes:** may be repeated for credit when topics differ.

This seminar examines the breadth of research in human and physical geography focused on issues related to environmental justice. Through an intensive engagement with relevant literature and contemporary data, students will be exposed to a series of select historical and contemporary debates in critical geographic studies as we examine the ontological, epistemological and practical dilemmas concerning research driven by and concerned with environmental justice.

**GEOS 536. GIS PROGRAMMING. 5 Credits.**

**Pre-requisites:** GEOS 528.

This is an advanced course in GIS programming concepts and techniques. Students will be exposed to both legacy and contemporary programming languages integrated with GIS packages. Emphasis will be on creating and interpreting scripts using languages supported by current GIS software. The course includes hands-on GIS and programming work in the lab.

**GEOS 538. GEOGRAPHIC INFORMATION SYSTEMS II. 5 Credits.**

**Pre-requisites:** GEOS 528.

This course focuses on the design and implementation of geographic information system database structures. Emphasis is on the construction and analysis of contemporary and legacy vector structures, with basic exploration of raster structures. The course includes hands-on GIS work in the lab.

**GEOS 548. GEOGRAPHIC INFORMATION SYSTEMS III. 5 Credits.**

**Pre-requisites:** GEOS 528 and GEOS 538.

This is an advanced course in GIS project design and execution. Students will be expected to work independently on a "real-world" GIS project based on either thesis research or an on-going project developed with a community partner. Students will oversee all stages of the project from design to data collection to presentation of results. The course is required for the GIS Certificate program.

**GEOS 549. GIS PORTFOLIO. 2 Credits.**

**Pre-requisites:** GEOS 548 or permission of the instructor.

Advanced GIS course for students finishing their graduate degree and/or GIS Certificate program. This class will offer students the opportunity to review and revise previous work, arrange it into a portfolio, provide supporting documentation and metadata, and, optionally, create a web page featuring the portfolio material.

**GEOS 596. EXPERIMENTAL COURSE. 1-5 Credits.**

Experimental.

**GEOS 599. INDEPENDENT STUDY. 1-5 Credits.**

**Pre-requisites:** permission of the instructor, department chair and college dean.

**GEOS 600. THESIS. 1-5 Credits.**

**Notes:** may be repeated.

**Pre-requisites:** permission of the instructor, department chair and college dean.

The goal of this course is the successful production of a master's thesis of defensible quality. The master's thesis will be the presentation of original research in the field of geography and critical GIS. This document provides partial fulfillment of the MA requirement. This course provides an opportunity to sharpen research, writing and organizational skills under the direction of the student's graduate committee.

**GEOS 601. RESEARCH PROJECT. 5 Credits.**

**Notes:** may be repeated.

**Pre-requisites:** permission of the instructor, department chair and college dean.

The goal of this course is the successful completion of a master's research project of defensible quality. The research project will be the culmination of applied research in the field of geography and critical GIS. This research project provides partial fulfillment of the MA requirement for student's not pursuing the thesis track. This course provides the opportunity to sharpen research, writing, cartographic, advocacy and organizational skills under the direction of the graduate committee.

**GEOS 696. COLLEGE TEACHING INTERNSHIP. 5 Credits.**