Geosciences

GEOS 5101 Internship in Geosciences (1 semester credit hour) An internship in which a student gains experience through temporary employment at a geosciences based company or government organization. The activity must be monitored by one of the Geosciences faculty members and must be approved in advance of the employment. The student must provide regular progress updates and a final report to the faculty monitor. Pass/Fail only. May be repeated for credit (5 semester credit hours maximum). Instructor consent required. (1-0) S

GEOS 5301 Geology of the Metroplex (3 semester credit hours) Lithologic constituents, stratigraphic history, and geologic environments of the greater Dallas-Fort Worth metropolitan area. Special emphasis is given to the Cretaceous sediments that underlie Tarrant and Dallas Counties, with a secondary focus on the broader geologic environment. Three to four 1-day (Saturday) field trips. (3-0) T

GEOS 5306 Data Analysis for Geoscientists (3 semester credit hours) Advanced statistical techniques with important applications in Earth science. Topics include robust statistics, exploratory data analysis, surface modeling and contouring, Kriging, analysis of point patterns and directional data. Factor, cluster and time series analysis may also be considered. Emphasis will be on application and theoretical understanding. (3-0) R

GEOS 5308 Sustainable Energy (3 semester credit hours) Ensuring sustainable supplies of energy for the future will require a mix of fossil fuels and renewable energy. This course is an introduction to sustainable energy and will cover economics of energy generation and conservation, energy systems analysis methodologies; electricity use and efficiency in buildings and industry; electricity supply systems; fossil fuels; wind energy; capturing solar energy through biomass; fundamentals of solar radiation; photovoltaics; solar thermal collectors and systems; ocean, hydropower, and geothermal energy; storage technologies; and transportation. (3-0) Y

GEOS 5309 Geology of the Permian Basin (3 semester credit hours) The Permian Basin of west Texas and southeast New Mexico is one of the world's premier hydrocarbon-producing regions. The region constitutes a vital economic engine for Texas and the U.S., providing jobs, tax income for counties and the state, and royalty payments that support the UT education system. Topics covered in this course include the tectonic formation and structural evolution of the basin, basin stratigraphy, and the Permian Basin petroleum system. Students are assigned a topic to research and summarize in a series of brief oral presentations and a written report. (3-0) T

GEOS 5310 (GISC 5310) Hydrogeology (3 semester credit hours) Introduction to the principles and practice of ground- and surface-water hydrology. Study of the principles of occurrence and geologic controls of groundwater, physical flow and geochemistry of waters. Design and use of procedures for typical hydrologic investigations. (3-0) Y

GEOS 5311 (GISC 5311) Applied Groundwater Modeling (3 semester credit hours) This course is designed to provide students with hands-on experience using the most commonly-applied groundwater flow and transport models (e.g. modflow/modpath, MT3D/RT3D, GMS). Practical application of the models and design of modeling studies is emphasized; modeling theory and mathematics is de-emphasized. (3-0) Y

GEOS 5313 Applied Surface Water Modeling (3 semester credit hours) The development and application of
watershed models emphasizing runoff, stormflow and stormwater management design. This class combines aspects of GIS, remote sensing and surface water hydrology from an applied modeling perspective, using commonly applied computer models (e.g. Rational Method, TR-20, HEC-1) to address drainage problems related to urbanization and land-use changes. (3-0) T


**GEOS 5319 (GISC 5319)** Principles of Environmental Health (3 semester credit hours) Introduction to epidemiology and biostatistics. U.S. regulatory agencies. Ethics, risk assessment and public policy. Diseases spread by food and water. Lung diseases associated with particles and fibers. Health significance of exposures to arsenic, cadmium, chromium, lead and mercury compounds and to chemical substances - solvents, PCBs, PBBs, dioxins, and dibenzofurans. Ionizing radiation. Health implications of global warming. (3-0) R

**GEOS 5322 (GISC 5322)** GPS (Global Positioning System) Satellite Surveying Techniques (3 semester credit hours) The theory and application of satellite positioning utilizing the Global Positioning System Code and phase methodology in field observations, data processing and analysis of Differential GPS, high accuracy static and other rapid measurements, in real time and with post-processing. (3-0) Y

**GEOS 5324 (GISC 5324)** 3D Data Capture and Ground Lidar (3 semester credit hours) The theory and applications of 3D data acquisition in the field for geosciences and non-geosciences studies. The basics and applications of field digital mapping with emphasis on RTK GPS, laser range finder, and terrestrial scanners (ground lidar). 3D digital photorealistic modeling with field photogrammetry and digital cameras. (3-0) T

**GEOS 5325 (GISC 6325)** Remote Sensing Fundamentals (3 semester credit hours) Introduction to remote sensing principles, sensor technologies, image processing techniques, and applications. Topics covered include electromagnetic radiation theories, various satellite and airborne remote sensing systems, processing of remote sensing data to solve real world problems. State-of-the-art commercial software is used for class exercises. (3-0) Y

**GEOS 5326 (GISC 7365)** Advanced Remote Sensing (3 semester credit hours) Examines advanced remote sensing technologies, data processing techniques and applications. The latest remote sensors are introduced. The class will discuss how remote sensing data can be processed to extract information in support of important urban and environmental decision making. The current generation, industry standard software is used for labs and applications development. Prerequisite: GEOS 5325 or GISC 6325. (3-0) Y

**GEOS 5329 (GISC 7366)** Applied Remote Sensing (3 semester credit hours) Focuses on the application of one or more specialized remote sensing techniques to solve specific real world urban and environmental problems. Prerequisite: (GISC 6325 or GEOS 5325) or (GISC 7365 or GEOS 5326). (3-0) R

**GEOS 5335** Introductory Seismology (3 semester credit hours) This course covers the fundamentals of seismology and seismic wave propagation. An introduction to the theory of wave propagation in acoustic, elastic, anelastic and anisotropic medium, and observational methods in seismology applicable to the deep planetary structure of the Earth as well as petroleum deposits in the crust. The theory of earthquakes and
methods for retrieving seismic source information will also be addressed. Class projects will emphasize the use of seismic data from public databases and processing using python packages. (3-0) Y

**GEOS 5336** Computational Geophysics (3 semester credit hours) An introduction to numerical methods, including finite-difference, finite-element, and spectral-element methods, used in computational geophysics. Basic surface and volume elements, representation of fields, quadrature, assembly, local versus global meshes, domain decomposition, time marching, and stability will be considered. Implementation of the numerical methods using parallel processing on computer clusters will be emphasized. Data assimilation techniques and related adjoint methods will be considered for parameter estimation and imaging. The course offers hands-on experience in multidimensional model building as well as numerical solution of partial differential equations relevant to geophysics. (3-0) T

**GEOS 5341** Paleo Earth Systems (3 semester credit hours) The Earth is a complex dynamic system and Earth history constitutes a mix of uniformitarian processes against the background of plate tectonics, which drives long and short term cycles of paleogeography, tectonism, magmatism, sea-level and climate changes, and biologic evolution. This class discusses these cycles and provides the student with a series of predictive, time-based geologic models for Phanerozoic (post-Precambrian) stratigraphic sequences. (3-0) Y

**GEOS 5342** Clastic Sedimentology (3 semester credit hours) Review of sedimentary processes focusing on the transport of clastic sediments from source to sink. Students will learn about the formation and identification of sedimentary structures and how to interpret clastic depositional environments, facies, and systems using both modern and stratigraphic examples, such as fluvial, deltaic, shoreline, and deepwater accumulations. (3-0) Y

**GEOS 5343** Carbonate Sedimentology (3 semester credit hours) Carbonate sediments, comprised chiefly of organically-produced or chemically-precipitated calcium carbonate constitute a large portion of the sedimentary rock record, and over one-half of the world’s hydrocarbons occur in carbonate reservoirs. Topics covered in this class include carbonate rocks and platforms; carbonate chemistry and mineralogy; the carbonate factory; reefs; carbonate slope and basinal carbonates; carbonate sequence stratigraphy; Precambrian carbonates; Phanerozoic carbonates; carbonate diagenesis; and carbonate petroleum reservoirs. (3-0) Y

**GEOS 5347** Sequence Stratigraphy (3 semester credit hours) Overview of the history and theory of sequence stratigraphy and how this is used to understand stratigraphic architecture and for petroleum exploration and development of hydrocarbon resources. Students will learn how to interpret outcrop, well log, core, and seismic data using sequence stratigraphic methods. (3-0) Y

**GEOS 5356** Isotope Geochemistry (3 semester credit hours) Synthesis of the elements in stars and chronologies for the galaxy. Isotope systematics in meteorites, abundance anomalies, cosmogenic nuclides, and solar system chronologies. The development of the modern multi-collector mass spectrometer. Mass fractionation laws, double spiking techniques, and high precision isotope ratio measurements. Isotope geochemistry of noble gases and radiogenic nuclides as pertaining to the composition and history of the mantle and crust. Application of stable isotopes to studies of diagenesis and water-rock interaction, groundwater management, paleoceanography and secular variations in the isotopic composition of seawater. High-temperature and, where applicable, low-temperature water-rock interactions pertaining to the origin of igneous rocks. The evolution of radiogenic Sr in sea water. Radiometric age dating as applied to the solution of geologic problems. (3-0) R

**GEOS 5369** Volcanic Successions (3 semester credit hours) Terrestrial volcanism is considered from the perspective of volcanic processes, and the properties, products and deposits of volcanic eruptions, all in
the context of definable facies models. The effects of subsequent sedimentological processes are also considered. Volcanic settings are explored in detail as they are related to their plate tectonic settings. Recognition of volcanically derived deposits are emphasized using the facies model concepts, and are considered with respect to their geological and economic significance. Students will perform case studies on select volcanic environments to gain a thorough understanding of the specific processes, products and deposits associated with a diverse range of volcanic terranes. (3-0) T

**GEOS 5373** Physical Properties of Rocks (3 semester credit hours) This course provides an understanding of the physical phenomena and processes that determine properties of rocks and soils. Topics include porosity and permeability; surface energy, roughness, and absorption; percolation, fractures and heterogeneous media; problems of scale; mechanical behavior of dry and fluid saturated rocks; elasticity; viscoelasticity, and plasticity; acoustic, electric, dielectric, thermal, and magnetic properties. The approach is practical, with emphasis on understanding why rocks behave as they do, and how simple physical principles can be used to predict rock and soil properties under various conditions. Suitable for graduate students in any branch of geosciences who wish to obtain a broad introduction to physical properties as they pertain to lab and field measurements, and are applied to reservoir, engineering, and environmental problems. (3-0) R

**GEOS 5375** Tectonics (3 semester credit hours) Study of the earth's present tectonic environments, including geochemistry, sedimentology, and structure; application of present tectonic environments towards the reconstruction of ancient crustal events; consideration of temporal aspects of crustal evolution. Oral and written presentations required. (3-0) Y

**GEOS 5381** Digital Geophysical Signal Processing (3 semester credit hours) Principles of the analysis of geophysical signals in both time and space. Includes integral transforms, spectral analysis, linear filter theory and deconvolution techniques. Computer applications are emphasized. (3-0) R

**GEOS 5384** Near-Surface Geophysical Imaging (3 semester credit hours) This course covers theoretical and practical aspects of Ground Penetrating Radar (GPR) data applications. It is a "hands-on" course that covers the physical basis, rock properties, equipment, planning and execution of small scale surveys, data processing and interpretation. Examples of applications include reservoir analogs, and engineering, groundwater and environmental site evaluations. Techniques include low and high frequency, single and multi-channel ground-penetrating radar. A one-day field trip for collection of GPR data from the Woodbine formation at Grapevine Lake is the basis of the laboratory report. A background in calculus and general physics is required. Instructor consent required. Lab fee of $30 required. (2-3) T

**GEOS 5387** Applied Geophysics (3 semester credit hours) This is the Geosciences core graduate course in geophysics. Emphasis is on the application of geophysical methods to the solution of geological problems and the connection between geophysical measurements and the physical properties of Earth materials. Topics include seismology; gravity; magnetics; electromagnetics; resistivity; ground penetrating radar; and well logging. Case histories will be considered in addition to the technical aspects of data collection, processing and interpretation. (3-0) Y

**GEOS 5398** Miles Integration Research II (3 semester credit hours) Data reduction and analysis of results from preceding Miles Field Project (summer semester). Students will work individually and in teams to analyze data and to integrate results into a comprehensive model addressing research objectives. Oral presentations and discussions required. Instructor consent required. (3-0) Y

**GEOS 5V08** Special Topics in Geosciences (1-9 semester credit hours) Courses dealing with a variety of topics including new techniques and specific problems in rapidly developing areas of the science. Hours
vary depending on course requirements. May be repeated for credit as topics vary. Instructor consent required. Lab fee of $30 required. ([1-9]-[0-9]) R

**GEOS 6381 (GISC 6381)** Geographic Information Systems Fundamentals (3 semester credit hours) Examines the fundamentals of Geographic Information Systems and their applications. It emphasizes the concepts needed to use GIS effectively for manipulating, querying, analyzing, and visualizing spatial-based data. Lab exercises, which use industry-standard GIS software packages, provide GIS experience to investigate real world problems including social, economic, and environmental issues. (3-0) Y

**GEOS 6382** Geophysical Inversion Theory (3 semester credit hours) Theoretical and practical aspects of fitting mathematical models to data in geophysics. Topics covered include the inversion of both discrete systems and integral equations, for linear and non-linear relationships between data and parameters. Particular attention is paid to assessment of model accuracy and uniqueness. Instructor consent required. (3-0) R

**GEOS 6383 (GISC 6382)** Applied Geographic Information Systems (3 semester credit hours) Further develops hands-on skills with industry-standard GIS software for application in a wide variety of areas including urban infrastructure management, marketing and location analysis, environmental management, geologic and geophysical analysis and the Economic, Political and Policy Sciences. Prerequisite: (GISC 6381 or GEOS 6381) or equivalent with instructor consent required. (3-0) Y

**GEOS 6384 (GISC 6384)** Advanced Geographic Information Systems (3 semester credit hours) Treatment of more advanced GIS topics with real world applications. Topics covered include raster and vector data models, Geodatabase, map algebra, 3-D surface analysis, spatial interpolation and network analysis. Student will be acquainted with state-of-the-art software through hands-on laboratory experiences. Prerequisite: GEOS 6381 or GISC 6381. (3-0) Y

**GEOS 6385 (GISC 6385)** GIS Theories, Models and Issues (3 semester credit hours) Provides an understanding of the underlying theories, mathematical and geometric tools, and their computational implementations that establish GIS capabilities to handle and analyze geo-referenced information. Associated issues (such as uncertainty, spatial analysis and spatial data management) highlighted. Prerequisite: GEOS 6381 or GISC 6381 or equivalent with instructor consent required. (3-0) Y

**GEOS 6387 (GISC 6387)** Geospatial Sciences Workshop (3 semester credit hours) Fulfills the research project requirement for one of the Geospatial Science graduate certificate programs, e.g. GIS, remote sensing and geospatial intelligence. Each participant develops a project which should include aspects of geospatial database design, manipulation, and analysis, and cartographic production. Projects may be designed in coordination with a local government, utility, business, or other entity that uses GIS in its operations and research. Note: Students should take this course with varied research topics if different certificate programs are pursued. May be repeated for credit as topics vary (9 semester credit hours maximum). Prerequisite: GEOS 6381 or GISC 6381. (3-0) Y

**GEOS 6392** Exploration Seismology (3 semester credit hours) Theoretical and practical aspects of seismic reflection data acquisition and processing. Includes the wave equation, the convolutional model, coded sources, the array response, velocity estimation, statics, filtering, pre- and post-stack migration, and direct and indirect detection of hydrocarbons, VSPs, AVO and 3-D processing. Instructor consent required. (3-0) R

**GEOS 6396** Seismic Inversion (3 semester credit hours) Theory and application of the major techniques for inversion of seismic data. Topics include linear and nonlinear matrix methods, Wiechert-Herglotz integration, extremal inversion, migration, wavefield imaging of body and surface waves, and tomography,
imaging of VSPs, Born inversion, and full wavefield inversion. Readings will be drawn from the literature. Prerequisite: GEOS 6392 and instructor consent required. (3-0) R

**GEOS 6398** Thesis (3 semester credit hours) Pass/Fail only. May be repeated for credit. Instructor consent required. (3-0) S

**GEOS 7110** Workshop in Environmental Geosciences (1 semester credit hour) Discussion of current topics in environmental geoscience, including student and faculty research, scientific literature, and advanced techniques in environmental geosciences. May be repeated for credit. (1-0) R

**GEOS 7190** Workshop in Seismology (1 semester credit hour) Informal presentation and discussion of current research of graduate students and faculty, of new computing equipment and software, and of current research literature. Pass/Fail only. May be repeated for credit. (1-0) S

**GEOS 7V00** Research and Literature Seminar (1-2 semester credit hours) Presentations and critical analysis of independent work and of the recent literature. Pass/Fail only. May be repeated for credit. Instructor consent required. ([1-2]-0) Y

**GEOS 8399** Dissertation (3 semester credit hours) Pass/Fail only. May be repeated for credit. Instructor consent required. (3-0) S

**GEOS 8V10** Research in Hydrogeology-Environmental Geosciences (1-9 semester credit hours) Pass/Fail only. May be repeated for credit. Instructor consent required. ([1-9]-0) S

**GEOS 8V21** Research in Remote Sensing, GIS and GPS (1-9 semester credit hours) Pass/Fail only. May be repeated for credit. Instructor consent required. ([1-9]-0) S

**GEOS 8V50** Research in Geochemistry (1-9 semester credit hours) Pass/Fail only. May be repeated for credit. Instructor consent required. ([1-9]-0) S

**GEOS 8V70** Research in Structural Geology-Tectonics (1-9 semester credit hours) Pass/Fail only. May be repeated for credit. Instructor consent required. ([1-9]-0) S

**GEOS 8V80** Research in Geophysics (1-9 semester credit hours) Pass/Fail only. May be repeated for credit. Instructor consent required. ([1-9]-0) S

**GEOS 8V90** Research in Seismology (1-9 semester credit hours) Pass/Fail only. May be repeated for credit. Instructor consent required. ([1-9]-0) S