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 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 5317** Natural Resources (3 semester credit hours) Overview of the exploration for and exploitation of petroleum, mineral and geothermal resources. Characteristics of natural resources and design of
exploration programs through integration of geophysical and geochemical methods. Emphasis on student projects and presentations. (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 5350** Geoinformatics of Igneous Rocks (3 semester credit hours) How geochemical and isotopic databases (EarthChem) can be used to understand the origin and evolution of igneous rocks from different tectonic environments. Project oriented. GEOS 5352 and GEOS 5356 recommended. Instructor consent required. (3-0) T

**GEOS 5352** Geochemistry of Igneous Rocks (3 semester credit hours) Chemical composition of igneous rocks and the major processes that control the distribution of the elements in silicate melts. Topics to be covered include the composition of the earth, the structure of silicate melts, trace element partitioning between crystals and melts, and the use of major and trace elements in deciphering the formation and evolution of silicate melts. (3-0) T

**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 5370** Structural Analysis (3 semester credit hours) Application of structural geology concepts used to unravel the deforming history of rocks and regions. Topics include characterization and analysis of superposed brittle and ductile structures, assessment of displacement and strain fields, construction of inverse and forward structural sections and volumes, and integration of surface and subsurface data. Course requires familiarity with assigned reading assigned reading from the professional literature and oral and written presentations. Face-to-face discussion will be combined with online activities. Instructor consent required. (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 5376** Tectonics and Evolution of the Gulf of Mexico Region (3 semester credit hours) Study of how the Gulf of Mexico formed and evolved from Precambrian times to the present, including plate tectonic environments, evolution of sedimentary basins, igneous activity and hydrocarbon resources. Oral and written presentations will be required. Prerequisite: **GEOS 5375** and instructor consent required. (3-0) T

**GEOS 5380** Seismic Interpretation (3 semester credit hours) Interpretation of seismic reflection profiles used together with surface maps and well data to characterize the subsurface geometry of sedimentary rocks and their relation to faults. The course focus is on the integration of data sets and development of conceptual models of stratal accumulation during displacement on faults. Work is performed in a digital environment (Computer Aided Design) with special emphasis on developing sound geologic interpretations and not the manipulation of standard seismic processing software packages. Face-to-face meetings, discussions, and presentations will be combined with directed assignments using online resources and interaction. (3-0) T

**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. (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 5396** Miles Integrated Research I (3 semester credit hours) Assessment and background development for selected research projects employing integrated datasets. Students will access the professional literature and online data sources to establish background information and an understanding of project research objectives. Activities will focus on identification of geological and geophysical tools needed for the research, how the datasets will contribute to the overarching research objective, and provide training in the use of the required data acquisition and analysis tools. Oral presentations and discussions required. Instructor consent required. (3-0) Y
GEOS 5397 Miles Field Project (3 semester credit hours) Field work and data acquisition. Preliminary data reduction and analysis following field work. Field work in remote regions for 4-6 weeks. Laboratory analysis for remainder of summer session following field work. Instructor consent required. (1-6) 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 5399 Miles Integrated Research III (3 semester credit hours) Integration of geological and geophysical datasets to develop comprehensive solution to research project. Students to work individually and in teams. Oral and written presentations required. Joint report by team required. Instructor consent required. (3-0) Y

GEOS 5441 Stratigraphy and Sedimentology (4 semester credit hours) Origin and classification of sedimentary rocks, reconstruction of ancient environments, and basic principles of modern stratigraphic nomenclature. Concepts of space and time in the rock record and methods of stratigraphic correlation. Integrated stratigraphic techniques. Study of sedimentary rocks in hand specimen and outcrop. Laboratory course. Field trips. Course is directed to graduate students not majoring in geology and is meant to provide a practical overview of sedimentary geology. Instructor consent required. (3-3) Y

GEOS 5470 Structural Geology (4 semester credit hours) Examination of stress and strain, failure criteria, fault analysis, rheologic properties of geologic materials, fold analysis, and a survey of major structural provinces in North America, with supplemental readings. Laboratory includes map interpretation, standard graphical techniques, and use of stereographic projections, oral presentations, and problem sets. Laboratory and field trip course. Instructor consent required. (3-3) 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. ([1-9]-[0-9]) R

GEOS 5381 (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** Reflection 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 6393** Computational Seismology (3 semester credit hours) Principles of parallel computing with applications to seismology. Includes overviews of current computer cluster and switch architectures, writing and debugging parallel code, characterization of machine performance, fast Fourier transforms, Radon transforms, solution of matrix and wave equations. Prerequisites: GEOS 5381 and GEOS 6392 and any numerical analysis course. (3-0) R

**GEOS 6395** Seismic Modeling (3 semester credit hours) Theory and application of the major techniques for computation of synthetic seismograms. Topics include asymptotic ray theory, spectral and slowness methods, finite differences, finite elements, Kirchhoff, and boundary integral methods. Readings will be drawn from the literature. Prerequisites: GEOS 6392 and 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 7170** Workshop in Structure/Tectonics (1 semester credit hour) Presentation and discussion of current research with emphasis on problems, techniques, and recent literature. May be repeated for credit. (1-0) Y
**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 7327 (GISC 7367)** Remote Sensing Workshop (3 semester credit hours) An independent project is designed and conducted by the student, after instructor approval. The project develops and demonstrates student's competence in using remote sensing techniques in a substantive application to his/her field of interest. Projects may be developed in coordination with a local government, utility, business, or other entity, which uses remote sensing in its operations and research. A formal presentation and a project report are required. Prerequisite: GISC 7365 or GEOS 5326. (3-0) Y

**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