# Geosciences

**GEOS 5100** Introductory Graduate Seminar (1 semester hour) Presentations of current research by the Geosciences faculty members and orientation for new graduate students. (1-0) Y

**GEOS 5101** Internship in Geosciences (1 semester 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. May be repeated 5 times. (1-0) S

**GEOS 5301** Geology of the Metroplex (3 semester 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 5302** Ocean Science (3 semester hours) Overview of geological, chemical, physical and biological aspects of oceanography, marine resources and environmental concerns. This course is for students seeking the M.A.T. degree. This course cannot be used to satisfy degree requirements of geosciences majors. (3-0) R

**GEOS 5303** Computing for Geoscientists (3 semester hours) Application of computer techniques in solving geological problems. Includes instruction in the MATLAB (r) software, plotting facilities, introductory matrix theory, and statistics. Students will examine problems in basic statistical analysis, graphics, and mapping of geological and geophysical data. Development of programming skills in areas directly related to thesis and dissertation research is encouraged. Serves as introduction to UNIX and the U.T. Dallas computing facility. (3-0) Y

**GEOS 5304** Geosciences Field Trip (3 semester hours) A study of the geology of a selected region within North America and the Caribbean followed by a field trip to the selected region in order to study the relationships of geologic features within that region. This course can only be used to partially satisfy the field experience requirement and breadth requirement for geosciences majors. Field trip course. (May be repeated for credit.) (3-0) Y

**GEOS 5306** Data Analysis for Geoscientists (3 semester 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 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 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 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 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 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) T

GEOS 5322 (GISC 5322) GPS (Global Positioning System) Satellite Surveying Techniques (3 semester 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 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 hours) Application of airborne and satellite remote sensing for understanding the surface of the earth. Focus on interpretation of images obtained by passive and active imaging systems using electromagnetic radiation, especially visible, infrared, and radar. Laboratory course. (2-3) Y

GEOS 5326 (GISC 7365) Remote Sensing Digital Image Processing (3 semester hours) Introduction to remote sensing digital image processing techniques. Topics covered include principles of remote sensing
and remote sensors, image visualization and statistics extraction, radiometric and geometric correction, image enhancement, image classification and change detection. Innovative image processing approaches will also be introduced. State-of-the-art commercial image processing software is used for labs and applications development. (3-0) Y

**GEOS 5329 (GISC 7366) Applied Remote Sensing (3 semester hours)** Focuses on the application of remote sensing techniques to solving real world urban and environmental problems in areas such as urban and suburban landscape, land use and land cover, transportation and communication, vegetation and forestry, biodiversity and ecology, water and water quality control, soils and minerals, geology and geomorphology studies. The current generation, industry standard software is used for labs and applications development. Prerequisite: (GISC 6325 or GEOS 5325) or (GISC 7365 or GEOS 5326). (3-0) Y

**GEOS 5330 (GISC 5330) Geospatial Applications in Earth Science (3 semester hours)** Application of geospatial techniques in solving earth science problems. Emphasis will be placed on the use of the Global Positioning System in survey and geodetic applications, airborne and ground-based LiDAR (Light Detection and Ranging), and digital acquisition and analysis techniques. Case histories will be considered and supplemented by hands-on exercises using a broad range of digital acquisition and analysis equipment and tools. (3-0) Y

**GEOS 5350 Geoinformatics of Igneous Rocks (3 semester 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. (3-0) T

**GEOS 5352** Geochemistry of Igneous Rocks (3 semester 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 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 diageneosis 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 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 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 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 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**. (3-0) T

**GEOS 5380** Seismic Interpretation (3 semester hours) Seismic reflection profiling as it is used to map the distribution of sedimentary layers and faults in the subsurface. Special emphasis is given to applications in hydrocarbon exploration. Extensive use is made of software processing packages. (3-0) T

**GEOS 5387** Applied Geophysics (3 semester 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 5395 (GISC 5395)** Satellite Geophysics and Applications (3 semester hours) This course concerns both the theory and application of observing geophysical fields from space-borne platforms. The observation procedures including orbital mechanics are introduced and signal propagation, errors and uncertainties will be addressed. Concepts of current satellite missions such as radar and laser altimetry, space gravimetry and magnetometry, and synthetic aperture radar will be discussed. Applications of satellite geophysical observations in tectonics, geodynamics, ocean and ice surface monitoring, hydrology, and terrain modeling will be introduced through student projects and presentations. (3-0) Y

**GEOS 5400** Earth Science (4 semester hours) A review of Earth processes as a whole: time and geology; igneous and sedimentary processes and products; metamorphism; structure; evolution of continents and oceans. This course is open only to those students whose major undergraduate study was in subjects other than geology. Laboratory and field trip course. (3-3) R

**GEOS 5441** Stratigraphy and Sedimentology (4 semester 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. Permission of instructor is required to take this course. (3-3) Y

**GEOS 5470** Structural Geology (4 semester 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. Prerequisite: PHYS 1301 or equivalent. (3-3) Y

**GEOS 5481** Digital Geophysical Signal Processing (4 semester 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. Laboratory course. Prerequisite: GEOS 5303 or equivalent may be taken concurrently. (3-3) R

**GEOS 5484** Near-Surface Geophysical Imaging (4 semester hours) This course concerns the theoretical and practical aspects of geophysical data collection. The planning and execution of small-scale surveys, of the type employed in engineering, groundwater and environmental site evaluations, is featured. Techniques covered include both refraction and reflection seismology and both low and high frequency, single and multi-channel ground-penetrating radar. Advantage is taken of both the similarities and complementary behaviors of seismic and radar waves. An integration, of both seismic and radar data is emphasized in interpretation. A background in calculus (MATH 2417) and general physics (PHYS 1301) is required. Permission of instructor is required. (3-3) T

**GEOS 5490** Applied Geophysics (4 semester hours) The theoretical basis and practical aspects of the collection, processing and interpretation of geophysical data. A broad range of methods will be discussed including: gravity, magnetic, electrical and seismic. Applications to geologic problems at a variety of scales from the near surface to continental will be considered. A laboratory will feature geophysical data acquisition and interpretation for a specific local geological target. (3-3) Y

**GEOS 5v08** Special Topics in Geosciences (1-9 semester 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. ([1-9]-[0-9]) R

**GEOS 6381 (GISC 6381)** Geographic Information Systems Fundamentals (3 semester hours) Examines the fundamentals of Geographic Information Systems and their applications. Emphasizes the concepts needed to use GIS effectively for manipulating, querying, analyzing, and visualizing spatial-based data. Industry-standard GIS software is used to analyze spatial patterns in social, economic and environmental data, and to generate cartographic output from the analysis. (3-0) Y

**GEOS 6382** Geophysical Inversion Theory (3 semester 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. Prerequisites: Advanced calculus (MATH 2419) and linear algebra (MATH 2418) or equivalent. (3-0) R

**GEOS 6383 (GISC 6382)** Applied Geographic Information Systems (3 semester 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's permission. (3-0) Y

**GEOS 6384 (GISC 6384) Spatial Analysis and Modeling** (3 semester hours) Treatment of more advanced topics in the application of spatial analysis in a GIS environment. Topics covered include raster-based cartographic modeling, 3-D visualization, geostatistics 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 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. Prerequisites: (GEOS 6381 or GISC 6381) and (GEOS 6383 or GISC 6382), or equivalent with instructor's permission. (3-0) Y

**GEOS 6387 (GISC 6387) Geographic Information Systems Workshop** (3 semester hours) Provides a structured laboratory experience focused on the students' substantive area of interest. Each participant develops a project which should include aspects of database design and manipulation, spatial 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. Prerequisites: (GEOS 6381 or GISC 6381) and (GEOS 6383 or GISC 6382). (3-0) Y

**GEOS 6392** Reflection Seismology (3 semester 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. Prerequisites: GEOS 5481, and GEOS 5392 or equivalent. (3-0) R

**GEOS 6393** Computational Seismology (3 semester 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. Laboratory course. Prerequisites: GEOS 5303, G EOS 5481, and any numerical analysis course. (2-3) R

**GEOS 6395** Seismic Modeling (3 semester 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 5392 and any two graduate seismology courses. (3-0) R

**GEOS 6396** Seismic Inversion (3 semester 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, and Born inversion. Readings will be drawn from the literature. Prerequisite: Any two graduate seismology courses. (3-0) R

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

**GEOS 7170** Workshop in Structure/Tectonics (1 semester 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 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 grading only. May be repeated for credit.) (1-0) S

**GEOS 7327 (GISC 7367)** Remote Sensing Workshop (3 semester 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 or 2 semester hours) Presentations and critical analysis of independent work and of the recent literature. Pass/Fail only. (May be repeated for credit.) ([1-2]-0) Y

**GEOS 8398** Thesis (3 semester hours) May be repeated for credit. (3-0) S

**GEOS 8399** Dissertation (3 semester hours) May be repeated for credit. (3-0) S

**GEOS 8v10** Research in Hydrogeology-Environmental Geosciences (1-9 semester hours) May be repeated for credit. ([1-9]-0) S

**GEOS 8v21** Research in Remote Sensing, GIS and GPS (1-9 semester hours) May repeat for credit. ([1-9]-0) S

**GEOS 8v50** Research in Geochemistry (1-9 semester hours) (May be repeated for credit.) ([1-9]-0) S

**GEOS 8v70** Research in Structural Geology-Tectonics (1-9 semester hours) May be repeated for credit. ([1-9]-0) S

**GEOS 8v80** Research in Geophysics (1-9 semester hours) May be repeated for credit. ([1-9]-0) S

**GEOS 8v90** Research in Seismology (1-9 semester hours) May repeat for credit. ([1-9]-0) S

**GEOS 8v99** Dissertation (1-9 semester hours) May be repeated for credit. ([1-9]-0) S