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

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

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

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

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

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

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

GIS Data Analysis Fundamentals (3 semester hours) Focuses on data handling techniques and
applying basic statistical methodology to spatial research questions. Concepts of statistical data analysis including descriptive statistics, exploratory methods, sampling theory, statistical inference and correlation analysis are reviewed from a Geo-Information Sciences perspective. Regression analysis and basic methods of spatial pattern analysis are introduced. A prior course in statistics (such as EPPS 3405) is strongly recommended. (3-0) Y

**GISC 6311 (ECON 6311)** Statistics for Geospatial Science (3 semester hours) The course introduces calculus-based statistical analysis and probability theory, providing background for econometrics and economic modeling of simple stochastic processes. Standard probability distributions are covered, including Bernoulli, binomial, negative binomial, hypergeometric, Poisson, normal, gamma, beta, t and F distributions. Estimation and hypothesis testing are discussed. Introductory asymptomatic theory, including the Law(s) of Large Numbers and the Central Limit Theorem, will be covered as well as real-world applications of probability theory as time permits. (2-3) Y

**GISC 6317** Computer Programming for GIS (3 semester hours) General introduction to Visual Basic and other languages with GIS related applications. Topics covered include fundamental data structures and algorithms, user-interface design, component object model, and data base management. Emphasis on rapid GIS application development with hands-on experiences. Students are expected to design and implement a project. (3-0) Y

**GISC 6325 (GEOS 5325)** 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, infra-red, and radar. Laboratory course. (2-3) Y

**GISC 6326** Geovisualization (3 semester hours) Examines the theoretical concepts and practical applications of cartographic and geographic visualization. Topics covered in lectures include concepts for geographic data representation, symbolization and map design, and methods for geographic visualization and display. 3D visualization, cartographic animation, and web-based mapping may also be included. Lab sessions explore the implementation of cartographic and geographic visualization with industry standard GIS software. Prerequisite: (GISC 6381 or GEOS 6381) or equivalent knowledge. (3-0) R

**GISC 6379** Special Topics in Geographic Information Sciences (3 semester hours) Topics vary from semester to semester. May be repeated for credit (9 hours maximum). Consult with adviser to determine appropriateness of topic for degree plan. (3-0) R

**GISC 6380** Spatial Concepts and Organization (3 semester hours) Examines the recurring patterns of physical and human objects on the Earth's surface, the flows of circulations among them, and the spatial concepts and theories which have been advanced to help understand and explain these spatial arrangements. Provides a fundamental understanding of spatial processes, concepts, and theories. (3-0) R

**GISC 6381 (GEOS 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

**GISC 6382 (GEOS 6383)** 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

**GISC 6383** Geographic Information Systems Management and Implementation (3 semester hours) Management strategies for GIS are examined by presenting GIS as an integrated system of people, computer hardware, software, applications and data. Implementation is examined as a systematic process of user needs assessment, system specification, database design, application development, implementation, operation, and maintenance. Includes design of implementation plans as case studies to explore various techniques associated with each step of this process. (3-0) Y

**GISC 6384 (GEOS 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: GISC 6381 or GEOS 6381. (3-0) Y

**GISC 6385 (GEOS 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: (GISC 6381 or GEOS 6381) and (GISC 6382 or GEOS 6383), or equivalent with instructor's permission. (3-0) Y

**GISC 6387 (GEOS 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: (GISC 6381 or GEOS 6381) and (GISC 6382 or GEOS 6383). (3-0) Y

**GISC 6388** GIS Application Software Development (3 semester hours) Provides instruction and hands-on experience in specific techniques and languages for developing application systems based on GIS concepts. Students will learn to use current generation commercial software to design and implement an application. Prerequisites: (GISC 6381 or GEOS 6381) and GISC 6317, or permission of instructor. (3-0) R

**GISC 6389** Geospatial Information Sciences Master's Research (3 semester hours) Requires completion, according to uniform guidelines established by the GIS program, of a GIS Master's Project proposal under the supervision of an advisor identified by the student. Students are also expected to conduct a majority of the research for the GIS Master's Project under the supervision of his/her advisor. May be repeated in the following semester. Pass/Fail only. (3-0) S

**GISC 6v01** Independent Study in GIS (1-9 semester hours) Provides faculty supervision for a student's individual study of a topic agreed upon by the student and the faculty supervisor. Prerequisite: Permission of instructor. May be repeated for credit. ([1-9]-0) S

**GISC 6v98** Master's Thesis (3-9 semester hours) Provides faculty supervision of a student's master's thesis research. Prerequisite: Consent of GIS Program Head and instructor. May be repeated for credit. ([3-9]-0) S
GISC 7310 Regression Analysis with GIS Applications (3 semester hours) The specification, interpretation and properties of the multiple linear regression model including spatial and aspatial regression diagnostics are examined. Extensions to the logistic and Poisson regression models and spatial heterogeneity are provided. A review of the key concepts of matrix algebra and simulation techniques is given. Practical data analysis for large datasets is exercised by coupling statistical software with GIS environments. Prerequisite: GISC 6301 or (ECON 6311 or GISC 6311 or equivalent). (3-0) Y

GISC 7360 GIS Pattern Analysis (3 semester hours) Examines univariate and multivariate methods for point pattern analysis, geo-statistical surface interpolations, and spatial regression models. Underlying models and processes leading to spatially clustered and spatially dispersed patterns are discussed. Course has particular relevance for local and global spatial analyses of crime, disease, or environmental patterns. Prerequisites: (GEOS 6381 or GISC 6381) or (ECON 6311 or GISC 6311) and (GISC 6301 or equivalent). (3-0) R

GISC 7361 Spatial Statistics (3 semester hours) The application of statistical techniques to the explicit treatment of space (geography) in social science models. Covers indices of spatial autocorrelation, the specification of autoregressive models (Gaussian, Poisson, binomial/logistic), geostatistical modeling, spatial filtering, Bayesian map analysis, random effects in models, and imputation of missing geocoded data. Recommended: GISC 7360. Prerequisite: GISC 7310 or EPPS 7316 or equivalent. (3-0) R

GISC 7363 Internet Mapping and Information Processing (3 semester hours) Provides a conceptual overview and hands-on experiences in Internet mapping and web-based geospatial information processing with state-of-the-art commercial software. Topics covered include client/server configuration, distributed data access and display, web-based user interaction and customization. (3-0) T

GISC 7364 Demographic Analysis and Modeling (3 semester hours) Examines key demographic models for population analysis, their underlying theoretical foundations, and extensions into the spatial domain. Incorporates quantitative estimation and projection techniques and their use within a geographic information systems framework. Provides a solid understanding of spatio-temporal population dynamics, either local or global, which is essential to many disciplines engaged in planning for the public and private service sectors, for transportation networks or for regional development projects. Prerequisite: EPPS 7313. (3-0) R

GISC 7365 (GEOS 5326) 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

GISC 7366 (GEOS 5329) 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
**GISC 7367 (GEOS 7327)** 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

**GISC 7387** GIS Research Design (3 semester hours) Examines issues relative to the conduct of effective and valid research in geospatial information sciences and related fields. (3-0) Y

**GISC 7389** GIS Ph.D. Research Project (3 semester hours) Requires completion, according to uniform guidelines established by the GIS program, of a GIS Research Project proposal in preparation for its presentation to a committee of at least three GISC faculty. May be repeated in the following semester. Pass/Fail only. Prerequisite: completion of 24 hours of coursework in GIS Ph.D. program. (3-0) Y

**GISC 8320** Seminar in Spatial Analysis (3 semester hours) Examines selected topics in spatial analysis or GI Science. May be repeated for credit when topics differ. (3-0) R

**GISC 8v27** Internship in GIS (1-9 semester hours) Provides faculty supervision for a student's internship, which must be related to GIS. ([1-9]-0) S

**GISC 8v29** Research in GIS (1-9 semester hours) Provides faculty supervision of research conducted by a student. Prerequisite: Permission of instructor. May be repeated for credit. ([1-9]-0) S

**GISC 8v99** Dissertation (1-9 semester hours) Provides faculty supervision of a student's dissertation research. Prerequisite: Permission of instructor. May be repeated for credit. ([1-9]-0) S