Geospatial Information Sciences

GISC 5310 (GEOS 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

GISC 5311 (GEOS 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

GISC 5319 (GEOS 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

GISC 5322 (GEOS 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

GISC 5324 (GEOS 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

GISC 5330 Geospatial Applications in Earth Science (3 semester credit 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

GISC 5395 Satellite Geophysics and Applications (3 semester credit 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

GISC 6301 GIS Data Analysis Fundamentals (3 semester credit hours) Statistical techniques are examined with a focus on fundamental geospatial data handling techniques and algorithms as well as applied geospatial data analysis. The underlying concepts of descriptive statistics, data visualization, and exploratory methods; probability theory, study design and sampling theory; statistical inference and simulation experiments; basic correlation and regression analyses; as well as methods of pattern analysis are discussed from a Geoinformation Sciences perspective. A course in statistics (such as EPPS 2302 or EPPS 2303) is strongly recommended. No prior GIS knowledge is required. (3-0) Y

GISC 6311 Statistics for Geospatial Science (3 semester credit 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) R

GISC 6317 (EPPS 6317) Social and Geospatial Science Programming Fundamentals (3 semester credit hours) General introduction to programming language and other techniques for social and geospatial science related applications. Topics covered include fundamental data structures and algorithms, data manipulation and processing, database management, and data analysis. Emphasis is placed on rapid program development with hands-on experience. Students are expected to design and implement a project. Corequisite: GISC 6381 or GEOS 6381 or equivalent with instructor consent required. (3-0) Y

GISC 6321 Spatial Data Science (3 semester credit hours) Introduces data science for spatial problem solving. Course topics cover all five stages of the data science life cycle: capture, maintain, process, analyze, and communicate, with emphases on spatial data. Spatial data is critical to solving problems or developing applications for energy planning, emergency management, environmental sustainability, public health, smart city, public safety, business logistics, autonomous vehicles, ecological conservation, and many other problem domains. Besides an overview of cyberGIS and spatial semantics web, the course discusses the essential characteristics of spatial data, types of spatial problems, relevant spatial concepts, and key spatial data science methods. Computer lab exercises offer hands-on practices on spatial data analytics with both structured data from government statistics or systematic data collections as well as unstructured data from social media, location-aware mobile devices (such as smart phones), and/or web scrapping. This course aims to help students develop fundamental knowledge and basic skills to ask spatial questions, find, process and analyze spatial data, solve spatial problems, and communicate their findings. (3-0) Y

GISC 6323 (EPPS 6326) Machine Learning for Socio-Economic and Geo-Referenced Data (3

semester credit hours) Models and algorithms as well as their underlying conceptional foundations to structure dynamic socio-economic and geo-referenced data are introduced. Open-source software and commonly available hardware are used. Practical examples of [a] supervised machine learning to develop classification rules and [b] unsupervised data mining to uncover a hidden organization of data objects are used to explore the strength and weaknesses of selected data analytical methods and to examine the resulting output. Where appropriate, ethical ramifications are discussed. (3-0) T

GISC 6325 (GEOS 5325) 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

GISC 6331 (CRIM 6332) GIS Applications in Criminology (3 semester credit hours) Examines spatial distributions of crime, criminals, and criminal justice interventions. Students conduct spatial analysis of point patterns and area-based data in studies of the locations of crime events and rates, offenders, police patrolling practices, judicial districts and community corrections and how they relate to physical and social characteristics of neighborhoods. (3-0) R

GISC 6334 (PPPE 6334) Workshop in Environmental and Health GIS/Policy (3 semester credit hours) Students join a faculty member in a research project on environmental and health policy. Specific topics vary from semester to semester, but special emphasis will be on the applications of statistical and spatial analytic methods (e.g. GIS, spatial econometrics, decision analysis, etc.) to various real-life data in the environmental and health field. Class exercises will be completed using state-of-the-art statistics and GIS software. May be repeated for credit as topics vary (9 semester credit hours maximum). Prerequisite: EPPS 6313 or EPPS 7313 or GISC 6301 or GISC 6381. (3-0) Y

GISC 6363 Internet Mapping and Information Processing (3 semester credit hours) Provides a conceptual overview and hands-on experiences in Internet mapping and web-based geospatial information processing with a wide range of state-of-the-art software, including both open-source and commercial packages. Topics covered include cloud computing, client/server configuration, distributed data access and display, web-based user interaction and customization. (3-0) T

GISC 6375 Spatial Optimization (3 semester credit hours) Provides an understanding of applied mathematical and computational techniques used in optimization problems that have a strong spatial component. Students will learn the basics of problem formulation and various solution strategies, both exact (e.g., linear and nonlinear programming) and heuristic (e.g., genetic programming). Students will gain hands-on experience linking GIS and other software systems to solve these sorts of problems. At the conclusion of this class students will be able to formulate and solve a variety of spatial optimization problems that are beyond the capabilities of any single off-the-shelf software system. (3-0) Y

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

GISC 6381 (GEOS 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

GISC 6382 (GEOS 6383) 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

GISC 6384 (GEOS 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

GISC 6385 (GEOS 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

GISC 6387 (GEOS 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

GISC 6388 Advanced GIS Programming (3 semester credit 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 programming language to design and implement GIS applications. Class exercises further provide experience to customize and develop advanced GIS tools. Prerequisites: (GISC 6381 or GEOS 6381) and GISC 6317, or instructor consent required. (3-0) Y

GISC 6389 Geospatial Information Sciences Master's Research (3 semester credit 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. Pass/Fail only. May be repeated in the following semester. Instructor consent required. (3-0) S

[GISC 6V01](#) Independent Study in GIS (1-9 semester credit hours) Provides faculty supervision for a student's individual study of a topic agreed upon by the student and the faculty supervisor. Pass/Fail only. May be repeated for credit. Instructor consent required. ([1-9]-0) S

[GISC 6V98](#) Master's Thesis (3-9 semester credit hours) Provides faculty supervision of a student's master's thesis research. May be repeated for credit. GIS Program Head and instructor consent required. ([3-9]-0) S

[GISC 7310](#) Advanced GIS Data Analysis (3 semester credit hours) The specification, interpretation and properties of the multiple linear regression model including spatial and aspatial regression diagnostics are examined. A detailed review of the key concepts of matrix algebra, optimization techniques and simulation experiments is given. GIS and GPS data handling procedures are discussed from a regression and linear transformation perspective. Extensions to principal component analysis, ridge regression, weighted regression, logistic and Poisson regression are provided. Practical data analysis for large Geo-referenced data sets are exercised. Prerequisite: [GISC 6301](#) or equivalent. (3-0) R

[GISC 7360](#) GIS Pattern Analysis (3 semester credit hours) Examines tranformations among geospatial object classes, topological measures, edge effects, univariate and multivariate methods for point pattern analysis, directional data, geo-statistical surface interpolations, and spatial regression models. Underlying models and data generating processes leading to spatial heterogeneity and spatially clustered/dispersed patterns are discussed and simulated. examples of local and global spatial analyses of crime, disease, real estate or environmental patterns are discussed. Prerequisites: ([GEOS 6381](#) or [GISC 6381](#)) and ([GISC 6301](#) or equivalent). (3-0) R

[GISC 7361](#) Spatial Statistics (3 semester credit 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 7364](#) Demographic and Epidemiological Analysis and Modeling (3 semester credit hours) Examines the demographic and epidemiological terminology, key statistical measures, data sources, models, projection methods and analysis techniques of the distribution of population and its characteristics as well as disease, mortality and fertility patterns. The underlying theoretical foundations are examined and extended into the spatial domain to understand the spatio-temporal dynamics of population characteristics and disease patterns. A solid knowledge of population and disease patterns, either on a local or global level, is essential to many disciplines engaged in planning for the public and private service sectors, public health, transportation networks, migration patterns or regional development projects. Prerequisite: [GISC 7310](#) or equivalent. (3-0) R

GISC 7365 (GEOS 5326) 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

GISC 7366 (GEOS 5329) 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

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

GISC 8320 Geospatial Sciences Seminar (3 semester credit hours) Examines selected topics in spatial analysis or GI Science. Pass/Fail only. May be repeated for credit as topics vary (12 semester credit hours maximum). (3-0) R

GISC 8V27 Internship in GIS (1-9 semester credit hours) Provides faculty supervision for a student's internship, which must be related to GIS. Pass/Fail only. May be repeated for credit (9 semester credit hours maximum). Instructor consent required. ([1-9]-0) S

GISC 8V29 Research in GIS (1-9 semester credit hours) Provides faculty supervision of research conducted by a student. Pass/Fail only. May be repeated for credit. Instructor consent required. ([1-9]-0) S

GISC 8V99 Dissertation (1-9 semester credit hours) Provides faculty supervision of a student's dissertation research. Pass/Fail only. May be repeated for credit. Prerequisites: Open to PhD students only and instructor consent required. ([1-9]-0) S