GEOGRAPHIC INFORMATION SCIENCE (GIS)

GIS 2010 - Introduction to Location Science
3 Credits
This course introduces students to the core concepts of location science, including Earth coordinate systems, geospatial data, geographic information systems (GIS), remote sensing, cartography, and GPS navigation, along with supporting concepts from other disciplines (such as mathematical tools, basic physics principles, data science, electrical engineering, and aerospace engineering). Students gain hands-on experience using GIS software to create maps, manage data, perform analyses, and communicate visually, as well as solving for positions through trilateration. This course serves as a gateway to the geospatial program at SLU.
Attributes: UUC:Natural & Applied Science

GIS 2030 - Spatial Analysis
3 Credits
This course introduces students to the basic theory and application of spatial analyses in Geographic Information Systems. Students learn about spatial analyses topics such as spatial statistics, surfaces, hydrology, network analyses, and geocomputation. Students get hands-on experience using Geographic Information Systems software to perform spatial analyses, displaying results, and communicating results. (Offered in Spring)
Prerequisite(s): GIS 2010*

* Concurrent enrollment allowed.

GIS 2050 - Introduction to Global Positioning Systems: Theory and Applications
3 Credits
This course introduces students to the basic theory and applications in Global Positioning Systems. Topics include calculating location, satellite orbits, GPS errors and biases, GPS data, applications, and other types of navigation systems. Students receive experience in determining location using GPS receivers and computer software to collect, process, and correct GPS data. (Offered in Spring)
Prerequisite(s): GIS 2010

GIS 2930 - Special Topics
3 Credits (Repeatable for credit)
Attributes: Natural Science Req (A&S)

GIS 2980 - Independent Study
1 or 3 Credits (Repeatable for credit)
Attributes: Natural Science Req (A&S)

GIS 4010 - Introduction to Geographic Information Systems
3 Credits
This class introduces concepts, science, and theory of GIS and provides hands-on learning experiences. After successful completion of the course, students will be able to demonstrate fundamental techniques of geospatial analysis and mapping.
Attributes: Natural Science Req (A&S), Public Health Major Elective

GIS 4030 - Geospatial Data Management
3 Credits
This class teaches students how to design and implement spatial databases, topology, spatial data models, spatial query languages, relational database architecture, data storage and indexing, SQL, data mining, etc. Students learn data management skills including relational databases, server GIS, schemas, and enterprise data management using OGC standards, web application program Interfaces (iOS, Android), data security and risk management. (Offered in Spring)
Prerequisite(s): GIS 4010
Attributes: Natural Science Req (A&S)

GIS 4040 - Introduction to Remote Sensing
3 Credits
This course include fundamental knowledge on the physics of remote sensing; photogrammetry; multispectral, hyperspectral, and thermal imaging; RADAR; and LIDAR. Principles are reviewed in lectures, and lab assignments cover image processing, environmental modeling, and analysis. The course objective is to demonstrate applications of remote sensing in environmental sciences with software training in ENVI&IDL and SARscape. (Offered every fall.)
Attributes: Environmental Science Elective, Natural Science Req (A&S)

GIS 4050 - Digital Image Processing
3 Credits
This course will concentrate on the theories and applications of image processing and the extraction of thematic information from satellite images. Students learn key concepts and techniques of image processing through hands-on lab exercises involving image calibration, rectification, fusion, transform, filtering, classification, segmentation, and image quality & accuracy assessment. (Offered in Spring)
Prerequisite(s): GIS 4040
Attributes: Natural Science Req (A&S)

GIS 4061 - Photogrammetry
3 Credits
Photogrammetry studies the principles of precise location measurement from photographs. This course introduces the foundations and modern technologies of photogrammetry as it relates to remote sensing, computer vision, engineering, surveying, and location science. This course will also demonstrate practical photogrammetry data acquisition, processing, product generation, and quality assessment, as well as developing an understanding of the necessary optics, mathematics, sensor systems, image processing, and computer vision fundamentals. (Offered occasionally)
Prerequisite(s): GIS 4040
Attributes: Geospatial Elective

GIS 4066 - UAS Remote Sensing
3 Credits
This course will concentrate on UAS remote sensing sensors (Hyperspectral, LiDAR, multispectral, and thermal), flight planning, ground targets, data collection, calibration, post-processing, and applications. A brief overview of UAS rules, regulations, and safety procedures will be followed by consideration of UAS sensor products and standard operating procedures. Students will learn key techniques of UAS remote sensing through hands-on exercises involving UAS componentry, data collection flights, processing, and analysis.

GIS 4080 - Digital Cartography and Geovisualization
3 Credits
This course comprehensively covers concepts, methods, and applications in the visualization of geographic data using GIS and computer programming languages. (Offered in Spring)
Attributes: Geospatial Elective

GIS 4090 - Introduction to Programming for GIS and Remote Sensing
3 Credits
This course will introduce students to Python programming and its applications to remote sensing and GIS. Through completing this course, students will be able to use Python to perform common GIS and remote sensing analysis tasks, automate workflows, and develop custom Python tools. Topics will include describing data, manipulating data, automating spatial analysis tasks, creating Python scripts and tools, and using Python for imagery analysis."
Attributes: Geospatial Elective, Natural Science Req (A&S)

GIS 4091 - Advanced Programming for GIS and Remote Sensing
3 Credits
In this class, students will learn how to publish, consume, and analyze web services using Python, Javascript, and HTML. They will be introduced to more powerful, more advanced Python libraries such as Pandas, Numpy, ArcGIS, and Folium in addition to learning advanced geographic data visualization techniques that leverage Python, Javascript, and web APIs. They will also learn how to use the Javascript to create their first stand-alone web applications. This class builds on what students learned in GIS 4090 and helps them develop knowledge and skills that they will use throughout their careers.
Attributes: Geospatial Elective, Natural Science Req (A&S)

GIS 4092 - Machine Learning for GIS and Remote Sensing
3 Credits
This course introduces machine learning and applied computer vision techniques for using GIS and remotely sensed data to solve Earth science problems related to climate resilience and sustainability. Topics include supervised learning, neural networks, convolutional neural networks, dimension reduction, and unsupervised learning (clustering). The course interweaves theory and practice where classes provide theoretical depth into contemporary artificial intelligence approaches. The hands-on labs, assignments, and projects give students experience managing, wrangling, and utilizing geospatial data in machine learning tasks. Students will explore integrations of machine learning methods in Earth, environmental, and geospatial sciences via in-class artificial intelligence applications of contemporary Earth science topics such as food-water nexus, natural hazard detection, and computational sustainability. Students taking GIS 4092 will work with the instructor to choose and develop research projects with curated datasets.
Prerequisite(s): GIS 4090
Attributes: Geospatial Elective, Natural Science Req (A&S)

GIS 4100 - Microwave Remote Sensing: SAR Principles, Data Processing and Applications
3 Credits
The course covers principles of synthetic aperture radar (SAR), SAR satellites and data sources, SAR image processing, interpretation and applications. Popular data processing techniques, including SAR intensity processing, InSAR and DInSAR techniques, polarimetry tools/ classification methods, Persistent Scatterer Interferometry are discussed through detailed step-by-step lab work on the processing chain including measuring earthquake deformation, land subsidence, landslides, building sinking, and tree height/health estimation, DEM generation, and various environmental applications. Students will have experience on ordering, processing and interpreting SAR data, and an opportunity to discuss advantages and limitations of SAR remote sensing for their specific research, and to explore RADAR w/ LiDAR for its common applications in vegetation assessment and terrain characterization.
Attributes: Geospatial Elective, Natural Science Req (A&S)

GIS 4110 - Interferometric Synthetic Aperture Radar (InSAR)
3 Credits
This course focuses on providing application oriented forum on InSAR for geoscientists. Principles of InSAR, DInSAR, timeSAR are introduced through hands-on lab work on measuring earthquake deformation, volcanic unrest, land subsidence due to extraction of groundwater, oil, gas, and coal mining using both commercial and open-source software tools.

GIS 4120 - Geospatial Analytics
3 Credits
This class introduces geospatial solutions to grand societal challenges. Emphasis is placed on the roles that location intelligence and geospatial technology play in scientific discovery. Discussion of emerging technologies to tackle grand challenges such as controlling the spread of infectious disease, providing access to clean water, human mobility and migration, and creating smart and connected cities. (Offered in Spring)
Prerequisite(s): GIS 4010; GIS 4040
Attributes: Geospatial Elective

GIS 4130 - Human Geography
3 Credits
This class provides an overview of the major themes of human geography that comprise the complexities of systemic interactions between humans and the environment. Each lecture will highlight a specialized perspective and disciplinary skills that contribute to providing the human geography backdrop for a variety of global issues. Discussions will span data taxonomies and data visualization and analysis, biodiversity, cultures and geopolitics, a human security use case linking wildlife trafficking with disease vector analysis, and geopolitical for a and policies with human geography applications.
Attributes: Geospatial Elective

GIS 4140 - Satellite Geodesy
3 Credits
This course introduces modern techniques that are used to study the Earth's shape, rotation, and gravitational field focusing on satellite-based measurements. Specific topics include satellite orbit perturbations due to the gravity field, satellite tracking systems, geodetic systems, datums and coordinate systems, Earth rotation and reference frames, ocean and solid Earth tides, and gravity field representations. (Offered occasionally)
Prerequisite(s): GIS 2010; GIS 2050
Attributes: Geospatial Elective

GIS 4220 - Precise Positioning and Applications of GNSS
3 Credits
This course (GIS discusses how to reach centimeter-level positioning using Global Navigation Satellite System (GNSS). Students learn about physical effects that impact the positioning accuracy and precision. Students get hands-on experience of using GNSS software to perform high-precision positioning. In addition, students learn about the sophisticated applications of GNSS exemplified by real-time kinematic positioning, precise timing, autonomous driving, satellite orbit determination, geodesy, and remote sensing. Students will design a project in the second half of the semester.
Attributes: Geospatial Elective

GIS 4930 - Special Topics
3 Credits (Repeatable for credit)
Attributes: Natural Science Req (A&S)

GIS 4960 - GIS Capstone
3 Credits
In this course, students will consolidate their coursework and demonstrate their mastery of professional remote sensing and/or GIS competencies through ongoing research projects. Depending on whether students' interests are in remote sensing or GIS, topics will cover spatial analysis, web GIS, database design, management and data mining with integration of GIS, remote sensing and GPS, InSAR, and various applications of techniques. (Offered as needed.)
Attributes: Natural Science Req (A&S)

GIS 4980 - Advanced Independent Study in Geographic Information Science
1 or 3 Credits (Repeatable for credit)
Attributes: Natural Science Req (A&S)

GIS 5010 - Introduction to Geographic Information Systems
3 Credits
This class introduces concepts, science, and theory of GIS and provides hands-on learning experiences. After successful completion of the course, students will be able to demonstrate fundamental techniques of geospatial analysis and mapping. (Offered every fall.)
Attributes: Environment Geoscience GR Elec, Geophysics GR Elective, MPH-Behavior Sci & Health Equi, MPH-Biosecurity & Disaster Prp, MPH-Epidemiology, MPH-Global Health, MPH-Health Management & Policy, MPH-Maternal & Child Health, MPH-Biostatistics, Grad Pol Sci Skills

GIS 5030 - Geospatial Data Management
3 Credits
This class teaches students how to design and implement spatial databases, topology, spatial data models, spatial query languages, relational database architecture, data storage and indexing, SQL, data mining, etc. Students learn data management skills including relational databases, server GIS, schemas, and enterprise data management using OGC standards, web application program Interfaces (iOS, Android), data security and risk management. (Offered in Spring)
Prerequisite(s): GIS 5010 with a grade of C or higher

GIS 5040 - Introduction to Remote Sensing
3 Credits
This course include fundamental knowledge on the physics of remote sensing; photogrammetry; multispectral, hyperspectral, and thermal imaging; RADAR; and LIDAR. Principles are reviewed in lectures, and lab assignments cover image processing, environmental modeling, and analysis. The course objective is to demonstrate applications of remote sensing in environmental sciences with software training in ENVI&IDL and SARscape. (Offered every fall.)
Attributes: Aviation Elective (Graduate), Environment Geoscience GR Elec, Geophysics GR Elective, MPH-Epidemiology

GIS 5050 - Digital Image Processing
3 Credits
This course will concentrate on the theories and applications of image processing and the extraction of thematic information from satellite images. Students learn key concepts and techniques of image processing through hands-on lab exercises involving image calibration, rectification, fusion, transform, filtering, classification, segmentation, and image quality & accuracy assessment. (Offered in Spring)
Prerequisite(s): GIS 5040 with a grade of C or higher

GIS 5061 - Photogrammetry
3 Credits
Photogrammetry studies the principles of precise location measurement from photographs. This course introduces the foundations and modern technologies of photogrammetry as it relate to remote sensing, computer vision, engineering, surveying, and location science. This course will also demonstrate practical photogrammetry data acquisition, processing, product generation and quality assessment, as well as developing an understanding of the necessary optics, mathematics, sensor systems, image processing, and computer vision fundamentals. (Offered in Summer)
Prerequisite(s): GIS 5040 with a grade of C or higher

GIS 5066 - UAS Remote Sensing
3 Credits
This course will concentrate on UAS remote sensing sensors (Hyperspectral, LiDAR, multispectral, and thermal), flight planning, ground targets, data collection, calibration, post-processing, and applications. A brief overview of UAS rules, regulations, and safety procedures will be followed by consideration of UAS sensor products and standard operating procedures. Students will learn key techniques of UAS remote sensing through hands-on exercises involving UAS componentry, data collection flights, processing, and analysis.

GIS 5080 - Digital Cartography and Geovisualization
3 Credits
Readings, discussion, and hands-on investigation of advanced cartography topics and contemporary geovisualization issues. Analytic cartography, spatial analysis, and visualization techniques. Offered every spring.

GIS 5090 - Introduction to Programming for GIS and Remote Sensing
3 Credits
This course will introduce students to Python programming and its applications to remote sensing and GIS. Through completing this course, students will be able to use Python to perform common GIS and remote sensing analysis tasks, automate workflows, and develop custom Python tools. Topics will include describing data, manipulating data, automating spatial analysis tasks, creating Python scripts and tools, and using Python for imagery analysis."
Attributes: MPH-Epidemiology

GIS 5091 - Advanced Programming for GIS and Remote Sensing
3 Credits
In this class, students will learn how to publish, consume, and analyze web services using Python, Javascript, and HTML. They will be introduced to more powerful, more advanced Python libraries such as Pandas, Numpy, ArcGIS, and Folium in addition to learning advanced geographic data visualization techniques that leverage Python, Javascript, and web APIs. They will also learn how to use the Javascript to create their first stand-alone web applications. This class builds on what students learned in GIS 5090 and helps them develop knowledge and skills that they will use throughout their careers.
Prerequisite(s): GIS 5090

GIS 5092 - Machine Learning for GIS and Remote Sensing
3 Credits
This course introduces machine learning and applied computer vision techniques for using GIS and remotely sensed data to solve Earth science problems related to climate resilience and sustainability. Topics include supervised learning, neural networks, convolutional neural networks, dimension reduction, and unsupervised learning (clustering). The course interweaves theory and practice where classes provide theoretical depth into contemporary artificial intelligence approaches. The hands-on labs, assignments, and projects give students experience managing, wrangling, and utilizing geospatial data in machine learning tasks. Students will explore integrations of machine learning methods in Earth, environmental, and geospatial sciences via in-class artificial intelligence applications of contemporary Earth science topics such as food-water nexus, natural hazard detection, and computational sustainability. Students taking GIS 5092 will work on self-guided final projects that apply machine learning methods to a problem in Earth, environmental, or geospatial sciences.
Prerequisite(s): GIS 5090
Attributes: AI Applications

GIS 5100 - Microwave Remote Sensing: SAR Principles, Data Processing and Applications
3 Credits
The course covers principles of synthetic aperture radar (SAR), SAR satellites and data sources, SAR image processing, interpretation and applications. Popular data processing techniques, including SAR intensity processing, InSAR and DInSAR techniques, polarimetry tools/classification methods, Persistent Scatterer Interferometry are discussed through detailed step-by-step lab work on the processing chain including measuring earthquake deformation, land subsidence, landslides, building sinking, and tree height/health estimation, DEM generation, and various environmental applications. Students will have experience on ordering, processing and interpreting SAR data, and an opportunity to discuss advantages and limitations of SAR remote sensing for their specific research, and to explore RADAR w/ LiDAR for its common applications in vegetation assessment and terrain characterization.

GIS 5110 - Interferometric Synthetic Aperture Radar (InSAR)
3 Credits
This course focuses on providing application oriented forum on InSAR for geoscientists. Principles of InSAR, DInSAR, timeSAR are introduced through hands-on lab work on measuring earthquake deformation, volcanic unrest, land subsidence due to extraction of groundwater, oil, gas, and coal mining using both commercial and open-source software tools.
Attributes: Geophysics GR Elective

GIS 5120 - Geospatial Analytics
3 Credits
This class introduces geospatial solutions to grand societal challenges. Emphasis is placed on the roles that location intelligence and geospatial technology play in scientific discovery. Discussion of emerging technologies to tackle grand challenges such as controlling the spread of infectious disease, providing access to clean water, human mobility and migration, and creating smart and connected cities.

GIS 5130 - Human Geography
3 Credits
This class provides an overview of the major themes of human geography that comprise the complexities of systemic interactions between humans and the environment. Each lecture will highlight a specialized perspective and disciplinary skills that contribute to providing the human geography backdrop for a variety of global issues. Discussions will span data taxonomies and data visualization and analysis, biodiversity, cultures and geopolitics, a human security use case linking wildlife trafficking with disease vector analysis, and geo-political fora and policies with human geography applications. (Offered even years in Fall)
Prerequisite(s): GIS 5010 with a grade of C or higher

GIS 5140 - Satellite Geodesy
3 Credits
This course introduces modern techniques that are used to study the Earth's shape, rotation, and gravitational field focusing on satellite-based measurements. Specific topics include satellite orbit perturbations due to the gravity field, satellite tracking systems, geodetic systems, datums and coordinate systems, Earth rotation and reference frames, ocean and solid Earth tides, and gravity field representations. (Offered occasionally)
Prerequisite(s): GIS 5040 with a grade of C or higher
Attributes: Geophysics GR Elective

GIS 5220 - Precise Positioning and Applications of GNSS
3 Credits
This course discusses how to reach centimeter-level positioning using Global Navigation Satellite System (GNSS). Students learn about physical effects that impact the positioning accuracy and precision. Students get hands-on experience of using GNSS software to perform high-precision positioning. In addition, students learn about the sophisticated applications of GNSS exemplified by real-time kinematic positioning, precise timing, autonomous driving, satellite orbit determination, geodesy, and remote sensing. Students will design a project in the second half of the semester.

GIS 5930 - Special Topics
3 Credits (Repeatable for credit)

GIS 5970 - Research Topics
0-3 Credits (Repeatable for credit)
A non-classroom course in which a student engages in research on a topic that is related to the student's graduate work and career goals. Offered annually.

GIS 5980 - Graduate Independent Study in Geographic Information Science
1 or 3 Credits (Repeatable for credit)

GIS 5990 - Thesis Research
0-6 Credits (Repeatable for credit)
Research that leads to a Master's Thesis and defense of the Thesis. Offered every fall and spring.

GIS 6970 - Advanced Research Topics in Geographic Information Science
0-3 Credits (Repeatable up to 6 credits)
A non-classroom course in which a student engages in research on a topic that is related to the student's graduate work and career goals. Offered annually. Registration restricted to PhD Students.

GIS 6990 - Dissertation Research
0-6 Credits (Repeatable up to 12 credits)
Dissertation Research.