

GEOGRAPHY AND GEOINFORMATION SCIENCE (GGS)

100 Level Courses

GGG 101: *Major World Regions*. 3 credits.

Patterns, problems, and prospects of the world's principal human-geographic regions. Emphasizes areal differentiation and role of geographic differences in interpreting current world scene. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Mason Core: Mason Core (All), Global Contexts, Global Understanding (<http://catalog.gmu.edu/mason-core/>)

Specialized Designation: Non-Western Culture

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 102: *Physical Geography*. 3 credits.

Interrelated processes affecting global distribution and character of climate, soils, vegetation, hydrology, and landforms. Includes elements of mapping. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Mason Core: Mason Core (All), Just Societies, Natural Science Overview, Encore: Sustainability (<http://catalog.gmu.edu/mason-core/>)

Specialized Designation: Green Leaf Related Course

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 103: *Human Geography*. 3 credits.

Overview of major ideas and approaches to studying spatial aspects of human social and behavioral systems. Surveys distribution and movement of human populations, characteristics and distribution of cultural mosaics, patterns of economic interdependence, and study of forces of cooperation and conflict among people from global perspective. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Mason Core: Mason Core (All), Social/Behavioral Sciences, Encore: Sustainability (<http://catalog.gmu.edu/mason-core/>)

Specialized Designation: Green Leaf Related Course

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 110: *Introduction to Geoinformation Technologies*. 3 credits.

This course introduces students to basic geoinformation technology concepts and applications. Students learn about and apply spatial data collection analytic tools and methods, including geographic information systems, and web-based map developments. Lectures examine social trends, ethical issues including privacy state of the art technological

research and developments of geoinformation technologies in industry, government, education, and everyday life. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Specialized Designation: Mason Impact.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 121: *Dynamic Atmosphere and Hydrosphere*. 4 credits.

Systematic study of weather, climate, energy, and hydrologic systems viewed from a geospatial and global perspective. Studies the spatial distribution and relationships of the Earth's climate and hydrologic systems to other Earth systems, as well as the processes driving and changing them, including energy, climate, weather, and water resources. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Mason Core: Mason Core (All), Natural Science with Lab, Encore: Sustainability (<http://catalog.gmu.edu/mason-core/>)

Specialized Designation: Green Leaf Related Course

Schedule Type: Laboratory, Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 122: *Dynamic Geosphere and Ecosphere*. 4 credits.

Systematic study of biogeography and soils, viewed from a geographic, or spatial, perspective. We will study the spatial distribution and relationships of Earth's biomes and soils systems to other Earth systems, and the processes driving them, including energy, climate, nutrients, chemistry, and moisture. Cannot be combined for credit with EVPP 110 or EVPP 111. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Specialized Designation: Green Leaf Related Course

Schedule Type: Laboratory, Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

300 Level Courses

GGG 300: *Quantitative Methods for Geographical Analysis*. 3 credits.

Comprehensive introduction to quantitative methods in spatial analysis, with emphasis on solving geographical research problems. Topics include nature of spatial data; collection of spatial data; preparation of spatial data for mapping, geographic information systems, and statistical analysis; descriptive spatial statistics; areal sampling theory and methods; probability theory and distributions; hypothesis testing; correlation and regression; and areal and point pattern spatial statistics. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Specialized Designation: Mason Impact.

Recommended Prerequisite: 30 credits, including GGS 102 and 103 or permission of instructor.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 301: Political Geography. 3 credits.

Distribution and effects of power on landscape, particularly on national and global scales. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Mason Core: Mason Core (All), Just Societies, Social/Behavioral Sciences (<http://catalog.gmu.edu/mason-core/>)

Recommended Prerequisite: 30 credits

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 302: Global Environmental Hazards. 3 credits.

Introduces applications of observational and modeling techniques to natural hazards and the threat they pose to the world, as well as a general introduction to global climate change and its effect on regional and local scales. Examples include topics of interest to different countries and regions of the world, such as earthquakes, sand and dust storms, slope failures, volcanoes, land slides, droughts and desertification, floods, hurricanes and typhoons, severe weather, wild fires (U.S., Indonesia, Africa, S. America), sea-level rise, and tsunamis. Covers Earth system science topics related to the above hazards and their coupling with anthropogenic hazards as well as how societies respond to natural disasters and mitigation. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Specialized Designation: Green Leaf Related Course

Recommended Prerequisite: 30 hours and undergraduate status

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 303: Geography of Resource Conservation. 3 credits.

Provides analysis of world resources distribution, conservation, and preservation; and problems resulting from their natural occurrence and utilization. Uses knowledge from physical and social sciences to develop complex and sophisticated understanding of issues surrounding natural resource exploitation and management, conservation, and preservation. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Mason Core: Mason Core (All), Mason Apex, Encore: Sustainability (<http://catalog.gmu.edu/mason-core/>)

Specialized Designation: Green Leaf Related Course

Recommended Prerequisite: 30 credits, and completion or concurrent enrollment in all other required Mason Core courses.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 304: Population Geography. 3 credits.

Spatial distribution of population, its causes and effects, and changing patterns resulting from population mobility. Emphasizes spatial characteristics of variables such as age, sex, race, education, and income. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Mason Core: Mason Core (All), Mason Apex, Encore: Sustainability (<http://catalog.gmu.edu/mason-core/>)

Specialized Designation: Green Leaf Related Course

Recommended Prerequisite: 30 credits and completion of or concurrent enrollment in all Mason Core requirements.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 305: Economic Geography. 3 credits.

Analyzes pattern of distribution of world economic activity, spatial economics behind this pattern, and influence of distribution on other spatial systems. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Recommended Prerequisite: 30 credits

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 306: Urban Geography. 3 credits.

Structure and internal differentiation of cities. Variety of perspectives on nature of cities, and opportunities for intensive use of space. Urban problems and alternatives in their spatial context. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 307: Geographic Approaches for Sustainable Development. 3 credits.

Sustainability lies at the intersection of the environment, society, and economics. This course explores the concepts of sustainable development at different geographical scales (local, national and international). We examine the applications, indicators, measurement tools of sustainable development for analysis and decision making in support of environmentally sustainable development from a geographic perspective. Case studies and problem-solving exercises will be used to stimulate learning and provide practical experience in addressing

sustainable development issues. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Specialized Designation: Green Leaf Focused Course

Recommended Prerequisite: GGS 102 or GGS 121 or GGS 122 or permission of instructor.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 308: *Field Mapping Techniques*. 3 credits.

Basic techniques for collecting and recording spatial field data, including topographic maps, compass, transit, alidade, and geographic positioning systems. Includes field work. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Recommended Prerequisite: MATH 105, GGS 102 or GEOL 101 and GEOL 103, and 30 credits.

Schedule Type: Laboratory

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 309: *Introduction to Weather and Climate*. 3 credits.

Foundations and elements of weather and climate from an Earth system perspective; analysis of spatial and temporal distribution of weather and climate controls as bases of global climate change and geographical variation. Monitoring weather and climate with satellite remote sensing and in situ data products. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Recommended Prerequisite: GGS 102, 121, or equivalent, or permission of instructor.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 310: *Cartographic Design*. 3 credits.

Focused on the creation and application of maps, with an emphasis on thematic mapping. Includes fundamental mapping principles (projection, scale, generalization, symbolization), spatial data selection and acquisition, and effective design choices for geospatial communication, utilizing mapping software and digital outputs. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 311: *Geographic Information Systems*. 3 credits.

Fundamental concepts and theories for appropriate use of geographic information systems (GIS). Topics include social and cultural contexts of the use of geographic information, sources of digital geospatial data, and methods of input, storage, display, and processing of spatial data for

geographic analysis using GIS. Lectures, hands-on exercises familiarize students with current technology. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Specialized Designation: Mason Impact.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 312: *Physical Climatology*. 3 credits.

Quantitative description of nature and theory of the climate system, dynamics of atmosphere-ocean-land surface, internal interactions and response to external forcing, description of the climate record and simple climate models. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts. Equivalent to CLIM 312.

Specialized Designation: Green Leaf Related Course

Recommended Prerequisite: 30 hours; and GGS 121, MATH 113, PHYS 243-244, or permission of instructor.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 314: *Severe and Extreme Weather*. 3 credits.

Behavior of weather events ranging from small scale (e.g., thunderstorms and tornadoes) to mesoscale (e.g., fronts and hurricanes). Introduces the dynamical and physical processes, atmospheric boundary layer processes, and coupling between different spatial scales that create and shape severe and localized weather events. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts. Equivalent to CLIM 314.

Specialized Designation: Green Leaf Related Course

Recommended Prerequisite: MATH 113 or equivalent; CLIM/PHYS 111/112 or EOS 121 or GGS 121.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 315: *Geography of the United States*. 3 credits.

Diversity of US physical and cultural landscapes. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Recommended Prerequisite: 6 credits of geography or American Studies, or permission of instructor.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 316: *Geography of Latin America*. 3 credits.

Regional survey of physical resources, populations, cultural characteristics, and economic activities in Latin America. Offered by

Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Specialized Designation: Non-Western Culture

Recommended Prerequisite: 6 credits of Geography or Latin American Studies, or permission of instructor.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 317: *Geography of China*. 3 credits.

Survey the physical, resources, environmental and population characteristics of China, and its urban, economic, and transportation systems development from a geographical perspective. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Mason Core: Mason Core (All), Global Contexts, Global Understanding (<http://catalog.gmu.edu/mason-core/>)

Specialized Designation: Non-Western Culture

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 320: *Geography of Europe*. 3 credits.

Environmental, economic, social, and political factors influencing regional structure of Europe. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Recommended Prerequisite: 6 credits of Geography or European Studies, or permission of instructor.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 321: *Biogeography*. 3 credits.

A survey of the relationship between distribution of plants and animals on the earth surface and the physical geography and environmental characteristics. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts. Equivalent to BIOL 374.

Recommended Prerequisite: GGS 122 or permission of instructor.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 325: *Geography of North Africa and the Middle East*. 3 credits.

Environmental, economic, and social factors of differentiation of regional structure and distribution of resources in North African and Middle Eastern countries. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Specialized Designation: Non-Western Culture

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 326: *Geography of Eastern Europe and Russia*. 3 credits.

A regional study of Eastern Europe and European Russia in terms of population patterns, economic activities, urbanization, planning and politics, migration, religion, landscape, and physical geographic features. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Recommended Prerequisite: 6 credits of geography or Russian studies, or permission of instructor.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 333: *Issues in Regional Geography*. 3 credits.

Geographical study of particular region or relevant regional issue. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May be repeated within the degree for a maximum 6 credits.

Recommended Prerequisite: 30 credits.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 340: *Health Geography*. 3 credits.

Spatial approaches to the study of health and disease. Topics include disease ecology and diffusion, and geographic perspectives on improving health care delivery. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Recommended Prerequisite: Course in statistics.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 344: *Military Geography*. 3 credits.

The geographical study of warfare. Investigations on the effects of physical and cultural geographic features on military operations with focus on the scale of operation and usage of maps. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 346: *Geography of Religions and Belief Systems*. 3 credits.

Investigation of spatial aspects of religions and belief systems. Includes geographic distribution and diffusion, cultural landscapes of belief, territoriality, and sacred spaces of both religious and non-religious belief systems. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Schedule Type: Seminar

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 354: *Data Analysis and Global Change Detection Techniques*. 3 credits. Introduces basic time series methods, especially those used in detecting trends and randomness in time series data. Various data related to global changes on different temporal and spatial scales will be identified, and the relevant analysis methods will be used to those data so that students can detect or confirm changing trends or lack of them in data. Other topics such as data formats, data visualization, and data mining may also be included based on the background of the student body. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Recommended Prerequisite: IT 104, STAT 250, or permission of instructor

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 357: *Urban Planning*. 3 credits.

Reviews spatial, policy, and administration principles that guide urban planning activities in the United States. Outlines differences between theory and practice and provides tools, methods, and perspectives commonly incorporated into practice of urban planning and policy analysis. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts. Equivalent to GOVT 357.

Recommended Prerequisite: 30 credits

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 366: *Spatial Computing*. 3 credits.

Comprehensive introduction to spatial computing using modern computing environments with emphasis on programming and problem solving. Introduces students to modern programming practices using both paradigms of imperative and object-oriented programming. Topics include 1) working with geospatial objects, such as points, lines and polygons; 2) hands-on experience in processing spatial data; 3) solving classic spatial computing problems, such as point-in-polygon tests and line segment intersection tests efficiently; 4) techniques for spatial navigation, such as shortest path algorithms spatial networks; 5) technical challenges such as storing, reading and parsing geospatial data. Tutorials and instruction assume no prior programming experience in Python or other programming languages. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 379: *Remote Sensing*. 3 credits.

Foundations of remote sensing, and of processing, analyzing, and using remotely sensed data for monitoring the earth. Introduces key concepts in electromagnetic radiation, passive (panchromatic, multi-, and hyper-spectral) and active (microwave and Lidar) sensor systems, and methods for information extraction, including image interpretation and analysis, measurement and rectification, classification, and digital image processing. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 380: *Geography of Virginia*. 3 credits.

Natural and cultural forces of Virginia. Studies regional makeup and analysis of human and environmental characteristics. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Recommended Prerequisite: 30 credits

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 384: *Special Topics in Geospatial Intelligence*. 3 credits.

Selected topics concerning human activity on earth derived from the exploitation and analysis of imagery and geospatial information that describes, assesses, and visually depicts physical features and geographically referenced activities on the Earth. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May be repeated within the term.

Specialized Designation: Topic Varies

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 399: *Select Topics in GGS*. 3 credits.

Content varies; determined by instructor. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May be repeated within the term for a maximum 12 credits.

Specialized Designation: Topic Varies, Non-Western Culture

Recommended Prerequisite: 30 credits.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

400 Level Courses

GGG 400: *Colloquium in Geoinformation Science*. 1 credit.
Presentations in specific research areas of Geography and Geoinformation Science by faculty and staff, Mason faculty in related programs, and professional visitors. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Recommended Prerequisite: 60 credits or permission of instructor.

Schedule Type: Seminar

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 411: *Geovisualization*. 3 credits.

Cartography course focused on thematic map design, with an objective to produce a portfolio of well-designed, professional grade maps. Theoretical concepts and principles will be introduced using practical examples and written assignments. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Registration Restrictions:

Required Prerequisites: GGS 310^C or 310^{XS}.

^C Requires minimum grade of C.

^{XS} Requires minimum grade of XS.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 415: *Seminar in Geographic Thought and Methodology*. 3 credits.
Focused on the trajectories and presentation of geographic thought, geographic research techniques, and methods of analysis. Students produce original research that engages current scholarship. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Mason Core: Mason Core (All) (<http://catalog.gmu.edu/mason-core/>)

Specialized Designation: Writing Intensive in Major

Registration Restrictions:

Required Prerequisites: GGS 300^C or 300^{XS}.

^C Requires minimum grade of C.

^{XS} Requires minimum grade of XS.

Students with a class of Freshman or Sophomore may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 416: *Satellite Image Analysis*. 3 credits.

Examines methods and techniques of interpreting and using information obtained by non-photographic remote sensing systems, with particular emphasis on space-borne platforms. Includes analysis of imagery for both physical and cultural environments. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Recommended Prerequisite: GGS 379

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 422: *Drone Remote Sensing*. 3 credits.

An advanced remote sensing course that focuses on the fundamentals of collecting and processing drone-based sensor data for various scientific applications. Explores the principles involved in drone-based photogrammetry, 3D reconstruction, multi-spectral and LiDAR sensing, whilst providing hands-on experience with drone mission planning, data acquisition and data processing. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Registration Restrictions:

Required Prerequisites: GGS 379^C, 379^{XS}, 416^C or 416^{XS}.

^C Requires minimum grade of C.

^{XS} Requires minimum grade of XS.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 426: *Physical Fundamentals of Remote Sensing*. 3 credits.

An introduction to fundamental physical principles of remote sensing as applied to Earth science. Focus on the physical and mathematical principles underlying satellite remote sensing techniques. Topics include radiometric information, satellite orbits, atmospheric corrections, data records, and in situ measurements. Current and planned satellite instruments, particularly those operated by NASA, NOAA, and USGS, are utilized. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Registration Restrictions:

Required Prerequisites: (GGS 379^C, 379^{XS}, 416^C or 416^{XS}).

^C Requires minimum grade of C.

^{XS} Requires minimum grade of XS.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 429: *Remote Sensing of the Environment and Earth System*. 3 credits.

Theory and methods for remote sensing features and phenomenon comprising the Earth system. Topics include surface and atmospheric information retrieval, radiation budgets, atmospheric gas detection, mapping the cryosphere, measurements of vegetation and biomass, soil moisture, and precipitation. Focus on satellite-based systems, with applications to both passive and active sensor systems. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Registration Restrictions:

Required Prerequisites: GGS 379^C, 379^{XS}, 416^C or 416^{XS}.

^C Requires minimum grade of C.

^{XS} Requires minimum grade of XS.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 432: *Spatial Modeling for Public Health*. 3 credits.

Discusses spatial modeling as a tool in public health, particularly for explaining, predicting, and responding to diseases within human and ecological systems. Hands on development of models using geospatial data. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Registration Restrictions:

Required Prerequisite: GGS 311^C.

^C Requires minimum grade of C.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 462: *Web-based Geographic Information Systems*. 3 credits.

Managing geospatial data is at the core of an emerging Billion-Dollar industry. This course will provide the students with the knowledge to manage and query geospatial data using relational database management systems and how to build Javascript-based Web mapping applications on top of a database to communicate and interact with the data. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Recommended Prerequisite: GGS 311

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 463: *RS: GIS Analysis and Application*. 3 credits.

Explores existing and potential capabilities of geographic information systems in conducting spatial analysis and modeling. Topics include spatial data acquisition and advanced spatial analytical techniques. Major purpose of course is to extend fundamental theories and concepts in GIS so students are able to conduct research with and on GIS. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Specialized Designation: Research/Scholarship Intensive

Registration Restrictions:

Required Prerequisites: (GGS 300^C, 300^{XS}, L300 or 300T) and (GGS 311^C, 311^{XS}, 311T or L311).

^C Requires minimum grade of C.

^{XS} Requires minimum grade of XS.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 470: *Special Topics in Geographic Techniques*. 3 credits.

Content varies in the subject of Geographic Techniques. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May be repeated within the term for a maximum 12 credits.

Specialized Designation: Topic Varies

Recommended Prerequisite: GGS 110.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 480: *GGS Internship*. 1-3 credits.

Approved study programs with specific employers. Notes: Credit determined by department. Contact department one semester before enrollment. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May be repeated within the degree for a maximum 6 credits.

Recommended Prerequisite: Open to authorized GGS majors and minors with 75 credits and GPA of 2.50 or higher in GGS courses.

Schedule Type: Independent Study

Grading:

This course is graded on the Satisfactory/No Credit scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 485: *Capstone in Geography and Geoinformation Science*. 3 credits.

Provides students with project-based culminating experience that integrates geographic problem solving with real-world data and questions. Students work in teams on client-based projects and present project deliverables. This course requires analytical, collaborative, communication, organizational, and research skills, with students demonstrating mastery of geographic thought and practice. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). Limited to three attempts.

Recommended Corequisite: GGS 415

Registration Restrictions:

Required Prerequisites: (GGS 300^C, 300^{XS}, 311^C, 311^{XS} or L311).

^C Requires minimum grade of C.

^{XS} Requires minimum grade of XS.

Enrollment limited to students with a class of Senior Plus or Senior.

Schedule Type: Seminar

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 499: *GGS Independent Study*. 1-3 credits.

Individual study of selected area of geography. Notes: Requires directed research paper. May be repeated with permission of the department. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May be repeated within the degree for a maximum 6 credits.

Recommended Prerequisite: Open only to authorized GGS majors with 90 credits and GPA of 2.50 or higher.

Schedule Type: Independent Study

Grading:

This course is graded on the Undergraduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

500 Level Courses

GGS 504: *Population Geography*. 3 credits.

Spatial distribution of population, its causes and effects, and changing patterns resulting from population mobility. Emphasizes spatial characteristics of variables such as age, sex, race, education, and income. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 505: *Transportation Geography*. 3 credits.

Structure, principles, location, and development of world transportation. Critical role of transportation in moving people, goods, and ideas at international, national, regional, and urban levels. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 507: *Geographic Approaches for Sustainable Development*. 3 credits.

Sustainability lies at the intersection of the environment, society and economics. This course explores the concepts of sustainable development at different geographical scales (local, national and international). We examine the applications, indicators, measurement tools of sustainable development for analysis and decision making in support of environmentally sustainable development from a geographic perspective. Case studies and problem-solving exercises will be used to stimulate learning and provide practical experience in addressing sustainable development issues. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 516: *Geography of Latin America*. 3 credits.

Regional survey of physical resources, populations, cultural characteristics, and economic activities in Latin America. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 517: *Geography of China*. 3 credits.

Survey the physical, resources, environmental and population characteristics of China, and its urban, economic, and transportation systems development from a geographical perspective. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 518: *Geography of North Africa and the Middle East*. 3 credits.

Environmental, economic, and social factors of differentiation of regional structure and distribution of resources in North African and Middle Eastern countries. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 526: *Geography of Eastern Europe and Russia*. 3 credits.

A regional study of Eastern Europe and European Russia in terms of population patterns, economic activities, urbanization, planning and

politics, migration, religion, landscape, and physical geographic features. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 531: *Land-Use Modeling Techniques and Applications*. 3 credits. Survey of literature on spatially explicit empirical models of land-use change. Hands-on experience developing and running simple models. Techniques covered include statistical models, mathematical programming models, cellular automata, agent-based models, and integrated models. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit. Equivalent to EVPP 531.

Recommended Prerequisite: GGS 550, or permission of instructor.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 533: *Issues in Regional Geography*. 3 credits.

Geographical study of particular region or relevant regional issue. Notes: Content varies. May be repeated with permission of the department. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May be repeated within the term for a maximum 12 credits.

Specialized Designation: Topic Varies

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 540: *Health Geography*. 3 credits.

Spatial approaches to study of health and disease. Topics include disease ecology and diffusion, and geographic perspectives on improving health care delivery. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Recommended Prerequisite: Course in statistics.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 544: *Military Geography*. 3 credits.

The geographical study of warfare. Investigations on the effects of physical and cultural geographic features on military operations with focus on the scale of operation and usage of maps. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 550: *Geospatial Science Fundamentals*. 3 credits.

Introduces geospatial sciences, emphasizing concepts and theories of cartography, remote sensing, air photo interpretation, Global Positioning Systems, spatial data structures, and geographic information systems. Lectures accompanied by hands-on exercises. Notes: Only available for students without previous course work in cartography. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 551: Cartographic Design. 3 credits.

Focused on the creation and application of maps, with an emphasis on thematic mapping. Includes fundamental mapping principles (projection, scale, generalization, symbolization), spatial data selection and acquisition, and effective design choices for geospatial communication, utilizing mapping software and digital outputs. Additionally considers cartographic research and the usage of spatial data analysis in research contexts. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture**Grading:**

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 553: Geographic Information Systems. 3 credits.

Fundamental concepts and theories for appropriate use of geographic information systems (GIS). Topics include social and cultural contexts of the use of geographic information, sources of digital geospatial data, and methods of input, storage, display, and processing of spatial data for geographic analysis using GIS. Lectures, hands-on exercises familiarize students with current technology. Additional focus on published scholarship and current research in the field. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture**Grading:**

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 554: History of Cartography. 3 credits.

History of cartographic portrayal of Earth from ancient times through 19th century, emphasizing interrelation of human culture, technological development, and geographical knowledge as reflected in maps. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture**Grading:**

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 557: Urban Planning. 3 credits.

Reviews spatial, policy, and administration principles that guide urban planning activities in the United States. Outlines differences between theory and practice and provides tools, methods, and perspectives commonly incorporated into practice of urban planning and policy analysis. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture**Grading:**

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 560: Quantitative Methods. 3 credits.

Survey of quantitative methods commonly used in geographic research. Emphasizes spatial analysis techniques. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Recommended Prerequisite: Previous course work in statistics or permission of instructor

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture**Grading:**

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGG 562: Photogrammetry. 3 credits.

Treatment of photogrammetric problems, including least squares adjustments, image coordination refinements, collinearity equation, resection, relative orientation, and analytic aerotriangulation. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Recommended Prerequisite: GGS 412, or permission of instructor.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 563: *Advanced Geographic Information Systems*. 3 credits.
Discusses advanced GIS concepts including but not limited to spatial data structures, spatial analysis, and spatial database management. Hands-on activities demonstrate concepts and technical skills applied to real world problem spaces. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Recommended Prerequisite: GGS 553 or equivalent.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 579: *Remote Sensing*. 3 credits.
Examines use of various types and combinations of electromagnetic energy to obtain spatial information. Concentrates on nonphotographic and spaceborne remote sensing platforms and sensors. Examines essential operational parameters for existing and future systems and strategies for visual extraction of features. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 590: *Selected Topics in Geography*. 3 credits.
Analyzes topics of immediate interest. Notes: Content varies. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May be repeated within the term for a maximum 12 credits.

Specialized Designation: Topic Varies

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

600 Level Courses

GGS 615: *Economic Geography*. 3 credits.

Analyzes pattern of distribution of world economic activity, spatial economics behind this pattern, and influence of distribution on other spatial systems. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 622: *Drone Remote Sensing*. 3 credits.

An advanced remote sensing course that focuses on the fundamentals of collecting and processing drone-based sensor data for various scientific applications. Explores the principles involved in drone-based photogrammetry, 3D reconstruction, multi-spectral and LiDAR sensing, whilst providing hands-on experience with drone mission planning, data acquisition and data processing. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Recommended Prerequisite: GGS 579 or permission of instructor

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 626: *Physical Fundamentals of Remote Sensing*. 3 credits.

An introduction to fundamental physical principles of remote sensing as applied to Earth science. Focus on the physical and mathematical principles underlying satellite remote sensing techniques. Topics include radiometric information, satellite orbits, atmospheric corrections, data records, and in situ measurements. Current and planned satellite instruments, particularly those operated by NASA, NOAA, and USGS, are utilized. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>)

catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/). May not be repeated for credit.

Recommended Prerequisite: GGS 579

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 629: Remote Sensing of the Environment and Earth System. 3 credits.

Theory and methods for remote sensing features and phenomenon comprising the Earth system. Topics include surface and atmospheric information retrieval, radiation budgets, atmospheric gas detection, mapping the cryosphere, measurements of vegetation and biomass, soil moisture, and precipitation. Focus on satellite-based systems, with applications to both passive and active sensor systems. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Recommended Prerequisite: GGS 579

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 631: Spatial Agent-Based Models of Human-Environment Interactions. 3 credits.

Discusses key challenges in spatial modeling of human-environment interactions. Reviews agent-based modeling applications in urban and rural interactions, agriculture, forestry, and other areas. Hands-on development of simple ABM models and investigation of linkages between GIS and ABM. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit. Equivalent to EVPP 631.

Recommended Prerequisite: GGS 531 or CSS 600, or permission of instructor.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 632: Spatial Modeling for Public Health. 3 credits.

Discusses spatial modeling as a tool in public health, particularly for explaining, predicting, and responding to diseases within human and ecological systems. Hands on development of models using geospatial data. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Recommended Prerequisite: GGS 553

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 650: Introduction to GIS Algorithms and Programming. 3 credits.

Introduction to programming methods and their application to Geographic Information Systems, including the fundamentals of object-oriented programming and GIS-specific data structures and algorithms. Employs an object-oriented language such as Visual Basic.Net, and existing freeware and commercial GIS libraries. Topics covered include variables, arrays, control structures, objects and classes, raster and vector data structures, spatial algorithms, and spatial indexing methods. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Recommended Prerequisite: GGS 553 or equivalent introductory GIS course, or permission of instructor.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 653: GIS Analysis and Application. 3 credits.

Explores existing and potential capabilities of geographic information systems in conducting spatial analysis and modeling. Topics include spatial data acquisition and advanced spatial analytical techniques. Major purpose of course is to extend fundamental theories and concepts in GIS so students are able to conduct research with and on GIS. Additionally includes elements on scholarly publication and engagement. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Recommended Corequisite: C or better in GGS 311 OR B- or better in GGS 553

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 655: Geovisualization. 3 credits.

Cartography course focused on thematic map design, with an objective to produce a portfolio of well-designed, professional grade maps.

Theoretical concepts and principles will be introduced using practical examples and written assignments. Includes theoretical concepts and applications of interactivity and animation, and research on map design and analytic cartography. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Recommended Prerequisite: GGS 551 or permission of instructor

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 656: The Hydrosphere. 3 credits.

Covers components and transfer processes in hydrosphere, which consists of aqueous envelope of Earth including oceans, lakes, rivers, snow, ice, glaciers, soil moisture, ground water, and atmospheric water vapor. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit. Equivalent to EVPP 652.

Recommended Prerequisite: Two semesters of calculus, partial differential equation recommended; or permission of instructor.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 657: The Lithosphere. 3 credits.

Global-scale overview of lithosphere; the solid nonliving Earth, its materials, cycles, plate tectonic and geomorphic processes; and history, including interactions with and history of hydrosphere, atmosphere and biosphere, and methods of analysis. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit. Equivalent to GEOL 601.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 658: Terrain Mapping. 3 credits.

Covers fundamental methods of digitally representing terrain data, major technologies, and programs for generating terrain data; methods for quantifying terrain error and assessing terrain data quality; and a variety of applications. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Recommended Prerequisite: GGS 553 or equivalent, or permission of instructor.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 664: Spatial Data Structures. 3 credits.

Studies spatial data structures and their application in digital cartography, geographic information systems, and image-processing systems. Examines raster and vector data structures, and attribution schemes and topological models. Includes data transformation, information loss, data quality, and the role of metadata. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Recommended Prerequisite: B or better in GGS 560.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 670: *Introduction to Atmosphere and Weather.* 3 credits.

Applies climatic concepts to natural and human-modified environments, and analyzes climatic change. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 675: *Location Science.* 3 credits.

This course presents the theory and practice of Location Science - the study of the optimal or near optimal spatial location or allocation of facilities, routes, personnel, or other assets. A variety of algorithms and heuristics for location problems is presented. Lectures and both in-class and take-home exercises reinforce students' mastery of the techniques and understanding of advanced theoretical issues. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 680: *Earth Image Processing.* 3 credits.

Focuses on how geoinformation technologies, including GIS, RS, and GPS, and spatial analytical techniques can be integrated to address various situations in environmental risk assessment, monitoring, and planning. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Recommended Prerequisite: GGS 416 or GGS 579 or permission of instructor.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 681: *Social Media Analysis.* 3 credits.

The course covers theory, principles, and analytical techniques in geospatial analysis of social media, including data collection, location-based and cyberspace social network analysis, content analysis, and geovisualization of such data. Examples of applications in various domains are used to demonstrate and explore the use of social media analysis. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Recommended Prerequisite: GGS 550 or GGS 553 or permission of the instructor.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 684: *Selected Topics in Geospatial Intelligence.* 3 credits.

Covers topics relevant to geospatial intelligence, especially addressing emerging trends, focused intelligence applications, and relevant technological advances, not covered by existing courses. Sample topics addressed in this course include geosensor networks, landmine detection using remote sensing techniques, the use of unmanned aerial vehicles in geospatial intelligence, and the use of virtual reality techniques for geospatial information modeling and analyst training. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Specialized Designation: Topic Varies

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 685: Capstone Course in Geoinformatics. 3 credits.

This course is intended to provide a capstone experience for graduate students by synthesizing knowledge and experience that they acquired in earlier coursework to address a complex geospatial intelligence problem. The course requires analytical, collaborative, and communication skills. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture**Grading:**

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 689: Seminar in Geographic Thought and Methodology. 3 credits.

Focused on the trajectories and presentation of geographic thought, geographic research techniques, and methods of analysis. Students produce original research that engages current scholarship. Additional content focuses on disciplinary breadth and depth in relation to the student's research interest. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Recommended Corequisite: GGS 300 or GGS 560

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Seminar**Grading:**

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 692: Web-based Geographic Information Systems. 3 credits.

Management of geospatial data by means of a database system. Communication of geospatial data over the Internet using browser-based interfaces. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture**Grading:**

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 695: Geography and Geoinformation Science Graduate Internship. 1-6 credits.

Approved study programs with specific employers. Students and employer supervisors must demonstrate relevancy of study program to degree requirements. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May be repeated within the degree for a maximum 6 credits.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Internship**Grading:**

This course is graded on the Satisfactory/No Credit scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 698: Directed Readings and Research. 1-3 credits.

Reading and research on specific topic under direction of faculty member. Notes: Written report required; oral exam and report may be required. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May be repeated within the term for a maximum 12 credits.

Specialized Designation: Topic Varies

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture**Grading:**

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

700 Level Courses**GGS 700: Comprehensive Exam.** 1 credit.

Preparation and completion for the comprehensive exam within the GGS department. Instructor should be the chair of the examination committee. The exam committee will specify exam content. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May be repeated within the degree for a maximum 2 credits.

Registration Restrictions:

Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Independent Study**Grading:**

This course is graded on the Graduate Special scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 704: *Spatial Demography*. 3 credits.

Intermediate-level, population geography course discussing demographic concepts and spatial dimensions of population. Features various indices, measures, and models commonly used in human geography. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Recommended Prerequisite: Prior courses in quantitative methods and GIS recommended.

Registration Restrictions:

Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture**Grading:**

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 740: *Hyperspectral Imaging Systems*. 3 credits.

Provides requisite materials to understand hyperspectral imaging technology and its many civilian and military applications. Emphasizes scientific principles involved and technology application to real-world imaging systems. Topics include hyperspectral concepts and system tradeoffs; data collection systems; calibration techniques; data processing techniques and software; classification methods; and case studies. Data processing techniques include N-dimensional space, scatterplots, spectral angle mapping, spectral mixture analysis, spectral matching, and mixture tuned matched filtering. Discusses ground, airborne, and spaceborne hyperspectral remote sensing systems. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Recommended Prerequisite: GGS 560 or equivalent, GGS 579 or equivalent, or permission of instructor.

Registration Restrictions:

Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture**Grading:**

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 754: *Earth Science Data and Advanced Data Analysis*. 3 credits.

Covers accessing and applying Earth observations and remote-sensing data for Earth system science research and applications. Major topics are data formats, advanced data analysis methods, and data applications. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Recommended Prerequisite: GGS 579 or permission of instructor.

Registration Restrictions:

Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture**Grading:**

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 760: *Advanced Topics in Remote Sensing*. 3 credits.

Content varies in the area of remote sensing. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May be repeated within the term for a maximum 12 credits.

Specialized Designation: Topic Varies

Recommended Prerequisite: GGS 579 or GGS 680.

Registration Restrictions:

Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture**Grading:**

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 773: *Interoperability of Geographic Information Systems*. 3 credits.

Advanced course addressing theories, standards, and implementations of web-based interoperable geographic information systems for online data and information services. Reviews international standards, including OGC, and associated tools for interoperability. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Recommended Prerequisite: GGS 754 and GGS 553, or a course in GIS.

Registration Restrictions:

Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture**Grading:**

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 777: *Remote Sensing Natural Hazards*. 3 credits.

Provides an overview of major natural hazards, their governing dynamics and remote-sensing techniques used to study, forecast, and mitigate hazards. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Recommended Prerequisite: GGS 579 or GGS 680; or permission of instructor.

Registration Restrictions:

Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture**Grading:**

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 787: *Scientific Data Mining for Geoinformatics*. 3 credits.

Covers specialized data mining algorithms, geoscience data models, and data information systems. Emphasis on domain-specific data mining algorithms suitable for spatial data and spatio-temporal data with geoscience and geoinformatics applications. Introduces real geoscience data mining applications in detailed applications. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Recommended Prerequisite: Competency in programming at the level of CSI 601-607 or permission of instructor.

Registration Restrictions:

Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 788: *Deep Learning for Geoinformation*. 3 credits.

Advanced course on machine learning theory and practice as applied to multi dimensional geoinformation. Includes application of machine learning algorithms to problems involving spatial data and spatial analysis, including image analysis. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Recommended Prerequisite: GGS 560 and GGS 650, or permission of instructor

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate or Non-Degree.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 791: *Advanced Spatial Statistics*. 3 credits.

Advanced course focusing on analyzing georeferenced or spatial data represented as points or polygons. Addresses higher moments, point pattern analyses, and interpolations of points to surfaces. Includes spatial regression. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Recommended Prerequisite: GGS 560 or STAT 535/554, or permission of instructor.

Registration Restrictions:

Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 798: *Master's Research Project*. 1-6 credits.

Reading project chosen and completed under guidance of graduate faculty member resulting in acceptable technical report. Notes: For students enrolled in Earth Systems Science master's program or the Geoinformatics and Geospatial Intelligence master's program. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May be repeated within the degree for a maximum 6 credits.

Recommended Prerequisite: Admission to Earth Systems Science MS program or Geoinformatics and Geospatial Intelligence MS, 12 graduate credits, and permission of instructor.

Registration Restrictions:

Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Thesis

Grading:

This course is graded on the Satisfactory/No Credit scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 799: *Thesis*. 1-6 credits.

Degree candidacy and departmental approval of thesis proposal. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May be repeated within the degree for a maximum 6 credits.

Recommended Prerequisite: Admission to Earth Systems Science MS program or Geoinformatics and Geospatial Intelligence MS, 12 graduate credits, and permission of instructor.

Registration Restrictions:

Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Thesis

Grading:

This course is graded on the Satisfactory/No Credit scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

800 Level Courses

GGS 840: *Hyperspectral Imaging Applications*. 3 credits.

Introduces advanced hyperspectral imaging and multisensor concepts with emphasis on real-world civilian and military applications. Topics include advanced hyperspectral concepts, multisystem tradeoffs, data collection and processing systems, imaging radar systems, laser systems, calibration techniques, data fusion, quantitative remote sensing techniques, data compression techniques, case studies, and U.S. national policy. Applications and case studies include environmental, homeland security, medical, military, disaster mitigation, agricultural, and transportation. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May not be repeated for credit.

Recommended Prerequisite: Permission of instructor.

Registration Restrictions:

Enrollment is limited to Graduate level students.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

900 Level Courses

GGS 900: *Geography and Geoinformation Science Colloquium*. 1 credit. Presentations in specific research areas of Geography and Geoinformation sciences by faculty and staff, Mason faculty in related programs, and professional visitors. Notes: Maximum 3 credits may be applied to Earth systems and geoinformation sciences PhD. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May be repeated within the degree for a maximum 3 credits.

Registration Restrictions:

Enrollment is limited to Graduate level students.

Schedule Type: Seminar

Grading:

This course is graded on the Graduate Regular scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 998: *Dissertation Proposal*. 1-12 credits.

Covers development of research proposal that forms basis for doctoral dissertation, under guidance of dissertation director and doctoral committee. Notes: May be repeated, but no more than 12 credits of GGS 998 may satisfy doctoral degree requirements. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May be repeated within the degree for a maximum 12 credits.

Recommended Prerequisite: Doctoral student or permission of instructor.

Registration Restrictions:

Enrollment is limited to Graduate level students.

Schedule Type: Dissertation

Grading:

This course is graded on the Satisfactory/No Credit scale. (<http://catalog.gmu.edu/policies/academic/grading/>)

GGS 999: *Dissertation*. 1-12 credits.

Doctoral dissertation research under direction of dissertation advisor. Notes: May be repeated, but no more than total 24 credits in GGS 998 and 999 may be applied to doctoral degree. Offered by Geography/Geoinformation Sci (<http://catalog.gmu.edu/colleges-schools/science/geography-geoinformation-science/>). May be repeated within the degree for a maximum 24 credits.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy.

Enrollment is limited to Graduate level students.

Schedule Type: Dissertation

Grading:

This course is graded on the Satisfactory/No Credit scale. (<http://catalog.gmu.edu/policies/academic/grading/>)