Graduate Courses
Geology / Hydrology / Earth Science
UNC Charlotte

In order to inform prospective M.S. Earth Science students as to what graduate-level courses are offered across the broad disciplines of geology, hydrology, and earth sciences at UNC Charlotte, here is a list of relevant courses that *have been offered in the past five years* and thus will likely be offered in future years (but not necessarily every year). Also, students may wish to consult the course lists for meteorology and atmospheric science – as these courses are available, count toward the degree, and are encouraged for those students searching for a more interdisciplinary education. Course descriptions are provided on the subsequent pages.

Fall Courses:

ESCI 5000 Biogeography (3 credits)
ESCI 5000 Soil and Groundwater Remediation (3)
ESCI 5000 Coastal Sedimentary Environments (3)
ESCI 5140 Hydrologic Processes (4)
ESCI 5170 Fundamentals of Remote Sensing (4)
ESCI 5210 Soil Science (4)
ESCI 5233 Geo-environmental Site Characterization (4)
ESCI 6000 Advanced Sedimentology (3)
ESCI 6000 Energy and Climate Change (3)
ESCI 6900 Earth Sciences Research (1-9)

GEOL 5105 Geomorphology (3)
GEOL 5130 Optical Mineralogy (4)
GEOL 5140 Coastal Geology (3)
GEOL 5145 Hydrogeology (4)
GEOL 5185 Mineralogy, Economics, & Environment (3)
GEOL 5175 Geochemistry (4)
GEOL 6101 Geodynamics (3)

GEOG 5120 Introduction to GIS (4)
GEOG 6100 Quantitative Analysis in Geography (3)
GEOG 6131 Research Design Fundamentals (3)

INES 8101 Environmental Systems (3)
INES 8110 Acquisition & Analysis of Scientific Data (3)

Spring Courses:

ESCI 5150 Applied Climatology (3)
ESCI 5155 Fluvial Processes (4)
ESCI 5180 Advanced Remote Sensing (4)
ESCI 5222 Watershed Science (3)
ESCI 6000 Geology for Educators (3)
ESCI 6000 Paleoclimatology (3)
ESCI 6000 Environmental Remote Sensing (3)
ESCI 6105 Landscape Assessment (4)
ESCI 6202 Biogeochemical Cycles (3)
ESCI 6900 Earth Sciences Research (1-9)

GEOL 5000 Geoforensics (3)
GEOL 5100 Igneous, Metamorphic Petrology (4)
GEOL 5110 Stratigraphy (4)
GEOL 5115 Applied Geophysics (4)
GEOL 5120 Geologic Mapping Interpretation (4)
GEOL 5135 Tectonics (4)
GEOL 5410 Applied Soil Science (4)
GEOL 6102 Paleo-environments (3)

GEOG 5000 Urban Ecology (3)
GEOG 5000 Landscape Ecology (3)
GEOG 5130 Advanced GIS (4)
GEOG 5131 Environmental Modeling & GIS (4)
GEOG 6120 Spatial Statistics (3)

INES 8102 Infrastructure Systems (3)

Course Descriptions:

Earth Science

ESCI 5000 Biogeography (3): An exploration of biodiversity in space and time. The course will focus on the distribution and abundance of species on Earth, but also the reasons for these geo-temporal patterns. Additional time will be devoted to examining paleo-geographic data and considering species distributions and their relationship to plate tectonics.

ESCI 5000 Soil and Groundwater Remediation (3): This course will concentrate on in-situ regolith and ground-water remediation design, fabrication, installation, and operation and maintenance in both the unsaturated and saturated subsurface zones. A wide range of geologic disciplines will be drawn upon to analyze both active and passive remediation systems. The criteria for analysis of remediation systems will be objectives of remediation, contaminant compatibility, economics, liability, operation and maintenance, stage of development, installation/site requirements, limitations, abilities, and field/pilot test evaluation.

ESCI 5000 Coastal Sedimentary Environments (3): A focus on waves, tides, currents and Holocene sea-level change and how they influence shoreline morpho-dynamics. Studies include problems and potential solutions arising from anthropogenic development of retreating shorelines and coastal management practices. This course will also investigate modern shallow-water clastic depositional environments and their sediments with an emphasis on the barrier islands, estuaries, and wetlands of the southeastern Atlantic coast.

ESCI 5140 Hydrologic Processes (4): Atmospheric, soils and geologic aspects of surface and ground water processes.

ESCI 5150 Applied Climatology (3): Methods of acquiring and analyzing climactic data in various types of applied problems. Emphasis will be on methods to assess and reduce the impact of weather and climate upon human activities.

ESCI 5155 Fluvial Processes (4): Hydrologic and geomorphic study of the transport of water and earth materials within stream systems. Erosion, mass wasting, open channel flow, sediment transport, flooding, stream channel morphology, evolution of drainage basins, and related topics.

ESCI 5170 Fundamentals of Remote Sensing (4): Physical fundamentals of remote sensing and overview of airborne and satellite systems operating in the visible, infrared, and radar regions, and a review of applications for resource exploration, environmental studies, land use and land cover analysis, and natural hazards.

ESCI 5180 Advanced Remote Sensing (4): Scientific and computational foundations of remote sensing techniques for extracting earth resource information from remotely-sensed data.

ESCI 5210 Soil Science (4): Study of soils, soil-forming processes and soil morphology with an emphasis on soils as they relate to geologic landscapes and surficial processes. Students will learn how to describe and interpret soils in the field.

ESCI 5222 Watershed Science (3): Examination of the cycling of water and chemical elements in natural and perturbed watersheds with emphasis on linkages between the hydrologic and biogeochemical processes which control runoff water quality. Topics include runoff processes, evapo-transpiration, nutrient export and stream, riparian and hyporheic zone dynamics.

ESCI 6000 Energy and Climate Change (3): Explores the complex relationship between energy and climate change. Examines how different energy sources and energy production are linked to climate change, and their economic, social, and environmental impacts. Explores tradition energy sources (e.g., coal, oil, natural gas, nuclear) as well as renewable energy sources (e.g., wind, solar, tidal, hydro-electric, biomass, geothermal).

ESCI 5233 Geoenvironmental Site Characterization (4): Advanced field-based examination of hydrologic and geologic conditions in the southeastern United States within the context of current state and federal regulatory requirements and site characterization activities currently performed by professional environmental geoscientists. Topics include hydrologic investigation and water quality characterization, and geological and geophysical site investigations.

ESCI 6000 Advanced Sedimentology (3): Detailed examination of sedimentary rock features and compositions as related to origin, dispersion, deposition, diagenesis, classification and general distribution of sedimentary materials.

ESCI 6000 Environmental Remote Sensing (3): Overview of environmental remote sensing fundamentals, image processing, and GIS software, appropriate literature, and field methodologies. Students will conduct regional environmental mapping projects using these tools.

ESCI 6000 Geology for Educators (3): This course provides an integrated overview and introduction to geology for geoscience educators. The course is intended for distance education students – although qualifying students in other areas of geosciences education are welcome. In addition to core science concepts, this course has a complementary pedagogical component.

ESCI 6000 Paleoclimatology (3): Current working hypotheses and research methods are reviewed for the study of paleo-climates. The interrelationships of tectonics, paleogeography, biogeography, and orbital climate forcing, as represented in the geologic record, are discussed and reviewed in light of modern concerns for climate change.

ESCI 6105 Landscape Assessment (4): An advanced geomorphology course that examines current climatic and/or tectonic geomorphology research topics and methods with a focus on regional or disciplinary issues that will vary each offering. Using a variety of field-based quantitative and qualitative techniques such as laser surveys, GPS, trenching and/or coring, students will devise and implement a research project that includes two separate field sites.

ESCI 6202 Earth Systems Analysis – Biogeochemical Cycles (3): This course examines the Earth's water and major elemental cycles including those of carbon, nitrogen, sulfur, phosphorus and the major crustal elements. Special emphasis is placed on how these cycles are currently being modified through human activities.

ESCI 6900 Earth Sciences Research (1-9): Students will complete hypothesis or problem-driven research that will include formulation, implementation, analysis and presentation components.

Geology

GEOL 5000 Geoforensics (3): Application of geological methods and procedures to forensic investigations, including geological, environmental, geotechnical, and archaeological sites and problems. Remote sensing tools used include ground penetrating radar and magnetics for near-surface and sub-surface, non-destructive observations. Other geophysical methods including geochemical analyses of earth materials at a crime scene will be discussed.

GEOL 5100 Igneous and Metamorphic Petrology (4): Classification, mineralogy and chemical properties of igneous and metamorphic rocks including the tectonic processes by which they formed. Lab emphasizes hand specimen and petrographic description and interpretation of rocks in thin sections.

GEOL 5105 Geomorphology (3): Surficial processes and landform development as controlled by climate, tectonics, rock characteristics and time with emphasis on plate tectonic, weathering, erosion, mass wasting, surface water, groundwater, glacial, wind coastal processes and climate change in landscape development.

GEOL 5110 Stratigraphy (4): Vertical and horizontal relationships of layered earth materials as a key to understanding basin history, past depositional environments and their transformation through time.

GEOL 5115 Applied Geophysics (4): Instrumental analysis of the earth's physical parameters - study of human-induced seismic and electrical signals, and natural magnetic / gravitational fields for the purposes of locating faults, ore bodies, ground water and other earth hazards or resources.

GEOL 5120 Geologic Mapping and Interpretation (4): Field and lab oriented study using principles of mineralogy, petrology and structural geology - involves collection and resolution of field data, techniques of presenting data, development of geologic maps, and critical reviews of existing literature.

GEOL 5130 Optical Mineralogy (4): Light optics theory, the behavior of plane polarized light in a solid medium. The laboratory emphasizes the use of petrographic microscope oil immersion techniques and identification of the common rock forming minerals.

GEOL 5135 Tectonics (4): A systematic examination of the evolution and dynamics of the earth from the perspective of plate tectonics theory.

GEOL 5140 Coastal Geology (3): Examination of coastal environments, sediments, and wave-related processes in the present and geologic past. Major topics considered include barrier-island and salt-marsh development, sea-level fluctuations, and the relationship between human development and natural hazards.

GEOL 5145 Hydrogeology (4): Fundamentals of groundwater hydrology, including the principles of flow and transport in groundwater aquifers and the vadose zone. Selected topics include: storage, compressibility, capillarity, Darcy's Law, aquifer parameters, steady and transient flow equations, well hydraulics, geological controls on groundwater flow, and transport of non-reactive chemical species by advection, diffusion and dispersion in porous media. A series of experiments and problems illustrating flow/transport in porous media with applied problems.

GEOL 5175 Geochemistry (4): Geochemical survey of origin, evolution and present composition of the earth. Lab focuses on analytical methods and sample preparation techniques used by geochemists.

GEOL 5185 Mineralogy, Economics and the Environment (3): This course will focus on the origin, distribution, and consumption rate of the Earth's mineral resources. This lecture-based course will promote an understanding of not only the geologic, engineering and economic factors that govern mineral production, but also the resulting environmental pollution problems.

GEOL 5410 Applied Soil Science (4): Students will read and discuss current literature pertaining to the application of soils to various fields of research such as surficial processes, active tectonics, ecology, stratigraphy, archaeology, and environmental assessment. Topics covered will vary depending on the interests of the students. Students will create and execute a semester-long soils-based field or laboratory research project of their choosing.

GEOL 6101 Earth Systems Analysis – Geodynamics (3): Current working hypotheses and research methods are reviewed for the study of crustal and lithospheric processes on time scales from the seismic cycle to the long-term geologic evolution of basins and mountain belts and on physical scales ranging from the fracture and flow of rock masses to regional deformation and mountain building.

GEOL 6102 Earth Systems Analysis – Paleo-environments (3): Current working hypotheses and research methods are reviewed for the study of paleo-environments. The interrelationships of tectonics, paleogeography, biogeography, and orbital climate forcing, as represented in the geologic record, are discussed and reviewed in light of modern concerns for climate change.

Geography

GEOG 5000 Urban Ecology (3): An introduction to the emerging field of urban ecology. This course will explore the biological, physical and social components of the urban ecosystem at local, regional and global scales. Emphasis is on the interplay among components and the sustainability of cities during lectures, field trips, and group discussions.

GEOG 5000 Landscape Ecology (3): An introduction to landscape ecology, the study of the effects of spatial pattern on ecological processes. Emphasis is on in-class group discussion.

GEOG 5120 Introduction to Geographic Information Systems (4): Development, current state-of-the-art and future trends in geographic information processing with emphasis on data gathering, storage, and retrieval, analytical capabilities and display technologies. A laboratory component will include development and completion of an applied GIS research project.

GEOG 5130 Advanced Geographic Information Systems (4): Advanced GIS study with emphasis on (1) advanced skills for database development and management; (2) spatial analysis and modeling; and (3) Macro language programming and user interface design.

GEOG 5131 Environmental Modeling with GIS (4): Theories and practices of modeling the environment with GIS. Topics include types of spatial modeling frameworks; GIS data sources and measurement technologies for environmental modeling; development, calibration, and validation of environmental models; 3-dimensional modeling and visualization of physical processes; and spatial analysis of human-environment interactions.

GEOG 6100 Quantitative Analysis in Geography (3): Topic areas include multiple regression, trend surface, factorial analysis, cluster analysis, discriminant analysis - emphasis on applied methods and skill development useful in geographic research.

GEOG 6120 Spatial Statistics (3): Statistical analysis of the spatial dimension of data. Topics include advanced aspects of spatial autocorrelation, global and local measures of spatial association, modifiable area unit problems, spatially weighted regression, and other spatial models - emphasis on applying methods and developing skills useful in empirical research.

GEOG 6131 Research Design Fundamentals (3): Scientific research and problem solving with emphasis on problem identification, bibliographic search, data sources and collection, techniques selection and preparation of reports and proposals.

Infrastructure and Environmental Systems

INES 8101 Environmental Systems (3): This course examines the principles of energy and mass transport as applied to the atmosphere, hydrosphere, lithosphere and the Earth's biogeochemical systems and how these impact human activities and infrastructure. Emerging environmental issues and technologies in the areas of environmental impact due to human activities and natural disasters, and environmental sustainability including industrial ecology, waste minimization and recycling, will also be examined.

INES 8102 Infrastructure Systems (3): Overview of urban infrastructural development. Sustainable design features for facilities including municipal, transit, industrial, agricultural, telecommunications, and waste management. Impact of infrastructure development on environmental management including storm water quality and quantity, soil and channel erosion, urban air quality, sprawl, and waste production, treatment, and storage.

INES 8110 Acquisition and Analysis of Scientific Data (3): The study of theories and techniques for acquiring and analyzing scientific data and information related to the analysis, design and management of the infrastructure and the environment. Includes pertinent aspects of data analysis such as statistical analysis, uncertainty, detection limits, correlation methods, trend analysis, and data management/warehousing. Includes applications of GIS and non-destructive assessment technologies to data acquisition.