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**EES Earth and Environmental Sciences**

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**EES 110 ENDANGERED PLANET: AN INTRODUCTION TO ENVIRONMENTAL GEOLOGY. (3)**

An introductory course that applies basic geological concepts to current environmental issues including the availability and use of water and soil resources, pollution causes, effects and solutions, and causes and prediction of environmental hazards including floods, landslides, subsidence, earthquakes and volcanoes.

**EES 120 SUSTAINABLE PLANET: THE GEOLOGY OF NATURAL RESOURCES. (3)**

An introduction to the geologic and societal controls that govern the distribution and cost of using geologic resources: minerals, soils, and energy and industrial materials. Topics include the geological processes responsible for forming these resources, controls on their distribution, quality and abundance, economic factors that drive their recovery, and the legal/political arena in which we attempt to utilize them.

**EES 130 DINOSAURS AND DISASTERS. (3)**

More than 65 million years ago, dinosaurs and their kin dominated the earth and relegated our mammalian ancestors to positions of unimportance for nearly 155 million years. This course traces the history of dinosaurs from early vertebrate ancestors to their final extinction and surveys the evolutionary, paleogeographic, environmental, and possible extraterrestrial causes for the rise to dominance and sudden fall. Along the way and afterwards, dinosaur interactions with other organisms and the environment, as well as their indirect influence on mammals, particularly on the much later evolution of humankind, will be examined.

**EES 150 EARTHQUAKES AND VOLCANOES. (3)**

An introduction to earthquakes and volcanoes through theory, active learning assignments, and case studies. Using the basic principles of plate tectonics, students will learn why, where and how earthquakes and volcanoes occur. The hazards associated with earthquakes and volcanic eruptions will be discussed, as well as their societal implications in both the United States and developing world. Earthquake and volcanic hazard mitigation techniques will be addressed. In addition, earthquake hazards in the central United States will be discussed.

**EES 151 QUANTITATIVE PLANET. (3)**

A basic problem solving approach to quantifying and predicting how Earth changes through time. Involves application of math skills of sufficient level for UK admission. Satisfies the UK Core Quantitative Foundations requirement; no prerequisites.

**EES 155 EARTHQUAKES AND QUANTITATIVE REASONING. (3)**

Earthquake phenomena will be introduced in a manner that will allow students to learn why, where, and how earthquakes occur using elements of fundamental topics in algebra and trigonometry. These quantitative foundations will be used to investigate the origins and hazards associated with earthquakes, as well as their societal implications in both the United States and developing world. Students will often work in small groups to increase confidence in orally communicating their quantitative thinking and defending their logic, as well as providing an opportunity to consider alternative problem solving strategies.

**EES 160 GEOLOGY FOR TEACHERS. (3)**

The basic principles of geologic processes, materials, and history with primary emphasis on inquiry-based laboratory and field activities. The course is designed in conjunction with PHY 160 to provide basic concepts of earth science, astronomy and physics appropriate for elementary and middle school teachers. Both courses are taught with an emphasis on inquiry-based, laboratory activities. Lecture, two hours per week; laboratory, three hours per week. Not available for credit to students who have received credit for EES 220.

**EES 170 BLUE PLANET: INTRODUCTION TO OCEANOGRAPHY. (3)**

Survey of oceanography, including the geologic evolution of the ocean floor; composition and dynamics of ocean water; interaction of lithosphere with hydrosphere; ocean-atmosphere interaction and oceanic controls on climate dynamics; marine life and ecosystems; impact of human activity on marine ecosystems.

**EES 180 GEOLOGY OF THE NATIONAL PARKS. (3)**

The American system of national parks and monuments provides a natural and exciting basis for learning about geology, the scientific study of the Earth. These spectacular, diverse natural classrooms will be used to uncover the origin and variety of Earth materials, probe the dynamic processes that have produced and continue to modify internal and surficial environments over geologic time, critically examine the effects of changing patterns of land use on the natural environment, and recount the conservation efforts that have preserved these unique natural environments for future generations. The course includes a required, two-day (Saturday-Sunday) field trip to Mammoth Cave National Park.

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### **EES 185 QUANTIFYING THE BLUEGRASS WATER SUPPLY. (3)**

This course develops the ability to locate and identify data, critically evaluate the data, develop probabilistic models, and present the results of their research. Geology provides important information on the origins of natural resources and the amounts available for exploitation and use. Course focuses on the issues surrounding the water supply and demand in the central Kentucky Bluegrass region, and the impact of global climate change.

### **EES 220 PRINCIPLES OF PHYSICAL GEOLOGY. (4)**

How the Earth Works: an integrated course in physical geology, covering the physical, chemical and biological processes that combine to produce geological processes. Attention is focused on plate tectonics, earth surface processes, and properties and formation of earth materials. Lab exercises emphasize identification and interpretation of geologic materials and maps. Lecture/Discussion, three hours per week; laboratory, three hours per week.

### **EES 230 FUNDAMENTALS OF GEOLOGY I. (3)**

Field and laboratory methods for identification and description of rocks and minerals with emphasis on sedimentary rocks and rock-forming minerals. Field study of geologic structures. Interpretation of geologic maps. Laboratory, three hours per week. Eight days in the field. Prereq: EES 220.

### **\*EES 235 FUNDAMENTALS OF GEOLOGY II. (3)**

Modern techniques for displaying and interpreting surface and subsurface data. GIS-based field data collection and geologic mapping. Introduction to Appalachian tectonics. Laboratory, three hours per week. Four days in the field. This course is a Graduation Composition and Communication Requirement (GCCR) course in certain programs, and hence is not likely to be eligible for automatic transfer credit to UK. Prereq: EES 220 and 230.

### **EES 295 GEOSCIENCE ORIENTATION. (1)**

Survey of geoscience disciplines and post-baccalaureate career options for Geology majors. Introduction to the range of geoscience research approaches and means of dissemination of geoscience information. Guest speakers from industry, government, and academia will discuss career issues specific to geology, including consideration of appropriate educational preparation for potential career paths. Pass/Fail only. Prereq: EES 220 and sophomore standing.

### **EES 310 EXPLORATIONS OF THE SOLAR SYSTEM. (3)**

Fundamental and current topics in the space exploration of our solar system. Topics and examples of themes include: What is a planet; critical evaluation of the evidence for the heliocentric system; electromagnetic waves; the threat of asteroid impact; critical evaluation of the possibilities of extra-terrestrial life; critical evaluation of the evidence for climate change; and other topical items based on the results of on-going space missions. Prereq: Any two university science/math courses or completion of one and concurrent enrollment in another.

### **EES 323 FIELD WORK IN REGIONAL GEOLOGY. (6)**

Geologic mapping in the field for a six-week period. Description, measurement, and mapping of a wide variety of rocks and structures, and analysis of geologic events in mountainous regions of the Rockies or Appalachians. Includes practice in writing geologic field reports. Offered only during the summer session. At least 40 hours of field-related work per week. Special fee. Prereq: EES 230 and EES 235.

### **EES 341 LANDFORMS. (3)**

A study of the origin and distribution of landforms. Lecture, three hours per week. (Same as GEO 351.)

### **EES 345 PALEOCLIMATOLOGY: THE SCIENCE. (3)**

This course focuses on the science behind our understanding of how our planet's climate has changed over time, in particular from 100 million years ago to the present. The most significant processes, astronomical, geological, oceanographic, and atmospheric, are examined with an emphasis on the broad scales of time and space over which they operate, and drive climatic change. Proxy data records are defined in the context of how they record climatic data, and how we "read" them to learn the climatic history they store. Finally, the course brings us into the historical age, where data stores on climate change are the most diverse, but shortest in duration. The ultimate goal is for students to understand how we know what we know about Earth's past climatic changes, so that we can formulate informed strategies moving forward to mitigate our own species' impact on global climate.

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- EES 350 REGIONAL HISTORICAL GEOLOGY. (3)**  
Integration of basic rock types, geologic structures, geomorphology, and natural resources in the context of geologic history of the major regions of North America. Global plate tectonics as a framework for evolution of the North American continent. Prereq: EES 230.
- \*EES 360 MINERALOGY. (4)**  
The study of mineral structure and composition, and mineral classification through crystallographic and crystal chemical techniques. Laboratory work includes study of minerals via crystallography, X-ray diffraction, mineral chemical analysis, and optical petrographic techniques. Lecture, three hours per week; laboratory, three hours per week. Prereq: CHE 105 and EES 220.
- EES 385 HYDROLOGY AND WATER RESOURCES. (3)**  
The occurrence, movement, and quality of fresh water in the water cycle, including environmental problems and possible solutions. Case studies are explored through readings, videos, and required field trips. Prereq: EES 220.
- EES 395 SPECIAL PROBLEMS IN GEOLOGY. (1-3)**  
Individual work on a special problem in geology. Report required. May be repeated to a maximum of six credits. Prereq: Consent of instructor.
- EES 399 WORK EXPERIENCE IN GEOLOGICAL SCIENCES. (1-6)**  
Professional-level, pre-planned learning experience in geological sciences in the work place under the supervision of a faculty member. The student will complete work of the type done by professional geoscientists in the same setting. May be repeated to a maximum of six credits. Pass/fail only. Prereq: Approval of learning contract by faculty supervisor, director of undergraduate studies, and department chair.
- EES 401G INVERTEBRATE PALEOBIOLOGY AND EVOLUTION. (3)**  
Basic ecologic and evolutionary framework of common fossil invertebrate taxa. Major principles of paleontology, ecology, systematics, and evolution; and the use of fossils in paleoecology and biostratigraphy. Laboratory work in classification of common fossils. Lecture, two hours; laboratory, three hours per week. Prereq: EES 102/112.
- EES 420G STRUCTURAL GEOLOGY. (4)**  
An introduction to earth structures. Advanced geologic map interpretation. Prereq: EES 230.
- EES 450G SEDIMENTARY GEOLOGY. (4)**  
Basic principles and concepts of stratigraphy and sedimentation. Lithologic correlation and the interpretation of geologic history and paleogeography. Field and laboratory analysis of sedimentary rocks including megascopic and microscopic methods. Lecture, three hours per week; laboratory, three hours per week. Prereq: EES 230 and EES 360.
- EES 461 IGNEOUS AND METAMORPHIC PETROLOGY. (4)**  
Classification and origins of the common igneous and metamorphic rocks. Lecture material will emphasize the mineralogical, chemical, and physical equilibria within the earth. Laboratory topics will stress hand-specimen and microscopic petrography. Lecture, three hours; laboratory, three hours per week. Prereq: EES 230 and 235 and EES 360. This course is a Graduation Composition and Communication Requirement (GCCR) course in certain programs, and hence is not likely to be eligible for automatic transfer credit to UK.
- EES 480 ADVANCED TOPICS IN GEOLOGICAL SCIENCES (Subtitle Required). (1-6)**  
Advanced topical course in the geological sciences. May be repeated to a maximum of six credits under different subtitles. Prereq: Consent of instructor.
- EES 490 EARTH DYNAMICS. (3)**  
Basic planetary changes through geological time, including continental drift, formation of supercontinents, paleoclimate, and the growth of the earth's crust. Students will be required to take the Fundamentals component of the ASBOG professional geologist certification exam (fee required). Prereq: Senior standing with at least 30 credits in a Geological Sciences curriculum.
- EES 511 PETROLEUM GEOLOGY. (3)**  
Survey of the origin, chemical composition, occurrence in the context of stratigraphy, structure, and reservoir types of natural hydrocarbons; exploration methods and production techniques; environmental impacts of exploration and production. Prereq: EES 450G, EES 420G, or equivalent, or consent of instructor.

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- \*EES 530 LOW TEMPERATURE GEOCHEMISTRY. (3)**  
An introduction to sedimentary and environmental geochemistry, including carbonate equilibria, redox chemistry, acid-base reactions, and kinetics. These examples will be considered in the context of geologic and environmental topics including acid mine drainage, groundwater, chemical oceanography, and changes across earth history.
- EES 550 FUNDAMENTAL GEOPHYSICS. (3)**  
Survey of active geophysical measurements and passive geophysical observations and their relation to Earth's structure and composition. Investigation of the relationship between Earth's elastic, potentiometric, and thermodynamic properties and traditional geophysical methods for measurement (e.g., gravity, magnetics, seismic, and heat flow). Material will help students improve their quantitative problem-solving abilities, but will also emphasize the visual learning skills commonly developed in the broader geology curricula. Prereq: MA 113, PHY 211 or 213, or consent of instructor. (MA 114 suggested).
- EES 555 STRATIGRAPHY. (3)**  
Principles of stratigraphy, depositional systems, sequence stratigraphy, and tectonic framework of sedimentation. Prereq: EES 450G.
- EES 560 GEOPHYSICAL FIELD METHODS. (4)**  
An introduction to the principles and applications of geophysics in the field. The course will present the geophysical methods used to assess the configuration and physical properties of the Earth's subsurface, as well as to explore for natural resources. Designed for geology students (upper-division or first-year graduate) and other science or engineering students without prior formal instruction in geophysics. To understand the discussions and exercises, the student should be familiar with first-year calculus and physics. Prereq: MA 113, 114; PHY 211, 213 or PHY 231, 232 or consent of instructor. MA 114, PHY 213 or PHY 232 may be taken concurrently.
- EES 570 SEMINAR IN GEOLOGICAL SCIENCES (Subtitle required). (1)**  
A general seminar in a broad range of topics in the geological sciences. May be repeated to a maximum of six credits under different subtitles. Prereq: Senior or graduate standing in Geological Sciences.
- EES 585 HYDROGEOLOGY. (3)**  
A study of the physical aspects of groundwater, including regional flow, well hydraulics, and computer simulation. Prereq: EES 220 and MA 113 or 123.
- EES 610 TOPICS IN HYDROGEOLOGY AND SURFICIAL PROCESSES (Subtitle required). (3)**  
Study of topics in hydrogeology and surficial processes. Recent topics include: models of surface processes; contaminant hydrogeology; modeling in hydrogeology. May be repeated to a maximum of nine credits under different subtitles. Prereq: Consent of instructor.
- EES 620 TECTONICS. (3)**  
A study of the structural features of the earth's crust with an analysis of the mechanics involved. Prereq: PHY 211, 213; EES 420G.
- EES 624 ADVANCED STRUCTURAL GEOLOGY. (3)**  
An advanced study of the theory, principles, and application of structural geology. Prereq: EES 420G.
- EES 625 TOPICS IN GEOPHYSICS. (3)**  
Special topics in geophysics such as advanced seismology, seismic processing, seismic stratigraphy, earthquake seismology, geologic hazards, gravity fields, magnetic fields, heat flow, geodynamics, planetary geophysics, quantitative methods, inverse methods, geophysical modeling. May be repeated to a maximum of nine credits under different subtitles. Prereq: Consent of instructor.
- EES 626 GRAVITY AND MAGNETIC METHODS. (3)**  
Theory and practice of the gravity and magnetic methods of geophysical exploration as applied to geological, archeological, environmental, and planetary exploration problems. The course includes principles of instrumentation, surveying, reduction of anomalies, and their interpretation. Prereq: MA 113, MA 114; PHY 211 and PHY 213 or PHY 231 and PHY 232; or consent of instructor. MA 114 and PHY 213 or 232 may be taken concurrently.
- #EES 630 STABLE ISOTOPES IN THE ENVIRONMENT. (3)**  
An overview of stable isotope systematics and applications related to environmental applications. Key topics covered include trophic ecology, nutrient cycling, carbonate chemistry, oceanography, petroleum geology, and hydrology.

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- EES 645 TOPICS IN PETROLOGY AND GEOCHEMISTRY (Subtitle required). (3)**  
Study of selected topics in petrology and geochemistry. Past topics include: Carbonate Petrology; Igneous Petrology; Organic Petrology; Isotope Geochemistry. May be repeated to a maximum of nine credits under different subtitles. Prereq: Consent of instructor.
- EES 652 TECTONICS AND STRATIGRAPHY. (3)**  
Use of stratigraphic data in the interpretation of tectonic framework of sedimentation, tectonic controls on paleogeography, and interactions between sedimentary rocks and geologic structures. Prereq: EES 420G and 450G or equivalent.
- #EES 665 MUD AND MUDSTONES. (3)**  
This course focuses on the geology and geochemistry of muds and mudstones. Lectures emphasize the generation of silt and clay, processes of transport and accumulation, muddy depositional environments, provenance techniques (inorganic geochemistry and mineralogy), organic geochemistry, and concepts/tools in basin analysis. An introduction to petroleum resource exploration in shale plays of the USA will be presented. An introduction to applied paleontology and paleoclimatology using deposits from muddy basins will also be presented.
- EES 670 EXPLORATION SEISMOLOGY. (3)**  
Advanced study of the acquisition, processing and interpretation of reflected and refracted seismic waves in layered media with applications to energy and geotechnical exploration. Prereq: EES 550 or EES 560 or consent of instructor.
- EES 675 EARTHQUAKE SEISMOLOGY. (3)**  
A study of the principles and methods of earthquake and engineering seismology. Specifically, the course will focus on the concepts of the seismic source, path, and site effects phenomena, as well as the practical aspects of seismic hazard assessment. Prereq: EES 550 or consent of instructor.
- EES 685 GROUNDWATER MODELING. (3)**  
This course teaches the basic concepts in groundwater modeling and provides basic exposure to standard modeling software. Prereq: EES 585 Hydrogeology; or consent of instructor.
- EES 695 SCIENTIFIC COMMUNICATION. (3)**  
A professional development course focused on scientific communication in the geosciences. Prereq: Graduate student in Geological Sciences or related field.
- EES 715 COAL GEOLOGY SEMINAR. (2)**  
Seminar discussion and presentation of current work in coal geology from current literature or ongoing research. May be repeated to a maximum of eight credits. Prereq: EES 515 or 617 or consent of instructor.
- EES 730 SEMINAR IN TECTONICS AND STRATIGRAPHY (Subtitle required). (3)**  
Seminar in Tectonics and Stratigraphy. Past topics include: Tectonics and Stratigraphy of the Appalachians; Tectonics and Sedimentation; Basin Analysis. May be repeated to a maximum of nine credits under different subtitles. Prereq: Consent of instructor.
- EES 735 TOPICS IN STRUCTURE AND TECTONICS. (3)**  
Seminar or new course offering in Structure and Tectonics. May be repeated to a maximum of nine credits under different subtitles. Prereq: Consent of instructor.
- EES 741 ENVIRONMENTAL CLAY MINERALOGY. (3)**  
A comprehensive study of the crystal structures of clay minerals commonly found in soils and sediments. Lecture and discussion, two hours; laboratory, three hours. Prereq: EES 360 or consent of instructor. (Same as PLS 741.)
- EES 748 MASTER'S THESIS RESEARCH. (0)**  
Half-time to full-time work on thesis. May be repeated to a maximum of six semesters. Prereq: All course work toward the degree must be completed.
- EES 749 DISSERTATION RESEARCH. (0)**  
Half-time to full-time work on dissertation. May be repeated to a maximum of six semesters. Prereq: Registration for two full-time semesters of 769 residence credit following the successful completion of the qualifying exams.

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- EES 767 DISSERTATION RESIDENCY CREDIT. (2)**  
Residency credit for dissertation research after the qualifying examination. Students may register for this course in the semester of the qualifying examination. A minimum of two semesters are required as well as continuous enrollment (Fall and Spring) until the dissertation is completed and defended.
- EES 768 RESIDENCE CREDIT FOR THE MASTER'S DEGREE. (1-6)**  
May be repeated to a maximum of 12 hours.
- EES 769 RESIDENCE CREDIT FOR THE DOCTOR'S DEGREE. (0-12)**  
May be repeated indefinitely.
- EES 782 INDIVIDUAL WORK IN GEOLOGY. (1-3)**  
Problems involving independent laboratory and/or library study conforming to the student's special interest under the direction of an appropriate staff member having proficiency in the area selected. May be repeated to a maximum of nine credits. Prereq: Geology major with graduate standing.
- EES 790 RESEARCH IN GEOLOGICAL SCIENCES. (0-6)**  
Research in the geological sciences. May be repeated to a maximum of twelve credits. Prereq: Approval of instructor and Director of Graduate Studies.