

# EARTH & ENVIRONMENTAL STUDIES (EAES)

## EAES 100 Principles of Geography (3 credits)

The course studies the major elements of the natural environment and their interrelation. The principles and processes essential to the understanding of the natural environmental system and their significance are stressed. The elements studied include: atmosphere, weather and climate, continents, landforms, river systems, ocean currents and tides, soils, vegetation, animal and marine life. Meets Gen Ed - Interdisciplinary Studies.

## EAES 101 Planet Earth (4 credits)

An introduction to the physical characteristics of planet earth. The focus is on processes and interactions of the four components of the earth system: atmosphere, hydrosphere, lithosphere and biosphere. An understanding of the human impact on earth systems is also developed and maintained in perspective. Satellite information, aerial photography, maps, charts and other Geographic Information Systems technologies are used to study planet earth in this course. Meets Gen Ed - Natural Science Laboratory.

## EAES 104 Natural Disasters (3 credits)

The study of natural disasters such as volcanic activity, earthquakes and hurricanes: the causes, effects and means of predicting, preventing and minimizing the effects of disasters will be discussed. The relationships between man and his sometimes hostile habitat will be included. Meets Gen Ed - Interdisciplinary Studies.

## EAES 105 Physical Geology (4 credits)

Materials of the earth; landforms and structures; the processes and agents responsible for their formation and modification. Modern tectonic concepts. Topographic and geologic maps. Required field trips. Not open to students who have had Principles of Geology. Meets Gen Ed - Natural Science Laboratory.

## EAES 106 The National Parks and their Geology (3 credits)

The National Parks and Monuments as regions of relatively undisturbed natural history. The minerals, fossils and rock formations which occur as well as the story of their formation. Specific parks and monuments will be studied in detail.

## EAES 107 Earth and the Environment (4 credits)

The study of the natural processes of the earth and the effects of human activities on the environment. Earth materials, processes and systems, and the engineering properties of natural materials will be discussed, as well as pollution of soil, water and air. Meets Gen Ed - Natural Science Laboratory.

## EAES 109 Freshman Seminar in Geoscience and Geography (1 credit)

This course introduces entering freshmen or transfer students to the University, the departments of the College of Science and Mathematics, the culture of higher education, and the field of geoscience and geography. Students learn about campus resources and activities, majors/careers in geoscience and geography, and techniques that foster the development of good study skills and academic success. Open to all MSU students.

## EAES 150 General Oceanography (3 credits)

A general study of the oceans and methods of modern oceanography including the physical, chemical, geological, and biological aspects of the oceans and their interrelationships. This course is designed for non-science majors. Meets Gen Ed - Interdisciplinary Studies.

## EAES 160 The Human Environment (3 credits)

An interdisciplinary course which explains the human impact, as social groups and individuals, on the natural environment. It explores the relationships and interconnectedness between natural processes and social, economic, cultural, technological, and political culture. Critical environmental issues are discussed. Meets Gen Ed - Social Science Perspectives.

## EAES 161 Human Geography (3 credits)

Human Geography presents the interaction of culture and environment. Variations in environment and culture result in great differences how culture is imprinted upon the environment. The role of politics, language, religion, economics, urban systems, and technology reveal the relative intensity with which culture roots in nature. Emphasis is upon culture as a force that shapes the human use of the earth.

## EAES 170 World Geography (3 credits)

World geography aims to present essential facts and concepts about the natural and human environment of major regions and countries.

The course presents a picture of regions as developed through the interactions of natural, cultural, economic and political forces. Geopolitical, social and economic relationships between and among countries are studied. Meets Gen Ed - Social Science Perspectives.

## EAES 200 Geomorphology (3 credits)

Prerequisite(s): EAES 100, EAES 101, EAES 105 or EAES 107. Major controls of climate and the landforms of North America are analyzed in order to gain an understanding of how the continent compares and is related to the rest of the world. The basis and distinct characteristics of the subdivisions of North America are examined in order to bring out contrasts and unique features within the continent. Required field trips.

## EAES 201 Understanding Weather and Climate (4 credits)

Prerequisite(s): GNED 199, WRIT 105 or HONP 100 may be taken as prerequisite or corequisite. Presents a basic understanding of the dynamic atmosphere and explores the impacts that weather and climate have on humans and the biosphere. Basic physical laws of energy and motion are employed to explain temperature, precipitation, atmospheric circulation, storms, and how climates vary regionally. Connections are made toward management of weather hazards, air pollution, impacts on agriculture and economy, and environmental and social implications of climate change. Lectures are supplemented by current events discussions and hands-on exercises in lab sections. Meets Gen Ed - Natural Science Lab.

## EAES 202 Introduction to Sustainability Science (3 credits)

Prerequisite(s): EAES 101 or EAES 105 or EAES 107; and EAES 160. Introduction to sustainability science and the challenges confronting society's transition to global sustainability; an investigation into the systems and processes basic to sustainability science; and the relationship of sustainability science to business, public policy, and the sciences. Meets the Graduation Writing Requirement for majors in Sustainability Science.

## EAES 204 Earth and Environmental Science Field Trip (1 credit)

Prerequisite(s): EAES 100, EAES 101, EAES 105, EAES 107 or departmental approval. An approximately one-week trip through areas of earth and environmental science significance. Trip timing and location will vary. Field trip report required. Expenses shared by the participants.

## EAES 210 Introduction to GIS and Remote Sensing (3 credits)

Prerequisite(s): CSIT 111, EAES 100, EAES 101, EAES 105, EAES 107, EAES 160, EAES 161 or EAES 170. Introduces the basic principles of Geographic Information Systems (GIS) and remote sensing. Focus on digital cartographic science, graphic design, spatial data and image portrayal and inquiry, map overlays, and applications.

**EAES 220 Mineralogy (4 credits)**

Prerequisite(s): EAES 101, EAES 105 or EAES 107. Introduction to the physical and optical properties, chemistry, structure, and significance of common rock-forming minerals. Applied analytical techniques include optical microscopy, x-ray diffraction (XRD), and scanning electron microscopy energy dispersive spectroscopy (SEMEDS). Required field trips.

**EAES 230 Hydrology (3 credits)**

Prerequisite(s): EAES 100, EAES 101, EAES 105 or EAES 107. Water, its availability, distribution and usefulness. Hydrologic cycle examined in detail. Interaction with man and his usage. Applications to models and systematic processes. Required field trips.

**EAES 240 Earth System History (4 credits)**

Prerequisite(s): EAES 101, EAES 105, EAES 107 or EAES 250. The earth systems through time; the evolution of continents, oceans, climate and life as interpreted from the rock and fossil record. Required field trips.

**EAES 250 Introduction to Marine Sciences (4 credits)**

Prerequisite(s): GNED 199, WRIT 105 or HONP 100 may be taken as prerequisite or corequisite. A general study of the marine sciences, including origin and evolution of the oceans, physical and chemical properties of seawater, marine life, oceanic circulation, atmospheric-ocean exchange and other processes that take place in the oceans. This course also deals with marine resources and human interaction with the marine environment. Field trips required. May be taught off-campus at the NJ Marine Sciences Consortium in the summer. Meets Gen Ed - Natural Science Laboratory. Mutually Exclusive with PHMS 250.

**EAES 260 Energy, Environment and Society (3 credits)**

Prerequisite(s): WRIT 105 or HONP 100. An introductory survey of present-day energy sources, the impact of their extraction and utilization on Earth's environment, and future options to meet the energy needs of society. Topics include basic principles of energy, carbon cycle, greenhouse effect, origin and production of fossil fuels, hydraulic fracturing ("fracking"), consequences of fossil fuel combustion, nuclear energy, renewable energy sources, energy efficiency, and conservation. Also considered are the impacts of the energy economy on international relations and the uneven distribution of the benefits and negative consequences of resource utilization. Meets Gen Ed - Interdisciplinary Studies.

**EAES 271 Geography of East and Southeast Asia (3 credits)**

Prerequisite(s): GNED 199, WRIT 105 or HONP 100 may be taken as prerequisite or corequisite. Regional analysis of East Asia (China and Japan) and Southeast Asia (Indonesia): (1) physical environments; (2) human landscape and their cultural heritages; (3) contemporary issues including economic development, political configurations, and environmental problems.

**EAES 272 Land and Life in Latin America (3 credits)**

Prerequisite(s): GNED 199, WRIT 105 or HONP 100 may be taken as prerequisite or corequisite. "Land and Life in Latin America" is a regional survey course that explores and explains the physical-human interface and the constantly changing environmental societal needs. The course focuses on the functional processes that mold contemporary states and regional realignments. Emphasis is upon environmental conservation, demographic transitions, the role of culture and politics to foster a viable ecumene. Meets World Cultures Requirement.

**EAES 280 Principles of Land Use (3 credits)**

Prerequisite(s): GNED 199, WRIT 105 or HONP 100 may be taken as prerequisite or corequisite. Geographical analysis of rural and urban land use patterns in the United States. Field work stresses mapping techniques and socio-economic aspects of urban land use in the New York-New Jersey metropolitan area.

**EAES 281 Introduction to American Urban Studies (3 credits)**

Prerequisite(s): GNED 199, WRIT 105 or HONP 100 may be taken as prerequisite or corequisite. An interdisciplinary introduction to the development of American cities and their suburbs, with an emphasis on current patterns of urbanism and urbanization. The growth and evolution of metropolitan systems, urban-suburban ecology, and planning responses to critical metropolitan issues. Meets World Cultures Requirement.

**EAES 283 Urban Geography (3 credits)**

Prerequisite(s): GNED 199, WRIT 105 or HONP 100 may be taken as prerequisite or corequisite. Principles of location, interaction in the socioeconomic spheres, and the increasing importance of sustainable environmental management are dominant themes. Close attention to socio-spatial conditions, especially the housing sector, are addressed, as well as the suburbanization process and the urban sprawl challenge to a viable long-term urban system. Assignments are structured to introduce students to professional presentations, both maps and graphics, and written analysis. Meets World Cultures Requirement.

**EAES 300 Energy Transitions: A Global Dependence (3 credits)**

Prerequisite(s): ECON 207, ECON 208, EAES 202, EAES 210, EAES 281, EAES 283 or departmental approval. This course assesses the interactions of shifting energy dependence and adaptive technologies to add energy sources to the current national energy matrices. Included in this analysis will be a discussion of the growing roster of accessible energy sources by type and environmental source and environmental limitations. History, economy, politics, and culture will be addressed to provide the social context to gauge the growing impact of energy dependence in the contemporary global system.

**EAES 301 Climatology (3 credits)**

Prerequisite(s): EAES 201. Basic climate elements examined in terms of their influence on habitats and various aspects of human activities. The energy flux between atmosphere and biosphere affords a fundamental understanding of limitations in ecosystems development. Knowledge and climatic influences on health, clothing, human comfort, architecture, commerce and industry encourages the student to investigate new ways of living rationally within a climatic environment.

**EAES 302 Structural Geology (3 credits)**

Prerequisite(s): EAES 200, EAES 220, EAES 230, EAES 240, or EAES 250. Recognition and interpretation of fundamental rock structures and deformation processes that relate to large-scale tectonic features (mountain belts, rift basins, strike-slip systems). Field and laboratory work emphasizes the analysis of faults, joints, folds, foliation, and ductile shear zones. Introduction to field mapping techniques. Required field trips.

**EAES 303 Environmental Field Methods (3 credits)**

Prerequisite(s): EAES 200, EAES 202, EAES 210, EAES 220, EAES 230, EAES 240, EAES 281, EAES 283 or departmental approval. Application of quantitative field data collection methods relevant to both the physical and human environment. Methods include topographic, hydrologic, and geophysical surveying using modern instrumentation (total station GPS, digital flow meters, GPR, shallow seismic, electrical resistivity, and magnetics). Field investigations focus on topics such as surface and groundwater flow, soil identification and profiling, and topographic and surficial geologic mapping. Emphasis on design of a field investigation, collection of data to address a specific problem, and interpretation and reporting of the results. Special fee.

**EAES 310 Geographic Information Systems (GIS) (3 credits)**

Prerequisite(s): EAES 210. This course deals with fundamental principles and applications of GIS. Various ways in which GIS can be used in planning and management analysis and research will be discussed. Students will learn the issues which need to be considered when planning and implementing GIS. One or two widely used software packages will be employed as a tool to study GIS applications.

**EAES 311 Fundamentals of Remote Sensing of Environment (3 credits)**

Prerequisite(s): EAES 210. Systematic study of multiband spectral reconnaissance of the environment; multifrequency radar systems and their uses.

**EAES 320 Igneous Metamorphic Petrology (4 credits)**

Prerequisite(s): EAES 220. Description, identification, classification, origin and occurrence of sedimentary, igneous and metamorphic rocks. Laboratory study of the common rocks. Required field trips. Meets the Graduation Writing Requirement for majors in Earth and Environmental Science.

**EAES 321 Economic Geology (3 credits)**

Prerequisite(s): EAES 220. Geology and geography of non-metallic and metallic mineral resources and fuels. Problems associated with their occurrence and exploitation. Required field trips. (Not given every year.)

**EAES 322 Environmental Geochemistry (3 credits)**

Prerequisite(s): EAES 220 or CHEM 230. Chemical principles and methods applied to the study of interactions among lithosphere, hydrosphere and atmosphere. Topics such as water pollution, waste disposal and human impact on global geochemical cycles will be discussed. The course will stress the measurement of chemical properties related to water and soil quality as well as computer modeling of chemical transport in porous media.

**EAES 330 Fluvial Geography (3 credits)**

Prerequisite(s): EAES 200 or EAES 230 or departmental approval. Detailed study of streams and rivers emphasizing processes causing variations of size and shape; the morphology of streams and stream channels; processes, quantitative techniques. Required field trips.

**EAES 331 Geohydrology (3 credits)**

Prerequisite(s): EAES 200, EAES 230 or EAES 240. The study of ground water with particular emphasis given to its mode of migration, chemistry and relation to the geographic environment. Particular attention is given to Darcy's law, soil porosity, soil permeability and the ability to withdraw water for human consumption. Water pollutants and salt water incursions are investigated. Spatial distributions are analyzed and the processes examined.

**EAES 332 Hydroclimatology (3 credits)**

Prerequisite(s): EAES 201, EAES 230 or EAES 301. Climatology emphasizing moisture as one of the fundamental factors in climatic analysis; processes and problems of classification and variability. Examines energy and water balance.

**EAES 337 Environmental Isotope Geochemistry (3 credits)**

Prerequisite(s): EAES 200 or EAES 201 or EAES 220 or EAES 230 or EAES 240 or EAES 250. This course examines isotopes as tools to study climate change, biogeochemical cycles, ecology, and Earth's environment. Labs provide hands-on opportunities for students to learn mass spectrometry, and isotopic data collection and interpretation. Stable isotopes include H, C, N, O and S are discussed as tools to study Earth's processes that are environmentally important, such as carbon cycle and paleoenvironment reconstructions.

**EAES 340 Sedimentology (4 credits)**

Prerequisite(s): EAES 200, EAES 220, EAES 230, EAES 240 and EAES 250. Geological processes and agents which form, transport, deposit, consolidate and alter sediments. Interpretation of the resultant sedimentary rocks. Laboratory work on the texture, mineralogy and mass properties of sedimentary particles. Required field trips. (Not offered every year.)

**EAES 341 Principles of Soil Science (3 credits)**

Prerequisite(s): ANTH 270, ANTH 360, ANTH 370, BIOL 213, CHEM 230, EAES 200, EAES 220, EAES 230 or EAES 240. Origin, composition, properties and classification of soils. Additional topics include water in soils and human impact on soil resources. Laboratory covers the measurement of soil properties and principles of soil mapping and soil resource assessment. Field trips are required.

**EAES 342 Invertebrate Paleobiology (4 credits)**

Prerequisite(s): EAES 240, BIOL 213 or BIMS 220. Invertebrate fossils—their classification, morphology, evolution, stratigraphic distribution and paleoecology. Required field trips.

**EAES 343 Geoarchaeology (3 credits)**

Prerequisite(s): ANTH 103 or HUMN 181 or EAES 100 or EAES 101 or EAES 105 or EAES 107, plus one of any of the following: EAES 200, EAES 220, EAES 240, EAES 340, EAES 341, ANTH 270, ANTH 370, HUMN 351, HUMN 361, HUMN 362, or departmental approval. This course explores the use of geological concepts and methods toward the solution of archaeological problems. Discusses earth materials and processes relevant to archaeology; evidence and timing of environmental change; human environmental impacts; field, lab, and spatial analytical techniques. Field trips expected.

**EAES 350 Oceanography (3 credits)**

Prerequisite(s): EAES 240, EAES 250, PHMS 250 or departmental approval. Study of the physical and chemical properties of sea water, oceanic circulation, waves and tides, and estuarine and shoreline processes. May be taught off-campus at the NJ Marine Sciences Consortium in the summer. Mutually Exclusive with PHMS 350.

**EAES 361 Environmental Policy (3 credits)**

Prerequisite(s): EAES 202, EAES 281, EAES 283, JUST 209, LAWS 200, JURI 210, POLS 201 or departmental approval. The course studies U.S. environmental policy in air, water, land use, agriculture, energy, and waste disposal and other areas. It examines the major ideas that shape environmental policy, the institutional processes by which these ideas are turned into policy, and how these policies affect both U.S. and global environments. Issues of international environmental policy will also be discussed.

**EAES 363 Geopolitics (3 credits)**

Prerequisite(s): EAES 202, EAES 210, EAES 281, EAES 283 or departmental approval. Main theories of the field and their application to selected political entities, current problem zones and the spatial interaction of nations.

**EAES 370 World Resources and Industries (3 credits)**

Prerequisite(s): ECON 207, ECON 208, EAES 202, EAES 210, EAES 281 or EAES 283 or departmental approval. Distribution, flow and consumption of mineral resources. Political, economic and social implications of the geography of resources. Basic studies in industrial location, agricultural land use, problems of economic development and population-resource ratios. Examines world trend in production controls and market allocations.

**EAES 371 Geography of Europe (3 credits)**

Prerequisite(s): EAES 202, EAES 210, EAES 281, EAES 283 or departmental approval. The modern European landscape created by the activities, over many centuries, by a variety of peoples of differing cultural backgrounds, economic systems and ideologies.

**EAES 373 Historical Geography of the United States (3 credits)**

Prerequisite(s): EAES 202, EAES 210, EAES 281, EAES 283 or departmental approval. The slow pace of settlement of the Eastern Seaboard and the development of distinctive culture hearths prior to 1800; the rapid settlement and diffusion of culture traits in the area beyond the Appalachians since 1800.

**EAES 376 Geography of New Jersey (3 credits)**

Prerequisite(s): EAES 202, EAES 210, EAES 281, EAES 283 or departmental approval. Demographic and economic organization of the State. Spatial contrasts in population density; suburban-central city interactions; the influence of New York and Philadelphia on landscape organization. Philosophical concepts of regionalism and investigation of micro-regionalism in New Jersey.

**EAES 377 Geography of Sub-Sahara Africa (3 credits)**

Prerequisite(s): EAES 202, EAES 210, EAES 281, EAES 283 or departmental approval. Topical and regional study of African soils, vegetation, climate, physiography, mineral resources and other aspects of the physical environment in the light of man's habitation of the continent.

**EAES 378 Geography of the Middle East (3 credits)**

Prerequisite(s): EAES 202, EAES 210, EAES 281, EAES 283 or departmental approval. Topical study of area extending from Morocco to Iran: arid land agriculture, nomadism, land tenure systems, settlement patterns, problems of industrial development, and socio-economic and military implications of region's oil wealth. Includes Arab culture and Islamic influences on urban and rural landscapes.

**EAES 380 Transportation (3 credits)**

Prerequisite(s): EAES 202, EAES 210, EAES 281 or EAES 283 or departmental approval. Transportation is the study of spatial interaction of economic factors and societal functioning. Transportation flows are analyzed in the context of technological change, degree of accessibility, different transport cost surfaces, and transportation as it relates to land use planning.

**EAES 381 Urban Field Studies (3 credits)**

Prerequisite(s): EAES 281 or EAES 283. Off-campus study of urban conditions in New York-New Jersey metropolitan area: housing, mass transportation, social pathologies, inner city economics and the role of planning. On-campus discussion sessions alternate with field trips. Meets World Cultures Requirement.

**EAES 384 Managing the Urban Environment (3 credits)**

Prerequisite(s): EAES 202, EAES 210, EAES 281, EAES 283 or departmental approval. An advanced interdisciplinary investigation of the modern city and its suburbs, emphasizing the impact of selected social, political and economic issues.

**EAES 385 Urbanization and Environment (3 credits)**

Prerequisite(s): EAES 202, EAES 210, EAES 281, EAES 283 or departmental approval. Examines interaction between man and the physical urban environment. Studies dynamic and physical processes as related to air, water and noise pollution, and hydrologic and geologic hazards.

**EAES 390 Research Methods (3 credits)**

Prerequisite(s): STAT 109 and EAES 210. The course introduces a widely used statistical package to analyze data. The application and interpretation of results of frequently used statistical techniques remains the primary focus. Survey research techniques are stressed. All the steps in the completion of a research project are emphasized. Meets the Graduation Writing Requirement for majors in Geography.

**EAES 391 Quantitative Methods in Geography and Urban Studies (3 credits)**

Prerequisite(s): STAT 109 and EAES 210. Treatment of measurements and design in geography; definition of problems, hypotheses formulation and tests of hypotheses by alternative methods of measurement. Geographic applications of computer methods, multi-variate analysis, systems analysis, data bank maintenance and evaluation. Meets the Graduation Writing Requirement for majors in Geography.

**EAES 401 Geo-Ecology (3 credits)**

Prerequisite(s): EAES 322, EAES 332, EAES 341, BIOL 370 or departmental approval. Spatial relations of the living environment. A systems approach to functional processes, characteristics and relationships of the ecological elements, i.e. soil, water, air, vegetation, etc. Both natural succession and human-induced changes including pollution, within the ecosystem.

**EAES 402 Sustainability Science Seminar (3 credits)**

Prerequisite(s): EAES 202, BIOL 213 and EAES 370. The course consists of a literature search and application of research tools and methodologies appropriate for completion of a project, paper, or internship in sustainability science.

**EAES 403 Meteorology (4 credits)**

Prerequisite(s): EAES 301 or departmental approval. The characteristics of the earth's atmosphere. Meteorological instruments, principles of atmospheric physics, weather patterns and measurements of changes within the atmosphere.

**EAES 404 Field Geology (6 credits)**

Prerequisite(s): EAES 302, EAES 320 and EAES 441; or departmental approval. Special fee. Application of geologic principles to field mapping and interpretation in the North Central Appalachians, Rocky Mountains, and/or regional geology of another designated area. Map production and writing field reports will be emphasized. This is an intensive summer field course.



**EAES 410 Special Topics in Advanced GIScience (3 credits)**

Prerequisite(s): EAES 310 or EAES 311. This course will allow students with demonstrated knowledge and skills in the geographic information sciences (GIS and/or Spatial Analysis) to expand on those skills by applying them to a particular geological or geographical issue. Students will work closely with faculty to select appropriate project(s) based on the student's interest and the professor's expertise. Depending on the project's scope and scale, the course will use current software such as ESRI's ArcGIS or ERDAS Imagine.

**EAES 419 Senior Seminar in Geographic Information Science (3 credits)**

Prerequisite(s): EAES 310, EAES 311, EAES 410 or departmental approval. Provides students with the tools and experience to develop and complete a research or problem-solving project in geographic information science. Students will produce a senior thesis or digital presentation portfolio.

**EAES 425 X-ray Microanalysis (3 credits)**

Prerequisite(s): EAES 320 or EAES 340 or EAES 341 or EAES 343 or CHEM 311 or PHYS 350 or BIOL 360 or ANTH 370 or department permission. Students will learn the theory and practical applications of energy dispersive x-ray spectroscopy, qualitative and quantitative chemical analysis of natural and synthetic materials, and x-ray mapping techniques.

**EAES 427 Organic Geochemistry (3 credits)**

Prerequisite(s): BIOL 351 or BIOL 350 or BIOL 370 or CHEM 310 or CHEM 320 or CHEM 370 or EAES 320 or EAES 322 or EAES 340 or EAES 341 or EAES 342. This is a basic course in organic geochemistry, covering the occurrence of natural and anthropogenic organic matter in sediments and sedimentary rocks, emphasizing fossil fuels and environmental contaminants.

**EAES 429 Industrial Hygiene (3 credits)**

Prerequisite(s): EAES 302 or EAES 303 or EAES 320 or EAES 322 or EAES 330 or EAES 331 or EAES 337 or EAES 340 or EAES 341 or EAES 427 or EAES 441 or CHEM 340 or CHEM 310 or BIOL 350 or BIOL 370 or departmental approval. Principles of Industrial Hygiene provides an introduction to the field of Occupational Health and emergency response operations. Focus on concepts, terminology, and methodology in the practice of Occupational Health (also known as Industrial Hygiene). Benefits those wishing to pursue a Master's degree in Industrial Hygiene or Public health; those interested in the Industrial Hygiene, environmental health or safety professional and/or emergency response career fields; and applicable to students in allied disciplines such as Environmental Sciences, Environmental Engineering, and Industrial Engineering. As part of successfully passing the Principles of Industrial Hygiene course, student have an opportunity to attain a 40-hour HAZWOPER certificate (US Department of Labor, Occupational Safety and Health Administration (OSHA) regulation 29 CFR 1910.120).

**EAES 430 Numerical Modeling of Earth Systems (3 credits)**

Prerequisite(s): Department permission. This course is intended for students with even little or no background in numerical modeling. Students will learn how to approach and set up modeling problems in a simple programming environment such as Python or Matlab. Some of the topics include ordinary differential equations, partial differential equations, and moving boundary problems. Additionally, this class will include a segment discussing and applying lessons from complex systems and nonlinear dynamics research to earth science modeling.

**EAES 432 Groundwater Modeling (4 credits)**

Prerequisite(s): EAES 331 or equivalent. Introduction to groundwater flow and contaminant transport modeling, using a variety of current software packages. Saturated and unsaturated media will be considered. Emphasis is on application of models to the solution of common problems encountered in hydrology industry and research.

**EAES 437 Paleoclimatology (3 credits)**

Prerequisite(s): EAES 301 or EAES 302 or EAES 311 or EAES 320 or EAES 322 or EAES 332 or EAES 340 or EAES 341 or EAES 350. This course surveys major climatic events in the Earth's history and examines published peer-reviewed literature to introduce the basic concepts of Paleoclimatology and the fundamental approaches to conduct paleoclimate research. This is an upper-division course consisting of two lecture periods per week and suitable for students who are pursuing their degree and career in Geosciences, climate science, and environmental science. The course will focus on paleoclimate topics that are of policy-relevance and public concern.

**EAES 441 Stratigraphy (4 credits)**

Prerequisite(s): EAES 220 and EAES 302 or EAES 340. The earth systems through time; the evolution of continents, oceans, climate and life as interpreted from the rock and fossil record. Required field trips.

**EAES 451 Coastal Marine Geology (4 credits)**

Prerequisite(s): EAES 340, EAES 350, PHMS 350, BIOL 351, EAES 441 or departmental approval. A study of the geologic processes concerned with the supra-, inter-, and sub-tidal areas of the near shore environment. Field studies will emphasize the dynamics of erosion and deposition as well as general sedimentation associated with modification of barrier beaches and other land forms of the New Jersey shoreline. Offered at the New Jersey Marine Sciences Consortium.

**EAES 455 Field Methods in Oceanography (2 credits)**

Prerequisite(s): EAES 350, PHMS 350, BIOL 351, EAES 451 or departmental approval. This course is intended to familiarize the student with the applications and techniques of marine samplings. The nature and role of equipment will be stressed. Field experience at the New Jersey Marine Sciences Consortium field station.

**EAES 460 Environmental Law (3 credits)**

Prerequisite(s): ANTH 360, EAES 300, EAES 302, EAES 310, EAES 320, EAES 322, EAES 341, EAES 361, EAES 370, EAES 390, JUST 314, JUST 330, LAWS 302, JURI 300, POLS 365 or departmental approval. The study of the National Environmental Policy Act; the Environmental Impact Statement; the Clean Air Act; the Clean Water Act; Toxic Substances Control Act; Solid and Hazardous Waste; related environmental laws, i.e. OS&H act; and litigation are analyzed. Aspects of environmental law, within which institutions and corporations must operate, are discussed. Equivalent courses ENVR 410 and EUGS 410 effective through Spring 2012.

**EAES 475 Environmental Economics (3 credits)**

Prerequisite(s): BIOL 213 or BSLW 235 or ECON 207 or ANTH 360 or EAES 300 or EAES 363 or EAES 370 or EAES 390 or JUST 314 or SOCI 314 or JUST 330 or POLS 365 or departmental approval. This course explores the economic foundations of environmental problems such as natural resource depletion, conservation, pollution control, climate change, energy and other contemporary problems. In particular, the course develops students' understanding of why resource and environmental problems have occurred from the economic point of view and what kind of economic tools can be used for informed decision-making and tackling of environmental problems.

**EAES 481 Problems in Urban Geography (3 credits)**

Prerequisite(s): EAES 363, EAES 380, EAES 385, EAES 390 or departmental approval. Seminar on the application of geographic concepts and theories to the analysis of urban problems. Field or library research projects by students on specific urban problems.

**EAES 484 Urban Planning (3 credits)**

Prerequisite(s): EAES 373, EAES 380, EAES 385 or departmental approval. The course focuses on the principles, processes, and practices of urban planning. The formulation of policies and the management roles of the planning agencies are emphasized.

**EAES 487 Senior Seminar in Urban Study (Urban Studies Internship) (3 credits)**

Prerequisite(s): EAES 390 or departmental approval. A seminar to be taken in conjunction with the urban studies semester internship, and designed as a synthesis of the various approaches in urban studies which the student has acquired in previous urban-related courses. Each semester the seminar focuses upon a specific in-the-field research project, and an analysis and evaluation of the student's internship experience.

**EAES 490 Independent Study in Geography (1-4 credits)**

Prerequisite(s): Departmental approval. Preparation of a research paper or project to be presented to members of the staff. May be repeated three times for a maximum of 10 credits as long as the topic is different.

**EAES 491 Internship (3-12 credits)**

Prerequisite(s): EAES 390 or departmental approval. A full semester internship in an urban or environmental agency. Students will be expected to carry out agency assignments, observe and participate in decision making processes and engage in middle management activities.

**EAES 492 Honors Research (3 credits)**

Prerequisite(s): EAES 390 or departmental approval. Provides original research experience to superior undergraduates.

**EAES 494 Independent Study in Geoscience (1-4 credits)**

Prerequisite(s): Departmental approval. An opportunity for the qualified student to do library and/or laboratory investigation in a field of science of his/her choice under the guidance of a faculty member. The course is conducted exclusively by scheduled individual conferences and reports. (Offered on demand.) May be repeated three times for a maximum of 10 credits.

**EAES 496 Special Topics in Earth and Environmental Studies Seminar (3 credits)**

Prerequisite(s): Departmental approval. Problem-oriented seminar. Specific topics in urban, environmental studies or geography. Content changes according to the needs of the instructor. May be taken three times for a total of nine credits.

**EAES 497 Senior Seminar Geography (3 credits)**

Prerequisite(s): EAES 390 or departmental approval. The course provides students with the tools and experience to develop and complete a geographic research project from start to finish. Students will be introduced to issues associated with becoming a professional geographer. Students will produce a senior thesis.

**EAES 498 Senior Seminar in Earth and Environmental Science (3 credits)**

Prerequisite(s): EAES 302, EAES 320, or departmental approval. Student field, laboratory and library investigation of a problem in the area of his/her interest in earth and environmental science; results presented in oral and written form. Class discussion of the individual papers and of other pertinent topics of current interest in earth and environmental science.

**EAES 499 Special Topics in Earth and Environmental Studies (1-4 credits)**

Prerequisite(s): Departmental approval. An in-depth study of a particular topic in geoscience, the specific subject matter of which is not offered regularly in an existing course. May be repeated three times for a maximum of 10 credits as long as the topic is different.

**EAES 505 Environmental Geoscience (3 credits)**

Restriction(s): Matriculation in a College of Science and Mathematics graduate program or departmental approval. In-depth study of the relationships between man and the physical environment of atmosphere, hydrosphere and lithosphere. Particular attention to problems of mineral resource and fossil-fuel depletion; pollution of air, water and soils and waste disposal and recycling, simple computer modeling of environmental situations.

**EAES 506 Introduction to Geographic Information Science and Remote Sensing (3 credits)**

Prerequisite(s): Departmental approval required. Introduction to GIS and Remote Sensing. Introduces the basic principles of Geographic Information Systems (GIS) and remote sensing. Focus on digital cartographic science, graphic design, spatial data and image portrayal and inquiry, map overlays, and applications.

**EAES 507 Tectonics (3 credits)**

Restriction(s): Matriculation in MS in Earth and Environmental Science program or departmental approval. The study of the major structures of the earth, the principle of isostasy, mountain-building, continental drift, sea-floor spreading, and possible causes of tectonism in the earth. Discussion will include the methods of study, results obtained, interpretation of the data, and the latest theories of tectonism.

**EAES 508 Field Geology (4 credits)**

Prerequisite(s): Equivalent of EAES 302; and EAES 320 or EAES 441 or departmental approval. Restriction(s): Matriculation in MS in Earth and Environmental Science. Not open to students who have taken EAES 404. Special fee. The principles and techniques of geologic field work. Independent and team mapping of local areas of geologic interest using modern field methods and instruments.

**EAES 509 Current Issues in Sustainability Science (3 credits)**

Restriction(s): Matriculation in a graduate program or departmental approval. Overview of current issues in sustainability science and the challenges confronting society's transition to global sustainability: sustainable use of natural resources; social learning; engaging scientists at the science-policy interface; and the application of systems science to better predict the consequences of human actions and forecast outcomes of the multiple interacting stresses on the life support systems around us.

**EAES 510 Geographic Information Systems (3 credits)**

Prerequisite(s): Equivalent of EAES 210 or departmental approval. Restriction(s): Matriculation in an Earth and Environmental Studies graduate program. Not open to students who have taken EAES 310. Provides graduate students who have finished any introductory GIS courses or equivalents an opportunity to advance both the practical skills and theoretical understanding of GIS. The course will focus on application of GIS to urban planning, locational analysis, public health, crime analysis, resource and land use management, transportation planning, environmental management etc. In the meantime, specific topics such as geovisualization, geographic database design, GIS modeling and management will be treated as an integrated part during the applications.

**EAES 511 Fundamentals of Remote Sensing of the Environment (3 credits)**

Prerequisite(s): Equivalent of EAES 210 or departmental approval.  
 Restriction(s): Matriculation in an Earth and Environmental Studies graduate program. Not open to students who have taken EAES 311. This course affords graduate students who have completed introductory courses or equivalents the opportunity to advance both practical skills in and theoretical understanding of remote sensing. The course covers a wide range of applications and promotes facility in image processing and visualization, integration with Geographic Information Systems, and spatial modeling techniques. Industry-standard software is used for demonstration and laboratory exercises. A semester project must be completed that demonstrates an application of remote sensing to a real-world environmental problem. Students are required to submit a term paper, an oral presentation, and a poster related to this project.

**EAES 512 Earth and Space Science for Middle Grade Teaching (4 credits)**

Restriction(s): Restricted to majors in Elementary School with Subject Matter Specialization: Science 5-8 or program coordinator approval. This course introduces students to the physical world and how humans and other organisms fit into that world. The events that lead to the Earth's present configuration, natural phenomenon and water resource questions will be discussed. Equivalent course SCIM 503 effective through Summer 2019.

**EAES 520 Advanced Mineralogy (3 credits)**

Prerequisite(s): Equivalent of EAES 220. Restriction(s): Matriculation in MS in Earth and Environmental Science. Chemical and physical principles as applied to minerals. Detailed study of representative minerals from the various families. Advanced techniques will be performed by the student. Field trips.

**EAES 521 Optical Mineralogy (4 credits)**

Prerequisite(s): Equivalent of EAES 220. Restriction(s): Matriculation in MS in Earth and Environmental Science. Theory and practice of using the polarizing microscope to study and identify minerals; theory of light transmission in minerals; the practical effect. Required field trips.

**EAES 522 Igneous Metamorphic Petrology (4 credits)**

Prerequisite(s): Equivalent of EAES 220. Restriction(s): Matriculation in MS Earth and Environmental Science. Not open to students who have taken EAES 320 or equivalent. Description, identification, classification, origin and occurrence of igneous and metamorphic rocks in order to interpret the geochemical and tectonic processes that form them. Laboratory study includes hand sample and thin-section analysis using the petrographic microscope as well as geochemical analysis using ICP-OES, ICP-MS, SEM-EDS, and/or XRD instrumentation. Required field trips.

**EAES 524 Igneous and Metamorphic Geology (4 credits)**

Prerequisite(s): Equivalent of EAES 220 and EAES 320 or departmental approval. Restriction(s): Matriculation in MS in Earth and Environmental Science. The interpretive study of igneous and metamorphic rocks in detail with the aim of properly identifying and naming the rocks and interpreting their history: rock suites from classical areas. Required field trips.

**EAES 525 X-ray Microanalysis (3 credits)**

Prerequisite(s): Equivalent of EAES 220, CHEM 410, PHYS 470 or departmental approval. Restriction(s): Matriculation in a College of Science and Mathematics graduate program. Students will learn energy dispersive spectroscopy, qualitative and quantitative chemical analysis, and x-ray mapping.

**EAES 526 Geochemistry (3 credits)**

Restriction(s): Matriculation in a College of Science and Mathematics graduate program or departmental approval. Chemical laws and principles applied to the earth, chemical composition of the earth, distribution and relative abundance of the elements. Radioactive materials, atmospheric precipitation of geochemicals, the geochemistry of polluted water (including solid and liquid wastes) study of meteorites.

**EAES 527 Organic Geochemistry (3 credits)**

Prerequisite(s): Equivalent of CHEM 230, EAES 322, EAES 441 or departmental approval. Restriction(s): Matriculation in a College of Science and Mathematics graduate program. Not open to students who have taken EAES 427. This is an introductory graduate course in organic geochemistry, covering the occurrence of natural and anthropogenic organic matter in sediments and sedimentary rocks, emphasizing fossil fuels and environmental contaminants.

**EAES 528 Environmental Forensics (3 credits)**

Prerequisite(s): Equivalent of EAES 427 or EAES 527 or departmental approval. Restriction(s): Matriculation in a College of Science and Mathematics graduate program. Environmental Forensics seeks to answer the questions: "How did environmental contamination occur?" and "Who/what caused it?" It involves the use of analytical (geo)chemistry, field geology and biology, remote sensing, integrated with law and policy. This course will focus primarily on the methods and applications of chemical fingerprinting, using petroleum biomarkers, polycyclic aromatic compounds, isotopes, and heavy metals.

**EAES 529 Instrumental Environmental Analysis (3 credits)**

Prerequisite(s): Equivalent of EAES 322, CHEM 410, EAES 526, EAES 527 or departmental approval. Restriction(s): Matriculation in a CSAM graduate program. A survey of instrumentation and methods for quantitative environmental analysis of inorganic earth materials (e.g., waters, soils, sediments). Hands-on analytical techniques will typically include, but are not limited to, pH and conductivity measurements, ion chromatography, UV-Vis and optical ICP spectrometry, ICP mass spectrometry, and SEM-EDS depending on expertise of the instructor(s).

**EAES 530 Numerical Modeling of Earth Systems (3 credits)**

Prerequisite(s): Departmental approval. This course is intended for students with even little or no background in numerical modeling. Students will learn how to approach and set up modeling problems in a simple programming environment such as Matlab. Some of the topics include ordinary differential equations, partial differential equations, and moving boundary problems. Additionally, this class will include a segment discussing and applying lessons from complex systems and nonlinear dynamics research to earth science modeling.

**EAES 531 Hydroclimatology (3 credits)**

Prerequisite(s): Equivalent of EAES 201, EAES 230, or EAES 301 or departmental approval. Restriction(s): Matriculation in an Earth and Environmental Studies graduate program. Not open to students who have taken EAES 332. Climatology emphasizing moisture as one of the fundamental factors in climatic analysis: processes and problems of classification and variability. Examines energy and water balance.

**EAES 532 Applied Groundwater Modeling (4 credits)**

Prerequisite(s): Equivalent of EAES 331; and AMAT 120 or MATH 122 or departmental approval. Restriction(s): Matriculation in a College of Science and Mathematics graduate program. Introduction to groundwater flow and contaminant transport modeling, using a variety of current software packages. Saturated and unsaturated media will be considered. Emphasis is on application of models to the solution of common problems encountered in hydrology industry and research.

**EAES 533 Water Resource Management (3 credits)**

Restriction(s): Matriculation in a College of Science and Mathematics graduate program or departmental approval. The spatial patterns of the water resource both as surface water and ground-water. Processes affecting availability and techniques of estimation are stressed.

**EAES 535 Geophysics (3 credits)**

Restriction(s): Matriculation in MS in Earth and Environmental Science program. Theory and application of conventional geophysical methods: seismology, magnetism, electricity and gravity. Laboratory includes the collection and interpretation of geophysical data. Field trips.

**EAES 537 Environmental Isotope Geochemistry (3 credits)**

This course examines isotopes as tools to study climate change, biogeochemical cycles, ecology, and Earth's environment. Labs provide hands-on opportunities for students to learn mass spectrometry, and isotopic data collection and interpretation. Stable isotopes include H, C, N, O and S are discussed as tools to study Earth's processes that are environmentally important, such as carbon cycle and paleoenvironment reconstructions.

**EAES 539 Principles of Soil Science (3 credits)**

Prerequisite(s): One introductory Earth Science course; May not be taken if student has already completed EAES 341; Departmental approval. Origin, composition, properties and classification of soils. Additional topics include water in soils, soil ecology, human impact on soils, soil resource management. Laboratory covers the measurement of soil properties and principles of soil mapping and soil resource assessment. Field trips are required.

**EAES 541 Stratigraphy (4 credits)**

Restriction(s): Matriculation in MS in Earth and Environmental Science program or departmental approval. Stratigraphic principles and their application. Case studies of selected regions. Local stratigraphy interpreted through field studies. Required field trips.

**EAES 544 Sedimentology (4 credits)**

Prerequisite(s): Introductory Earth Science course. Geological processes and agents which form, transport, deposit, consolidate and alter sediments. Interpretation of the resultant sedimentary rocks. Laboratory work on the texture, mineralogy and mass properties of sedimentary particles. Required field trips. (Not offered every year.) May not be taken after EAES 340.

**EAES 545 Paleocology (3 credits)**

Restriction(s): Matriculation in a CSAM graduate program or departmental approval. Distribution and association of fossils as interpreted from the evidence presented in the geologic record. Detailed paleoecological field study made of selected faunal assemblages.

**EAES 550 Advanced Marine Geology (3 credits)**

Restriction(s): Matriculation in a Earth and Environmental Science graduate program or department approval. Development and evolution of the ocean basins; marine sedimentation; shoreline development and classification; submarine topography; mineral resources of the sea. Laboratory analysis of marine sediments and fossil assemblages. Required field trips.

**EAES 551 Coastal Geomorphology (4 credits)**

Prerequisite(s): Equivalent of EAES 200 or departmental approval. Restriction(s): Matriculation in an Earth and Environmental Science or MS Biology graduate program. Coastlines and their evolution; processes and materials of the coastal zone; shore zone hydrodynamics and sedimentation: beach and barrier systems with special emphasis on the New Jersey shoreline. Offered at the site of the New Jersey Marine Sciences Consortium. Mutually Exclusive with PHMS 551.

**EAES 559 Special Topics in the Marine Sciences (1-4 credits)**

Prerequisite(s): Departmental approval. An opportunity for the qualified graduate student to do research in a field of marine science selected under the guidance of a professor. Open only to graduate students who have indicated a potential for original thinking. Also offered at the site of the New Jersey Marine Sciences Consortium. May be repeated three times for a maximum of 10 credits as long as the topic is different. Mutually Exclusive with PHMS 559.

**EAES 560 Environmental Law (3 credits)**

The course focuses on The National Environmental Policy Act; The preparation of an environmental impact statement; The Clean Air Act; The Clean Water Act; The Endangered Species Act; Toxic Substance Control Act; Solid and Hazardous Waste and other Environmental laws. The role of environmental professionals in the formulation and implementation of environmental law and policy are discussed.

**EAES 561 Environmental Law and Policy (3 credits)**

The goal of this course is to provide students with the theoretical foundations and practical applications of Environmental Law. The course will utilize a model and method approach, which will present theory and procedure in a case problem context. The course will acquaint students with various traditional legal theories and compare and contrast them with law as it has evolved to meet the changes in society.

**EAES 562 Waste Management (3 credits)**

Restriction(s): Matriculation in a College of Science and Mathematics graduate program or departmental approval. This course examines liquid waste management (sewage, sewerage, septic, and acid mine drainage) and solid waste management (composting, incineration, dumps, sanitary landfills, ocean dumping, and resource recovery). Management of radioactive wastes is included.

**EAES 563 Natural Resource Management (3 credits)**

Provide background in natural resource management; wildlife, fisheries, forests, water and related components. Includes field trips.

**EAES 565 Environmental Change and Communication (3 credits)**

Prepare students as professional environmentalists: Communication and journalism strategies, theory of persuasion, and roles as catalyst, solution giver, process helpers, and resource person.

**EAES 569 Air Resource Management (3 credits)**

Restriction(s): Matriculation in a College of Science and Mathematics graduate program or departmental approval. Spatial distribution of energy in the atmosphere treated in terms of natural factors and man's induced changes (atmospheric pollution). Incoming sun energy as modified by man is traced through the atmosphere, vegetation, soil and water.

**EAES 572 Advanced Geohydrology (3 credits)**

Prerequisite(s): EAES 230 hydrology or equivalent. The study of groundwater with particular emphasis given to its mode of occurrence, migration, chemistry and relation to the geographic environment. Particular attention is given to Darcy's Law, soil porosity, soil permeability and the ability to withdraw water for human consumption. Water pollutants and salt water incursions are investigated. Spatial distributions are analyzed and the processes examined.



**EAES 575 Environmental Economics (3 credits)**

This course explores the economic foundations of environmental problems such as natural resource depletion, conservation, pollution control, climate change, energy and other contemporary problems. In particular, the course develops students' understanding of why resource and environmental problems have occurred from the economic point of view and what kind of economic tools can be used for informed decision-making and tackling environmental problems.

**EAES 584 Urban Studies and Policy Analysis (3 credits)**

Interdisciplinary study of urbanization, the processes that produce and shape urban agglomerations. From this holistic perspective the interaction of different social, cultural economic, political and planning forces examined for their impact upon the resulting system.

**EAES 586 Urban Contamination (3 credits)**

This course uses examples from the published peer-reviewed literature to introduce the basic concepts of environmental contamination and the fundamental principles of environmental assessment. This is an introductory course at the graduate level and suitable for the students who are pursuing their graduate degree study and career in environmental education, science and management. The course will focus on environmental topics that are of current public concern and interest.

**EAES 590 Independent Study in Environmental Studies (1-4 credits)**

Prerequisite(s): Departmental approval. Student must develop statement of goals and phasing for completion, prior to consultation with instructor. May be repeated three times for a maximum of 10 credits as long as the topic is different.

**EAES 591 Methods in Environmental Research (3 credits)**

Formulation of the research problem, use of bibliographical sources and reference material organizing the research tests and measurements, analysis of data, and report writing.

**EAES 592 Pro Seminar (1-4 credits)**

Prerequisite(s): Departmental approval. Research on selected problems which will vary according to instructor. May be repeated once for a maximum of eight semester hours as long as the topic is different each time.

**EAES 593 Research Seminar (3 credits)**

Restriction(s): Matriculation in an Earth and Environmental Studies graduate program or departmental approval. Student field, laboratory, and library investigation of a problem in the area of his or her interest in geoscience, the results of which will be presented in oral and written form. Class discussion of the individual papers and of other pertinent topics of current interest in geoscience.

**EAES 594 Research in Geoscience Literature (1 credit)**

Restriction(s): Matriculation in an Earth and Environmental Studies graduate program or departmental approval. Investigation and evaluation of a topic in geoscience under the supervision of a faculty member by: (1) preparing a bibliography from standard sources, including an on-line computer search; and, (2) preparing a report written in standard professional format.

**EAES 599 Special Topics in Earth and Environmental Studies (1-4 credits)**

Restriction(s): Matriculation in an Earth and Environmental Studies graduate program or departmental approval. Independent research project to be performed by the student under the guidance of the faculty or experimental course offered by faculty that is not currently in the university catalog. May be repeated three times for a maximum of 10 credits as long as the topic is different.

**EAES 610 Spatial Analysis (3 credits)**

Prerequisite(s): Equivalent of EAES 510 or departmental approval. Restriction(s): Matriculation in an Earth and Environmental Studies program. This course will introduce students to techniques for the analysis of spatial data. The course will heavily utilize GIS and Remote Sensing data with particular attention to applications and manipulation techniques. Topics include characterizing spatial data, data sampling, visualization, data modeling, point pattern analysis, and spatial data interaction.

**EAES 637 Paleoclimatology (3 credits)**

This course surveys major climatic events in the Earth's history and examines published peer-reviewed literature to introduce the basic concepts of Paleoclimatology and the fundamental approaches to conduct paleoclimate research. This is an upper-division consisting of two lecture periods per week and suitable for students who are pursuing their graduate degree and career in Geosciences, climate science, and environmental science. The course will focus on paleoclimate topics that are of policy-relevance and public concern.

**EAES 660 Seminar in Environmental Management (3 credits)**

This is a methods seminar focusing on the techniques of managing a project with environmental significance. Students will design and plan in detail a project to improve an existing environmental problem or to implement an economically important project that would minimize environmental problems.

**EAES 662 Energy and the Environment (3 credits)**

Restriction(s): Enrollment in one of the following programs: MA in Environmental Studies, MS in Earth and Environmental Science, MS in Sustainability Science, PSM in Sustainability Science w/concentration in Applied Sustainability Science, PhD in Environmental Management. In-depth study of present-day energy sources, the impact of their extraction and utilization on Earth's environment, and future options. Topics include physics of energy, carbon cycle, greenhouse effect, origin and production of fossil fuels, hydraulic fracturing ("fracking"), consequences of fossil fuel combustion, nuclear energy, renewable energy sources (including biomass, waste-to-energy, solar, hydro, wind, tidal), as well as the technical and sociopolitical aspects of energy utilization, efficiency, and conservation.

**EAES 690 Research Project in Environmental Studies (3 credits)**

Prerequisite(s): Departmental approval. To complete the research proposal initiated in the research methods course.

**EAES 696 Applied Research or Internship Project in Sustainability Science (6 credits)**

Prerequisite(s): EAES 509 and EAES 591 and departmental approval. Students develop an independent applied research project or semester internship project in consultation with a faculty supervisor and an external advisor from academic, business, government or not-for-profit organization. Sectors of concern include energy use and conservation; urban design and the ecology of cities; green infrastructure design and engineering; globalization and negative externalities; climate change mitigation and adaptation; global extinctions and biodiversity; eutrophication and nutrient flux; habitat loss, alteration and degradation; alteration of biogeochemical cycles and land use patterns; environmental and social justice, and the "north-south" divide; or an approved topic or internship experience. This project or full semester internship is aimed at providing real life experience and problem-solving analytics to address key sustainability issues. Students will prepare an extensive written report and deliver an oral presentation in a specific format provided by the Program at the end of the semester.

**EAES 698 Master's Thesis (6 credits)**

Prerequisite(s): Departmental approval. Independent research project done under faculty advisement. Students must follow the MSU Thesis Guidelines, which may be obtained from the Graduate School. Students should take EAES 699 if they don't complete EAES 698 within the semester.

**EAES 699 Master's Thesis Extension (1 credit)**

Prerequisite(s): EAES 698. Continuation of Master's Thesis Project. Thesis Extension will be graded as IP (in Progress) until thesis is completed, at which time a grade of Pass or Fail will be given.

**EAES 700 Earth Systems Science (3 credits)**

Restriction(s): Matriculation in a College of Science and Mathematics graduate program or departmental approval. This course investigates geosystems. In studying processes within the atmosphere, hydrosphere, biosphere, and lithosphere, the course provides a holistic understanding of earth's historical, present, and future systems. Current techniques and tools for data collection and analysis, such as field methods, GIS, Remote Sensing, are included in the course.

**EAES 710 Advanced Geographic Information Systems (3 credits)**

Prerequisite(s): Equivalent of one of the following: EAES 510, EAES 511, EAES 610 or departmental approval. Restriction(s): Matriculation in an Earth and Environmental Studies graduate program. This course will allow students with demonstrated knowledge and skills in the geographic information sciences (GIS and/or Spatial Analysis and/or Remote Sensing) to expand on the range of techniques at their disposal for analyzing and visualizing geographic and other spatial data sets. Students are expected to develop and effect a small but well-defined research project which will result in a paper and an oral presentation. The course will make much use of industry standard GIS and Remote Sensing software packages in data application, manipulation and visualization. The course will cover programming in 3GLs, 4GLs and macro languages for processing and analyzing extensive spatial data sets as well as the construction of customized graphical user interfaces for specific applications.

**EAES 760 Organizational Environmental Management (3 credits)**

Restriction(s): Matriculation in a graduate program or department approval. This course examines the impact of profit, non-profit and public organizations on the natural environment. It analyzes the pressure, the types, and the procedures for implementing an environmental management system (EMS); and case studies from various organizations. It also studies the internal and external strategies of organizations relative to environmental sustainability goals.

**EAES 790 Colloquium in Environmental Management (1 credit)**

Restriction(s): Matriculation in a graduate program or departmental approval. Topical issues of current research in environmental management will be discussed. Presentations will be made by invited scholars, faculty, students, and research staff. For doctoral students in Environmental Management, the course may be repeated up to 10 times, but a maximum of 6 hours will be applied towards the PhD degree.

**EAES 791 Research Methods (3 credits)**

Advanced research techniques, beginning with census reports, government surveys and reports from other agencies. Field research, both cultural and physical; mapping techniques; the design of appropriate scale and data transformation to familiarize the range of possibilities and the need for careful choice of data and maps. Computer applications in geographic problem solving.

**EAES 792 Special Topics in Environmental Science and Management (1-4 credits)**

Prerequisite(s): Departmental approval. Special Topics is a detailed and literature intensive exploration of one particular focus in contemporary environmental management. The topic for the course will fall under one of several general areas. Topics will cover specific research areas in water-land systems, sustainability, vulnerability and equity, modeling analysis and visualization. This course is designed to fulfill elective requirements of the Doctoral Degree in Environmental Management. This course may be repeated for a maximum of 8 credits.

**EAES 895 Research Project in Environmental Management I (3 credits)**

Restriction(s): Matriculation in the PhD Environmental Science and Management. The course is structured to provide doctoral students with the opportunity to develop or update the research skills needed to design and complete a dissertation. Students can either develop an independent topic for their research project in consultation with faculty advisors or they can choose to work on one of the University's on-going environmental studies research projects.

**EAES 896 Research Project in Environmental Management II (3 credits)**

Prerequisite(s): EAES 895. The course is structured to provide doctoral students with the opportunity to develop or update the research skills needed to design and complete a dissertation. Students can either develop an independent topic for their research project in consultation with faculty advisors or they can choose to work on one of the University's on-going environmental studies research projects.

**EAES 900 Dissertation Advisement (3-12 credits)**

Restriction(s): Matriculation in the PhD Environmental Science and Management; Advancement to Candidacy. This department requires 30 credits of EAES 900. While enrolled in EAES 900, students will work with their Dissertation Chair and their Dissertation Committee. Credits are reported as IP (In Progress) while the dissertation is being written. At the conclusion of the dissertation defense, a final grade of Pass or Fail will be recorded.

**EAES 901 Dissertation Extension (1 credit)**

Prerequisite(s): 30 credits of Dissertation Advisement. Once students have acquired 30 credits of EAES 900 Dissertation Advisement, they must enroll in 1 credit of EAES 901 in every semester in which they intend to work on the dissertation, up to and including the semester of the defense. Credits are reported as IP (In Progress) while the dissertation is being written. At the conclusion of the dissertation defense, a final grade of Pass or Fail will be recorded. EAES 901 may be repeated until the time limitation for completion of the doctoral program as specified in the Doctoral Policy Manual has been reached.