Course #	Course Name	Description	Pre-requisites
103	Earth System Science Foundation and Applications	Instruction focuses on the basic principles and foundations of earth and environmental sciences. Course consists of lectures and in-class exercises designed to teach concepts in earth system science in addition to the use and applications of basic tools for students in the earth sciences. In-class exercises will range from effective use of Excel and PowerPoint, to overviews of hardware and software principles, to correct formats for technical writing and reference citations. Topically, this course addresses a wide range of areas in environmental earth science focusing especially on land processes. Examples include: ecosystems, geology, soil science, water, pollution, agriculture, population, natural disasters, and energy. The course is designed to guide instruction based on applications and real-world examples.	
111/L	Climate and Global Change	Introduction to earth's atmosphere and climate system. Structure and interaction of the components of this system. Natural and human-induced changes including these topics, the greenhouse effect, global warming, ozone depletion, air pollution and acid rain, effects of volcanoes, urban heat island processes, continental drift effects, glacial melting and sea level changes, atmospheric and ocean circulations and climate, and solar activity variability.	
112	Severe & Hazardous Weather	Weather systems, severe weather, hurricanes, weather forecasting. Interpretation of current conventional surface-based, satellite, and radar weather observations.	ESS 111 concurrency
210	Collapse of Civilizations	This course investigates why some cultures succeed and others fail. Many ancient societies experienced factors which led to their collapse, including environmental damage, climate change, overpopulation, and warfare. However, other societies found solutions to these problems and survived. From the archaeological record of past civilizations we will examine the factors that lead to collapse in an attempt to address a question that is relevant to the contemporary world—how can our world best avoid destroying itself?	
301	Introduction to Earth & Atmospheric Science	This course provides a survey of earth and atmospheric science for undergraduate students. Topics that will be covered will focus on how the earth-atmosphere system works in an integrated fashion. Students will integrate material from their introductory and ancillary courses and apply it to studies about earth and atmosphere processes.	ESS 103, ESS 111, PH 101 or 111, MA 120 or 171
303	Classifications & Physical Causes of Climate	Basic atmospheric structure and physical processes, surface processes, climate history and climate change, land use and land change, microclimates, topoclimates, ecoclimatology.	ESS 103, ESS 111, MA 120 or 171, and PH 101 or 111 or consent
305	Hydrology	Introduction to the hydrologic cycle and basic concepts of how water on the Earth moves, distributes, circulates and interacts with the environment. Major topics are water properties, precipitation, infiltration, evapotranspiration (evaporation and transpiration), groundwater, and runoff. Oceanographic concepts are introduced including currents, waves, tides, and coastal sediment processes. The response of water to environmental changes and conservation/management strategies are discussed.	ESS 103 or 102 and 111, MA 120 or 171, and PH 101 or 111
307	Environmental Archaeology	Archaeologists today need a wide range of scientific approaches in order to delineate and interpret the ecology of their sites. This approach is revolutionizing archaeology and making archaeological information relevant to the modern-day world. The analytical techniques that will be investigated in this course include climate modeling, climate reconstruction, geomorphology, sedimentology, soil science, paleobotany, paleoecoloy, remote sensing and GIS.	ESS 103 or consent
321	Pollution Problems	Quantitative descriptions of environmental conditions, regulations, and abatement technologies. Specific pollution problems with air, water, noise, and radiation; assessment of environmental impacts of development or construction projects.	ESS 103, ESS 111, MA 120 or MA 171, CH 101 or 121, PH 101 or 111 or consent

370	Intro to Remote Sensing	This course investigates the basic physical principles of remote sensing systems and discusses the processing, interpretation, and applications of airborne and satellite data. No prior training in remote sensing is required. Remote sensing can be used to measure and monitor important biophysical characteristics and human activities on Earth. This information is critical in addressing the global environmental threats of the next few decades.	ESS 103, ESS 111, MA 120 or 171, PH 101 or 111 or consent.
401	Survey of Atmospheric Science	General survey of the field of atmospheric science. Quantitative examination of atmospheric physical properties, including atmospheric composition, structure and dynamics. Detailed inspection of evolving atmospheric structures using real-time data systems. Topics include atmospheric thermodynamics, atmospheric dynamics, cloud physics, atmospheric radiation, and related topics in atmospheric remote sensing.	ESS 111, MA172, PH112 or consent of instructor
402	Scientific & Societal Aspects of Natural Disasters	Students will understand causes of major natural events and evaluate effects of disasters on populations and possible mitigation measures. GIS software will be used to show progression of events and/or their impacts, with course case studies.	Departmental approval for Undergrads
407	Environmental Threats, Public Policy, Decision Making	Researchers, policymakers and environmental campaigners have identified 25 potential future threats to the global environment. Some of these threats include climate, energy, water, food, environment, poverty, terrorism, disease, education, democracy, and population. This course examines the nature and consequences of these threats and their potential impacts for the survival of the human race. More importantly, potential solutions to these threats and how public policy and decision making is affected will be discussed.	ESS 103 or consent.
408	Python for Interdisciplinary Earth System Science Applications	This course will provide an introduction and overview of the applications of model building, Python programming, and automation of scripts for ArcGIS. Techniques in Model Builder, Python, and the methods for automation will be taught using data from numerous available data sources across the internet with heavy emphasis on the Earth Sciences	CS 102
409	Applications of Computers in Meteorology	Survey of data types and languages commonly used in the meteorological community along with practical applications to meteorology. Course is designed to prepare students for graduate work and research in atmospheric science.	CS 102, MA 172, PH 112 or consent of instructor
410	Operational Weather Forecasting	Operational Meteorology covers subjective and objective methods of atmospheric prognosis, including techniques for forecasting operationally-important weather elements. The course explores interpretation, use and systematic errors of computer-generated products, human factors with forecasting, and application of meteorological theory in an operational setting. Course instruction is accomplished through analysis of various weather events from beginning to completion.	ESS 111, 112, 301 or 401, MA 120 or 171, PH 101 or 111.
413	GIS and Image Processing	Data processing with focus on ESRA ArcGIS and ENVI software packages. Provides basic concepts central to GIS data management and creation, as well as those needed in the scientific manipulation of satellite imagery. Topics include image interpretation, classification, enhancement, multispectral transformations, raster data, vector data, digitizing, projections, data query, and map creation.	CS 102 or consent of instructor
414	Geospatial Applications	Course builds on basic concepts in GIS and Remote Sensing. Techniques in GIS are approached through real world case studies in applied earth sciences including: geology, ecology, natural disasters, demography, climate, and archaeology among others. Students learn to apply GIS technology to locate and download geospatial data, and address public policy and decision making questions through their production of presentation-quality maps. Software emphasized includes: ESRI's ArcGIS, ENVI, and MS Excel, among others.	ESS 413 or consent of instructor
415	Advanced Topics in GIS	Advanced continuation of concepts applied in Geospatial Applications. Students will learn through modules of real world scientific research how to use further tools in ArcGIS, including: 3D Analyst, Spatial Analyst, Network Analyst. Topics will also include web data dissemination, spatiotemporal analysis, and some basic spatial statistics measures.	ESS 414 or consent of instructor

420	Intro to Atmospheric Chemistry and Air Pollution	This self-contained introductory course in atmospheric chemistry and air pollution is designed to provide students the basics of atmospheric chemistry and air pollution concepts. Topics include air pollutants, air-pollution meteorology, atmospheric gases and aerosols, and atmospheric processes. This course will also develop the necessary fundamentals for those wishing to take the advanced (600-level) courses in atmospheric chemistry and air pollution.	PH 112, CH 121 and ESS 321 or consent of instructor.
441	Atmospheric Thermodynamics & Cloud Physics	General aspects of thermodynamics and cloud physical processes occurring within the atmosphere; atmospheric statics and stability, saturation point analysis, aerosols, nucleation, and the behavior/growth of cloud particles and hydrometers.	MA 238, PH 112
451	Atmospheric Fluid Dynamics 1	Fluid dynamics in the atmosphere. Coriolis accelerations, scale analysis, and appropriate approximations of the complete governing equations. Numerical analysis and interpretation of weather phenomena.	MA 238, PH 112.
452	Synoptic Meteorology	Analysis, interpretation, and forecasting synoptic-scale and mesoscale phenomena, including air masses, frontal systems, cyclones, anti-cyclones, tropical cyclones, and associated mesoscale phenomena. Emphasis on the use of remotely sensed data from satellites, radars, and profilers using state-of-the-art workstations.	ATS 441, 451
454	Forecasting Mesoscale Processes	Detection and forecasting of atmospheric mesoscale phenomena including the structure and evolution of clouds, precipitation (including floods), thunderstorms and severe weather. Includes basics on instruments used to detect mesoscale phenomena, most notably satellite and radar.	ATS 451
461	Atmospheric Radiation 1	Fundamentals of terrestrial atmospheric radiation. Specific topics include solar radiation at the top of the atmosphere, radiative transfer equation, gaseous absorption, scattering by molecules and particles, band models, transmittance along inhomogeneous path, and microwave radiative transfer.	MA 238, PH 113
471	Introduction to Radar Meteorology	Introduction to principles of radar meteorology, including radar operations, hardware, interpretation and analysis. Doppler, dual-polarization and dual-wavelength radar theory, methods and applications are covered.	ESS/ATS 441
498	Undergraduate Research Capstone Proposal	Students identify an Earth system science problem and formulate their capstone research proposal under the direct supervision of a research advisor during this first semester of a two-part capstone.	
499	Undergraduate Research Capstone	Individual investigations into Earth system science problems under direct supervision of various faculty members. Research is conducted and thesis-style paper is written and orally presented.	ESS 498