School of Environmental and Sustainability Sciences (SESS)

Executive Director, Feng Qi
C-309 (908) 737-3737

The SESS provides a unique and collaborative scientific research-focused division within Kean University. Through the use of multiple scientific disciplines, students work with scientists in a transdisciplinary manner. The SESS faculty integrates their research into training, education, field and laboratory work, and mentoring of students who are destined for science research or professional careers as consultants and in local, state, and federal government agencies, regional biotechnology, health care, pharmaceutical industries and other private sector areas, the media, sustainability industries, and academia as intertwined with the natural environment and its living systems that interact with society and societal infrastructures.

The SESS has been designed to provide students with professional development opportunities so that they may be able to recognize and reconcile the highly complex and integrated nature of environmental, ecological, and health-related problems, issues, and questions facing the world today and in the future – particularly with regard to air, water, and land systems and their interaction with life and societal systems and how these pertain to sustainability concepts and best practices. Traditional single discipline-trained scientists are not adequately prepared to address such contemporary problems as they do not have the critical multi-scale and trans-disciplinary background and perspective, or the awareness of the needs/concerns of society with respect to the sciences.

Consequently, the SESS Faculty provide a transformative and global model of approach that connects research and education to help students gain strong scientific background, powerful research skills, critical thinking and analytic abilities, and multiple opportunities to practice their communication skills and gain awareness of how these necessarily connect to the global society. SESS program graduates understand and appreciate the connections among all of the basic and applied sciences, and between science and society; have the ability to design, implement, and evaluate research studies; are adept at identifying and resolving local to global issues across the environmental and life systems; and communicating scientific results and conclusions to scientific, public, and governmental private sector and governmental audiences; and as such, will be the next generation of scientists who will be able to address highly complex environmental and biological challenges now and into the future with consideration of sustainability.

The educational objectives are delivered in Degree Programs in Environmental Biology, Earth Sciences (several options of study, including Environmental Science), and Sustainability. Students within these programs must maintain GPA of 3.0 in order to enter any SESS BS degree program, and must maintain a GPA of 3.0 to remain in and graduate from any of the SESS programs.

For information regarding College/program mission and student learning outcomes please see http://www.kean.edu/KU/CNAHS-Mission-and-SLOs

STATEMENT FROM THE FACULTY OF SESS

We welcome all students to consider an academic experience within SESS. Our faculty philosophy in SESS is that graduates from our programs should demonstrate a clear understanding of the connections among all the sciences, and between science and society, and be adept at identifying, addressing, discerning, and communicating regional, national, and global issues and solutions across the environmental and sustainability sciences to scientists, the general public, and governmental agencies and decision-makers. We believe these characteristics and outcomes are critical for the success of the next generation of scientists, who must observe, analyze, interpret, and address highly complex environmental challenges now and into the future.

SESS Earth Science

The Earth Science Program at Kean University offers general degree options in: Earth Science General Option, Teacher Certification Option, and Teacher of Students with Disabilities Option (Dual Certification). The programs provide education in the earth sciences and are dedicated to the academic growth of students. Students share concerns about our global environment and an interest in how the earth behaves and the appropriate management of these systems and their interactions. Our graduates have been successful in exciting careers including government agencies, private sector companies, consulting firms, teaching, and studies for graduate degrees.

In addition, programs for teacher certification in earth science and elementary education with an earth science specialization are offered. Collateral studies in environmental and marine sciences may be selected within the Earth Science major.

B.A. DEGREE EARTH SCIENCE

OPTION: GENERAL

The general earth science program provides students with a broad background in the earth sciences. This option covers the spectrum of earth science with emphasis on problem solving and topics of environmental importance.

GENERAL EDUCATION 44-45

FOUNDATIONS REQUIREMENTS

GE 1000 Transition to Kean 1 1
OR
GE 3000 Transfer Transitions 1 1
ENG 1030 College Composition 3
MATH 1000 Algebra for College Students # 3
COMM 1402 Speech Communication 3
GE 2024 Research and Technology 3

DISCIPLINARY/INTERDISCIPLINARY DISTRIBUTION REQUIREMENTS

Humanities 9
*ENG 2403 World Literature 3
Select two courses from different areas:
Fine Arts or Art History 3
Foreign Languages 3
Music or Theatre 3
Philosophy or Religion 3
Interdisciplinary 3

Social Sciences 9
*HIST 1062 Worlds of History 3
Select two courses from different areas:
Economics or Geography 3
Political Science 3
Psychology 3
Sociology or Anthropology 3
Interdisciplinary 3

Science & Mathematics 11
MATH 1054 Precalculus # 3
CHEM 1083-1084 Chemistry I & II 4, 4
### B.A. DEGREE EARTH SCIENCE

#### OPTION: P-12 TEACHER CERTIFICATION

Students choosing this (P-12) option must make a formal application for admission to the Middle & Secondary Education Department (MSE). Prior to taking education courses, all prerequisites must be met. See the description under the College of Education.

#### GENERAL EDUCATION

**FOUNDATIONS REQUIREMENTS**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>GE 1000 Transition to Kean</td>
<td>1</td>
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<tr>
<td>OR</td>
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<tr>
<td>GE 3000 Transfer Transitions</td>
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</table>

**DISCIPLINARY/INTERDISCIPLINARY DISTRIBUTION REQUIREMENTS**

- Humanities: 9 credits
- Fine Arts or Art History: 3 credits
- Foreign Languages: 3 credits
- Music or Theatre: 3 credits
- Philosophy or Religion: 3 credits
- Interdisciplinary: 3 credits
- Social Sciences: 3 credits

### MAJOR AND GE CAPSTONE COURSE

Select one of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tr>
<td>ES 4981 Environmental Issues Seminar (WE)</td>
<td>3</td>
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**OR**

<table>
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<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ES 4953 and 4954 ES Seminar I &amp; II</td>
<td>2,2</td>
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**FREE ELECTIVES**

- 44-47 credits (50% of free electives must be at the 3000-4000 level. Additional courses in Earth Science, Biology, Chemistry, Mathematics and Physics that leads to a collateral or minor program are recommended)

**TOTAL**

1 University Requirement for Graduation for all undergraduate students that must be satisfied in one of two ways: Complete GE 1000 (all freshmen and transfers entering with 0-29 credits) OR GE 3000 (transfers entering with 30 credits or more).

# A student whose qualifying score on the placement test makes them eligible to take either MATH 1054 or MATH 2411 may take that course instead. In that case, either MATH 1054 or MATH 2411 will count as the General Education requirement and the student may take another three to six credits in Free Electives to total 124 S.H.

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>MATH 2411 Calculus I #</td>
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<td>OR</td>
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<tr>
<td>MATH 2412 Calculus II #</td>
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### PROFESSIONAL EDUCATION

<table>
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<th>Course</th>
<th>Credits</th>
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<tr>
<td>EMSE 3000 Curriculum, Evaluation and the Learner</td>
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**OR**

<table>
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<tr>
<th>Course</th>
<th>Credits</th>
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<tr>
<td>EDUC 3401 Language Arts/Reading K-12</td>
<td>3</td>
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**PROFESSIONAL/GE CAPSTONE COURSE**

<table>
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<tr>
<th>Course</th>
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<tbody>
<tr>
<td>EDUC 4000 Teacher and Classroom</td>
<td>3</td>
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</tbody>
</table>

**TOTAL**

1 University Requirement for Graduation for all undergraduate students that must be satisfied in one of two ways: Complete GE 1000 (all freshmen and transfers entering with 0-29 credits) OR GE 3000 (transfers entering with 30 credits or more).

# A student whose qualifying score on the placement test makes them eligible to take either MATH 1054 or MATH 2411 may take that course instead. In that case, either MATH 1054 or MATH 2411 will count as the General Education requirement and the student may take another three to six credits in Free Electives to total 124 S.H.

### MAJOR AND CAPSTONE REQUIREMENTS

- Required Foundation Core Courses
- ASTR 1100 Introduction to Astronomy
- GEOL 1200 Introduction to Geology
- METR 1300 Introduction to Meteorology
- OCEN 2400 Introduction to Oceanography
- Select 3 courses from ASTR/ATMS/ENV/ES/GEOG/GEOL/GEOS/METR/OCEN/SUST

#### PROFESSIONAL EDUCATION

- Sophomore Level
- EMSE 2801 Introductory Field Experience K-12
- Junior Level
- EDUC 3000 Curriculum, Evaluation and the Learner
- EDUC 3401 Language Arts/Reading K-12
- EMSE 3122 Computers in Education
- EMSE 3230 Science Education K-12
- EMSE 3801 Junior Field Experience/Subject Area K-12
- EMSE 3903 Eng Lang Learn in America
- Senior Level
- EMSE 4811 Professional Internship/Subject Area K-12

### PROFESSIONAL/GE CAPSTONE COURSE

<table>
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<tbody>
<tr>
<td>EDUC 4000 Teacher and Classroom</td>
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</tbody>
</table>
students that must be satisfied in one of two ways: Complete GE 1000 (all freshmen and transfers entering with 0-29 credits) OR GE 3000 (transfers entering with 30 credits or more).

# A Student whose qualifying score on the placement test makes them eligible to take either MATH 1054 or MATH 2411 may take that course instead. In that case, either MATH 1054 or MATH 2411 will count as the General Education requirement and the student may take another three to six credits in Free Electives to total 124 S.H.

B.A. DEGREE EARTH SCIENCE/TEACHER OF STUDENTS WITH DISABILITIES

Students who wish to be certified in both Earth Science P-12 and Educator of Students with Disabilities should consult the Catalogue under Special Education programs for a complete description of this dual certification program.

GENERAL EDUCATION 45

FOUNDATIONS REQUIREMENTS
GE 1000 Transition to Kean
OR
GE 3000 Transfer Transitions
ENG 1030 College Composition

MATH 1000 Algebra for College Students
COMM 1402 Speech Communication
GE 2024 Research and Technology

DISCIPLINARY/INTERDISCIPLINARY DISTRIBUTION REQUIREMENTS
 Humanities
ENG 2403 World Literature
Select two courses from different areas:
Fine Arts or Art History
Music or Theatre
Philosophy or Religion
Social Sciences
HIST 1062 Worlds of History

PSY 1000 General Psychology
SOC 1000 Introduction to Sociology

OR

ANTH 1800 Cultural Anthropology
Science & Mathematics
MATH 1054 Precalculus #
CHEM 1083 Chemistry I
BIO 1000 Principles of Biology
Health & Physical Education

ID 1225 Issues in Contemporary Health

*GE Required distribution course

ADDITIONAL REQUIREMENTS 27
MATH 2411 Calculus I #

MATH 2412 Calculus II #

CHEM 1084 Chemistry II

PHYS 2091 General Physics I

PHYS 2092 General Physics II

PSY 2110 Psychology Adolescence

ID 2052 Human Exceptionality

ID 3051 Computer Technology in Today’s Inclusive Society

ID 3163 Building Inclusive Environments through Positive Behavioral Supports

MAJOR AND CAPSTONE REQUIREMENTS 31

Required Foundation Core Courses

ASTR 1100 Introduction to Astronomy

GEOL 1200 Introduction to Geology

METR 1300 Introduction to Meteorology

OCEN 2400 Introduction to Oceanography

GEOL 3266 Hydrology

One of the following courses

GEOL 3261, GEOL 3263, GEOL 3264, GEOL 3265

MAJOR/GE CAPSTONE COURSE

ES 4953 and 4954 ES Seminar I & II 2,2

OR 3

ES 4963 and 4964 Honors Research Seminar in ES I & II 2,2

PROFESSIONAL EDUCATION 32

Sophomore Level

SPED 2120 Introductory Field Experience

SPED 2220 Multicultural Learner in Diverse Settings

Junior Level

EDUC 3000 Curriculum, Evaluation and the Learner

EDUC 3401 Language Arts/Reading K-12

EMSE 3230 Science Education K-12

SPED 3000 Principles and Practices for the Contemporary Educator

SPED 3001 Preprofessional Field Experience

Senior Level

SPED 4135 Professional Field Experience

EDUC 4000 Teacher and Classroom

(SPED 4135 and EDUC 4000 must be taken concurrently)

TOTAL 135

1 University Requirement for Graduation for all undergraduate students that must be satisfied in one of two ways: Complete GE 1000 (all freshmen and transfers entering with 0-29 credits) OR GE 3000 (transfers entering with 30 credits or more).

# A Student whose qualifying score on the placement test makes them eligible to take either MATH 1054 or MATH 2411 may take that course instead. In that case, either MATH 1054 or MATH 2411 will count as the General Education requirement and the student may take another three to six credits in Free Electives to total 124 S.H.

ASTRONOMY COURSES

ASTR 1100 Introduction to Astronomy (4)

A study of our solar system and the sidereal universe, with an emphasis on the nature of astronomical investigation. (3 hr. lec/3 hr. lab.) (E) Approved General Education Distribution Course

ASTR 3168 Practical Astronomy (3)

Methods of determining, describing and using the positions and apparent motions of celestial bodies. Topics include fundamental position determination, time systems and standards, celestial navigation, the calendar, and related astronomical instrumentation. Prerequisites: ASTR 1100 and MATH 2412 or permission of the instructor.

ASTR 3171 The Solar System (3)

Planets, moons, and other members of the solar system: techniques and results of planetary investigations; theories of planetary origin, efforts to detect other planetary systems, the search for extraterrestrial life. Prerequisite: ASTR 1100 or permission of instructor.

EARTH SCIENCE COURSES

ES 1000 Observing the Earth (3)

A study of the earth and its processes from the perspective of observations and measurement, observing technology and systems, applications of observations and data to problem solving. (E) Approved General Education Distribution Course

ES 2000 Foundations of Earth System Science (4)

An introduction to the study of Earth as an inclusive system. The atmosphere, geosphere, biosphere, hydrosphere and cryosphere and their interrelations. (3 hr. lec/3 hr. lab.) Prerequisites: ES 1000 or permission of instructor

ES 2200 Methods in Geoscience (4)
Fundamental skills and scientific techniques used in the study of geoscience; computer applications; Internet resources, spatial data representation and analysis; quantitative descriptions of geophysical phenomena; statistical methods for data analysis; basic numerical methods. (3 hr lec./3 hr lab.)
Prerequisites: MATH 1054 and four hours of Geoscience

**ES 3000 Global Climate Change and Society (4)**
Analysis of evidence of past climate change, present climate variability, and trends related to future climate fluctuation. Examination of major variables controlling climate at a range of temporal scales. Study of the human role in the global climate change, and the response of the environment to such changes, including effects such as ecosystem changes, ocean current changes, and sea level rise. (3 hr. lec./3 hr. lab) (FA)
Prerequisites: METR 1300 and one 2000 level course (GEOG, OCEN)

**ES 3010 Data Analysis and Modeling in Geoscience (4)**
Overview of quantitative skills that is essential in the study of modern earth system science. Introduction to the principles of experimental design, data collection, data analysis, data visualization. Using modern analysis software and tools to facilitate data interpretation, modeling and theory development. (3 hr lec./3 hr lab.) (SO)
Prerequisites: MATH 1010 and four hours of Geoscience or permission of instructor

**ES 3020 Aerial Photography and Digital Image Interpretation (4)**
Overview of basic concepts related to the acquisition, processing, and interpretation aerial earth data. Procedures for ground feature identification, measurement, and analysis of aerial photographs and digital images. Review of principles related to satellite data acquisition, map making using new technology such as Geographic Information Systems (GIS), Google Earth, and Google Ocean. (3 hr. lec./3 hr. lab) (SO)
Prerequisites: 2000 Level GEOG or permission from instructor

**ES 3200 Geographic Information Systems in Geoscience (4)**
Principles and applications of Geographic Information Systems (GIS). Fundamentals of digital cartography, spatial analysis, digital data. Acquiring, assembling, geo-referencing field data; topographic maps; images from remote sensing. Emphasis on Earth and Human Systems; population, urban development and land use. (3 hr lec./3 hr lab.) (SP)
Prerequisites: MATH 1054, four hours of Geoscience or permission of instructor

**ES 3310 The Geosphere in the Earth System (4)**
Examination of the solid earth as part of an Earth System: Earth origin, chemistry, internal structure and processes, mineralogic and lithologic composition, origin and effect of organisms, history, modern processes and human impacts. (3 hr lec./3 hr lab.)
Prerequisites: take 1 course from Departments OCEN, METR, ASTR, ES, from levels 2000, 3000, 4000

**ES 3320 The Atmosphere in the Earth System (4)**
Examination of the atmosphere as part of an Earth System: History of atmosphere, source of energy, pollution, extreme weather events, atmospheric processes and climatic dynamics, and its interaction with organisms and human impacts. (3 hr lec./3 hr lab.)
Prerequisites: take 1 course from Departments OCEN, METR, ASTR, ES, from levels 2000, 3000, 4000

**ES 3330 The Hydrosphere in the Earth System (4)**
Examination of the distribution and movement of water as part of an Earth System: Oceans and seas, ice, surface waters, groundwater, historical and modern processes, the relationship to organisms and human impacts. (3 hr lec./3 hr lab.)
Prerequisites: 1 Geoscience course at the 2000 level or above (OCEN, METR, ASTR) ENROLLMENT LIMIT: 18 course type: Major elective

**ES 4200 Remote Sensing (4)**
Theory, technology and methods of remote sensing for observing the earth. Application of remote sensing to problems in the earth sciences including resource exploration, weather forecasting, environmental monitoring and land use. (3 hr lec./3 hr lab.) (SP)
Prerequisites: Eight hours of Geoscience, MATH 1054, PHYS 2091 or PHYS 2095

**ES 4980 Environmental Internship(3)**
A work-study opportunity to obtain practical experience with the multidisciplinary nature of environmental problems, relate course material to these problems, and discern decision-making processes associated with their solution.
Prerequisites: Permission of the department and the supervising instructor.

**ES 4981 Environmental Issues Seminar (3)**
Contemporary environmental topics are explored from a scientific and societal perspective. Students perform literature search, gather scientific information and study societal impact individually, in teams, and as part of a group, and present in written and oral form, issues of local, national, and global concern. (E)
Prerequisites: Senior Standing in Earth Science

**ENV 1000 Introduction to Environmental Science (3)**
An introduction to the study of the environment as an inclusive system that is connected to the diverse scientific fields of biology, chemistry, geology, hydrology, atmospheric science, climatology and geography. Processes of data collection, sampling, analysis, mapping and predicting are explored. (E)
Prerequisites: ES 1000 or permission of instructor

**ENV 3051 Field Biology Methods (4)**
Field-based course providing the opportunity to collect biological data in a terrestrial ecosystem while applying current field research methods. Emphasis will be on observation, species identification, field notes, sampling methods, observational and experimental study design, mapping, data analysis, and scientific writing. (3 hours lecture, 3 hours lab).
Pre-requisites: GE 2024

**ENV 3201 Biodiversity (4)**
An introduction to the concepts, methods and significance of biodiversity science. Case studies and readings from the primary literature are used to apply the ideas and analytical techniques introduced in lecture. This course is equivalent to SUST 3310.
Prerequisites: GE 2024

**ENV 3230 Urban Ecology (3)**
An examination of ecological processes in human-dominated landscapes from the scientific, historical and cultural perspectives. Human influence on, and response to, natural systems is emphasized. Readings from the primary literature are used to illustrate current research trends and methodologies. This course is equivalent to SUST 3330 (3 hr. lecture).
Prerequisites: GE 2024 or permission of instructor

**ENV 3250 Medicinal Botany (3)**
Explores the uses of plants as medicine, ranging from traditional indigenous approaches to modern western pharmaceuticals. The biology and use of medicinal plants for treating everything from the common cold to cancer is investigated. (3 credits of lecture).
Prerequisite: GE 2024 or Permission of Instructor.

**ENV 3720 Entomology (4)**

An introduction to the biology of insects and related arthropods. Lectures integrate ecology, evolution and behavior with functional biology and focus on insects as examples of fundamental concepts. Consideration is also given to effects of insects on the global economy and to sustainable solutions to these problems. Laboratories stress collection, identification and preservation of arthropod specimens. Fieldwork and the preparation of a collection are required. (3 hours lecture, 3 hours lab).

Prerequisites: ENV 3201 or BIOS 3201 or SUST 3310.

**ENV 4210 Conservation Ecology (4)**

This course examines the historical and ethical background of the conservation movement and the science of conservation biology. It covers various aspects that must be considered in conservation including genetic, species, and ecosystem dynamics and diversity. Connections are made between industrial development and the natural world, relating societal impacts on plants and wildlife to the goals of conservation. Parts of the course will be presented using a Problem-based Learning (PBL) format involving student-led case studies based on real issues.

Prerequisites: ENV 3201 or BIOS 3201 or SUST 3310 or BIO 3614

**ENV 4435 Behavioral Ecology (3)**

An introduction to the behavior of animals in natural settings, with emphasis on the ecological and evolutionary levels of organization. Topics include communication, foraging, defense, mating systems, social biology, and research methodology. Lectures stress analytical models, hypothesis testing and methodology. This course is a major elective for Environmental Biology majors (BS) in the School of Environmental and Sustainability Sciences.

Prerequisites: BIO 3614 or permission of instructor

**ENV 4600 Plant-Animal Interactions (3)**

An examination of how plant and animals interact through evolutionary time and thereby shape communities and ecosystems. Topics include coevolutionary theory, herbivory, plant defense strategies, sequestration of plant compounds, animal agriculture, pollination ecology and seed dispersal. (3 hr. lecture).

Prerequisites: BIO 3614

**ENV 4710 Physiological Ecology (3)**

A consideration of the varied strategies by which animals have solved the functional challenges of life, including homeostasis, locomotion, feeding, functional control, and reproduction. Lectures emphasize the effects of habitat, ecology and historical contingency on the evolution of physiological systems.

Prerequisites: BIO 3614

**ENV 4961 Independent Study Research (1)**

A field, laboratory, library and/or policy investigation of a basic or applied environmental issue performed independently by the student under the supervision of a faculty research mentor. ENV 4961 may be repeated, or combined with ENV 4962 or ENV 4963, to a total of four credits toward a SESS program’s major elective requirement.

Prerequisites: Sophomore, Junior or Senior status in the School of Environmental and Sustainability Sciences, and permission of instructor. Faculty mentors may stipulate additional course prerequisites related to their disciplines.

**ENV 4962 Independent Study Research (2)**

A field, laboratory, library and/or policy investigation of a basic or applied environmental issue performed independently by the student under the supervision of a faculty research mentor. ENV 4962 may be repeated, or combined with ENV 4961, to a total of four credits toward a SESS program’s major elective requirement.

Prerequisites: Sophomore, Junior or Senior status in the School of Environmental and Sustainability Sciences, and permission of instructor. Faculty mentors may stipulate additional course prerequisites related to their disciplines.

**ENV 4963 Independent Study Research (3)**

A field, laboratory, library and/or policy investigation of a basic or applied environmental issue performed independently by the student under the supervision of a faculty research mentor. ENV 4963 may combined with ENV 4961 to a total of four credits toward a SESS program’s major elective requirement.

Prerequisites: Sophomore, Junior or Senior status in the School of Environmental and Sustainability Sciences, and permission of instructor. Faculty mentors may stipulate course prerequisites related to their disciplines

**ENV 4964 Independent Study Research (4)**

A field, laboratory, library and/or policy investigation of a basic or applied environmental issue performed independently by the student under the supervision of a faculty research mentor. ENV 4964 may combined with ENV 4961 to a total of four credits toward a SESS program’s major elective requirement. Prerequisites: Sophomore, Junior or Senior status in the School of Environmental and Sustainability Sciences, and permission of instructor. Faculty mentors may stipulate course prerequisites related to their disciplines.

**GEOG 2010 World Geography (3)**

World geography from the point of view of how physical features, resources, climates, and economic and political systems help to shape human culture. Using geographic tools to explore current themes and problems in various world geographic regions. (E) Approved General Education Distribution Course

**GEOG 2020 Conservation of Natural Resources (3)**

A study of relationships among natural resources, technological development, population growth and levels of living as a means of exploring and evaluating the foundations of environmental management and conservation.

Prerequisite: Three hours of geography or science or permission of instructor.

**GEOG 3110 Practical Geographic Skills (3)**

The practical skills and techniques of the geographer, such as those developed for studies in the field and the laboratory, and for graphic, cartographic, written and oral presentation of geographic information.

Prerequisite: Six hours of geography or permission of instructor.

**GEOG 3410 Urban Geography (3)**

An examination of urban settlements with special emphasis on the practical application of modern geographic theories to the contemporary urban situation.

Prerequisite: Six hours of geography or permission of instructor.

**GEOG 3420 The Resource Base and the Urban Pattern (3)**

An investigation of the problems posed by the multiplicity of users for the limited natural resources of urban areas.

Prerequisite: Six hours of geography or permission of instructor.

**GEOG 3920 Geography of Latin America (3)**

The physical geography and human adaptation in Middle South America.

Prerequisite: Six hours of geography or permission of instructor.

**GEOG 3950 The Geography of New Jersey (3)**
The various geographic aspects of the State of New Jersey: physical environment, cultural diversity, resource base, and economic pattern. Special emphasis placed on the high degree of urbanization which characterizes New Jersey. Field observations included.

ECO 3730 Economic Geography (3)
(See Economics and Finance Department for course description.)

GEOLOGY COURSES

GEOL 1200 Introduction to Geology (4)
Processes at work upon and within the earth; earth history; rocks, minerals, and fossil; historical development of geology as a science. (3 hr. lec/ 3 hr. lab.) (E) Approved General Education Distribution Course

GEOL 1201 Geologic Hazards (3)
An investigation of geologic hazards such as earthquakes, volcanic eruptions, flooding and beach erosion. Consideration given to hazards resulting from normal geologic activity as well as those caused by human interaction with the environment. Intended for non-majors. May be taken concurrently with GEOL 1202. Students cannot receive credit for both GEOL 1200 and GEOL 1201/1202.

GEOL 1202 Geologic Hazards Laboratory (1)
Must be taken concurrently with GEOL 1202.

GEOL 1205 Mineral and Fossil Fuel Resources (3)

GEOL 1210 Geology of the National Parks (3)
An in-depth study of the depositional, tectonic and erosional processes that have produced the unique geological regions designated as National Parks by the Congress of the United States. Does not fulfill major requirements.

GEOL 2262 Geology and the Environment (3)
Examination of the problems associated with man's urban pattern of civilization and resultant interactions with the geologic environment.
Prerequisite: GEOL 1200 or permission of the instructor.

GEOL 2263 Geology and the Environment Lab (1)
Must be taken concurrently with GEOL 2262.

GEOL 3261 Mineralogy (4)
An introductory study of minerals; their morphology, internal structure, origin, occurrence, and properties. (3 hr. lec/3 hr. lab.) (FO)
Prerequisites: GEOL 1200 and CHEM 1083-1084, or permission of the instructor.

GEOL 3263 Structural Geology (4)
A study of the architecture of the rock materials of the earth, including a description of geologic structure in terms of origin, principles and mechanics of crustal deformation. (3 hr. lec/3 hr. lab.) (FE)
Prerequisite: GEOL 1200 or permission of the instructor.

GEOL 3264 Invertebrate Paleontology (4)
A study of the classification, relationships, and evolutionary history of fossils. Emphasis is placed on paleoecological relationships. (3 hr. lec/3 hr. lab.) (SP)
Prerequisite: GEOL 1200 or permission of the instructor.

GEOL 3265 Geomorphology (4)
Analysis of the various land forms of the Earth's surface in terms of their nature, origin, and evolution. The influence of the different geologic and climatic environments upon the development of land form. Map interpretation. (3 hr. lec/3 hr. lab.) (SO)
Prerequisite: GEOL 1200 or permission of the instructor.

GEOL 3266 Hydrology (4)
The distribution and movement of water with emphasis given to surface waters, their relation to the fluvial aspects of geomorphology and to the impact of man on the hydrologic cycle. (3 hr. lec/3 hr. lab.) (SP)
Prerequisite: GEOL 1200 or METR 1300 or permission of instructor.

GEOL 3269 Astrogeology (4)
The geologic environments of the moon and the planets examined with emphasis on the nature of the lunar surface. Consideration given to pertinent terrestrial environments and phenomena and to the related aspects of meteoritics. (3 hr. lec/3 hr. lab.)
Prerequisite: ASTR 1100 or GEOL 1200 or permission of instructor.

GEOL 3281 Field Geology (2)
Field practice in the methods of geological mapping including the use of pace, compass, and clinometer surveys, the plane table and alidade, and aerial photographs. (FE)
Prerequisite: GEOL 1200 or permission of the instructor.

GEOL 4252 Field Geology II (2)
Field conference and studies of one or more selected areas with written reports and maps. Additional expenses may be incurred. (SO)

Prerequisites: GEOL 3261, 3263, 4266 (may be taken concurrently), or permission of the instructor.

GEOL 4256 Glacial and Pleistocene Geology (3)
Analysis of the distribution, movement, and deposits of modern glaciers used to interpret glacial features formed during the Pleistocene glacial epoch. Theories concerning the cause or causes of continental glaciation.
Prerequisite: GEOL 1200 or permission of the instructor.

GEOL 4263 Optical Mineralogy (4)
Mineral identification through the use of the petrographic microscope by immersion and thin-section methods. (3 hr. lec/3 hr. lab.)
Prerequisite: GEOL 3261 or permission of the instructor.

GEOL 4265 Petrology (4)
A study of the petrologic processes at work upon and within the crust of the earth that produce and modify rock bodies. (3 hr. lec/3 hr. lab.)
Prerequisite: GEOL 3261 or permission of the instructor.

GEOL 4266 Stratigraphy and Sedimentation (4)
Origin and characteristics of sediment grains; sedimentation processes; diagenesis and rock classification; correlation of stratigraphic units; sedimentary environments and their deposits. (3 hr. lec/3 hr. lab.) (SO)
Prerequisite: Twelve hours of geology or permission of the instructor.

GEOL 4268 Topographic Map Interpretation (3)
Description and interpretation of selected topographic maps chosen to illustrate variety of landforms of the United States and the influence of structure, process and time on landform development. (1 hr. lec/6 hr. lab.)
Prerequisite: GEOL 3265 (may be taken concurrently) or permission of instructor.

METEOROLOGY COURSES

METR 1300 Introduction to Meteorology (4)
An introductory study of the atmosphere including historical perspectives, weather elements, instrumentation, fronts, air masses, cyclones and anticyclones, severe weather, weather analysis, weather prediction, pollution, ozone layer depletion, acid rain, global warming. (3 hr. lec/3 hr. lab.) (E)
Approved General Education Distribution Course

METR 2101, 2102, 2103, 2104
Meteorology Seminar I, II, III, IV (1, 1, 1, 1)
Course sequence is over four semesters. Students will investigate and explore specialization areas of the discipline in-depth to provide comprehensive skills and aptitude as evidenced by products generated and practicum completed. General topics include: Operational Meteorology with Modeling & Forecasting; Media Meteorology with Science Reporting; Environmental Meteorology including Air Quality; and Industrial/Forensic Meteorology with Consulting. Students may register for any of the courses in the sequence and are not required to complete all sessions.

Prerequisite: METR 1300 or permission of instructor.

METR 2300 Climatology (3) Global distribution of the principal climatic elements with emphasis on the physical causes of climate. Theories regarding climatic change will also be discussed.

Prerequisite: METR 1300 or permission of the instructor.

METR 2301 Climatology Laboratory (1) Techniques in handling climatological data.

Corequisite: METR 2300 or permission of the instructor.

METR 2310 General Meteorology (4) An overview of meteorology with emphasis on the dynamic aspects of atmospheric behavior. Topics include air masses, fronts, cyclones and anticyclones, winds, theoretical basis for weather forecasting, and mathematical techniques. (3 hr. lec./3 hr. lab.)

Prerequisite: METR 1300 and Math 2412 (may be taken concurrently) or permission of instructor.

METR 2350 Aviation Meteorology (3) A study and analysis of mid-latitude meteorology in the Northern Hemisphere with an emphasis on those phenomena affecting aircraft operation.

Prerequisite: METR 1300 or permission of instructor.

METR 2360 Weather Analysis (3) Familiarization with daily weather data and NCEP forecasting products; plotting and analyzing of weather maps; weather map discussion; weather forecasting; daily weather observations. (2 hr. lec./3 hr. lab.)

Prerequisite: METR 1300.

METR 3360 Air Pollution (3) An examination of the problem of air pollution as seen principally from a meteorological viewpoint. Topics include the terminology and nomenclature of air pollution, the history of air pollution, types of pollutants in the atmosphere, atmospheric dispersion of pollutants, methods of sampling and control, trends in legislation, and cost benefit and risk analysis.

Prerequisites: METR 1300 and Math 1054.

METR 3369 Planetary Atmospheres (4) The earth's atmosphere as a planetary environment and the origin, evolution and current state of knowledge of the atmospheres of other planets and their prospects for harboring life. (3 hr. lec./3 hr. lab.)

Prerequisites: ASTR 1100 or METR 1300 and MATH 1054.

METR 3370 Atmospheric Dynamics (4) A mathematical formulation of the physical laws which govern weather processes and atmospheric motion. (3 hr. lec./3 hr. lab.)

Prerequisites: METR 1300, PHYS 2096, MATH 2412 or permission of instructor.

METR 3371 Atmospheric Thermodynamics (4) The application of thermodynamic principles to the atmosphere: heat, work, internal energy and available energy of the atmosphere; the thermodynamics of water vapor and moist air; dry and moist thermodynamic processes; hydrostatic equilibrium and altimetry; atmosphere stability and convection. (3 hr. lec./3 hr. lab.)

Prerequisites: METR 1300, PHYS 2096, MATH 2412 or permission of instructor.

METR 3372 Physical Meteorology (3) An examination of the physics of atmospheric phenomena. Topics include wave theory, transfer processes, cloud physics, atmospheric radiation, and remote sensing. Emphasis is placed on the application of physical theory to obtain a better understanding of atmospheric phenomena.

Prerequisites: MATH 2412, METR 1300, PHYS 2096.

METR 3380 Meteorological Instrumentation (4) Familiarization with the various instruments used to observe the atmosphere; principles of operation, instrument calibration and maintenance, error analysis, observing systems. (3 hr. lec./3 hr. lab.)

Prerequisites: METR 1300 and MATH 1054.

METR 4301-4302 Meteorology Cooperative Education I and II (3,3) A practical field experience. Student assigned to an organization involved in meteorological activity such as federal and state government, industry, media, etc. Cooperative employers matched with student's area of interest within field of meteorology. Working hours flexible. Credits earned count as free electives. (E)

Prerequisite: Explicit written permission of the instructor.

METR 4351-4352 Synoptic Meteorology I and II (4,4) Understanding the processes which govern the weather; practical application of the predictive equations through use of weather maps; in depth analysis of NCEP forecasting products; extensive plotting and analysis of synoptic charts stressing the three dimensional nature of weather systems; weather forecasting and briefing. (2 hr. lec./6 hr. lab.) (SE)

Prerequisites: METR 3370 and 3371 or permission of instructor. MET 4351 is a prerequisite to 4352.

METR 4370 Advanced Atmospheric Dynamics (3) Circulation, vorticity, and divergence theories, theory of Rossby Waves, pressure coordinates, turbulence and diffusion, energy conversions, numerical weather prediction, the general circulation. (SO)

Prerequisites: METR 3370 and METR 3371 or permission of the instructor.

OCEANOGRAPHY COURSES

OCEN 2400 Introduction to Oceanography (4) A survey of modern oceanography and including the biological, geological, chemical and physical characteristics of the ocean and, methods and applications of sciences to the study of the oceans. (3 hr. lec./3 hr. lab.) (E)

Prerequisites: MATH 1000, 4 credit lab science course or permission of instructor.

OCEN 3400 Global Change and the Ocean (3) The ocean's role in regulating climate and the interaction between the ocean, global change, and society. Oceanographic records of change to illustrate the natural variability of ocean circulation, sea-level, ocean acidification, organism migrations, invasions and mass extinctions through geologic time. Evidence of anthropogenic forcing, future predictions, and potential solutions for society. (SO)

Prerequisites: OCEN 2400

OCEN 3463 Marine Science (4) Impact of global change on the marine realm. The geologic, biologic and general oceanographic nature of beaches, coral reefs, swamps, estuaries, lagoons and tidal flats, continental shelf, deep sea, and mid-ocean rift zones. Major global environmental issues/topics such as sea level change, ocean carbon cycle, and catastrophic events will be discussed. (3 hr. lec./3 hr. lab.)
OCEN 3600 Coral Reefs and Coastal Systems (4)
Coral reef and coastal system function and form; hands-on study of the biodiversity, biogeography, ecological interactions, current threats and protection. (3 hr. lec./3 hr. lab.) (SP)

OCEN 4454 Marine Geology (4)
Introduction to the geology of the oceans, including tectonics, geochemistry, shoreline processes, stratigraphy, sedimentology, and related subjects. (3 hr. lec./3 hr. lab.)
Prerequisite: OCEN 3453 or permission of instructor.

OCEN 4455 Chemical Oceanography (4)
Study of the properties and interactions of chemical substances present in the marine environment, including their reactions at the air-sea and sea-bottom interfaces. (3 hr. lec./3 hr. lab.)
Prerequisite: OCEN 3453 or permission of instructor.

OCEN 4470 Physical Oceanography (4)
Detailed study of the physical aspects of the oceans including ocean currents, radiation, air-sea interaction, theories of the ocean circulation, geostrophic computations, vorticity. (3 hr. lec./3 hr. lab.)
Prerequisite: OCEN 3453 or permission of instructor.

OCEN 4600 Marine Conservation (3)
The science behind maintaining the ocean's diversity; historical context of current marine conservation concepts; marine population and system dynamics; threats to marine diversity; and conflicts between human exploitation, fisheries, and ecosystem function; design, function and policy of marine protected areas and reserves by non-governmental and governmental agencies. (FA)
Prerequisite: 2 lab science courses

OCEN 4601 Field Methods in Marine Research (4)
Field studies and research in the marine environment that integrate principles, techniques, and information for the multidisciplinary study of marine environments. Students participate in design; conduct a field research project to sample marine environments using oceanographic, geological, and a variety of marine science techniques. (SP)
Corequisite: OCEN 4600 or permission of instructor.

OCEN 4602 Marine Resource Management (3)
The science and politics of protecting the world's ocean's resources and the role of marine protected areas (MPAs) in conserving living marine resources. The rapidly developing science, rationale, and the controversies surrounding MPAs, fisheries management, ecosystem-based management strategies, and the collective societal impacts of protection.
Prerequisites: 2 lab science courses and permission of instructor

RESEARCH, SPECIAL TOPICS AND SEMINARS
ES 3801-3802 Special Topics in Earth Science (1, 2)
Intensive study of specific topics of an advanced nature in the Earth Science which are not studied in regular courses. Topics will be announced by the department. (E)
Prerequisite: Permission of the instructor.

ES 4901-4902 Special Topics in Earth Science (3, 3)
Intensive study of specific topics of an advanced nature in the earth sciences. Subject of a semester's work varies. (E)
Prerequisite: Permission of the instructor.

ES 4953, 4954 Earth Science Seminar I and II (2, 2)
The student is asked to pursue a problem of current interest in earth science. The student prepares and presents a paper to a seminar group. Following the presentation, the speaker serves as moderator in a discussion of the subjects.
Prerequisite: Senior standing in the Department of Geology and Meteorology.

Writing Emphasis Course

SESS Biological Sciences (Environmental)
The SESS students in this program will develop a strong foundation in the Biological Sciences while developing detailed expertise in Environmental Sciences, and will apply their knowledge to the environment around them through specialized course work and individual and team-based scientific research projects.

The SESS Environmental Biology graduate will be prepared to pursue advanced graduate or professional degrees within the many areas of the environmental and life sciences (for example, biotechnology, molecular biology, environmental biology, biomedical research, ecology and behavior, microbiology, medicine, etc.) and environmental consulting.

Students interested in careers in local, state, and federal government agencies will be prepared for opportunities associated with areas such as planning and development of growth, natural resource management and conservation, environmental monitoring and assessment. Students interested in the private and public research
sector will be prepared for careers in medicine, the regional biotechnology, other areas of health care, and pharmaceutical industries. SESS students can receive a degree in the following Degree Program Options:

**B.S. Degree, Biology, Environmental Biology Option**

### Optional: Environmental Biology

#### General Education
- **35**

#### Foundations Requirements
- **13**
  - GE 1000 Transition to Kean
  - OR
  - GE 3000 Transfer Transitions
  - ENG 1030 College Composition
  - MATH 1054 Precalculus
  - COMM 1402 Speech Communication
  - GE 2024 Research and Technology

#### Disciplinary/Interdisciplinary Distribution Requirements
- **22**
  - Humanities
  - *ENG 2403 World Literature
  - Select one course from below:
    - Fine Arts or Art History
    - Philosophy or Religion
    - Foreign Languages
    - Music or Theatre
    - Interdisciplinary
    - Social Sciences
  - *HIST 1602 Worlds of History
  - Select one course from below:
    - Economics or Geography
    - Political Science
    - Psychology
    - Sociology or Anthropology
    - Interdisciplinary
    - Science & Mathematics
  - *MATH 1016 Statistics
  - CHEM 1083 Chemistry I

#### Major/GE Capstone
- **3**
  - SUST 4300 Independent Practicum in Sustainability
  - *Required Distribution Course

#### Additional Requirements
- **32**
  - BIO 1300 Biology I
  - BIO 1400 Biology II
  - BIO 3709 Genetics
  - CHEM 1084 Chemistry II
  - CHEM 2180 Principles of Organic Chemistry
  - MATH 2415 Calculus I
  - PHYS 2091 General Physics I

### PROGRAM FOCUS-RELATED ELECTIVES
- **16-19**
  - To be selected with advisement from approved program list maintained in the School of Environmental and Sustainability Sciences and in consultation with the Program Coordinator. At least 50% must be at the 3000-4000 level.

### FREE ELECTIVES
- **5-9**

### TOTAL
- **120**

### ENVIRONMENTAL BIOLOGY COURSES

#### ENVIRONMENTAL SCIENCE COURSES

**ENV 1000 Introduction to Environmental Science**

An introduction to the study of the environment as an inclusive system that is connected to the diverse scientific fields of biology, chemistry, geology, hydrology, atmospheric science, climatology and geography. Processes of data collection, sampling, analysis, mapping, modeling and predicting are explored. (E) Prerequisites: ES 1000 or permission of instructor.

**ENV 2000 Evolution and Biodiversity**

A consideration of the principles and methodologies of evolutionary thought, and a reconstruction of the history of life. Through an understanding of micro- and macro evolutionary mechanisms, students will analyze the diversification of earth’s biota and the influence of current ecological conditions on possible future trajectories. Labs emphasize comparative biology through morphological and computer-based phylogenetic analyses (3 hr. lecture, 3 hr. lab). Prerequisites: ENV 1000 and BIO 1400

**ENV 2100 Ecosystem Science**

This course provides an introduction to ecosystem science, focusing on foundations and applications of ecology. Using tools discussed in class and lab, students will begin to understand species interactions in biological communities and relationships of these communities to environmental factors. Human impacts on the environment are examined, as are methods used to conserve and restore species and ecosystems. Laboratories stress the scientific method applied in the field, data collection, and species identification. This course is a major requirement for Biology Majors (B.S.) in the School of Environmental and Sustainability Sciences who are in the Environmental Biology track (3 hours lecture, 3 hours lab). Prerequisites: ENV 1000 and BIO 1400

**ENV 3051 Field Biology**

Field-based course providing the opportunity to collect biological data in a terrestrial ecosystem while applying current field research methods. Emphasis will be on observation, species identification, field notes, sampling methods, observational and experimental study design, mapping, data analysis, and scientific writing. (3 hours lecture, 3 hours lab). Pre-requisites: GE 2024

**ENV 3100 Principles of Environmental Soil Science**

An introduction to the chemical, physical, and biological properties of soils; the origin, classification, and distribution of soils and their influence on people and food production; the management and conservation of soils; and the environmental impact of soil use. 3 hours of lecture and 3 hours of lab. Prerequisites: CHEM 1084, ENV 1000 and GE 2024

**ENV 3201 Biodiversity**

An introduction to the concepts, methods and significance of biodiversity science. Case studies and readings from the primary literature are used to apply the ideas and analytical techniques introduced in lecture. This course is equivalent to SUST 3310. Prerequisites: GE 2024
ENV 3230 Urban Ecology (3)
An examination of ecological processes in human-dominated landscapes from the scientific, historical and cultural perspectives. Human influence on, and response to, natural systems is emphasized. Readings from the primary literature are used to illustrate current research trends and methodologies. This course is equivalent to SUST 3330 (3 hr. lecture).
Prerequisites: GE 2024 or permission of instructor.

ENV 3250 Medicinal Botany (3)
Explores the uses of plants as medicine, ranging from traditional indigenous approaches to modern western pharmaceuticals. The biology and use of medicinal plants for treating everything from the common cold to cancer is investigated. (3 credits of lecture).
Prerequisite: GE 2024 or Permission of Instructor.

ENV 3720 Entomology (4)
An introduction to the biology of insects and related arthropods. Lectures integrate ecology, evolution and behavior with functional biology and focus on insects as examples of fundamental concepts. Consideration is also given to effect of insects on the global economy and to sustainable solutions to these problems. Laboratories stress collection, identification and preservation of arthropod specimens. Fieldwork and preparation of a collection are required. (3 hours lecture, 3 hours lab).
Prerequisites: ENV 3201 or BIOS 3201 or SUST 3310.

ENV 4210 Conservation Ecology (4)
This course examines the historical and ethical background of the conservation movement and the science of conservation biology. It covers various aspects that must be considered in conservation including genetic species, and ecosystem dynamics and diversity. Connections are made between industrial development and the natural world, relating societal impacts on plants and wildlife to the goals of conservation. Parts of the course will be presented using a Problem-based Learning (PBL) format involving student-led case studies based on real issues.
Prerequisites: ENV 3201 or BIOS 3201 or SUST 3310 or BIO 3614.

ENV 4435 Behavioral Ecology (3)
An introduction to the behavior of animals in natural settings, with emphasis on the ecological and evolutionary levels of organization. Topics include communication, foraging, defense, mating systems, social biology, and research methodology. Lectures stress analytical models, hypothesis testing and methodology. This course is a major elective for Environmental Biology majors (BS) in the School of Environmental and Sustainability Sciences.
Prerequisite: BIO 3614 or permission of instructor.

ENV 4600 Plant-Animal Interactions (3)
An examination of how plant and animals interact through evolutionary time and thereby shape communities and ecosystems. Topics include coevolutionary theory, herbivory, plant defense strategies, sequestration of plant compounds, animal agriculture, pollination ecology and seed dispersal. (3 hr. lecture).
Prerequisites: BIO 3614

ENV 4710 Physiological Ecology (3)
A consideration of the varied strategies by which animals have solved the functional challenges of life, including homeostasis, locomotion, feeding, functional control, and reproduction. Lectures emphasize the effects of habitat, ecology and historical contingency on the evolution of physiological systems.
Prerequisites: BIO 3614

ENV 4971 Independent Study Research (1)
A field, laboratory, library and/or policy investigation of a basic or applied environmental issue performed independently by the student under the supervision of a faculty research mentor. ENV 4961 may be repeated, or combined with ENV 4962 or ENV 4963, to a total of four credits toward a SESS program’s major elective requirement.
Prerequisites: Sophomore, Junior or Senior status in the School of Environmental and Sustainability Sciences, and permission of instructor. Faculty mentors may stipulate additional course prerequisites related to their disciplines.

ENV 4973 Independent Study Research (3)
A field, laboratory, library and/or policy investigation of a basic or applied environmental issue performed independently by the student under the supervision of a faculty research mentor. ENV 4963 may combined with ENV 4961 to a total of four credits toward a SESS program’s major elective requirement.
Prerequisites: Junior or Senior status in the School of Environmental and Sustainability Sciences, and permission of instructor. Faculty mentors may stipulate course prerequisites related to their disciplines.

ENV 4974 Independent Study Research (4)
A field, laboratory, library and/or policy investigation of a basic or applied environmental issue performed independently by the student under the supervision of a faculty research mentor. ENV 4963 may combined with ENV 4961 to a total of four credits toward a SESS program’s major elective requirement.
Prerequisites: Junior or Senior status in the School of Environmental and Sustainability Sciences, and permission of instructor. Faculty mentors may stipulate course prerequisites related to their disciplines.

BIO COURSES

BIO 2500 Principles of Botany (4)
Structure, function, development, reproduction, and evolution of plants. (3 hm. Lec./3 hr. lab.) (E)
Prerequisite: BIO 1300 or BIO 2200 or equivalent or permission of instructor.

BIO 3305 Principles of Microbiology (4)
A study of microorganisms with emphasis on bacteria. Morphology, physiology and metabolism, ecology, taxonomy and methods of culture and identification of some common microorganisms. (3 hr. lec./3 hr. lab.) (E)
Prerequisite: BIO 2400 or permission of instructor.

BIO 3400 Zoology: Form and Function (4)
The evolution of invertebrates and vertebrates using principles of comparative anatomy and physiology. Morphological and functional changes will be correlated with varied environments and adaptations that gave rise to a diversity of life forms. (3 hr. lec./3 hr. lab.) (E)
Prerequisites: BIO 1400 or BIO 2400 and CHEM 1084, or permission of instructor.
BIO 3403-3404 - Anatomy and Physiology I and II (4,4)

An integrated understanding of the structures (both gross and microscopic) and the functions of various body systems. Laboratories are synchronized with lecture materials and include exercises using prosected models and other specimens.

BIO 3403 is the study of the organization of the human body, introductory chemistry, cells, tissues, the integumentary system, skeletal systems and articulations, muscular system and the nervous system. (3 hr. lec./3 hr. lab.) (E)

BIO 3404 is a continuation of BIO 3403 and includes the study of the endocrine system, cardiovascular system, the lymphatic system, the respiratory system, the digestive system, the urinary system and the reproductive system. (3 hr. lec./3 hr. lab.)

Credit not given for both BIO 2402/ BIO 2409 and BIO 3403-3404. (E)

Prerequisites: BIO 2400 and CHEM 2180 or CHEM 2581 or permission of instructor.

BIO 3403 prerequisite for BIO 3404.

BIO 3535 Field Botany (3)

Principles of field identification of local flora with emphasis on use and construction of keys. Two all day Saturday field trips. (E) (Kean Ocean)

Prerequisite: BIO 2500 or BIO 2601 or permission of instructor.

BIO 3614 Principles of Ecology (4)

Factors affecting the distribution and abundance of organisms. Basic ecology is examined at the organismal, population and ecosystem levels. Human impact on the environment. (3 hr. lec./3 hr. lab.) (E)

Prerequisite: BIO 1300 or permission of instructor. Writing Emphasis Course

BIO 4105 Essentials of Biochemistry (4)

An introduction to the chemistry of biologically important compounds and their relationship to the metabolic activity of living cells. Laboratory activities will utilize the methods and techniques currently used in biochemical research. (3 hr. lec./3 hr. lab.) (E)

Prerequisites: One semester of Organic Chemistry, BIO 2400, or permission of instructor.

BIO 4575 Plant Physiology (4)

A study of physiological mechanisms involved in the germination, growth, development and reproduction of green plants, including water relations, carbohydrate metabolism, translocation, photosynthesis, mineral nutrition, growth regulators, and growth and development. (3 hr. lec./3 hr. lab.)

Prerequisites: BIO 1400 or BIO 2400 and BIO 2500.

BIO 4615 Applied Ecology (4)

Examination of environmental problems, solutions and management dealt with by biologists in government and industry. Wildlife management, conservation biology and industrial ecology. Student must provide own transportation for some labs. (3 hr. lec./3 hr. lab.) (SP)

Prerequisite: BIO 3614 or equivalent.

EARTH SCIENCE COURSES

METR 3380 Meteorological Instrumentation (4)

Familiarization with the various instruments used to observe the atmosphere; principles of operation, instrument calibration and maintenance, error analysis, observing systems. (3 hr. lec./3 hr. lab.)

Prerequisites: METR 1300 and MATH 1054.

ATMS 4101 Physical Climatology (4)

The identification, examination, description, and study of the experimental and predictive climate particularly with regard to microclimatic behaviors, responses, and interactions among relevant environmental and life systems. Design and response to physical climate systems, including cost/loss and/or cost/benefit analyses are related to risk factors regionally and locally. Methods include distributional and spatio-temporal analyses to depict, visualize, and predict cause and effect of interactive and competing systems in terms of hazards and planning. Reliability and various applications are made to unique situations for management of physical environments with life systems. (3 hrs lecture, 3 hours lab).

This course is a Major requirement for B.S. in Earth Science.

Prerequisites: ATMS 3101, PHYS 2091, and METR 1300 or permission of instructor.

ES 3000 Global Climate Change and Society (4)

Analysis of evidence of past climate change, present climate variability, and trends related to future climate fluctuation. Examination of major variables controlling climate at a range of temporal scales. Study of the human role in the global climate change, and the response of the environment to such changes, including effects such as ecosystem changes, ocean current changes, and sea level rise. (3 hr. lec./3 hr. lab) (FA)

Prerequisites: METR 1300 and one of the following courses (GEOG, OCEN)

ES 3010 Data Analysis and Modeling in Geoscience (4)

Overview of quantitative skills that is essential in the study of modern earth system science. Introduction to the principles of experimental design, data collection, data analysis, data visualization. Using modern analysis software and tools to facilitate data interpretation, modeling and theory development. (3 hr lec./3 hr lab.) (SO)

Prerequisites: MATH 1010 and four hours of Geoscience or permission of instructor

ES 3020 Aerial Photography and Digital Image Interpretation (4)

Overview of basic concepts related to the acquisition, processing, and interpretation of aerial earth data. Procedures for ground feature identification, measurement, and analysis of aerial photographs and digital images. Review of principles related to satellite data acquisition, map making using new technology such as Geographic Information Systems (GIS), Google Earth, and Google Ocean. (3 hr. lec./3 hr. lab) (SO)

Prerequisites: 2000 Level GEOG or permission from instructor

ES 3200 Geographic Information Systems in Geoscience (4)

Principles and applications of Geographic Information Systems (GIS). Fundamentals of digital cartography, spatial analysis, digital data. Acquiring, assembling, georeferencing field data; topographic maps; images from remote sensing. Emphasis on Earth and Human Systems: population, urban development and land use. (3 hr lec./3 hr lab.) (SP)

Prerequisites: MATH 1054, four hours of Geoscience or permission of instructor

ES 3801-3802 Special Topics in Earth Science (1, 2)

Intensive study of specific topics of an advanced nature in the Earth Science which are not studied in regular courses. Topics will be announced by the department. (E)

Prerequisite: Permission of the instructor.

ES 4200 Remote Sensing (4)

Theory, technology and methods of remote sensing for observing the earth. Application of remote sensing to problems in the earth sciences including resource exploration, weather forecasting, environmental monitoring and land use. (3 hr lec./3 hr lab.) (SP)

Prerequisites: Eight hours of Geoscience, MATH 1054, PHYS 2091 or PHYS 2095

ES 4901-4902 Special Topics in Earth Science (3,3)

Intensive study of specific topics of an advanced nature in the earth sciences. Subject of a semester’s work varies. (E)

Prerequisite: Permission of the instructor.

GEOL 1201 Geologic Hazards (3)

An investigation of geologic hazards such as earthquakes, volcanic eruptions, flooding and beach erosion.
Consideration given to hazards resulting in normal geologic activity as well as those caused by human interaction with the environment. Intended for non-majors. May be taken without GEOL 1202. Students cannot receive credit for both GEOL 1200 and GEOL 1201/1202.

GEOL 1202 Geologic Hazards Laboratory (1)
Must be taken concurrently with GEOL 1202.

GEOL 1205 Mineral and Fossil Fuel Resources (3)

GEOL 1210 Geology of the National Parks (3)
An in-depth study of the depositional, tectonic and erosional processes that have produced the unique geological regions designated as National Parks by the Congress of the United States. Does not fulfill major requirements.

GEOL 2262 Geology and the Environment (3)
Examination of the problems associated with man's urban pattern of civilization and resultant interactions with the geologic environment. Prerequisite: GEOL 1200 or permission of the instructor.

GEOS 1100 Introduction to Earth and Geographical Systems (4)
A study of the earth system from the perspective of a coupled natural and human system. Examination of the physical nature of the system components and their interactions. Fundamental skills in observation, visualization, quantitative methods for diagnosis and prediction of impacts. (3 hrs lecture, 3 hrs lab). This course is a Major requirement for B.S. in Earth Science. (FA)
Prerequisites: MATH 1000

GEOS 2101 Geo-hydro Systems (4)
A study of the earth's geo-hydro systems from the perspective of system analysis. Examination of the dynamics of the systems, human-environment interactions, resource management, and connections with the biological and chemical systems. (3 hrs lecture, 3 hours lab). This course is a Major requirement for B.S. in Earth Science. (SP)
Prerequisites: SELS 1100, MATH 2411 2095

GEOS 4103 Environmental Hazards (4)
A systematic study of rapid-onset events such as seismic, mass movement, atmospheric, hydrological, technological and biophysical hazards that directly threaten human life and communities. Examination of environmental hazards from the perspective of both earth and social sciences. Fundamental skills in analytical, mapping, decision support tools and risk assessment for practical disaster management. (FO)
Prerequisites: GEOS 2101 and SELS 3101 or permission of instructor

GEOS 4201 Urban Geographic Systems (4)
A study of the urban geographic systems from the perspective of research and spatial analysis. Examination of the urban and city concepts and processes, internal structure and system of cities, segregation, migration, industrial geography, urban development and environmental problems. Fundamental skills in applied GIS and spatial analysis for urban geographic analysis, urban environmental assessment, urban and regional planning. (SO)
Prerequisites: ES 3200

METR 2300 Climatology (3)
Global distribution of the principal climatic elements with emphasis on the physical causes of climate. Theories regarding climatic change will also be discussed. Prerequisite: METR 1300 or permission of the instructor.

METR 2301 Climatology Laboratory (1)
Techniques in handling climatological data. Corequisite: METR 2300 or permission of the instructor.

METR 2310 General Meteorology (4)
An overview of meteorology with emphasis on the dynamic aspects of atmospheric behavior. Topics include air masses, fronts, cyclones and anticyclones, winds, theoretical basis of weather forecasting, and mathematical techniques. (3 hr. lec./3 hr. lab.)
Prerequisite: METR 1300 and Math 2412. (may be taken concurrently) or permission of instructor.

METR 2360 Weather Analysis (3)
Familiarization with daily weather data and NCEP forecasting products; plotting and analyzing of weather maps; weather map discussion; weather forecasting; daily weather observations. (2 hr. lec./3 hr. lab.)
Prerequisite: METR 1300.

METR 3360 Air Pollution (3)
An examination of the problem of air pollution as seen principally from a meteorological viewpoint. Topics include the terminology and nomenclature of air pollution, the history of air pollution, types of pollutants in the atmosphere, atmospheric dispersion of pollutants, methods of sampling and control, trends in legislation, and cost benefit and risk analysis. Prerequisites: METR 1300 and Math 1054.

OCEN 3400 Global Change and the Ocean (3)
The ocean's role in regulating climate and the interaction between the ocean, global change, and society. Oceanographic records of change to illustrate the natural variability of ocean circulation, sea-level, ocean acidification, organism migrations, invasions, and mass extinctions through geologic time. Evidence of anthropogenic forcing, future predictions, and potential solutions for society. (SO)
Prerequisites: OCEN 2400

OCEN 3463 Marine Science (4)
Impact of global change on the marine realm. The geologic, biologic and general oceanographic nature of beaches, coral reefs, swamps, estuaries, lagoons and tidal flats, continental shelf, deep sea, and mid-ocean rift zones. Major global environmental issues/topics such as sea level change, ocean carbon cycle, and catastrophic events will be discussed. (3 hr. lec./3 hr. lab.)
Prerequisite: Oceanography 3453 or permission of instructor.

OCEN 3600 Coral Reefs and Coastal Systems (4)
Coral reef and coastal system function and form; hands-on study of the biodiversity, biogeography, ecological interactions, current threats and protection. (3 hr. lec./3 hr. lab.) (SP)

OCEN 4470 Physical Oceanography (4)
Detailed study of the physical aspects of the oceans including ocean currents, radiation, air-sea interaction, theories of the ocean circulation, geostrophic computations, vorticity. (3 hr. lec./3 hr. lab.)
Prerequisite: OCEN 3453 or permission of instructor.

OCEN 4600 Marine Conservation (3)
The science behind maintaining the ocean's diversity; historical context of current marine conservation concepts; marine population and system dynamics; threats to marine diversity; and conflicts between human exploitation, fisheries, and ecosystem function; design, function and policy of marine protected areas and reserves by non-governmental and governmental agencies. (FA)
Prerequisite: 2 lab science courses

OCEN 4605 Field Methods in Marine Research (4)
Field studies and research in the marine environment that integrate principles, techniques, and information for the multidisciplinary study of marine environments. Students participate in
design; conduct a field research project to sample marine environments using oceanographic, geological, and a variety of marine science techniques. (SP)

Corequisite: OCEN 4600 or permission of instructor.

OCEN 4602 Marine Resource Management (3)
The science and politics of protecting the world’s ocean’s resources and the role of marine protected areas (MPAs) in conserving living marine resources. The rapidly developing science, rationale, and controversies surrounding MPAs, fisheries management, ecosystem-based management strategies, and the collective societal impacts of protection.

Prerequisites: 2 lab science courses and permission of instructor.

SUSTAINABILITY SCIENCE COURSES

SUST 1000 Introduction to Sustainability (3)
An introductory course (required for sustainability science majors) that presents the ecological basis for the concern about sustainability. Students will also gain an understanding of the economic and social sustainability issues facing humanity that are the result of the ecological sustainability issues. An introduction to possible solutions to these issues is also presented (3 hrs. lecture). (FA)

SUST 2008 Introduction to Composting (4)
An introduction to composting with an emphasis on anaerobic in-vessel digestion. (3 hrs. lecture, 2 hrs. lab.) (E)

SUST 2200 Introduction to Laws and Sustainability (3)
An overview of the legal system and the laws that have been developed to protect the environment and public health. Will cover the interplay of courts, environmental agencies, and legislatures, along with the role of attorneys and citizens, in the development of laws. Will review the current legal framework for regulating air, water, solid/hazardous wastes, and natural resources with related emerging concepts of sustainability. (3 hrs. lecture) (FA)

SUST 3200 Environmental Health and Safety for Sustainability (3)
Covers recognition, evaluation, and control of environmental health and safety hazards in the workplace and how they relate to the overall sustainability of the company or institution. (3 hrs. lecture) (FO)

SUST 4000 Technologies for Sustainability (3)

SUST 4300 Independent Practicum in Sustainability Science (3)
Concluding course in which students integrate the knowledge they have gained to select, develop and implement projects pertaining to environmental sustainability. This capstone course provides a single opportunity or experience during which students demonstrate that they have accomplished or achieved the program’s educational goals as represented by the various courses taken. Emphasis is on facilitating the students’ transitions to roles in sustainability careers. (SP)

SESS Earth Sciences

The SESS students in the B.S. Degree program options will develop a strong foundation in the Earth Sciences while developing detailed expertise in one of the Concentrations and will apply their knowledge to the environment around them through specialized course work and individual and team-based scientific research projects. Students fully integrate the Earth Science domains of land, water, and air with regard to interactions, impacts, and processes relevant to life systems and hazards. They will be familiar with disciplinary content, methods, and have technical abilities from each.

All SESS Earth Sciences graduates will be fully prepared to pursue advanced graduate degrees within their own or related concentrations; for career opportunities in local, state, and federal government agencies associated with such areas as private weather services, natural resource management and conservation, geological survey, industrial and business applications, environmental monitoring, assessment and mapping; and for career tracks in local weather forecasting (and media), oil, and mapping industries. SESS students can receive degrees in the following Degree Program Options:

BS Degree in Earth Science, Option in Geo-Science
BS Degree in Earth Science, Option in Environmental Science

For information regarding College/program mission and student learning outcomes please see http://www.kean.edu/KU/CNAHS-Mission-and-SLOs

B.S. DEGREE EARTH SCIENCE

OPTION: ENVIRONMENTAL SCIENCE

The Environmental Science program prepares our students for the demands and challenges of interdisciplinary careers and/or graduate studies in the environmental and sustainability sciences with an eye towards integrated societal systems and infrastructures. The option emphasizes modern quantitative and analytical skills for exploring multidisciplinary problems in a collaborative environment including field, laboratory, and practicum experiences.

GENERAL EDUCATION

FOUNDATIONS REQUIREMENTS

GE 1000 Transition to Kean
OR
GE 3000 Transfer Transitions
ENG 1030 College Composition
MATH 1054 Pre-Calculus #
COMM1402 Speech Communication
GE 2024 Research and Technology

DISCIPLINARY/INTERDISCIPLINARY DISTRIBUTION REQUIREMENTS

Humanities
*ENG 2403 World Literature
Select one course from following areas:
Fine Arts or Art History
Foreign Languages
Music or Theatre
Philosophy or Religion
Interdisciplinary
Social Sciences

*HIST 1602 Worlds of History
Select one course from following areas:
Economics or Geography
Political Science
Psychology
Sociology or Anthropology
Interdisciplinary
Science & Mathematics
MATH 1016 Statistics
CHEM 1083 Chemistry I
CHEM 1084 Chemistry II

* GE Required Distribution Course

ADDITIONAL REQUIREMENTS

BIO 1300 General Biology I
BIO 1400 General Biology II
CPS 1231 Fund of Computer Science
CHEM 1084 Chemistry II
environment.
problems in a collaborative
skills for exploring multi-disciplinary
modern quantitative and analytical
The option will emphasize using
graduate studies in the geosciences.
interdisciplinary careers and/or
program prepares our students for

14

SUST 1000 Intro to Sustainability 3
GEOS 2101 Geo-Hydro Systems
ES 2200 Methods in Geoscience 4
OCEN 2400 Oceanography 4
ATMS 3101 Atmosp Systems 4
ES 3200 GIS in Geoscience 4
BIO 3614 Principles of Ecology 4
ENV 3050 or 3051 Field Methods 4

MAJOR/GE CAPSTONE COURSE
ES 4981 Environmental Issues Seminar (WE) 3

PROGRAM FOCUS-RELATED ELECTIVES 15
(Select from approved list in consultation with Program Coordinators and advisors; at least 50% must be 3000/4000 level courses)

FREE ELECTIVES 9
(50% of free electives must be at the 3000-4000 level)

TOTAL 125

1 University Requirement for Graduation for all undergraduate students that must be satisfied in one of two ways: Complete GE 1000 (all freshmen and transfers entering with 0-29 credits) OR GE 3000 (transfers entering with 30 credits or more).

# A Student whose qualifying score on the placement test makes them eligible to take either MATH 1054 or MATH 2411 may take that course instead. In that case, either MATH 1054 or MATH 2411 will count as the General Education requirement and the student may take another three to six credits in Free Electives to total 124 S.H.

B.S. DEGREE EARTH SCIENCE

OPTION: GEO-SCIENCE
The Earth System Science program prepares our students for the demands and challenges of interdisciplinary careers and/or graduate studies in the geosciences. The option will emphasize using modern quantitative and analytical skills for exploring multi-disciplinary problems in a collaborative environment.

GENERAL EDUCATION 32

FOUNTAINS REQUIREMENTS
GE 1000 Transition to Kean1 1
OR
GE 3000 Transfer Transitions1 1
ENG 1030 College Composition 3
MATH 1000 Algebra for College Students # 3
COMM 1402 Speech Communication 4
GE 2024 Research and Technology 3

DISCIPLINARY/INTERDISCIPLINARY DISTRIBUTION REQUIREMENTS
Humanities 6
*ENG 2403 World Literature 3
Select one course from following areas:
Fine Arts or Art History 3
Foreign Languages 3
Music or Theatre 3
Philosophy or Religion 3
Interdisciplinary 3
Social Sciences
*HIST 1602 Worlds of History 3
Select one course from following areas:
Economics or Geography 3
Political Science 3
Psychology 3
Sociology or Anthropology 3
Interdisciplinary 3
Science & Mathematics 7
MATH 1054 Precalculus # 3
B IOS 1200 Introduction to Biology 4
* GE Required Distribution Course

ADDITIONAL REQUIREMENTS 24
MATH 2411 Calculus I 3
MATH 2412 Calculus II 3
CHEM 1083 Chemistry I 3
CHEM 1084 Chemistry II 3
MATH 2526 Applied Statistics 3
COMM 2405 Public Speaking 3
ENG 3090 Professional and Technical Writing 3
SELS 1000 Scientific Integrity 1

MAJOR AND CAPSTONE REQUIREMENTS 56
Required Foundation Core Courses
GEOS 1100 Intro to Earth & Geog Systems 4
GEOS 2101 Intro to Geo-hydro Systems 4
SELS 3101 Atmosp Systems 4
ES 3200 GIS in Geoscience 4
GEOL 3265 Geomorphology 4
GEOL 3266 Hydrology 4
ES 4200 Remote Sensing 4
GEOS 4103 Environmental Hazards 4
GEOS 4201 Urban Geographic Systems 4

SELS 4101 Physical Climatology

MAJOR/GE CAPSTONE COURSE
ES 4963 and 4964 Honors Research Seminar in ES I & II 2,2

INTERDISCIPLINARY ELECTIVES 6
(Select from approved interdisciplinary courses in Earth Science, Biology, or Chemistry)

MAJOR ELECTIVES 6
(Select from approved interdisciplinary courses in Earth Science, Biology, or Chemistry)

FREE ELECTIVES 12
(50% of free electives must be at the 3000-4000 level)

TOTAL 124

1 University Requirement for Graduation for all undergraduate students that must be satisfied in one of two ways: Complete GE 1000 (all freshmen and transfers entering with 0-29 credits) OR GE 3000 (transfers entering with 30 credits or more).

# A Student whose qualifying score on the placement test makes them eligible to take either MATH 1054 or MATH 2411 may take that course instead. In that case, either MATH 1054 or MATH 2411 will count as the General Education requirement and the student may take another three to six credits in Free Electives to total 124 S.H.

COURSES FOR SESS EARTH SCIENCE STUDENTS

ENV 1000 Introduction to Environmental Science (3)
An introduction to the study of the environment as an inclusive system that is connected to the diverse scientific fields of biology, chemistry, geology, hydrology, atmospheric science, climatology and geography. Processes of data collection, sampling, analysis, mapping, modeling and predicting are explored. (E)
Prerequisites: ES 1000 or permission of instructor.

ENV 3051 Field Methods (4)
Field-based course providing the opportunity to collect biological data in a terrestrial ecosystem while applying current field research methods. Emphasis will be on observation, species identification, field notes, sampling methods, observational and experimental study design, mapping, data analysis, and scientific writing. (3 hours lecture, 3 hours lab). Pre-requisites: GE 2024

ENV 3201 Biodiversity (4)
An introduction to the concepts, methods and significance of
readings from the primary literature are used to apply the ideas and analytical techniques introduced in lecture. This course is equivalent to SUST 3310. Prerequisites: GE 2024

ENV 3230 Urban Ecology (3)
An examination of ecological processes in human-dominated landscapes from the scientific, historical, and cultural perspectives. Human influence on, and response to, natural systems is emphasized. Readings from the primary literature are used to illustrate current research trends and methodologies. This course is equivalent to SUST 3330 (3 hr. lecture).
Prerequisites: GE 2024 or permission of instructor

ENV 3250 Medicinal Botany (3)
Explores the uses of plants as medicine, ranging from traditional indigenous approaches to modern western pharmaceuticals. The biology and use of medicinal plants for treating everything from the common cold to cancer is investigated. (3 credits of lecture).
Prerequisite: GE 2024 or Permission of Instructor.

ENV 3720 Entomology (4)
An introduction to the biology of insects and related arthropods. Lectures integrate ecology, evolution and behavior with functional biology and focus on insects as examples of fundamental concepts. Consideration is also given to effect of insects on the global economy and to sustainable solutions to these problems. Laboratories stress collection, identification and preservation of arthropod specimens. Fieldwork and the preparation of a collection are required. (3 hours lecture, 3 hours lab).
Prerequisites: ENV 3201 or BIOS 3201 or SUST 3310.

ENV 4210 Conservation Ecology (4)
This course examines the historical and ethical background of the conservation movement and the science of conservation biology. It covers various aspects that must be considered in conservation including genetic, species, and ecosystem dynamics and diversity. Connections are made between industrial development and the natural world, relating societal impacts on plants and wildlife to the goals of conservation. Parts of the course will be presented using a Problem-based Learning (PBL) format involving student-led case studies based on real issues.
Prerequisites: ENV 3201 or BIOS 3201 or SUST 3310 or BIO 3614

ENV 4435 Behavioral Ecology (3)
An introduction to the behavior of animals in natural settings, with emphasis on the ecological and evolutionary levels of organization. Topics include communication, foraging, defense, mating systems, social biology, and research methodology. Lectures stress analytical models, hypothesis testing and methodology. This course is a major elective for Environmental Biology majors (BS) in the School of Environmental and Sustainability Sciences. Prerequisites: BIO 3614 or permission of instructor

ENV 4600 Plant-Animal Interactions (3)
An examination of how plant and animals interact through evolutionary time and thereby shape communities and ecosystems. Topics include coevolutionary theory, herbivory, plant defense strategies, sequestration of plant compounds, animal agriculture, pollination ecology and seed dispersal. (3 hr. lecture).
Prerequisites: BIO 3614

ENV 4710 Physiological Ecology (3)
A consideration of the varied strategies by which animals have solved the functional challenges of life, including homeostasis, locomotion, feeding, functional control, and reproduction. Lectures emphasize the effects of habitat, ecology and historical contingency on the evolution of physiological systems.
Prerequisites: BIO 3614

ENV 4961 Independent Study Research (1)
A field, laboratory, library and/or policy investigation of a basic or applied environmental issue performed independently by the student under the supervision of a faculty research mentor. ENV 4961 may be repeated, or combined with ENV 4962 or ENV 4963, to a total of four credits toward a SESS program’s major elective requirement. Prerequisites: Sophomore, Junior or Senior status in the School of Environmental and Sustainability Sciences, and permission of instructor. Faculty mentors may stipulate additional course prerequisites related to their disciplines. Prerequisites: Sophomore, Junior or Senior status in the School of Environmental and Sustainability Sciences, and permission of instructor. Faculty mentors may stipulate additional course prerequisites related to their disciplines.

ENV 4962 Independent Study Research (2)
A field, laboratory, library and/or policy investigation of a basic or applied environmental issue performed independently by the student under the supervision of a faculty research mentor. ENV 4962 may be repeated, or combined with ENV 4961, to a total of four credits toward a SESS program’s major elective requirement. Prerequisites: Junior or Senior status in the School of Environmental and Sustainability Sciences, and permission of instructor. Faculty mentors may stipulate course prerequisites related to their disciplines.

ENV 4963 Independent Study Research (3)
A field, laboratory, library and/or policy investigation of a basic or applied environmental issue performed independently by the student under the supervision of a faculty research mentor. ENV 4963 may combined with ENV 4961 to a total of four credits toward a SESS program’s major elective requirement. Prerequisites: Junior or Senior status in the School of Environmental and Sustainability Sciences, and permission of instructor. Faculty mentors may stipulate course prerequisites related to their disciplines.

ENV 4964 Independent Study Research (4)
A field, laboratory, library and/or policy investigation of a basic or applied environmental issue performed independently by the student under the supervision of a faculty research mentor. ENV 4964 may combined with ENV 4961 to a total of four credits toward a SESS program’s major elective requirement. Prerequisites: Junior or Senior status in the School of Environmental and Sustainability Sciences, and permission of instructor. Faculty mentors may stipulate course prerequisites related to their disciplines.

ES 3200 Geographic Information Systems (GIS) in Geoscience (4)
Principles and applications of Geographic Information Systems (GIS). Fundamentals of digital cartography, spatial analysis, digital data. Acquiring, assembling, georeferencing field data; topographic maps; images from remote sensing. Emphasis on Earth and Human Systems: population, urban development and land use. (3 hr lec./3 hr lab.) (SP)
Prerequisites: MATH 1054, four hours of Geoscience or permission of instructor

ES 4200 Remote Sensing (4)
Theory, technology and methods of remote sensing for observing the earth. Application of remote sensing to problems in the earth sciences including resource exploration, weather forecasting, environmental monitoring and land use. (3 hr lec./3 hr lab.) (SP)
Prerequisites: Eight hours of Geoscience, MATH 1054, PHYS 2091 or PHYS 2095

ES 4963,4964 - Honors Research Seminar in Earth Science I and II (2,2)
Individual research of an original nature under the supervision of a research sponsor. Results of the work to be presented as a seminar. May be taken in place of but not in addition to ES 4953, 4954. Following the presentation, the speaker serves as moderator in a discussion of the subjects.
Prerequisite: Earth Science major of senior standing, with a grade point average of 3.0 overall as well as in Earth Science courses, admitted upon written nomination by a departmental research sponsor and written recommendation by one other departmental faculty member. (FA, SP)

Writing Emphasis Course

GEOL 3261 Mineralogy (4)
An introductory study of minerals; their morphology, internal structure, origin, occurrence, and properties. (3 hr. lec./3 hr. lab.) (FO)
Prerequisites: GEOL 1200 and CHEM 1083-1084, or permission of the instructor.

GEOL 3263 Structural Geology (4)
A study of the architecture of the rock materials of the earth, including a description of geologic structure in terms of origin, principles and mechanics of crustal deformation. (3 hr. lec./3 hr. lab.) (FE)
Prerequisite: GEOL 1200 or permission of the instructor.

GEOL 3264 Invertebrate Paleontology (4)
A study of the classification, relationships, and evolutionary history of fossils. Emphasis is placed on paleoecological relationships. (3 hr. lec./3 hr. lab.) (SP)
Prerequisite: GEOL 1200 or permission of the instructor.

GEOL 3265 Geomorphology (4)
Analysis of the various land forms of the Earth's surface in terms of their nature, origin, and evolution. The influence of the different geologic and climatic environments upon the development of land form. Map interpretation. (3 hr. lec./3 hr. lab.) (SO)
Prerequisite: GEOL 1200 or permission of the instructor.

GEOL 3266 Hydrology (4)
The distribution and movement of water with emphasis given to surface waters, their relation to the fluvial aspects of geomorphology and to the impact of man on the hydrologic cycle. (3 hr. lec./3 hr. lab.) (SP)
Prerequisite: GEOL 1200 or METR 1300 or permission of instructor.

GEOL 3281 Field Geology (2)
Field practice in the methods of geological mapping including the use of pace, compass, and clinometer surveys, the plane table and alidade, and aerial photographs. (FE)
Prerequisite: GEOL 1200 or permission of the instructor.

GEOL 4252 Field Geology II (2)
Field conference and studies of one or more selected areas with written reports and maps. Additional expenses may be incurred. (SO)
Prerequisites: GEOL 3261, 3263, 4266 (may be taken concurrently), or permission of the instructor.

GEOL 4265 Petrology (4)
A study of the petrologic processes at work upon and within the crust of the earth that produce and modify rock bodies. (3 hr. lec./3 hr. lab.)
Prerequisite: GEOL 3261 or permission of the instructor.

GEOL 4266 Stratigraphy and Sedimentation (4)
Origin and characteristics of sediment grains; sedimentation processes; diagenesis and rock classification; correlation of stratigraphic units; sedimentary environments and their deposits. (3 hr. lec./3 hr. lab.) (SO)
Prerequisite: Twelve hours of geology or permission of the instructor.

GEOS 1100 Introduction to Earth and Geographical Systems (4)
A study of the earth system from the perspective of a coupled natural and human system. Examination of the physical nature of the system components and their interactions. Fundamental skills in observation, visualization, quantitative methods for diagnosis and prediction of impacts. (3 hrs lecture, 3 hours lab). This course is a Major requirement for B.S. in Earth Science. (FA)
Prerequisites: MATH 1000

GEOS 2101 Geo-hydro Systems (4)
A study of the earth's geo-hydro systems from the perspective of system analysis. Examination of the dynamics of the systems, human-environment interactions, resource management, and connections with the biological and chemical systems. (3 hrs lecture, 3 hours lab). This course is a Major requirement for B.S. in Earth Science. (SP)
Prerequisites: SELS 1100, MATH 2411 2095

GEOS 4103 Environmental Hazards (4)
A systematic study of rapid-onset events such as seismic, mass movement, atmospheric, hydrological, technological and biophysical hazards that directly threaten human life and communities. Examination of environmental hazards from the perspective of both earth and social sciences. Fundamental skills in analytical, mapping, decision support tools and risk assessment for practical disaster management. (FO)
Prerequisites: GEOS 2101 and SELS 3101 or permission of instructor

GEOS 4201 Urban Geographic Systems (4)
A study of the urban geographic systems from the perspective of research and spatial analysis. Examination of the urban and city concepts and processes, internal structure and system of cities, segregation, migration, industrial geography, urban development and environmental problems. Fundamental skills in applied GIS and spatial analysis for urban geographic analysis, urban environmental assessment, urban and regional planning. (SO)
Prerequisites: ES 3200

METR 3370 Atmospheric Dynamics (4)
A mathematical formulation of the physical laws which govern weather processes and atmospheric motion. (3 hr. lec./3 hr. lab.) (FE)
Prerequisites: METR 1300, PHYS 2096, MATH 2412 or permission of instructor.

METR 3371 Atmospheric Thermodynamics (4)
The application of thermodynamic principles to the atmosphere: heat, work, internal energy and available energy of the atmosphere; the thermodynamics of water vapor and moist air; dry and moist thermodynamic processes; hydrostatic equilibrium and altimetry; atmosphere stability and convection. (3 hr. lec./3 hr. lab.) (FE)
Prerequisites: METR 1300, PHYS 2096, MATH 2412 or permission of instructor.

METR 3372 Physical Meteorology (3)
An examination of the physics of atmospheric phenomena. Topics include wave theory, transfer processes, cloud physics, atmospheric radiation, and remote sensing. Emphasis is placed on the application of physical theory to obtain a better understanding of atmospheric phenomena. (SE)
Prerequisites: MATH 2412, METR 1300, PHYS 2096.

METR 3380 Meteorological Instrumentation (4)
Familiarization with the various instruments used to observe the atmosphere; principles of operation, instrument calibration and maintenance, error analysis, observing systems. (3 hr. lec./3 hr. lab.) (SO)
Prerequisites: METR 1300 and MATH 1054.

METR 4351-4352 Synoptic Meteorology I and II (4,4)
Understanding the processes which govern the weather; practical application of the predictive equations through use of weather maps; in depth analysis of NCEP forecasting products; extensive plotting and analysis of synoptic charts stressing the three dimensional nature of weather systems; weather forecasting and briefing. (2 hr. lec./6 hr. lab.) (FO, SE) Prerequisites: METR 3370 and 3371 or permission of the instructor. METR 4351 is a prerequisite to 4352.

**Sustainability Science**

The B.S. in Sustainability Science is designed to prepare students in the discipline of sustainability and environmental sciences that focuses on three main areas: environment, economy, and society. These are examined contextually and with regard to their inter-relationships. Students in the Sustainability Science major must obtain at least a 3.25 high school GPA.

For information regarding College/program mission and student learning outcomes please see http://www.kean.edu/KU/Sustainability

**ATMS 3101 Atmospheric Systems (4)**

Atmospheric dynamics in relation to environmental and life systems based on fundamental principles using observational data, conceptualization of atmospheric features, forces, and processes, and analysis. These include basic principles in radiative transfers and chemistry, thermodynamic properties and behaviors, and fluid motion. Weather systems, hazards, and impacts are examined with regard to modeling and prediction in both a quantitative and qualitative manner. Emphases include graphical and statistical analysis, spatiotemporal relationships, and forecast uncertainty. Local and global scale aspects are studied with regard to physical models, bio-meteorology, atmospheric chemistry, and other relevant settings. (3 hrs lecture, 3 hours lab). This course is a Major requirement for B.S. in Earth Science

**Prerequisites:** ATMS 3101, PHYS

**ATMS 4101 Physical Climatology (4)**

The identification, examination, description, and study of the experimental and predictive climate particularly with regard to microclimatic behaviors, responses, and interactions among relevant environmental and life systems. Design and response to physical climate systems, including cost/loss and/or cost/benefit analyses are related to risk factors regionally and locally. Methods include distributional and spatio-temporal analyses to depict, visualize, and predict cause and effect of interactive and competing systems in terms of hazards and planning. Reliability and various applications are made to unique situations for management of physical environments with life systems. (3 hrs lecture, 3 hours lab). This course is a Major requirement for B.S. in Earth Science

**Prerequisites:** ATMS 3101, PHYS

**BACHELOR OF SCIENCE IN SUSTAINABILITY SCIENCE** 124

**GENERAL EDUCATION** 36

**FOUNDATION REQUIREMENTS** 13

GE 1000 Transition to Kean 1

OR

GE 3000 Transfer Transitions 1

ENG 1030 Composition 3

MATH 1054 Pre-Calculus 3

COMM 1402 Speech Communication

GE 2024 Research & Technology 3

**DISCIPLINARY & INTERDISCIPLINARY DISTRIBUTION REQUIREMENTS**

**Humanities: (from different areas)** 6

*ENG 2403 World Literature 3

Fine Arts/Art History 3

Philosophy or Religion 3

Foreign Languages (Must take I and II for credit) 3

Music or Theatre 3

Interdisciplinary 3

**Social Sciences: (from different areas)** 6

*HIST 1062 Worlds of History 3

Psychology 3

Economics or Geography 3

**Physical Science** 8

CHEM 1083 Chemistry I 4

**SUST 4903 Indep. Practicum in Sustainability Science** 3

**ADDITIONAL REQUIRED COURSES** 34

BIO 1000 Principles of Biology 4

BIO 2601 Ecology, Environment & Humanity 4

MATH 2411 Calculus I 3

MATH 2412 Calculus II 3

TECH 1010 Information Technology Foundations 3

CHEM 1084 Chemistry II 4

CHEM 2181 Organic Chemistry I 3

CHEM 2391 Inorganic Chemistry 3

HED 3635 Introduction to Public Health 3

PHY 2091 Physics I 4

**ACADEMIC MAJOR TOTAL CREDITS** 38

**REQUIRED: FOUNDATION CORE** 20

SUST 1000 Intro to Sustainability 3

SUST 2240 Systems Modeling 2

SUST 3210 GIS in Sustainability 4

SUST 3250 Climate Science 3

SUST 3340 Scientific Integrity 1

SUST 3310 Biodiversity for Sustainability 3

SUST 3400 Applied Statistics/Methods in Sustainability 4

**MAJOR/RELATED ELECTIVES** 18

SUST 3531 Energy & Pollution Management 3

SUST 3330 Urban Ecology 3

SUST 4330 Conservation Biology 3

BIO 2200 Cell Biology 4

BIO 2400 Genes, Organisms, Populations 4

BIO 2500 Principles of Botany 4

BIO 3400 Zoology: Form and Function 4

BIO 3614 Principles of Ecology 4

BIO 3000 Marine Biology 4

BIO 4615 Applied Ecology 4

CHEM 2182 Organic Chemistry II 3

GEOL 2020 Conservation of Natural Resources 3

GEOG 3410 Urban Geography 3

GEOL 1200 Introduction to Geology 4

GEOL 2262 Geology and the Environment 3
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>METR 1300</td>
<td>Introduction to Meteorology</td>
<td>4</td>
</tr>
<tr>
<td>METR 3360</td>
<td>Air Pollution</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 3266</td>
<td>Hydrology</td>
<td>4</td>
</tr>
<tr>
<td>OCEN 3453</td>
<td>Introduction to Oceanography</td>
<td>4</td>
</tr>
<tr>
<td>PS 3845</td>
<td>Regulatory Law and Public Policy</td>
<td>3</td>
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<tr>
<td>PHIL 3800</td>
<td>Environmental Ethics</td>
<td>3</td>
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<td>REC 3810</td>
<td>Recreation and the Environment</td>
<td>3</td>
</tr>
<tr>
<td>SOC 2500</td>
<td>Introduction to Global Studies</td>
<td>3</td>
</tr>
<tr>
<td>SOC 3420</td>
<td>Environment and Society</td>
<td>3</td>
</tr>
</tbody>
</table>

**FREE ELECTIVES**: 16

At least 50% must be 3000/4000 level

1 University Requirement for Graduation for all undergraduate students that must be satisfied in one of two ways: Complete GE 1000 (all freshmen and transfers entering with 0-29 credits) OR GE 3000 (transfers entering with 30 credits or more).

*G.E. required course

**Course required by Major

***All Major courses require a grade of C or better

Students should meet with the Executive Director for advisement because of pending changes to the guidesheet.

**SUSTAINABILITY COURSES**

**SUST 1000 Introduction to Sustainability (3)**

An introductory course (required for sustainability science majors) that presents the ecological basis for the concern about sustainability. Students will also gain an understanding of the economic and social sustainability issues facing humanity that are the result of the ecological sustainability issues. An introduction to possible solutions to these issues is also presented (3 hrs. lecture). (FA)

**SUST 1001 Biology Concepts for Sustainability I (4)**

An introductory course in biology concepts related to sustainability science. A broad overview of the diverse discipline of biology that introduces the chemical basis of life, cells, genetics, evolution, diversity, plants, animals, and ecology. (3 hrs. lecture, 3 hrs. lab) Equivalent to BIOS 1200. Not equivalent to BIO 1000.

**SUST 1002 Chemistry Concepts for Sustainability I (4)**

Essential concepts in the field of chemistry for sustainability majors will be covered. This includes basic chemistry concepts, bonding, chemical equations, behavior of light, chemistry of solutions, energy and thermodynamics, which are applied to sustainability issues. (3 hrs. lecture, 3 hrs. lab)

**SUST 1003 Earth Systems Concepts for Sustainability I (4)**

A study of Earth systems from the perspective of coupled non-human and human systems. Examination of the physical nature of the components of the systems and their interactions. Fundamental skills in observation, visualization, quantitative methods for diagnosis and prediction of impacts related to sustainability. (3 hrs lecture, 3 hours lab). Equivalent to SELS1100.

**SUST 1004 First Year Seminar on Sustainability (1)**

A discussion-based seminar to create a sense of unity and intellectual camaraderie among sustainability science majors as they explore contemporary events/issues regarding sustainability. (1 hr discussion) (SP)

**SUST 2000 Mathematical Principles for Sustainability (3)**

Environmental, social and economic sustainability issues investigated using relevant mathematical concepts. (3 hrs. lecture) (FA)

**SUST 2001 Biology Concepts for Sustainability II (4)**

An in-depth consideration of functional and ecological concepts introduced in SUST 1001. Topics include: animal diversity, plant and animal physiology, and the ecology of populations, communities and ecosystems. (3 hrs. lecture, 3 hrs. lab). Equivalent to BIOS 2201. Not equivalent to BIO 2200 or 2400.

**SUST 2002 Chemistry Concepts for Sustainability II (4)**

A continuation of SUST 1002. Essential concepts in the field of chemistry for sustainability majors will continue to be covered. This includes acid/base chemistry, nuclear chemistry, electrochemistry, organic chemistry and biochemistry. These subjects will be addressed with respect to sustainability issues. (3 hrs. lecture, 3 hrs. lab)

**SUST 2003 Earth Systems Concepts for Sustainability II (4)**

A study of Earth’s geo-hydro systems from the perspective of system analysis. Examination of the dynamics of the systems, human-environment interactions, resource management, and connections with the biological and chemical systems as related to sustainability. (3 hrs lecture, 3 hours lab). Equivalent to SELS 2101.

**SUST 2004 Second Year Seminar on Sustainability (1)**

A discussion-based seminar to create a sense of unity and intellectual camaraderie among sustainability science majors as they explore contemporary events/issues regarding sustainability. (1 hr discussion) (SP)

**SUST 2006 Mathematical Applications for Sustainability (3)**

An introduction to Mathematica for technical, scientific, and business computation and programming. Fundamental conventions and notation, basic concepts, applications: graphics and animation, lists, statistical calculations, max/min problems. (3 hrs. lecture) (SP)

**SUST 2007 Applied Calculus for Sustainability (4)**

Topics in differential and integral calculus with emphasis on environmental, social, and economic sustainability issues. Temporal and spatial rates of change, critical points, maximization, graph projections, functions of more than one variable, gradients. Use of Mathematica software. Not equivalent to Calculus I offered by the Math Department. (4 hrs. lecture)

**SUST 2008 Introduction to Composting (4)**

An introduction to composting with an emphasis onerobic in-vessel digestion. (3 hrs. lecture, 2 hrs. lab.) (E)

**SUST 2009 Applied Physics for Sustainability (4)**

An introduction to physics with emphasis on environmental, social, and economic sustainability issues. Newton’s Laws, energy, electricity and heat, fossil fuel production and consumption, alternative sources, Earth system issues and physics. Use of Mathematica software. (3 hrs. lecture, 3 hrs. lab) (FA)

**SUST 2094-96 Independent Research in Sustainability Science I (1-3)**

A laboratory or field investigation of a sustainability research topic, performed independently by student, under supervision of a faculty member. May be repeated for credit up to a total of 3 credits. A maximum of 3 credits of independent research may be used to fulfill major elective requirements.

**SUST 2097-99 Special Topics in Sustainability Science I(1-3)**

Class work designed to provide an opportunity to study special topics in sustainability science that are not studied in regular courses. The program will announce topics. One semester hour of credit given for each 15 hours of classwork. A maximum of 6 credits of special topics may be used to fulfill major elective requirements.

**SUST 2100 Systems Modeling for Sustainability (3)**
Focuses on the geosphere components in terms of human systems and their interactions as related to sustainable systems and environments. Human and environmental systems are analyzed conceptually, statistically, and in an integrated manner through modeling approaches. (3 hrs. lecture) (FE)

SUST 2101 Applied Organic Chemical Systems for Sustainability (4)
A fundamentals course in organic molecular structure, nomenclature, and basic reaction chemistry classification geared toward the justification of newly emerging sustainable chemical practices. (3 hrs. lecture, 2 hrs. lab) (SE)

SUST 2200 Introduction to Laws and Sustainability (3)
An overview of the legal system and the laws that have been developed to protect the environment and public health. Will cover the interplay of courts, environmental agencies, and legislatures, along with the role of attorneys and citizens, in the development of laws. Will review the current legal framework for regulating air, water, solid/hazardous wastes, and natural resources with related emerging concepts of sustainability. (3 hrs. lecture) (FA)

SUST 2201 Economics for Sustainability (3)
Uses economic theories and models to define and analyze issues of economic sustainability, development, and policy. In particular, the focus will be on intergenerational equity and human-nature relations. (3 hrs. lecture) (SE)

SUST 2202 Religion & Sustainability (3)
Explores the role of religion and of specific religions in fostering unsustainability and in achieving sustainability. (3 hrs. lecture) (SO)

SUST 2203 Intercultural Communication for Sustainability (3)
An analysis of skills and techniques for verbal and nonverbal communication and related factors within and between various cultures, predictions of patterns and effects, and communication barriers as they relate to communicating about sustainability. (3 hrs. lecture) (FA)

SUST 3000 Climate Science and Sustainability (4)
The course focuses on the climate system in terms of its observation, scale of motions and features, and analytic techniques used to understand its behavior and changes. The emphasis of the course is on both sustainability climates and climate variability in order to promote effective responses to climate changes. (3 hrs. lecture, 2 hrs. lab). (SP)

SUST 3001 Applied Statistics for Sustainability (4)
An interdisciplinary approach for sustainability majors, with emphasis on experimental design, analysis tool selection, and interpretation of results. Lectures emphasize hypothesis testing, categorization of data, analysis using current statistical packages, and interpretation and reporting of results. Students will demonstrate a working ability to identify and execute an appropriate method of analysis for specific studies. (3 hr. lecture, 3 hrs. tutorial) (SP)

SUST 3003 Third Year Seminar on Sustainability (1)
A discussion-based seminar to create a sense of unity and intellectual camaraderie among sustainability science majors as they explore contemporary events/issues regarding sustainability. (1 hr discussion) (SP)

SUST 3094-96 Independent Research in Sustainability Science I II (1-3)
A laboratory or field investigation of a sustainability research topic, performed independently by student, under supervision of a faculty member. May be repeated for credit up to a total of 3 credits. A maximum of 3 credits of independent research may be used to fulfill major elective requirements.

SUST 3097-99 Special Topics in Sustainability Science (1-3)
Class work designed to provide an opportunity to study special topics in sustainability science that are not studied in regular courses. The program will announce topics. One semester hour of credit given for each 15 hours of classwork. A maximum of 6 credits of Special Topics may be used to fulfill major option elective requirements.

SUST 3100 Urban Ecology and Sustainability (3)
An examination of ecological processes in human-dominated landscapes from the scientific, historical and cultural perspectives. Human influence on, and response to, natural systems is emphasized. Readings from the primary literature are used to illustrate current research trends and methodologies. Option elective for sustainability science major. (3 hrs. lecture)

SUST 3102 Biodiversity and Sustainability (3)
An introduction to the concepts, methods, and significance of biodiversity science. Case studies and readings from the primary literature are used to apply the ideas and analytical techniques introduced in lecture. Option elective for sustainability science major. (3 hrs. lecture)

SUST 3200 Environmental Health and Safety for Sustainability (3)
Covers recognition, evaluation, and control of environmental health and safety hazards in the workplace and how they relate to the overall sustainability of the company or institution. (3 hrs. lecture) (FO)

SUST 3201 Policies and Sustainability (3)
Provides an in-depth view of the stakeholders that have a role in managing our natural resources and the policy-making processes that will impact our ability to achieve sustainability. (3 hrs. lecture) (FO)

SUST 3202 Accounting for Sustainability (3)
Covers the measurement, reporting, and disclosure in financial statements of sustainability strategies adopted by for profit, not for profit, non-governmental, and governmental agencies. (3 hrs. lecture) (FE)

SUST 3203 Finance for Sustainability (3)
Examines the role of financial institutions, capital markets, and banking on sustainability. (3 hrs. lecture) (FE)

SUST 4000 Technologies for Sustainability (3)
Technologies that will support the transition to sustainability will be explored. Special emphasis will be given to those technologies that are not fully integrated into global sustainability initiatives. (FA)

SUST 4001 Essential Readings in Sustainability (3)
A review of the literature in the field of sustainability, including, but not limited to books, journal articles, proceedings, reports, and the popular press. Writing emphasis course. (FA)

SUST 4002 GIS for Sustainability (3)
Fundamental concepts of geographic information systems and their applications in sustainable development. (3 hrs. lecture, 3 hrs. lab) (SE)

SUST 4003 Fourth Year Seminar on Sustainability (1)
A discussion-based seminar to create a sense of unity and intellectual camaraderie among sustainability science majors as they explore contemporary events/issues regarding sustainability. (1 hr discussion) (SP)

SUST 4094-96 Independent Research in Sustainability Science III (1-3)
A laboratory or field investigation of a sustainability research topic, performed independently by student, under supervision of a faculty member. May be repeated for credit up to a total of 3 credits. A maximum of 3 credits of independent research may be used to fulfill major elective requirements.
SUST 4097-99 Special Topics in Sustainability Science III (1-3)
Class work designed to provide an opportunity to study special topics in sustainability science that are not studied in regular courses. The program will announce topics. One semester hour of credit given for each 15 hours of classwork. A maximum of 6 credits of Special Topics may be used to fulfill major option requirements.

SUST 4100 Conservation Biology and Sustainability (3)
This course examines the historical and ethical background of the conservation movement and the science of conservation biology. It covers various aspects that must be considered in conservation including genetic, species, and ecosystem dynamics and diversity. Connections are made between industrial development and the natural world, relating societal impacts on plants and wildlife to the goals of conservation. Parts of the course will be presented using a Problem-based Learning (PBL) format involving student-led case studies based on real issues. Option elective for sustainability science major. (3 hrs lecture)

SUST 4101 Natural Resource Management for Sustainability (3)
Examines current programs responsible for administering a range of key resources related to energy production, water purveyance, fisheries, wildlife, forests, wetlands, and coastal zones. May include field trips. (3 hrs. lecture) (FO)

SUST 4300 Independent Practicum in Sustainability Science (3)
Concluding course in which students integrate the knowledge they have gained to select, develop and implement projects pertaining to environmental sustainability. This capstone course provides a single opportunity or experience during which students demonstrate that they have accomplished or achieved the program’s educational goals as represented by the various courses taken. Emphasis is on facilitating the students’ transitions to roles in sustainability careers. (SP)