EARTH, ENVIRONMENTAL, AND PLANETARY SCIENCES

Contact Information
Earth, Environmental, and Planetary Sciences
https://earthscience.rice.edu/
105 Keith Wiess Geological Labs
713-348-4880

Julia K. Morgan
Department Chair
morganj@rice.edu

Earth, Environmental, and Planetary Sciences encompass a range of interrelated disciplines focused on understanding the origin of Earth and planetary systems, the processes that operate within them, and their evolution through time. Topics represented in our field include the physics and chemistry of the solid Earth and its planetary neighbors, the causes and consequences of plate tectonics, and the origin and importance of the oceans and atmosphere. The study of past and present-day environmental processes is integral to understanding the impacts of Earth’s climate, land surface evolution, natural resources, and natural hazards on the biosphere, including humans.

The Department of Earth, Environmental and Planetary Sciences offers undergraduate and graduate programs for a wide range of interests. All undergraduate majors take a five-course core sequence, typically in the freshman through junior years, gaining a fundamental understanding of Earth and planetary systems, processes, materials, history, and interactions. Majors also take a course in applied laboratory, field, and computational techniques, and introductory courses in mathematics, chemistry, and possibly, physics and biology. The BS degree provides three areas of specialization:

- **Geoscience** - focused on Earth systems and processes, including upper-level courses in solid Earth geophysics, geochemistry, tectonics, and a range of elective options.
- **Environmental Earth Science** - emphasizing interactions between Earth processes and Earth’s biosphere, enhanced by upper-level electives selected from BioSciences, Chemistry, Civil and Environmental Engineering, and more.
- **Planetary Science** - designed to apply our knowledge of the Earth to other planetary systems in our solar system, enhanced by upper-level electives in Physics and Astronomy and beyond.

The BS degree with a major in Earth, Environmental, and Planetary Sciences should be chosen by students planning a career or further study in Earth, Environmental, or Planetary Sciences, or a related field. The BA degree is a more flexible program that still provides a comprehensive overview of Earth, Environmental, and Planetary Sciences, but can be combined easily with other majors or professional career paths. Many undergraduate students engage in research projects during their careers, gaining the opportunity to work with complex and highly interconnected problems, gaining skills to become leaders and entrepreneurs in the real world - field and laboratory opportunities abound! Future career opportunities include academia, working in industry, business or government, or working with and for societal issues. Many students present their own research projects at national and international professional conferences.

The department also offers an undergraduate minor providing a solid introduction to the broad field of Earth, Environmental, and Planetary Sciences*, and allowing students to gain exposure to additional advanced topics, while pursuing their major in another field.

The department offers two graduate degrees, a Master of Science and Doctor of Philosophy. Students select research projects in concert with their research advisors, and have the opportunity to work on a wide-range of open-ended, complex, and highly interconnected problems.

Faculty members have joint research projects with scientists at over 100 institutions worldwide, giving an international scope to the department with research programs on all the continents, in all of the oceans, and on four planets. Faculty research interests span a wide range of topics; see https://earthscience.rice.edu for more information. Many departmental research programs involve substantial field activities, both on land and at sea. Several courses also include field trips to a variety of destinations and geologic settings.

*Students interested in an undergraduate major with an environmental emphasis have multiple options at Rice University, spanning the Schools of Natural Sciences, Engineering, Humanities, and Social Sciences, including:

- Environmental Earth Science Area of Specialization under the BS degree with a major in Earth, Environmental, and Planetary Sciences, described above. This major is built upon a strong foundation in Earth Science, and focuses on the interface between the Earth and life.
- Environmental Science (BS and BA degrees) is a broad and interdisciplinary program that incorporates humanities and social sciences perspectives of environmental issues, in addition to natural sciences. This major is jointly administered by the BioSciences and Earth, Environmental, and Planetary Sciences departments, and offers two corresponding Major Concentrations: Earth Science and Ecology and Evolutionary Biology.
- Environmental Engineering Area of Specialization within the Bachelor of Science in Chemical Engineering (BScChem) degree.
- Environmental Engineering Major Concentration within the BA degree with a major in Civil and Environmental Engineering.

Similarly, students interested in an undergraduate minor with an environmental emphasis have three options at Rice University:

- Minor in Environmental and Planetary Sciences offered by the Earth, Environmental, and Planetary Sciences department, with a strong Earth Science basis.
- Minor in Energy and Water Sustainability offered through the Civil and Environmental Engineering department, highlighting engineering and economic considerations.
- Minor in Environmental Studies, an interdisciplinary minor drawing broadly from the Schools of Natural Sciences, Engineering, Humanities, and Social Sciences.

**Bachelor’s Programs**

Earth, Environmental, and Planetary Sciences

• Bachelor of Science (BS) Degree with a Major in Earth, Environmental, and Planetary Sciences (https://ga.rice.edu/programs-study/departments-programs/natural-sciences/earth-environmental-planetary-sciences/earth-environmental-planetary-sciences-bs/)

Minor

Master's Programs
• Master of Science (MS) Degree in the field of Earth Science (https://ga.rice.edu/programs-study/departments-programs/natural-sciences/earth-environmental-planetary-sciences/earth-science-ms/)

Doctoral Program
• Doctor of Philosophy (PhD) Degree in the field of Earth Science (https://ga.rice.edu/programs-study/departments-programs/natural-sciences/earth-environmental-planetary-sciences/earth-science-phd/)

Chair
Julia K. Morgan

Professors
Jonathan Ajo-Franklin
Rajdeep Dasgupta
Richard G. Gordon
Cin-Ty Lee
Adrian Lenardic
Alan R. Levander
Caroline A. Masiello
Julia K. Morgan
Fenglin Niu
Colin A. Zelt

Associate Professors
Helge Gonnermann
Laurence Yeung

Assistant Professors
Sylvia Dee
Melodie French
Kirsten Siebach
Mark Torres

Professors Emeriti
John B. Anderson
Albert W. Bally
Dieter Heymann
William P. Leeman
Andreas Lütchte
Manik Talwani
Peter R. Vail

Lecturers
Kenneth Abdullah

Vitor dos Santos Abreu
Gary G. Gray
Eric Scott
Robert R. Stewart
John R. Sumner

Wiess Visiting Scholars
Francis Albarede
Yehuda Ben-Zion
Janne Blichert-Toft

Adjunct Faculty
Kevin Biddle
K. K. Bissada
Christian Davies
Jeffrey J. Dravis
Brandon Dugan
Paul M. "Mitch" Harris
N. Ross Hill
Stephen J. Mackwell
Patrick J. McGovern
Chin Man William Mok
David L. Olgaard
James Pindell
Malcolm Ross
Kurt Rudolph
Stephanie S. Shipp
Lori Summa
Robert Wegner

For Rice University degree-granting programs:
To view the list of official course offerings, please see Rice's Course Catalog (https://courses.rice.edu/admweb/JSWKS CAT.cat?p_action=cata)
To view the most recent semester's course schedule, please see Rice's Course Schedule (https://courses.rice.edu/admweb/JSWKS CAT.cat)

Earth, Environmental, and Planetary Sciences (EEPS)

EEPS 101 - THE EARTH
Short Title: THE EARTH
Department: Earth/Environment/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Distribution Group: Distribution Group III
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Lower-Level
Description: Study of the nature of the Earth and its processes. Mutually Exclusive: Cannot register for EEPS 101 if student has credit for ENST 101/ESCI 101/ESCI 115/ESCI 301.
EEPS 102 - HISTORY OF THE EARTH AND LIFE
Short Title: HISTORY OF THE EARTH & LIFE
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Distribution Group: Distribution Group III
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Lower-Level
Description: Study of Earth’s systems over the past 4.6 billion years. Topics include evolution of life, continents, ocean basins and climate. Mutually Exclusive: Cannot register for EEPS 102 if student has credit for ENST 102/ESCI 102.

EEPS 103 - FIELD TRIPS FOR THE EARTH
Short Title: FIELD TRIPS FOR THE EARTH
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hour: 1
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Lower-Level
Description: In this course, students will gain a better appreciation of our planet, from how it formed and evolved through millions of years to how its surface environment has been shaped by life, including by humans. These concepts will be introduced through one or more field trips in Texas. Through this course, students will become better stewards of our planet. Mutually Exclusive: Cannot register for EEPS 103 if student has credit for ESCI 103.

EEPS 106 - INVESTIGATING EARTH’S SURFACE
Short Title: INVESTIGATING EARTH’S SURFACE
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Distribution Group: Distribution Group III
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Lower-Level
Description: This course will be investigation-based course covering processes on Earth’s surface, such as carbon cycling, ocean and atmospheric circulation, and climate change. Lectures will be minimal. Most work will be in-class assignments. Mutually Exclusive: Cannot register for EEPS 106 if student has credit for ESCI 106.

EEPS 107 - THE SCIENCE OF CLIMATE CHANGE
Short Title: SCIENCE OF CLIMATE CHANGE
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Distribution Group: Distribution Group III
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Lower-Level
Description: This undergraduate course will introduce students to the fundamentals of natural and anthropogenic climate change. After briefly reviewing Earth’s composition and its fluid envelopes, we will cover the basic physics of the climate system, providing tools to understand weather and climate phenomena (e.g. monsoons, El Niño), the greenhouse effect, and climate feedbacks. Building on this understanding, a succinct tour of geologic history will help us paint a more complete picture of Earth’s climate variations and how they affected human evolution and history. With this context, we will be able to judge the anomalous character of recent climate change, establish its anthropogenic nature, and discuss solutions to the current climate crisis. Students from any major are encouraged to enroll and engage on important topic. Mutually Exclusive: Cannot register for EEPS 107 if student has credit for ENST 201/ESCI 201.

EEPS 108 - NATURAL DISASTERS
Short Title: NATURAL DISASTERS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Distribution Group: Distribution Group III
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Lower-Level
Description: In this course students will learn about the science behind natural disasters. The topics that will be discussed include earthquakes, tsunamis, volcanic eruptions, hurricanes, and tornadoes. We will cover the fundamental Earth Science concepts and processes required to understand these phenomena. Mutually Exclusive: Cannot register for EEPS 108 if student has credit for ESCI 108.

EEPS 109 - OCEANOGRAPHY
Short Title: OCEANOGRAPHY
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Distribution Group: Distribution Group III
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Lower-Level
Description: Introduction to the oceans, with an emphasis on how the physics, chemistry, geology, and biology of the oceans are linked. Mutually Exclusive: Cannot register for EEPS 109 if student has credit for ESCI 109.
EEPS 110 - THE EARTH SYSTEM, ENVIRONMENT, AND SOCIETY
Short Title: EARTH, ENVIRONMENT, & SOCIETY
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Distribution Group: Distribution Group III
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting undergraduate level students.
Course Level: Undergraduate Lower-Level
Description: This course introduces the Earth system, and explores how the environment has changed over time, and the physical, chemical and biological processes responsible for these changes. The course places special emphasis on human-Earth interactions, in the past, present, and future. Topics will include Earth’s ecosystems, oceans, and atmosphere, natural resources, natural hazards including catastrophic events, as well as climate change and the role of humans in modifying Earth’s environment. Mutually Exclusive: Cannot register for EEPS 110 if student has credit for ESCI 110.

EEPS 111 - INHABITING PLANET EARTH
Short Title: INHABITING PLANET EARTH
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Distribution Group: Distribution Group III
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Lower-Level
Description: Why is Earth habitable? How do we sustain our existence on this unique planet? This course will introduce students to our species’ interactions with Planet Earth. We will explore how Earth formed and what systems through time have made the planet habitable, how we use the rock record to investigate past surface environments and climate changes, and how humans are altering Earth’s future. The first segment covers the building of Planet Earth and geologic factors that control habitability. The second segment covers rocks of the American Southwest as a case study for how we read the rock record to understand ancient surface environments and climate changes. The final segment of the course will focus on human impacts on our planet, environmental policy and reading the recently published National Climate Assessment. Mutually Exclusive: Cannot register for EEPS 111 if student has credit for ESCI 111.

EEPS 114 - DISCOVERIES IN EARTH, ENVIRONMENTAL AND PLANETARY SCIENCES SEMINAR
Short Title: DISCOVERIES IN EEPS SEMINAR
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Seminar
Credit Hour: 1
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Lower-Level
Description: Overview of exciting discoveries, research and recent advances in Earth, Environmental, and Planetary Sciences, facilitated through discussions with graduate students and faculty, as well as laboratory visits and demonstrations. Topics may vary. Distribution Credit for ESCI/ENST 114 no longer eligible beginning Fall 2019. Mutually Exclusive: Cannot register for EEPS 114 if student has credit for ENST 114/ESCI 114.

EEPS 115 - THE PLANETS
Short Title: THE PLANETS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Distribution Group: Distribution Group III
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Lower-Level
Description: The physical, chemical, and geological development of the solar system from 4.6 billion years ago until today. All planets, their major satellites, comets, and asteroids will be discussed. Mutually Exclusive: Cannot register for EEPS 115 if student has credit for ESCI 214.

EEPS 116 - THE EARTH AND THE SOLAR SYSTEM
Short Title: EARTH AND THE SOLAR SYSTEM
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Distribution Group: Distribution Group III
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Lower-Level
Description: This course will provide students with an understanding of how the Earth and Solar System formed and evolved, emphasizing the evidence supporting theories of formation and evolution and the history of these theories. The course includes formation of the Universe, the elements, the stars, the Sun and the Solar System, the early Earth and Earth history, the other planets and the history of modern space exploration.
EEPS 220 - INTRODUCTION TO COMPUTATION IN THE EARTH, ENVIRONMENT AND PLANETARY SCIENCES
Short Title: INTRO TO EEPS COMPUTATION
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Distribution Group: Distribution Group III
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Lower-Level
Prerequisite(s): MATH 101 (may be taken concurrently) or MATH 105 or MATH 111 (may be taken concurrently) or MATH 112 (may be taken concurrently)
Description: A broad introduction to solving earth, environmental, and planetary science problems using programming and basic computational methods. The course will consist of a series of two week modules using the MATLAB environment. Each module consists of lectures to present theory and labs to provide guidance with relevant programming techniques. Recommended Prerequisite(s): Math 102 or equivalent, and PHYS 101 and 102 or equivalents. May be taken concurrently. Mutually Exclusive: Cannot register for EEPS 220 if student has credit for ESCI 220.

EEPS 238 - SPECIAL TOPICS
Short Title: SPECIAL TOPICS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Seminar, Independent Study, Internship/Practicum, Laboratory, Lecture, Lecture/Laboratory
Credit Hours: 1-4
Course Level: Undergraduate Lower-Level
Description: Topics and credit hours vary each semester. Contact department for current semester’s topic(s). Repeatable for Credit.

EEPS 299 - EXPERIENTIAL EDUCATION IN EARTH, ENVIRONMENTAL, AND PLANETARY SCIENCES
Short Title: EXPERIENTIAL ED IN EARTH SCI
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Internship/Practicum
Credit Hour: 1
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Lower-Level
Description: This course is designed to allow currently enrolled undergraduate students to gain experience in a department/faculty-approved internship/practicum with the goal of further developing their professional skills. Repeatable for Credit.

EEPS 307 - ENERGY AND THE ENVIRONMENT
Short Title: ENERGY AND THE ENVIRONMENT
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: This course explores the physical principles of energy use and its impacts on Earth's environment and climate. Topics will include energy mechanics, climate change, and the environmental impacts and future prospects of various fossil fuel and alternative energy sources. Cross-list: CEVE 307, ENST 307. Mutually Exclusive: Cannot register for EEPS 307 if student has credit for ESCI 307.

EEPS 309 - VISUALIZING NATURE
Short Title: VISUALIZING NATURE
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: An experimental course combining the scientific disciplines of the earth sciences with the artistic disciplines of creative photography to study the natural landscape and related ecosystems. The course will combine classroom lectures and laboratory demonstrations in geoscience with classes in the use of digital and film-based cameras and illustrated lectures on recognized achievements in landscape photography. Extensive field trips will be scheduled. Students will travel frequently, at times in pairs, other times in larger groups and as a full class, accompanied by one or both professors. The budget for the course includes funding both for travel and for photography expenses. Instructor Permission Required. Cross-list: FOTO 390. Mutually Exclusive: Cannot register for EEPS 309 if student has credit for ESCI 380.
EEPS 321 - EARTH AND PLANETARY SURFACE ENVIRONMENTS
Short Title: EARTH AND PLANETARY SURFACES
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 4
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): EEPS 101 (may be taken concurrently) or ESCI 101 or ENST 101 (may be taken concurrently) or EEPS 107 (may be taken concurrently) or ENST 107 (may be taken concurrently) or ESCI 201 or ENST 201 (may be taken concurrently) or EEPS 108 (may be taken concurrently) or ESCI 108 or EEPS 110 (may be taken concurrently) or ESCI 110 or EEPS 111 (may be taken concurrently) or ESCI 111
Description: This course introduces the processes that shape Earth and other planetary surfaces as well as how records of these processes are preserved on landscapes and in sediment deposits. This course will cover a range of topics including surface hydrology, erosion, sediment transport, and chemical weathering and connect them to the development and interpretation of the stratigraphic record. All topics will be treated using descriptive (qualitative) approaches as well as a range of quantitative methods. This course requires a once-a-week 3-hour lab. Prerequisites EEPS 101/ENST 101 or EEPS 107/ENST 107 or EEPS 108 or EEPS 110 or EEPS 111 can be taken concurrently or with permission of instructor. Recommended Prerequisite(s): MATH 101, 102, PHYS 101 or 111, CHEM 121 or 151. Mutually Exclusive: Cannot register for EEPS 321 if student has credit for ESCI 321.

EEPS 322 - EARTH AND PLANETARY CHEMISTRY AND MATERIALS
Short Title: EARTH AND PLANETARY MATERIALS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 4
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): ESCI 101 (may be taken concurrently) or ESCI 107 (may be taken concurrently) or ESCI 110 (may be taken concurrently) or ESCI 115 (may be taken concurrently) or ESCI 111 (may be taken concurrently) or ESCI 108 or ESCI 110 or ESCI 111 (may be taken concurrently) or ESCI 111
Description: This course introduces chemistry of the Solar System materials and geochemical cycles in Earth and rocky planets through whole planet scale cycles. Specific topics include rock-forming processes related to the chemical and physical differentiation of the solid Earth and terrestrial planets into their main reservoirs, e.g., continental crust, oceanic crust, mantle, and core. Beginning with the bulk composition of planetary bodies, and an overview of the chemical and petrologic properties of the rocks that make up each of these reservoirs, the basic principles of petrology and geochemistry will be presented in the context of the rock cycle, plate tectonics, as well as the origin of economically and societally important ore deposits. Some basic concepts as to how the whole planet scale processes influence the chemistry of surface environment of Earth will be also be introduced. A laboratory and field trip, where students will see petrologic and geochemical principles applied, will be required. Recommended Prerequisite(s): MATH 101 and MATH 102, PHYS 101 or 111, and CHEM 121 or CHEM 151. Mutually Exclusive: Cannot register for EEPS 322 if student has credit for ESCI 322.

EEPS 323 - EARTH AND PLANETARY STRUCTURE AND DYNAMICS
Short Title: EARTH AND PLANETARY STRUCTURE
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 4
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): ESCI 101 (may be taken concurrently) or ESCI 107 (may be taken concurrently) or ESCI 108 (may be taken concurrently) or ESCI 110 (may be taken concurrently) or ESCI 108 or ESCI 110 or ESCI 111 (may be taken concurrently) or ESCI 111 or ESCI 107 (may be taken concurrently) or ESCI 115
Description: This course covers the formation and differentiation of Earth and planetary bodies, the resulting structure and composition of planetary interiors, and the geophysical tools that reveal these details. The mechanics and deformation of the Earth's crust and lithosphere are presented, emphasizing rock strength and rheology, earthquakes and faulting, brittle and ductile deformation mechanisms and processes, and an introduction to tectonic systems. A required 3-hour lab and field trip will further develop skills for recognition, interpretation, and analysis of Earth structures and deformation processes. Prerequisites ESCI 101 or ESCI 107 or ESCI 108 or ESCI 110 or ESCI 111 or ESCI 115 or ESCI 301 can be taken concurrently or with permission of instructor. Recommended Prerequisite(s): MATH 101 and (PHYS 101 or 111). These may be taken concurrently. Mutually Exclusive: Cannot register for EEPS 323 if student has credit for ESCI 323.

EEPS 324 - EARTH'S INTERIOR
Short Title: EARTH'S INTERIOR
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 4
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): ESCI 101 or ESCI 115 or EEPS 101
Description: Formation of Earth and solar system, Earth differentiation and geochronology. Structural seismology and the composition of Earth's interior. Density, Earth's gravity, and the geoid. Heat flow and Earth energetics. Earth's core and magnetic field. Mantle convection and plate tectonics. Oceanic and continental crust. Recommended Prerequisite(s): MATH 212 and (PHYS 101 or PHYS 111 or PHYS 125 or PHYS 141) or (PHYS 102 or PHYS 112 or PHYS 126 or PHYS 142). Mutually Exclusive: Cannot register for EEPS 324 if student has credit for ESCI 324.
EEPS 325 - OCEANS, ATMOSPHERES AND CLIMATE
Short Title: OCEANS, ATMOSPHERES & CLIMATE
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Distribution Group: Distribution Group III
Credit Hours: 4
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): ESCI 101 or ESCI 107 or ESCI 109 or ESCI 110 or ESCI 111 or ESCI 201 or EEPS 101 or EEPS 109 or EEPS 110 or EEPS 111 or EEPS 107
Description: Earth's climate system is characterized by complex interactions between the ocean, atmosphere, and land surfaces that are constantly evolving. This course will cover the physics and chemistry of the ocean and atmosphere to explore the mechanisms that control global and regional climate. Topics include: Earth's energy balance, atmosphere and ocean circulation, and biogeochemical climate feedbacks. We will also explore records of past climate (historical and pre-historical) and projections of future climate. Students will engage in lab-based activities to understand fluid flow in the atmosphere and ocean and complete problem sets including programming assignments. Mutually Exclusive: Cannot register for EEPS 325 if student has credit for ESCI 325.

EEPS 334 - THE EARTH LABORATORY
Short Title: EARTH LABORATORY
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): (ESCI 322 or EEPS 322) and (ESCI 323 (may be taken concurrently) or EEPS 323 (may be taken concurrently)) and (ESCI 101 or ESCI 107 or ESCI 109 or ESCI 110 or ESCI 111 or ESCI 115 or ESCI 301 or EEPS 101 or EEPS 108 or EEPS 110 or EEPS 111)
Description: A capstone course aimed at the interpretation of the Earth's history through the integration of geological observations in the field. Includes the introduction to the basic methods of description, recording, and interpretation of geologic features in the field, including rock and outcrop description, geologic mapping and cross-section construction. The course includes a required seven-day excursion during Spring Break. Taught every Spring. ESCI 323 may be taken concurrently with ESCI 334. Mutually Exclusive: Cannot register for EEPS 334 if student has credit for ESCI 334.

EEPS 340 - GLOBAL BIOGEOCHEMICAL CYCLES
Short Title: GLOBAL BIOGEOCHEMICAL CYCLES
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Distribution Group: Distribution Group III
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: This course introduces students to the coupled nature of the biosphere, atmosphere and hydrosphere using as focal points elemental cycles such as those of carbon and nitrogen. This is a writing-intensive class, and will include 3 required Saturday field trips. Mutually Exclusive: Cannot register for EEPS 340 if student has credit for EBIO 340/EBIO 540/ESCI 340.

EEPS 390 - GEOLOGY FIELD CAMP
Short Title: GEOLOGY FIELD CAMP
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Independent Study
Credit Hours: 1-6
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: Field course typically involving geologic mapping in one or more of sedimentary, metamorphic, igneous rocks and structures. Not offered by Rice University. Students must take an approved field camp from another university and transfer credit to Rice University. Recommended Prerequisite(s): ESCI 334 or EEPS 334 Mutually Exclusive: Cannot register for EEPS 390 if student has credit for ESCI 390.

EEPS 391 - EARTH SCIENCE FIELD EXPERIENCE
Short Title: EARTH SCIENCE FIELD EXPERIENCE
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Independent Study
Credit Hours: 1-6
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: Comprises participating in an earth science expedition or research experience, follow-up analysis of some aspect of the data acquired, and a written report. Must be approved in advance by one of the department undergraduate advisors. Instructor Permission Required. Mutually Exclusive: Cannot register for EEPS 391 if student has credit for ESCI 391.

EEPS 401 - SEMINAR: UNDERGRADUATE HONORS THESIS
Short Title: SEM: UG HONORS THESIS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Seminar
Credit Hour: 1
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: Introduction to and presentation of original undergraduate research for Earth Science Undergraduate Honors Thesis candidates. Students will be introduced to basic research protocols and approaches, and will learn how to give presentations on their research, and gain experience presenting their research. Repeatable for Credit.
EEPS 403 - SEMINAR: DEPARTMENT RESEARCH
Short Title: SEMINAR: DEPARTMENT RESEARCH
Department: Earth/Environment/Planetary Sci
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Seminar
Credit Hour: 1
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: A series of lectures and paper discussions in various areas of Earth science. Graduate/Undergraduate Equivalency: EEPS 603. Repeatable for Credit.

EEPS 404 - SEMINAR: DEPARTMENT RESEARCH
Short Title: SEMINAR: DEPARTMENT RESEARCH
Department: Earth/Environment/Planetary Sci
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Seminar
Credit Hour: 1
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: A series of lectures and paper discussions in various areas of Earth science. Graduate/Undergraduate Equivalency: EEPS 604. Repeatable for Credit.

EEPS 405 - SEMINAR: CURRENT RESEARCH IN EARTH SCIENCE
Short Title: SEM:CURR RESRCH EARTH SCIENCE
Department: Earth/Environment/Planetary Sci
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Seminar
Credit Hour: 1
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: A series of lectures and paper discussions in various areas of Earth science. Graduate/Undergraduate Equivalency: EEPS 605. Repeatable for Credit.

EEPS 406 - SEMINAR: CURRENT RESEARCH IN EARTH SCIENCE
Short Title: SEM:CURR RESRCH EARTH SCIENCE
Department: Earth/Environment/Planetary Sci
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Seminar
Credit Hour: 1
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: A series of lectures and paper discussions in various areas of Earth science. Graduate/Undergraduate Equivalency: EEPS 606. Repeatable for Credit.

EEPS 410 - OPTICAL MINERALOGY AND PETROGRAPHY
Short Title: OPTICAL MINERALOGY & PETROGRAPHY
Department: Earth/Environment/Planetary Sci
Grade Mode: Standard Letter
Course Type: Laboratory
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): ESCI 322 or EEPS 322
Description: This is a lab course focused on the identification of minerals with petrographic microscopy. Principles of crystallography, mineral optics, and mineral chemistry will be covered in the first third of the course. The second third of the course will focus on the identification of minerals in igneous, metamorphic, and sedimentary rocks with emphasis on petrogenetic interpretation. The last third of the course will involve each student working on specific petrologic themes in the context of regional tectonics or magmatic processes. Taught every other Fall. Graduate/Undergraduate Equivalency: EEPS 610. Mutually Exclusive: Cannot register for EEPS 410 if student has credit for EEPS 610/ESCI 410/ESCI 610.

EEPS 411 - CHARACTERIZATION OF EARTH, ENVIRONMENTAL, AND PLANETARY MATERIALS
Short Title: EARTH MATERIALS
Department: Earth/Environment/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): CHEM 111 or CHEM 121 or CHEM 151
Description: This course will provide an overview of various characterization methods used in geological, chemical, material science and other natural science and engineering research. The techniques that will be discussed include but not limited to electron beam methods (imaging and spectroscopy), X-ray methods, ion-beam analysis, vibrational spectroscopies, and Synchrotron-based techniques. Graduate/Undergraduate Equivalency: EEPS 611. Mutually Exclusive: Cannot register for EEPS 411 if student has credit for EEPS 611/ESCI 419/ESCI 619.

EEPS 412 - ADVANCED PETROLOGY
Short Title: ADVANCED PETROLOGY
Department: Earth/Environment/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): ESCI 322 or EEPS 322
Description: Evaluation of the evolution of igneous rocks in the Earth's crust and mantle. Topics will include phase equilibria, experimental studies, and geochemistry. Labs will stress thin section petrography. Graduate/Undergraduate Equivalency: EEPS 612. Repeatable for Credit.
EEPS 413 - ADVANCED PETROLOGY II
Short Title: ADVANCED PETROLOGY II
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: This course will bring together constraints from field geology, petrography, petrology, geochemistry, and geodynamics to tackle advanced A87 research questions of whole Earth processes that are relevant in the 21st century. The topics that may be covered include, but are not limited to, interplay between magmatic and tectonic processes, magma generation, migration, extraction, and dynamic stability in various settings, magmatic differentiation, volatiles and fluids exchange between various reservoirs and effects on long-term climate, ore genesis, and formation and modification of continents. Graduate/Undergraduate Equivalency: EEPS 613. Mutually Exclusive: Cannot register for EEPS 413 if student has credit for EEPS 613/ESCI 411/ESCI 611.

EEPS 415 - GEOCHEMISTRY OF EARTH'S SURFACE
Short Title: GEOCHEM EARTH'S SURFACE
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: This course will cover concepts in aqueous geochemistry in the context of chemical weathering and Earth's major biogeochemical cycles. Central to this course will be weekly student-led discussions of scientific literature. Students will also learn basic numerical modeling and data analysis techniques using MATLAB, field methods, and basic analytical chemistry. Graduate/Undergraduate Equivalency: EEPS 615. Mutually Exclusive: Cannot register for EEPS 415 if student has credit for EEPS 615/ESCI 407/ESCI 607.

EEPS 417 - TRACE-ELEMENT AND ISOTOPE GEOCHEMISTRY FOR EARTH AND ENVIRONMENTAL SCIENCE
Short Title: TRACE-ELEMENT& ISOTOPE GEOCHEM
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: Introduction to the principles of trace-element and isotope geochemistry and their applications to high and low temperature processes in the earth. Topics to be covered are trace-element partitioning, basic quantum physics, radiogenic isotopic systems and stable isotope fractionation. Graduate/Undergraduate Equivalency: EEPS 617. Recommended Prerequisite(s): ESCI 322 or EEPS 322. Mutually Exclusive: Cannot register for EEPS 417 if student has credit for EEPS 617/ESCI 430/ESCI 630.

EEPS 418 - ISOTOPE GEOCHEMISTRY
Short Title: ISOTOPE GEOCHEMISTRY
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: An introduction to the principles and techniques of stable and radiogenic geochemistry in the geosciences. The course will begin by examining the fundamental physics relevant to isotope partitioning and decay, followed by a survey of different isotope systems and how they are used to study surface processes, element cycling, climate, and planetary science. Graduate/Undergraduate Equivalency: EEPS 618. Recommended Prerequisite(s): ESCI 322 or EEPS 322. Mutually Exclusive: Cannot register for EEPS 418 if student has credit for EEPS 618/ESCI 433/ESCI 633.

EEPS 420 - ORGANIC GEOCHEMISTRY
Short Title: ORGANIC GEOCHEMISTRY
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: This course covers the organic geochemistry of the natural environment. Topics include: production, transport, decomposition, and storage of organic matter in the marine and terrestrial environments, use of isotopes to track biogeochemical processes and natural and perturbed carbon cycle issues, including past and recent climate shifts. Graduate/Undergraduate Equivalency: EEPS 620. Mutually Exclusive: Cannot register for EEPS 420 if student has credit for EEPS 620/ESCI 425/ESCI 625.

EEPS 426 - GEOMORPHOLOGY
Short Title: GEOMORPHOLOGY
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): ESCI 321 or EEPS 321
Description: This course will investigate physical, chemical, and biological processes that contribute to the development and shaping of Earth's surface across a continuum of subaerial and subaqueous environments. Mandatory 4-day field trip is associated with this class. Graduate/Undergraduate Equivalency: EEPS 626. Mutually Exclusive: Cannot register for EEPS 426 if student has credit for EEPS 626/ESCI 431/ESCI 631. Repeatable for Credit.
EEPS 427 - MECHANICS OF SEDIMENT TRANSPORT  
**Short Title:** MECHANICS-SEDIMENT TRANSPORT  
**Department:** Earth/Environmnt/Planetary Sci  
**Grade Mode:** Standard Letter  
**Course Type:** Lecture  
**Credit Hours:** 3  
**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.  
**Course Level:** Undergraduate Upper-Level  
**Description:** Evaluation of sedimentary transport dynamics: physical interaction between fluid flow and sediment mobility, from grain to bedform scale; exploration of environments including rivers, estuaries, deltas, coasts, and deserts. Examination of sediment transport for geology, environmental, and engineering applications; formation of diagnostic sedimentary features recognized in the stratigraphic record. Graduate/Undergraduate Equivalency: EEPS 627. Mutually Exclusive: Cannot register for EEPS 427 if student has credit for EEPS 627/ESCI 435/ESCI 635.

EEPS 428 - ANTARCTIC MARINE GEOLOGY  
**Short Title:** ANTARCTIC MARINE GEOLOGY  
**Department:** Earth/Environmnt/Planetary Sci  
**Grade Mode:** Standard Letter  
**Course Type:** Lecture  
**Credit Hours:** 3  
**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.  
**Course Level:** Undergraduate Upper-Level  
**Description:** The study of marine geologic principles and processes using examples from the Southern Oceans. Graduate/Undergraduate Equivalency: EEPS 628. Recommended Prerequisite(s): ESCI 321 or EEPS 321. Mutually Exclusive: Cannot register for EEPS 428 if student has credit for EEPS 628/ESCI 423/ESCI 623.

EEPS 429 - PALEOCEANOGRAPHY  
**Short Title:** PALEOCEANOGRAPHY  
**Department:** Earth/Environmnt/Planetary Sci  
**Grade Mode:** Standard Letter  
**Course Type:** Lecture  
**Credit Hours:** 3  
**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.  
**Course Level:** Undergraduate Upper-Level  
**Prerequisite(s):** ESCI 321 or EEPS 321  
**Description:** The evolution of the ocean, climate and the global carbon cycle over the last 100 million years as recorded by the biology, chemistry and composition of deep-sea sediment. Graduate/Undergraduate Equivalency: EEPS 629. Recommended Prerequisite(s): ESCI 109 or EEPS 109. Mutually Exclusive: Cannot register for EEPS 429 if student has credit for EEPS 629/ESCI 421/ESCI 621.

EEPS 430 - SEQUENCE STRATIGRAPHY  
**Short Title:** SEQUENCE STRATIGRAPHY  
**Department:** Earth/Environmnt/Planetary Sci  
**Grade Mode:** Standard Letter  
**Course Type:** Lecture  
**Credit Hours:** 3  
**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.  
**Course Level:** Undergraduate Upper-Level  
**Prerequisite(s):** ESCI 321 or EEPS 321  
**Description:** This course will introduce students to the concepts of sequence stratigraphy and the power behind this correlation technique. The course is divided between classic sequence stratigraphy using cores, well-logs, and outcrop examples and seismic sequence stratigraphy. Graduate/Undergraduate Equivalency: EEPS 630. Mutually Exclusive: Cannot register for EEPS 430 if student has credit for EEPS 630/ESCI 427/ESCI 627.

EEPS 432 - QUANTITATIVE HYDROGEOLOGY  
**Short Title:** QUANTITATIVE HYDROGEOLOGY  
**Department:** Earth/Environmnt/Planetary Sci  
**Grade Mode:** Standard Letter  
**Course Type:** Lecture  
**Credit Hours:** 3  
**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.  
**Course Level:** Undergraduate Upper-Level  
**Description:** Advanced course that will provide a quantitative overview of groundwater hydrology. Emphasis will be placed on mastering concepts in fluid mechanics and applying these concepts to water supply, environmental, and geological problems. Graduate/Undergraduate Equivalency: EEPS 632. Mutually Exclusive: Cannot register for EEPS 432 if student has credit for EEPS 632/ESCI 418/ESCI 618.

EEPS 433 - CLIMATE DYNAMICS  
**Short Title:** CLIMATE DYNAMICS  
**Department:** Earth/Environmnt/Planetary Sci  
**Grade Mode:** Standard Letter  
**Course Type:** Lecture  
**Credit Hours:** 3  
**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.  
**Course Level:** Undergraduate Upper-Level  
**Prerequisite(s):** ESCI 101 or ESCI 107 or ESCI 109 or ESCI 115 or ESCI 201 or ESCI 301 or ESCI 321 or ESCI 340 or EEPS 101 or EEPS 109 or EEPS 107 or EEPS 321 or EEPS 340  
**Description:** Earth's climate is a chaotic system, characterized by nonlinear interactions between the ocean, atmosphere, and land surfaces. This course will focus on the dynamics of the ocean and atmosphere, including the drivers of large-scale circulation, heat transport, and modes of natural variability. We will also explore projections of future climate change scenarios and records of historical climate change. Students will learn to post-process climate model output, analyze, and map these data using Python. Graduate/Undergraduate Equivalency: EEPS 633. Mutually Exclusive: Cannot register for EEPS 433 if student has credit for EEPS 633/ESCI 422/ESCI 622.
EEPS 434 - CLIMATE OF THE COMMON ERA
Short Title: CLIMATE OF THE COMMON ERA
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): EEPS 101 or ESCI 101 or ENST 101 or EEPS 107 or ESCI 201 or ENST 201 or EEPS 109 or ESCI 109 or EEPS 321 or ESCI 321 or EEPS 340 or ESCI 340 or EEPS 448 or ESCI 442
Description: This course explores climate variability and change over the past two thousand years to contextualize current rates and magnitudes of anthropogenic climate change on Earth. This reading and discussion-focused seminar course will cover paleoclimate archives such as corals, tree rings, and ice cores, as well as climate reconstruction methods, detection and attribution. Students will be provided with an overview of methods and key findings in paleoclimatology and paleoceanography, using high-resolution archives to explore past changes in global climate. Students will read 3-4 scientific papers each week, provide summaries and volunteer to lead discussions surrounding topics of their choosing. Graduate/Undergraduate Equivalency: EEPS 634.

EEPS 435 - REMOTE SENSING
Short Title: REMOTE SENSING
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: Introduction to electromagnetic remote sensing of the earth and other planets using passive and active methods. The course includes a computer lab component involving processing and interpretation of remote sensing imagery, and an individual project. Graduate/Undergraduate Equivalency: EEPS 635. Mutually Exclusive: Cannot register for EEPS 435 if student has credit for CEVE 450/EEPS 635/ESCI 450/ESCI 650.

EEPS 436 - GIS FOR SCIENTISTS AND ENGINEERS
Short Title: GIS FOR SCIENTISTS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: Basic principles of Geographic Information Systems, with a focus on effectively applying the technology to the geosciences. Main platform of the class will be ESRI's ArcGIS, but a wide array of other tools will also be introduced. Material will be delivered via a blend of lecture and hands-on exercises. Graduate/Undergraduate Equivalency: EEPS 636. Mutually Exclusive: Cannot register for EEPS 436 if student has credit for EEPS 636/ESCI 452/ESCI 652.

EEPS 438 - SEMINAR: TOPICS IN ENVIRONMENTAL SCIENCE
Short Title: TOPICS: ENVIRONMENTAL SCIENCE
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Seminar
Credit Hours: 3
Restrictions: Enrollment limited to students with a class of Senior.
Course Level: Undergraduate Upper-Level
Description: This course provides an integration of interdisciplinary topics that span environmental sciences. Topics will vary depending upon the interests and needs of both students and faculty. Only Seniors may register for this course without instructor permission.

EEPS 445 - EARTH AND PLANETARY INTERIORS
Short Title: EARTH AND PLANETARY INTERIORS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): (ESCI 101 or EEPS 101 or ESCI 107 or ESCI 108 or EEPS 108 or ESCI 110 or EEPS 110 or ESCI 111 or EEPS 111 or ESCI 115 or ESCI 301) and (ESCI 323 or EEPS 323) and MATH 211 and (PHYS 101 or PHYS 111 or PHYS 102 or PHYS 112)

EEPS 446 - SEISMOLOGY I
Short Title: SEISMOLOGY I
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: Principles of elastic wave propagation, the determination of Earth structure, and the understanding of earthquake physics. Graduate/Undergraduate Equivalency: EEPS 646. Mutually Exclusive: Cannot register for EEPS 446 if student has credit for EEPS 646/ESCI 461/ESCI 661.
EEPS 448 - EXPLORATION GEOPHYSICS
Short Title: EXPLORATION GEOPHYSICS
Department: Earth/Environment/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): MATH 101 and (PHYS 101 or PHYS 102 or PHYS 111 or PHYS 112)
Description: Study of the principles and procedures involved in geophysical exploration. Includes acquisition, processing, and interpretation of seismic, ground-penetrating radar, gravity, magnetic, and electrical data. Graduate/Undergraduate Equivalency: EEPS 648.

EEPS 450 - GEOPHYSICAL DATA ANALYSIS: DIGITAL SIGNAL PROCESSING
Short Title: GEOPHYSICAL DATA ANALYSIS
Department: Earth/Environment/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): MATH 101 and MATH 102
Description: Data sampling, aliasing, discrete Fourier transform, digital filter design techniques, z-transform, and discrete Hilbert transform are introduced. Deconvolution, velocity filters, polarization filter, stacking, beam forming and migration techniques will be taught together with their application in geophysical studies. Graduate/Undergraduate Equivalency: EEPS 650.

EEPS 456 - 3D SEISMIC REFLECTION DATA INTERPRETATION
Short Title: 3D SEISMIC INTERPRETATION
Department: Earth/Environment/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): MATH 211

EEPS 454 - INTRODUCTION TO SEISMIC INTERPRETATION: STRUCTURAL STYLES AND SEISMIC STRATIGRAPHY
Short Title: 2D SEISMIC STRUCTURE AND STRAT
Department: Earth/Environment/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): ESCI 442 (may be taken concurrently) or EEPS 448 (may be taken concurrently)
Description: This course will introduce students to analysis of sub-regional structural and stratigraphic frameworks. We will utilize the interpretation of 2D seismic profiles to reconstruct basin history and discuss implications for petroleum systems. Students will gain an understanding of a variety of structural and stratigraphic styles, as expressed on seismic data. Instructor Permission Required. Graduate/Undergraduate Equivalency: EEPS 654.

EEPS 455 - REFLECTION SEISMIC DATA PROCESSING
Short Title: REFLEC SEISMIC DATA PROCESSING
Department: Earth/Environment/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): ESCI 442 or EEPS 448
Description: Experience with processing reflection seismic data. Includes seismic data organization, velocity analysis, stacking, filtering, deconvolution, migration, and display, using the Center for Computational Geophysics facility’s seismic processing system(s).

EEPS 451 - GEOPHYSICAL DATA ANALYSIS: INVERSE METHODS
Short Title: GEOPHYSICAL DATA ANALYSIS
Department: Earth/Environment/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): MATH 211

EEPS 448 - EXPLORATION GEOPHYSICS
Short Title: EXPLORATION GEOPHYSICS
Department: Earth/Environment/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): MATH 101 and MATH 102
Description: Data sampling, aliasing, discrete Fourier transform, digital filter design techniques, z-transform, and discrete Hilbert transform are introduced. Deconvolution, velocity filters, polarization filter, stacking, beam forming and migration techniques will be taught together with their application in geophysical studies. Graduate/Undergraduate Equivalency: EEPS 650.

EEPS 454 - INTRODUCTION TO SEISMIC INTERPRETATION: STRUCTURAL STYLES AND SEISMIC STRATIGRAPHY
Short Title: 2D SEISMIC STRUCTURE AND STRAT
Department: Earth/Environment/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): ESCI 442 (may be taken concurrently) or EEPS 448 (may be taken concurrently)
Description: This course will introduce students to analysis of sub-regional structural and stratigraphic frameworks. We will utilize the interpretation of 2D seismic profiles to reconstruct basin history and discuss implications for petroleum systems. Students will gain an understanding of a variety of structural and stratigraphic styles, as expressed on seismic data. Instructor Permission Required. Graduate/Undergraduate Equivalency: EEPS 654.
EEPS 458 - ENVIRONMENTAL & APPLIED ROCK PHYSICS
Short Title: APPLIED ROCK PHYSICS
Department: Earth/Environment/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): MATH 101 or MATH 102 and PHYS 101 or PHYS 102 or PHYS 111 and CAAM 210
Description: Rock physics, the study of the impact of rock microstructure, mineralogy, fluids, stress state, and diagenetic features on wave propagation in porous media. Understanding the use of such relationships for quantitative analysis of seismic datasets. Applications to geologic carbon storage, permafrost characterization, geothermal systems, and hydrogeology. Graduate/Undergraduate Equivalency: EEPS 658. Recommended Prerequisite(s): Knowledge of applied geophysics, seismology, continuum mechanics, differential equations, and petrology will expand the value of the material. Mutually Exclusive: Cannot register for EEPS 458 if student has credit for EEPS 658/ESCI 456/ESCI 665.

EEPS 459 - WELL LOGGING AND PETROPHYSICS
Short Title: WELL LOGGING AND PETROPHYSICS
Department: Earth/Environment/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: Basics of wireline logging and logging while drilling including borehole environment, resistivity, radiation, thermal, and elastic wave measurements and measuring tools. Building from this introduction, basic interpretation of logging data and formation evaluation will be studied. Graduate/Undergraduate Equivalency: EEPS 659.

EEPS 460 - GLOBAL TECTONICS
Short Title: GLOBAL TECTONICS
Department: Earth/Environment/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: Geometrical aspects of plate tectonics, the 3 traditional types of plate boundaries, instantaneous plate motions, earthquakes and faulting, space geodesy, geomagnetic reversals, palaeomagnetic poles, hotspots, “absolute” plate motion, true polar wander, driving forces, diffuse plate boundaries, plate nonrigidity, and rheology of the lithosphere. Graduate/Undergraduate Equivalency: EEPS 660.

EEPS 461 - STRUCTURE AND EVOLUTION OF TECTONIC SYSTEMS
Short Title: TECTONIC SYSTEMS
Department: Earth/Environment/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): ESCI 323 or EEPS 323
Description: The distribution, origin, and evolution of various tectonic systems, and characterization of their structural and geophysical signatures, emphasizing crustal and lithospheric processes associated with tectonic deformation. Review of representative global examples of convergent and collisional margins, divergent and passive margins, and transform margins. Graduate/Undergraduate Equivalency: EEPS 661.

EEPS 462 - TECTONOPHYSICS
Short Title: TECTONOPHYSICS
Department: Earth/Environment/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): MATH 102 or MATH 106 or PHYS 102 or PHYS 112
Description: Applications of continuum physics to the deformation, flexure, heat transfer, and gravity field of the lithosphere. Graduate/Undergraduate Equivalency: EEPS 662. Recommended Prerequisite(s): MATH 221.

EEPS 464 - INTRODUCTION TO THE HEAT AND MASS TRANSPORT PROCESSES OF PLANETARY INTERIORS
Short Title: GEODYNAMICS
Department: Earth/Environment/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: Introduction to the use of continuum mechanics to solve fundamental problems related to mass and energy transport problems arising in the study of the solid Earth, planets and moons. Topics include: heat conduction, convective heat transfer, planetary thermal evolution, geological fluid dynamics, flow through porous media, rheology of planetary materials. Graduate/Undergraduate Equivalency: EEPS 664.
### EEPS 465 - ROCK DEFORMATION AND RHEOLOGY
**Short Title:** ROCK DEFORMATION AND RHEOLOGY  
**Department:** Earth/Environmnt/Planetary Sci  
**Grade Mode:** Standard Letter  
**Course Type:** Lecture  
**Credit Hours:** 3  
**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.  
**Course Level:** Undergraduate Upper-Level  
**Prerequisite(s):** MATH 211 and MATH 212  
**Description:** Advanced course in the foundations of fluid mechanics and its application to Earth science. Aspects of continuum mechanics, heat and mass transfer, and the rheologic behavior of materials will be covered in developing the fundamental laws that describe fluid motion. Applications include atmospheric dynamics, mantle and lithospheric dynamics, and hydrogeology. Graduate/Undergraduate Equivalency: EEPS 665. Mutually Exclusive: Cannot register for EEPS 465 if student has credit for EEPS 665/ESCI 460/ESCI 660.

### EEPS 467 - GEOMECHANICS
**Short Title:** GEOMECHANICS  
**Department:** Earth/Environmnt/Planetary Sci  
**Grade Mode:** Standard Letter  
**Course Type:** Lecture  
**Credit Hours:** 3  
**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.  
**Course Level:** Undergraduate Upper-Level  
**Description:** An examination of deformation and failure processes within the Earth’s shallow crust, with a focus on rock and sediment mechanics, and associated fluid processes. Emphasis will be on geologic applications, including sediment consolidation, slope stability, fault mechanics, and earthquake nucleation and rupture. Graduate/Undergraduate Equivalency: EEPS 667.

### EEPS 468 - VOLCANOES
**Short Title:** VOLCANOES  
**Department:** Earth/Environmnt/Planetary Sci  
**Grade Mode:** Standard Letter  
**Course Type:** Lecture  
**Credit Hours:** 3  
**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.  
**Course Level:** Undergraduate Upper-Level  
**Description:** Introduction to volcanoes and associated physical processes. Conceptual and quantitative discussion of topics related to magma transport, magma storage, and volcanic eruptions. The course includes a 4-6 day field trip to California and Oregon. Graduate/Undergraduate Equivalency: EEPS 668.

### EEPS 469 - PLANETARY VOLCANISM
**Short Title:** PLANETARY VOLCANISM  
**Department:** Earth/Environmnt/Planetary Sci  
**Grade Mode:** Satisfactory/Unsatisfactory  
**Course Type:** Seminar  
**Credit Hours:** 2  
**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.  
**Course Level:** Undergraduate Upper-Level  
**Description:** This seminar will cover the broad range of volcanic phenomena in the solar system, via weekly readings of, and student presentations on, classic and recent papers. Topics include: Composition (basaltic, silicic, unusual, carbonatite), cryovolcanism, structure (caldera, rift zones, volcanic spreading radiating dike systems, magma chambers, and sill complexes), and dynamics (eruption mechanism, effusive vs. explosive, volatiles and atmospheres/oceans). The planetary settings to be considered include Earth, Venu, Mars, Mercury, Moon, large asteroids and outer planet satellites. Graduate/Undergraduate Equivalency: EEPS 669.

### EEPS 471 - EARTH SYSTEMS MODELING I: PHILOSOPHY AND FUNDAMENTALS
**Short Title:** EARTH SYSTEMS MODELING I  
**Department:** Earth/Environmnt/Planetary Sci  
**Grade Mode:** Standard Letter  
**Course Type:** Lecture  
**Credit Hours:** 3  
**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.  
**Course Level:** Undergraduate Upper-Level  
**Prerequisite(s):** CHEM 111 or CHEM 121 or PHYS 101 or PHYS 102  
**Description:** A model is a simplified representation of something. Scientific models range from conceptual to physical to mathematical. In Earth and planetary science, one is often concerned with modeling interactions between physical, chemical, and biological components, i.e., with modeling systems. This class will cover the fundamentals of scientific modeling with a focus on Earth systems. Graduate/Undergraduate Equivalency: EEPS 671. Recommended Prerequisite(s): MATH 211. Repeatable for Credit.

### EEPS 472 - EARTH SYSTEMS MODELING: NUMERICAL TECHNIQUES AND APPLICATIONS
**Short Title:** NUMERICAL METHODS EARTH SYSTEM  
**Department:** Earth/Environmnt/Planetary Sci  
**Grade Mode:** Standard Letter  
**Course Type:** Lecture/Laboratory  
**Credit Hours:** 3  
**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.  
**Course Level:** Undergraduate Upper-Level  
**Prerequisite(s):** CHEM 111 or CHEM 121 or PHYS 101 or PHYS 102  
**Description:** Introduction to numerical methods with applications in Earth Science using Matlab and COMSOL. Much of the class is spent in the computer lab learning Matlab and COMSOL, followed by hands-on exercises. Graduate/Undergraduate Equivalency: EEPS 672. Recommended Prerequisite(s): MATH 211. Mutually Exclusive: Cannot register for EEPS 472 if student has credit for EEPS 672/ESCI 472/ESCI 672.
EEPS 477 - SPECIAL TOPICS
Short Title: SPECIAL TOPICS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Independent Study, Seminar, Internship/Practicum, Laboratory, Lecture, Lecture/Laboratory
Credit Hours: 1-4
Course Level: Undergraduate Upper-Level
Description: Topics and credit hours vary each semester. Contact the department for current semester's topic(s). Repeatable for Credit.

EEPS 481 - UNDERGRADUATE RESEARCH IN EARTH SCIENCE
Short Title: UNDERGR RESEARCH EARTH SCIENCE
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Research
Credit Hours: 1-6
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: Advanced work adapted to the needs of the individual undergraduate student reading. Instructor Permission Required. Repeatable for Credit.

EEPS 484 - DECISION MAKING AND ECONOMICS IN THE ENERGY INDUSTRY
Short Title: DECISION MAKING AND ECONOMICS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: This course will provide students with an understanding of how energy projects are evaluated. Topics include resource-size determination, geologic and economic risk, discounted cash-flow economics, and other common methods used in decision making. Emphasis will be placed on working in teams to understand basic concepts and sensitivities. Graduate/Undergraduate Equivalency: EEPS 684. Recommended Prerequisite(s): (EEPS 321 or ESCI 321) and (EEPS 323 or ESCI 323).

EEPS 486 - PETROLEUM INDUSTRY ECONOMICS AND MANAGEMENT
Short Title: PETROLEUM IND ECONOMICS MGMT
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: Topics covered include resource size determination; geologic risk analysis; establishing minimum economic thresholds; economic chance factors; the concepts of present worth, investment efficiency, rates of return. Price forecasting, cost inflation are discussed. Graduate/Undergraduate Equivalency: EEPS 686. Recommended Prerequisite(s): ESCI 415 or EEPS 484

EEPS 488 - ECONOMIC GEOLOGY MINERAL DEPOSITS
Short Title: ECON GEOL MINERAL DEPOSITS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: An overview of metallic and nonmetallic mineral deposits, theories of their origin, and classification. The impact of government regulation, economics, production practices, and exploration will be considered. Graduate/Undergraduate Equivalency: EEPS 688.

EEPS 491 - SPECIAL STUDIES FOR UNDERGRADUATES
Short Title: SPECIAL STUDY FOR UNDERGRADS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Research
Credit Hours: 1-6
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: Work in Earth Science adapted to the needs of individual undergraduate research. Instructor Permission Required. Repeatable for Credit.

EEPS 495 - GRAPHIC AND VISUAL DESIGN FOR SCIENTISTS
Short Title: VISUAL DESIGN FOR SCIENTISTS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Seminar
Credit Hours: 3
Course Level: Undergraduate Upper-Level
Description: A significant portion of a scientists time is spent solving visual design problems (graphics for papers, visual layouts for seminars, posters, teaching). Effective communication of scientific information is part of a scientists skill set. This class is designed to enhance that skill set in terms of presenting visual information clearly, simply, and effectively. Graduate/Undergraduate Equivalency: EEPS 695. Repeatable for Credit.

EEPS 499 - GRAPHIC AND VISUAL DESIGN FOR SCIENTISTS
Short Title: GRAPHIC AND VISUAL DESIGN
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Seminar
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: A significant portion of a scientists time is spent solving visual design problems (graphics for papers, visual layouts for seminars, posters, teaching). Effective communication of scientific information is part of a scientists skill set. This class is designed to enhance that skill set in terms of presenting visual information clearly, simply, and effectively. Graduate/Undergraduate Equivalency: EEPS 699. Repeatable for Credit.
**EEPS 501 - SPECIAL STUDIES FOR GRADUATE STUDENTS**

Short Title: SPECIAL STUDIES GRAD STUDENTS  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Satisfactory/Unsatisfactory  
Course Type: Independent Study  
Credit Hours: 1-15  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Advanced work in Earth science adapted to the needs of individual graduate students. Instructor Permission Required. Repeatable for Credit.

**EEPS 510 - ADVANCED BIOGEOCHEMISTRY**

Short Title: ADVANCED BIOGEOCHEMISTRY  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Standard Letter  
Course Type: Lecture/Laboratory  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Seminar Topics will vary.

**EEPS 511 - ADVANCED TOPICS IN GEOCHEMISTRY**

Short Title: ADVANCED TOPICS IN GEOCHEMISTRY  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Standard Letter  
Course Type: Seminar  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Seminar topics may vary. Repeatable for Credit.

**EEPS 514 - SEMINAR: SPECIAL TOPICS IN HIGH TEMPERATURE GEOCHEMISTRY**

Short Title: SEM:SPEC TOPICS HIGH TEMP  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Standard Letter  
Course Type: Seminar  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Seminar topics may vary. Repeatable for Credit.

**EEPS 516 - FIELD TRIP FOR ADVANCED GEOLOGY AND PETROLOGY**

Short Title: FIELD TRIP-ADV GEOL & PETROL  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Standard Letter  
Course Type: Lecture/Laboratory  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Prerequisite(s): (ESCI 322 or EEPS 322) and ESCI 324 or EEPS 324  
Description: A field trip course centered on weekly readings and several mapping projects carried out over the course of 1 week. The course will focus on western North American geology with emphasis on igneous and metamorphic petrology and structural geology in the context of regional tectonics. Field studies will be accompanied by quantitative data collection and analysis. Each student will be responsible for a small field-based project. Repeatable for Credit.

**EEPS 525 - APPLIED SEDIMENTOLOGY I**

Short Title: APPLIED SEDIMENTOLOGY I  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Standard Letter  
Course Type: Seminar  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Topics may vary. 7-day field trip is required. Recommended Prerequisite(s): MATH 211. Repeatable for Credit.

**EEPS 526 - APPLIED SEDIMENTOLOGY II**

Short Title: APPLIED SEDIMENTOLOGY II  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Standard Letter  
Course Type: Lecture/Laboratory  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Prerequisite(s): ESCI 505  
Description: Advanced field studies in sedimentary geology. This course is intended to provide graduate students with experience working in sedimentary rocks by working on projects of their own design.

**EEPS 527 - CARBONATE DEPOSITIONAL SYSTEMS**

Short Title: CARBONATE DEPOSITIONAL SYSTEMS  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Standard Letter  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Prerequisite(s): ESCI 321 or EEPS 321  
Description: Characterization of modern and ancient, shallow and deep sedimentary environments and facies. Includes examination of different depositional models in relation both to climate and to hydrographic and geographic settings, as well as three field trips. Meeting times will be determined after registration.

**EEPS 528 - TOPICS ON CARBONATES**

Short Title: TOPICS ON CARBONATES  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Standard Letter  
Course Type: Lecture/Laboratory  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Topics may vary. 7-day field trip is required. Recommended Prerequisite(s): MATH 211. Repeatable for Credit.

**EEPS 530 - SILICICLASTIC DEPOSITIONAL SYSTEMS**

Short Title: SILICICLASTIC DEPOSITION SYST  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Standard Letter  
Course Type: Lecture/Laboratory  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Study of modern and ancient sedimentary environments with emphasis on field work. Depositional models examined in relation to climatic, oceanographic, and tectonic influences. Mutually Exclusive: Cannot register for EEPS 530 if student has credit for ESCI 504.
EEPS 531 - ADVANCED TOPICS IN BASIN SEDIMENTOLOGY AND STRATIGRAPHY
Short Title: ADV TOPICS: BASIN SEDIM & STRAT
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: This course will investigate the processes that lead to the development of sedimentary stratigraphy across a continuum of depositional environments, including: fluvial, deltaic, coastal near-shore, continental shelf and slope and abyssal settings. Material will include transport linkages based on studies from modern settings, and will also cover the unique stratigraphic signatures preserved in ancient depositional systems.

EEPS 532 - ADVANCED TOPICS IN FLUVIAL-DELTAIC SEDIMENTOLOGY AND STRATIGRAPHY
Short Title: ADV TOPICS FLUVIAL-DELTAIC
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Seminar
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: This course will investigate physical and biological processes that contribute to the development of fluvial-deltaic environments. Materials will include deriving physical erosion, transport, and deposition laws, in order to evaluate modern processes that shape deltas and coastlines. The course will also focus on sedimentary deposits of fluvial-deltaic systems and preservation potential of the stratigraphy, by examining ancient depositional systems that are preserved in the rock record. The course will explore these topics by reviewing science literature that utilizes numerical, experimental, and field studies, to further theory on the development of fluvial-deltaic systems. Repeatable for Credit.

EEPS 533 - CLASTIC DEPOSITIONAL SYSTEMS FIELD TRIP
Short Title: FIELD TRIP CLASTIC DEP SYS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Seminar
Credit Hour: 1
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Prerequisite(s): ESCI 504 or EEPS 530
Description: This is a five day trip that takes place in northwestern New Mexico. The trip is intended for students with strong interests in sedimentology and stratigraphy and focuses on field methods in interpretation of clastic sedimentary deposits in terms of their depositional environment, sequence stratigraphic occurrence and reservoir and source rock potential. The field area includes four different basins, which provides further opportunity for discussion of sedimentary basin evolution. The course also includes reading assignments and class presentations on topics related to the trip. Repeatable for Credit.

EEPS 535 - FIELD COURSE: APPLIED STRATIGRAPHY AND STRUCTURAL GEOLOGY
Short Title: FIELD COURSE: APPLIED STRAT
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Focus on how to interpret stratigraphy and structure from outcrop and subsurface data using a field transect from the orogenic belt to the foreland basin. By the end of the class, students should be able to measure/describe stratigraphic sections, construct a structural-stratigraphic framework, interpret structural profiles and integrate paleontology.

EEPS 537 - SEMINAR: TOPICS IN SEDIMENTOLOGY
Short Title: SEM: TOPICS-SEDIMENTOLOGY
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Seminar
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Seminar topics may vary. Repeatable for Credit.

EEPS 538 - SEMINAR: CARIBBEAN
Short Title: SEM: CARIBBEAN
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Seminar
Credit Hour: 1
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Seminar topics may vary. Repeatable for Credit.

EEPS 540 - CRYOSPHERE
Short Title: CRYOSPHERE
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Prerequisite(s): ESCI 321 or EEPS 321
Description: The growth and decay of glaciers play a large role in modulating Earth’s climate system. This course focuses on physical glaciology, glacial geomorphology, the geologic record of glaciation, and glacier-climate interactions in the past, present, and future. Mutually Exclusive: Cannot register for EEPS 540 if student has credit for ESCI 503.
EEPS 541 - MOUNTAINS, CLIMATE AND GLOBAL CARBON CYCLING  
**Short Title:** CARBON CYCLE  
**Department:** Earth/Environmnt/Planetary Sci  
**Grade Mode:** Satisfactory/Unsatisfactory  
**Course Type:** Seminar  
**Credit Hours:** 2  
**Restrictions:** Enrollment is limited to Graduate level students.  
**Course Level:** Graduate  
**Description:** The purpose of this course is to discuss the origins of high elevations, such as mountains and epeirogenic uplifts, and their impacts of climate, global carbon cycling, and sedimentary processes. We will discuss the physics and chemistry of building mountains by magmatism and tectonic thickening as well as destroying them by erosion, chemical weathering, and delamination. We will explore perspectives from the deep Earth to the atmosphere. The seminar will meet once a week for two hours with the first hour being a thematic overview given by faculty or students and the second hour devoted to discussion of assigned papers. Recommended Prerequisite(s): (ESCI 321 or EEPS 321) and (ESCI 322 or EEPS 322) Repeatable for Credit.

EEPS 542 - MARINE GEOLOGY SYSTEMS  
**Short Title:** MARINE GEOLOGY SYSTEMS  
**Department:** Earth/Environmnt/Planetary Sci  
**Grade Mode:** Standard Letter  
**Course Type:** Lecture  
**Credit Hours:** 3  
**Restrictions:** Enrollment is limited to Graduate level students.  
**Course Level:** Graduate  
**Description:** This course examines areas of the seafloor recently targeted by large-scale science projects, such as the ocean drilling program. The purpose is to understand current ocean geoscience problems, the research being conducted to address these problems, and preliminary results.

EEPS 543 - EARTH'S ATMOSPHERE  
**Short Title:** EARTH'S ATMOSPHERE  
**Department:** Earth/Environmnt/Planetary Sci  
**Grade Mode:** Standard Letter  
**Course Type:** Lecture  
**Credit Hours:** 3  
**Restrictions:** Enrollment is limited to Graduate level students.  
**Course Level:** Graduate  
**Description:** How and why has Earth's atmosphere evolved over time? We will begin with an understanding of the atmosphere today - its physics, chemistry, and dynamics - work backwards in time to frontiers that are comparatively data-poor. We focus on empirical/observational constraints that drive theories of atmospheric evolution on Earth and other planets. Recommended Prerequisite(s): MATH 211 Repeatable for Credit.

EEPS 544 - SEMINAR: ADVANCED TOPICS IN HYDROGEOLOGY  
**Short Title:** SEM:ADV TOPICS HYDROGEOLOGY  
**Department:** Earth/Environmnt/Planetary Sci  
**Grade Mode:** Standard Letter  
**Course Type:** Seminar  
**Credit Hours:** 3  
**Restrictions:** Enrollment is limited to Graduate level students.  
**Course Level:** Graduate  
**Description:** Seminar topics may vary. Repeatable for Credit.

EEPS 545 - THEORETICAL GLOBAL SEISMOLOGY I  
**Short Title:** THEORETICAL GLBL SEISMOLOGY I  
**Department:** Earth/Environmnt/Planetary Sci  
**Grade Mode:** Standard Letter  
**Course Type:** Lecture  
**Credit Hours:** 3  
**Restrictions:** Enrollment is limited to Graduate level students.  
**Course Level:** Graduate  
**Description:** The course provides a path through theoretical seismology from a comprehensive analysis perspective. It consists of five parts: (i) The introduction of Earth's elastic-gravitational deformations through the calculus of variations, and the introduction of fluid-solid boundaries involving Earth's core using an action integral. (ii) The variational linearized or weak formulation of Earth's elastic-gravitational deformations. (iii) Energy estimates and well-posedness under appropriate conditions (that, for example, constrain the shapes of the major boundaries) of the system of elastic-gravitational equations describing the oscillations of the earth, and a Volterra equation justifying the extraction of the system describing acousto-elastic waves. (iv) The characterization of the spectrum of the earth, seismic normal modes and the essential spectrum associated with internal or gravity modes and embedded eigenfrequencies. The "asymptotic" resolution of the identity or seismic normal mode summation. In radial models such as PREM, a discussion of the Einstein-Brioullin-Keller quantization, trace formula and length spectrum. (v) Incorporation of dynamic ruptures, using rate- and state-dependent friction laws, generating seismic waves through an iterative coupling scheme and viscosity solutions. All parts will be illustrated with computational simulations using numerical formulations closely related to the analysis.

EEPS 546 - SEISMOLOGY II  
**Short Title:** SEISMOLOGY II  
**Department:** Earth/Environmnt/Planetary Sci  
**Grade Mode:** Standard Letter  
**Course Type:** Lecture  
**Credit Hours:** 3  
**Restrictions:** Enrollment is limited to Graduate level students.  
**Course Level:** Graduate  
**Description:** Review of elastodynamics. Calculation of synthetic seismograms using asymptotic and finite-difference methods, wave propagation in layered and random media. Seismic migration and inversion using finite-difference. Kirchoff, and frequency-wave number methods.

EEPS 548 - 3D SEISMIC REFLECTION DATA INTERPRETATION  
**Short Title:** 3D SEISMIC REFLECTION DATA  
**Department:** Earth/Environmnt/Planetary Sci  
**Grade Mode:** Standard Letter  
**Course Type:** Lecture/Laboratory  
**Credit Hours:** 3  
**Restrictions:** Enrollment is limited to Graduate level students.  
**Course Level:** Graduate  
**Prerequisite(s):** ESCI 442 or ESCI 642 (may be taken concurrently) or EEPS 448 or EEPS 648 (may be taken concurrently)  
**Description:** Workstation-based geologic interpretation of 3D seismic reflection data. The course will focus on interpreting horizons and faults tying interpretation to well data, analyzing seismic attributes, and other relevant topics. Emphasis will be placed on workflows utilized in hydrocarbon exploration. Mutually Exclusive: Cannot register for EEPS 548 if student has credit for ESCI 558.
EEPS 550 - ADVANCED TOPICS IN THE SOLID EARTH I
Short Title: ADV TOPICS - SOLID EARTH I
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Seminar
Credit Hours: 2
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Seminar topics may vary.

EEPS 551 - ADVANCED TOPICS IN THE SOLID EARTH II
Short Title: ADV TOPICS - SOLID EARTH II
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Seminar
Credit Hours: 2
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Seminar topics may vary. Repeatable for Credit.

EEPS 552 - ADVANCED TOPICS IN GEOPHYSICS
Short Title: ADV TOPICS IN GEOPHYSICS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Seminar
Credit Hour: 1
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Seminar topics may vary. Repeatable for Credit.

EEPS 555 - SEMINAR: SEISMOLOGY
Short Title: SEM: SEISMOLOGY
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Seminar
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Seminar topics may vary. Repeatable for Credit.

EEPS 556 - SEMINAR: SEISMIC MODELING AND INVERSE METHODS
Short Title: SEM:SEISMICMODEL&INVERSEMETHOD
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Seminar
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Seminar topics may vary. Repeatable for Credit.

EEPS 557 - SEMINAR: GLOBAL SEISMOLOGY
Short Title: SEM:GLOBAL SEISMOLOGY
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Seminar
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Seminar topics may vary. Repeatable for Credit.

EEPS 560 - ADVANCED TECTONOPHYSICS/GLOBAL TECTONICS
Short Title: ADV TECTONOPHY/GLOBL TECTONICS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Seminar
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Seminar topics may vary. Repeatable for Credit.

EEPS 561 - TOPICS IN PLANETARY DYNAMICS AND MAGMATIC PROCESSES
Short Title: TOPICS IN PLANETARY DYNAMICS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Seminar
Credit Hours: 2
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Seminar topics may vary. Instructor Permission Required. Repeatable for Credit.

EEPS 563 - THE PLANET MARS: FORMATION, DIFFERENTIATION, STRUCTURE AND EVOLUTION
Short Title: PLANET MARS: FORM, STRUCT, EVO
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Seminar
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: This seminar addresses fundamental issues in Mars science, spanning the disciplines of geology, geophysics, geochemistry and petrology. Sources range over six decades of data from flybys and orbiting spacecraft, landed stations and rovers, and laboratory analysis of meteorites and experiments. Readings will be supplemented by presentations from active Mars researchers.

EEPS 564 - THE MOON: ORIGIN AND EVOLUTION OF EARTH'S COMPANION
Short Title: THE MOON: ORIGIN & EVOLUTION
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Seminar
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: This seminar addresses fundamental issues in the origin and evolution of the Moon, spanning the disciplines of geology, geophysics, geochemistry and petrology. Sources range from classic studies to recent results from orbiting spacecraft and laboratory analysis. Readings will be supplemented by presentations from active researchers in the field.
EEPS 567 - SEMINAR: ADVANCED TOPICS IN EARTH STRUCTURE AND DEFORMATION  
Short Title: SEM:ADV TOPICS EARTH STRUCTURE  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Standard Letter  
Course Type: Seminar  
Credit Hours: 1-4  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Seminar topics may vary. Please contact the department for more details. Repeatable for Credit.

EEPS 568 - SEMINAR: DEVELOPMENTS IN STRUCTURAL GEOLOGY  
Short Title: SEM: DEV STRUCTURAL GEOLOGY  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Standard Letter  
Course Type: Seminar  
Credit Hours: 2  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Seminar topics may vary. Repeatable for Credit.

EEPS 569 - SEMINAR: TECTONICS OF CONTINENTAL MARGINS  
Short Title: SEM:TECTONICS-CONTINEN-MARGINS  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Standard Letter  
Course Type: Seminar  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Seminar topics may vary. Repeatable for Credit.

EEPS 571 - SEMINAR: TOPICS IN VOLCANOLOGY, MAGMATIC, AND HYDROTHERMAL PROCESSES  
Short Title: SEM: PHYSICAL VOLCANOLOGY  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Satisfactory/Unsatisfactory  
Course Type: Seminar  
Credit Hour: 1  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Seminar topics may vary. Reading and discussions about current topics related to magma generation, migration, accumulation and eruption, as well as hydrothermal systems. Repeatable for Credit.

EEPS 572 - SEMINAR: ADVANCED TOPICS IN GEOFLOUIDS, GEOTHERMICS, AND PLANETARY EVOLUTION  
Short Title: SEM:GEOFLOUIDS/ THERMICS, PLANET  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Standard Letter  
Course Type: Seminar  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Seminar topics may vary.

EEPS 577 - HYDROCARBON EXPLORATION  
Short Title: HYDROCARBON EXPLORATION  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Standard Letter  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: A student team will analyze and assess petroleum prospects in a sedimentary basin. Using a dataset of industry well/seismic data, the team will analyze data, identify/prioritize exploration targets, and prepare a formal presentation. Team will review their findings to industry judges for AAPG Imperial Barrel Award competition. Instructor Permission Required.

EEPS 579 - HYDROCARBON SYSTEMS ANALYSIS  
Short Title: HYDROCARBON SYSTEMS ANALYSIS  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Standard Letter  
Course Type: Lecture/Laboratory  
Credit Hours: 4  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: This course has lecture, lab, and field components. Students will learn about the components of the hydrocarbon system and how to rank areas of a basin for prospectively. Activities will be organized on a class and small group basis. Recommended Prerequisite(s): ESCI 323 or EEPS 323 or ESCI 627 or EEPS 630

EEPS 580 - SEMINAR: QUANTITATIVE PETROLEUM SYSTEMS ANALYSIS  
Short Title: QUANT PETROLEUM SYS ANALYSIS  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Standard Letter  
Course Type: Seminar  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Seminar topics may vary. Course taught at the University of Houston. Repeatable for Credit.

EEPS 581 - MODERN EXPLORATION TECHNOLOGY  
Short Title: MODERN EXPLORATION TECHNOLOGY  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Standard Letter  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Prerequisite(s): ESCI 442 or ESCI 642 or EEPS 448 or EEPS 648  
Corequisite: EEPS 455  
Description: Modern petroleum exploration techniques using geology, geophysics, and information technology methods. As new techniques emerge, the course will change to ensure that the course material mirrors the exploration industry.
EEPS 583 - DATA MANAGEMENT AND DATA GOVERNANCE
Short Title: DATA MANAGEMENT
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: An organization's data is recognized as the most vital asset of an enterprise, yet far too many fail to appreciate the legal and fiscal responsibilities and liabilities associated with it. This course covers the foundations, principles and methodology of data management and data governance to ensure such high quality data. Mutually Exclusive: Cannot register for EEPS 583 if student has credit for ESCI 549.

EEPS 584 - DATA SCIENCE ENVIRONMENTAL AND GEOSCIENCES
Short Title: DATA SCIENCE GEO-HYDRO-ENV APP
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: This course focuses on practical applications of common data science techniques to extract information from environmental, hydrologic and geological data. Lectures cover theories and examples with biweekly course work assignments. Students are required to complete a group project and presentation at the end of the course.

EEPS 585 - COMPUTATIONAL AND DATA SCIENCE IN THE ENERGY INDUSTRY
Short Title: COMP&DATA SCI ENERGY INDUSTRY
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: This course will be dedicated to problems and topics occurring in the energy industry, both in R&D and in operations. It has three main components: 1. Computational Geophysics 2. Reservoir Simulation Fundamentals 3. Machine Learning The first two components will be taught together in the first 10 weeks by dedicating half of the class-time to each subject. The Machine Learning component will, in part, build on the first two fundamental components and will be taught using the full class time. Computational Geophysics The participants in this geophysics part of the course are expected to be interested into learn how to use modern seismic data to image the subsurface with awareness of the computational costs of the techniques involved. The main focus will be given to current seismic imaging tools including cutting-edge Machine Learning (ML) applications. As the result of the successful completion of this course part, the course participants should be able to: (1) Understand the context and value of imaging tools for the hydrocarbon exploration business. (2) Relate the imaging tools with their computational costs for modern computer resources. (3) Properly use wave-based geophysical imaging and ML-based tools and (4) Understand main seismic processing and interpretation decisions. Applied Reservoir Simulation This component of the course will introduce participants to the practice of reservoir simulation. This class will be an applied course on reservoir simulation. Theoretical descriptions will be provided as warranted but will be kept to minimum. Class participants will learn about the fundamentals of applied reservoir simulation, use of a reservoir simulator, and how to select the proper model for a simulation study. This course will also cover data preparation, grid design, calibration of the reservoir model, forecasting of future performance, and interpretation of simulation results. Participants will also be introduced to the role of simulation in reservoir management, limitations of reservoir simulation, and the structural aspects of the models. Upscaling and recent advances simulation techniques will also be discussed. A realistic open-source reservoir simulation software will be used during the tutorials and computer projects. Machine Learning for Oil & Gas This part of the course will introduce the fundamentals of statistical learning, present a few of the popular learning paradigms and algorithms, and culminate in a small student project applying them to an oil reservoir data set using the R programming language (solutions to class problems will be accepted in any programming language or system). Much of the material presented here is also known under the names “Big Data”, “Data Analytics”, “Artificial Intelligence”, “Data Mining”, “Petroleum Data Driven Analytics” and other terms. Weeks 11 and 12 are theory only, weeks 13-15 will have small hands-on exercises incorporated and week 16 and 17 are dedicated to solving a simple oil reservoir problem using machine learning. Mutually Exclusive: Cannot register for EEPS 585 if student has credit for ESCI 570.
EEPS 586 - DATA SCIENCE METHODS AND DATA MANAGEMENT
Short Title: METHODS DATA SCIENCE/MGMT
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Data has become a critical asset for enabling organizations to be competitive, make better decisions and support diverse stakeholders. In recent years, new methods, tools and techniques for data management and processing have been developed. In this vein, ensuring that users have the knowledge and skills to profit from this wealth of information is critical. In this course, participants will learn a holistic overview about infrastructure, data life cycles, metadata standards, policies and techniques for successfully managing and using data for decision-making. The emphasis of the course will be from the perspective of the Oil & Gas and Energy Industries. Recommended Prerequisite(s): Basic programming, introductory statistics

EEPS 587 - SEM: PETROLEUM GEOCHEMISTRY - PRINCIPALS AND PRACTICE
Short Title: SEM: PETROLEUM GEOCHEMISTRY
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Seminar
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Seminar topics may vary. Course taught at the University of Houston. Repeatable for Credit.

EEPS 589 - TOPICS IN GEOMATHEMATICS
Short Title: TOPICS IN GEOMATHEMATICS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 1-3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Content varies from year to year. Recommended Prerequisite(s): CAAM 335 and CAAM 336

EEPS 590 - SEMINAR: DEPARTMENT TYPE-LOCATE FIELD TRIPS
Short Title: SEM:DEPT-LOCATE FIELD TRIPS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Seminar
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Seminar topics may vary. Repeatable for Credit.

EEPS 591 - SEMINAR: DEPARTMENT TYPE - LOCALE FIELD TRIP
Short Title: SEM: LOCALE FIELD TRIP
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Seminar
Credit Hours: 2-4
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Prerequisite(s): (ESCI 321 (may be taken concurrently) or EEPS 321 (may be taken concurrently)) and (ESCI 322 (may be taken concurrently) or EEPS 322 (may be taken concurrently)) and (ESCI 323 (may be taken concurrently) or EEPS 323 (may be taken concurrently)) and (ESCI 324 (may be taken concurrently) or EEPS 324 (may be taken concurrently))
Description: Seminar topics vary depending on location of field trip. This is a Seminar/Trip type course combination. Undergraduates are required to take prerequisites to register for this course. Prerequisites do not apply for graduate students. Prerequisites may be taken concurrently. Additional fee may be required for this course. Instructor Permission Required. Repeatable for Credit.

EEPS 592 - SPECIAL TOPICS IN EARTH, ENVIRONMENTAL & PLANETARY SCIENCES
Short Title: SPECIAL TOPICS IN EEPS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Seminar
Credit Hour: 1
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: This course deals with miscellaneous special topics not covered in other courses. Please contact the Earth Science department for the specific topics. Topics change each semester. Repeatable for Credit.

EEPS 594 - INTRODUCTION TO SCIENCE COMMUNICATION
Short Title: INTRO TO SCIENCE COMMUNICATION
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Seminar
Credit Hour: 1
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: This course will introduce students to the methods of communicating science to the public, by exposing them to professionals and researchers from various communication careers. It will teach students to convey science to the lay audience through several methods, such as media reporting, museum programming, and general public outreach.
EEPS 595 - PITCHING YOUR SCIENCE
Short Title: PITCHING YOUR SCIENCE
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 2
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: This course is designed for senior level graduate students who will be facing high-stakes professional speaking opportunities, such as impromptu job conversations, formal academic and professional presentations, conversations with journalists, and/or industrial job interviews. Students will construct and practice 90-second, 5-minute, and 15-minute presentations. Most assignments will take place in-class, with limited work occurring outside of the classroom. Requirement: Participation in the Rice University 90-second thesis competition. Instructor Permission Required.

EEPS 597 - GEOPHYSICAL FIELD WORK FOR EDUCATORS
Short Title: GEOPHYS FLD WK FOR EDUCATORS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: This course consists of 2 weeks of geophysical field work and is designated for in-service K-12 teachers. Instructor Permission Required. Repeatable for Credit.

EEPS 598 - PUTTING EARTH SCIENCE INTO ACTION
Short Title: SEM: EARTH SCIENCE INTO ACTION
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Seminar
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Seminar topics may vary. Repeatable for Credit.

EEPS 603 - SEMINAR: DEPARTMENT RESEARCH
Short Title: SEMINAR: DEPARTMENT RESEARCH
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Seminar
Credit Hour: 1
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: This is a lab course focused on the identification of minerals with petrographic microscopy. Principles of crystallography, mineral optics, and mineral chemistry will be covered in the first third of the course. The second third of the course will focus on the identification of minerals in igneous, metamorphic, and sedimentary rocks with emphasis on petrogenetic interpretation. The last third of the course will involve each student working on specific petrologic themes in the context of regional tectonics or magmatic processes. Taught every other Fall. Graduate/Undergraduate Equivalency: EEPS 403. Repeatable for Credit.

EEPS 604 - SEMINAR: DEPARTMENT RESEARCH
Short Title: SEMINAR: DEPARTMENT RESEARCH
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Seminar
Credit Hour: 1
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Introduction to current research in the Earth Science department. Students will learn how to give a presentation and will get experience presenting their research. Graduate/Undergraduate Equivalency: EEPS 404. Repeatable for Credit.

EEPS 605 - SEMINAR: CURRENT RESEARCH IN EARTH SCIENCE
Short Title: SEM:CURR RESRCH EARTH SCIENCE
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Seminar
Credit Hour: 1
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: A series of lectures and paper discussions in various areas of Earth science. Graduate/Undergraduate Equivalency: EEPS 405. Repeatable for Credit.

EEPS 606 - SEMINAR: CURRENT RESEARCH IN EARTH SCIENCE
Short Title: SEM:CURR RESRCH EARTH SCIENCE
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Seminar
Credit Hour: 1
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: A series of lectures and paper discussions in various areas of Earth science. Graduate/Undergraduate Equivalency: EEPS 406. Repeatable for Credit.

EEPS 610 - OPTICAL MINERALOGY AND PETROGRAPHY
Short Title: OPTICAL MINERALOGY & PETROGRPH
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Laboratory
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: This is a lab course focused on the identification of minerals with petrographic microscopy. Principles of crystallography, mineral optics, and mineral chemistry will be covered in the first third of the course. The second third of the course will focus on the identification of minerals in igneous, metamorphic, and sedimentary rocks with emphasis on petrogenetic interpretation. The last third of the course will involve each student working on specific petrologic themes in the context of regional tectonics or magmatic processes. Taught every other Fall. Graduate/Undergraduate Equivalency: EEPS 410. Mutually Exclusive: Cannot register for EEPS 610 if student has credit for EEPS 410/ESCI 410/ESCI 610.
EEPS 611 - CHARACTERIZATION OF EARTH, ENVIRONMENTAL, AND PLANETARY MATERIALS
Short Title: MATERIALS CHARACTERIZATION
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: This course will provide an overview of various characterization methods used in geological, chemical, material science and other natural science and engineering research. The techniques that will be discussed include but not limited to electron beam methods (imaging and spectroscopy), X-ray methods, ion-beam analysis, vibrational spectroscopies, and Synchrotron-based techniques. Graduate/Undergraduate Equivalency: EEPS 411. Mutually Exclusive: Cannot register for EEPS 611 if student has credit for EEPS 411/ESCI 419/ESCI 619.

EEPS 612 - ADVANCED PETROLOGY
Short Title: ADVANCED PETROLOGY
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Evaluation of the evolution of igneous rocks in the Earth's crust and mantle. Topics will include phase equilibria, experimental studies, and geochemistry. Labs will stress thin section petrography. Graduate/Undergraduate Equivalency: EEPS 412. Repeatable for Credit.

EEPS 613 - ADVANCED PETROLOGY II
Short Title: ADVANCED PETROLOGY II
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: This course will bring together constraints from field geology, petrography, petrology, geochemistry, and geodynamics to tackle advanced A87 research questions of whole Earth processes that are relevant in the 21st century. The topics that may be covered include, but are not limited to, interplay between magmatic and tectonic processes, magma generation, migration, extraction, and dynamic stability in various settings, magmatic differentiation, volatiles and fluids exchange between various reservoirs and effects on long-term climate, ore genesis, and formation and modification of continents. Graduate/Undergraduate Equivalency: EEPS 413. Mutually Exclusive: Cannot register for EEPS 613 if student has credit for EEPS 413.

EEPS 614 - TRACE-ELEMENT AND ISOTOPE GEOCHEMISTRY FOR EARTH AND ENVIRONMENTAL SCIENCE
Short Title: TRACE-ELEMENT& ISOTOPE GEOCHEM
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: This course will cover concepts in aqueous geochemistry in the context of chemical weathering and Earth's major biogeochemical cycles. Central to this course will be weekly student-led discussions of scientific literature. Students will also learn basic numerical modeling and data analysis techniques using MATLAB, field methods, and basic analytical chemistry. Graduate/Undergraduate Equivalency: EEPS 415. Mutually Exclusive: Cannot register for EEPS 614 if student has credit for EEPS 415/ESCI 407/ESCI 607.

EEPS 615 - GEOCHEMISTRY OF EARTH'S SURFACE
Short Title: GEOCHEM EARTH'S SURFACE
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: This course will cover concepts in aqueous geochemistry in the context of chemical weathering and Earth's major biogeochemical cycles. Central to this course will be weekly student-led discussions of scientific literature. Students will also learn basic numerical modeling and data analysis techniques using MATLAB, field methods, and basic analytical chemistry. Graduate/Undergraduate Equivalency: EEPS 415. Mutually Exclusive: Cannot register for EEPS 615 if student has credit for EEPS 415/ESCI 407/ESCI 607.

EEPS 616 - ISOTOPE GEOCHEMISTRY
Short Title: ISOTOPE GEOCHEMISTRY
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: An introduction to the principles and techniques of stable and radiogenic geochemistry in the geosciences. The course will begin by examining the fundamental physics relevant to isotope partitioning and decay, followed by a survey of different isotope systems and how they are used to study surface processes, element cycling, climate, and planetary science. Graduate/Undergraduate Equivalency: EEPS 418. Recommended Prerequisite(s): ESCI 322 or ESCI 322 Mutually Exclusive: Cannot register for EEPS 616 if student has credit for EEPS 418/ESCI 433/ESCI 633.
EEPS 620 - ORGANIC GEOCHEMISTRY
Short Title: ORGANIC GEOCHEMISTRY
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: This course covers the organic geochemistry of the natural environment. Topics include: production, transport, decomposition, and storage of organic matter in the marine and terrestrial environments, use of isotopes to track biogeochemical processes and natural and perturbed carbon cycle issues, including past and recent climate shifts. Graduate/Undergraduate Equivalency: EEPS 420. Mutually Exclusive: Cannot register for EEPS 620 if student has credit for EEPS 420/ESCI 425/ESCI 625.

EEPS 625 - PLANETARY SURFACE PROCESSES
Short Title: PLANETARY SURFACE PROCESSES
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: This course is designed to expand understanding of geologic processes by considering how common or distinctive different geologic processes are on Earth compared to other bodies throughout the solar system. Students will leave the course with an appreciation for the types of surface processes that dominate different bodies throughout the solar system. How does the surface of Earth compare to the surfaces of other bodies in our solar system? How can we best extrapolate our understanding of Earth to other bodies? What do we learn about Earth from such comparisons? Mutually Exclusive: Cannot register for EEPS 625 if student has credit for ESCI 425/ESCI 625.

EEPS 626 - GEOMORPHOLOGY
Short Title: GEOMORPHOLOGY
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: This course will investigate physical, chemical, and biological processes that contribute to the development and shaping of Earth's surface across a continuum of subaerial and subaqueous environments. Mandatory 4-day field trip is associated with this class. Graduate students will be assigned exercises more challenging than those assigned to undergraduate students. Graduate/Undergraduate Equivalency: EEPS 426. Mutually Exclusive: Cannot register for EEPS 626 if student has credit for EEPS 426/ESCI 431/ESCI 631. Repeatable for Credit.

EEPS 627 - MECHANICS OF SEDIMENT TRANSPORT
Short Title: MECHANICS-SEDIMENT TRANSPORT
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Evaluation of sedimentary transport dynamics: physical interaction between fluid flow and sediment mobility, from grain to bedform scale; exploration of environments including rivers, estuaries, deltas, coastlines, and deserts. Examination of sediment transport for geology, environmental, and engineering applications; formation of diagnostic sedimentary features recognized in the stratigraphic record. Graduate/Undergraduate Equivalency: EEPS 427. Mutually Exclusive: Cannot register for EEPS 627 if student has credit for EEPS 427/ESCI 435/ESCI 635.

EEPS 628 - ANTARCTIC MARINE GEOLOGY
Short Title: ANTARCTIC MARINE GEOLOGY
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: The study of marine geologic principles and processes using examples from the Southern Oceans. Graduate/Undergraduate Equivalency: EEPS 428. Mutually Exclusive: Cannot register for EEPS 628 if student has credit for EEPS 428/ESCI 423/ESCI 623.

EEPS 629 - PALEOCEANOGRAPHY
Short Title: PALEOCEANOGRAPHY
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: The evolution of the ocean, climate and the global carbon cycle over the last 100 million years as recorded by the biology, chemistry and composition of deep-sea sediment. Graduate/Undergraduate Equivalency: EEPS 429. Mutually Exclusive: Cannot register for EEPS 629 if student has credit for EEPS 429/ESCI 421/ESCI 621.

EEPS 630 - SEQUENCE STRATIGRAPHY
Short Title: SEQUENCE STRATIGRAPHY
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: This course will introduce students to the concepts of sequence stratigraphy and the power behind this correlation technique. The course is divided between classic sequence stratigraphy using cores, well-logs, and outcrop examples and seismic sequence stratigraphy. Graduate/Undergraduate Equivalency: EEPS 430. Mutually Exclusive: Cannot register for EEPS 630 if student has credit for EEPS 430/ESCI 427/ESCI 627.
EEPS 632 - QUANTITATIVE HYDROGEOLOGY
Short Title: QUANTITATIVE HYDROGEOLOGY
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Advanced course that will provide a quantitative overview of groundwater hydrology. Emphasis will be placed on mastering concepts in fluid mechanics and applying these concepts to water supply, environmental, and geological problems. Graduate/Undergraduate Equivalency: EEPS 432. Mutually Exclusive: Cannot register for EEPS 632 if student has credit for EEPS 432/ESCI 418/ESCI 618.

EEPS 633 - CLIMATE DYNAMICS
Short Title: CLIMATE DYNAMICS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Earth's climate is a chaotic system, characterized by nonlinear interactions between the ocean, atmosphere, and land surfaces. This course will focus on the dynamics of the ocean and atmosphere, including the drivers of large-scale circulation, heat transport, and modes of natural variability. We will also explore projections of future climate change scenarios and records of historical climate change. Students will learn to post-process climate model output, analyze, and map these data using Python. Graduate/Undergraduate Equivalency: EEPS 433. Mutually Exclusive: Cannot register for EEPS 633 if student has credit for EEPS 432/ESCI 418/ESCI 618.

EEPS 634 - CLIMATE OF THE COMMON ERA
Short Title: CLIMATE OF THE COMMON ERA
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: This course explores climate variability and change over the past two thousand years to contextualize current rates and magnitudes of anthropogenic climate change on Earth. This reading and discussion-focused seminar course will cover paleoclimate archives such as corals, tree rings, and ice cores, as well as climate reconstruction methods, detection and attribution. Students will be provided with an overview of methods and key findings in paleoclimatology and paleoceanography, using high-resolution archives to explore past changes in global climate. Students will read 3-4 scientific papers each week, provide summaries and volunteer to lead discussions surrounding topics of their choosing. Graduate/Undergraduate Equivalency: EEPS 434.

EEPS 635 - REMOTE SENSING
Short Title: REMOTE SENSING
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Introduction to electromagnetic remote sensing of the Earth and other planets using passive and active methods. The course includes a computer lab component involving processing and interpretation of remote sensing imagery, and an individual project. Graduate/Undergraduate Equivalency: EEPS 435. Mutually Exclusive: Cannot register for EEPS 635 if student has credit for EEPS 435.

EEPS 636 - GIS FOR SCIENTISTS AND ENGINEERS
Short Title: GIS FOR SCIENTISTS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Basic principles of Geographic Information Systems, with a focus on effectively applying the technology to the geosciences. Main platform of the class will be ESRI's ArcGIS, but a wide array of other tools will also be introduced. Material will be delivered via a blend of lecture and hands-on exercises. Graduate/Undergraduate Equivalency: EEPS 436. Mutually Exclusive: Cannot register for EEPS 636 if student has credit for EEPS 436.

EEPS 645 - EARTH AND PLANETARY INTERIORS
Short Title: EARTH AND PLANETARY INTERIORS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Principles of elastic wave propagation, the determination of Earth structure, and the understanding of earthquake physics. Graduate/Undergraduate Equivalency: EEPS 445. Mutually Exclusive: Cannot register for EEPS 645 if student has credit for EEPS 445.
EEPS 648 - EXPLORATION GEOPHYSICS
Short Title: EXPLORATION GEOPHYSICS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 4
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: This course will introduce students to analysis of sub-regional structural and stratigraphic frameworks. We will utilize the interpretation of 2D seismic profiles to reconstruct basin history and discuss implications for petroleum systems. Students will gain an understanding of a variety of structural and stratigraphic styles, as expressed on seismic data. Instructor Permission Required. Graduate/Undergraduate Equivalency: EEPS 454. Mutually Exclusive: Cannot register for EEPS 654 if student has credit for EEPS 454.

EEPS 658 - ENVIRONMENTAL & APPLIED ROCK PHYSICS
Short Title: APPLIED ROCK PHYSICS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Rock physics, the study of the impact of rock microstructure, mineralogy, fluids, stress state, and diagenetic features on wave propagation in porous media. Understanding the use of such relationships for quantitative analysis of seismic datasets. Applications to geologic carbon storage, permafrost characterization, geothermal systems, and hydrogeology. Graduate/Undergraduate Equivalency: EEPS 458. Mutually Exclusive: Cannot register for EEPS 658 if student has credit for EEPS 458/ESCI 465/ESCI 665.

EEPS 659 - WELL LOGGING AND PETROPHYSICS
Short Title: WELL LOGGING AND PETROPHYSICS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Basics of wireline logging and logging while drilling including borehole environment, resistivity, radiation, thermal, and elastic wave measurements and measuring tools. Building from this introduction, basic interpretation of logging data and formation evaluation will be studied. Graduate/Undergraduate Equivalency: EEPS 459.

EEPS 660 - GLOBAL TECTONICS
Short Title: GLOBAL TECTONICS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Geometrical aspects of plate tectonics, the 3 traditional types of plate boundaries, instantaneous plate motions, earthquakes and faulting, space geodesy, geomagnetic reversals, paleomagnetic poles, hotspots, "absolute" plate motion, true polar wander, driving forces, diffuse plate boundaries, plate nonrigidity, and rheology of the lithosphere. Graduate/Undergraduate Equivalency: EEPS 460.

EEPS 661 - STRUCTURE AND EVOLUTION OF TECTONIC SYSTEMS
Short Title: TECTONIC SYSTEMS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: The distribution, origin, and evolution of various tectonic systems, and characterization of their structural and geophysical signatures, emphasizing crustal and lithospheric processes associated with tectonic deformation. Review of representative global examples of convergent and collisional margins, divergent and passive margins, and transform margins. Graduate/Undergraduate Equivalency: EEPS 461.
EEPS 662 - TECTONOPHYSICS  
Short Title: TECTONOPHYSICS  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Standard Letter  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Advanced course in the foundations of fluid mechanics and its application to Earth science. Aspects of continuum mechanics, heat and mass transfer, and the rheologic behavior of materials will be covered in developing the fundamental laws that describe fluid motion. Applications include atmospheric dynamics, mantle and lithospheric dynamics, and hydrogeology. Graduate/Undergraduate Equivalency: EEPS 465.  
EEPS 664 - INTRODUCTION TO THE HEAT AND MASS TRANSPORT PROCESSES OF PLANETARY INTERIORS  
Short Title: GEODYNAMICS  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Standard Letter  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Introduction to the use of continuum mechanics to solve fundamental problems related to mass and energy transport problems arising in the study of solid Earth, planets and moons. Topics include: heat conduction, convective heat transfer, planetary thermal evolution, geological fluid dynamics, flow through porous media, rheology of planetary materials. Graduate/Undergraduate Equivalency: EEPS 462.  
EEPS 665 - ROCK DEFORMATION AND RHEOLOGY  
Short Title: ROCK DEFORMATION AND RHEOLOGY  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Standard Letter  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Introduction to the use of continuum mechanics to solve fundamental problems related to mass and energy transport problems arising in the study of solid Earth, planets and moons. Topics include: heat conduction, convective heat transfer, planetary thermal evolution, geological fluid dynamics, flow through porous media, rheology of planetary materials. Graduate/Undergraduate Equivalency: EEPS 462.  
EEPS 666 - PLANETARY VOLCANISM  
Short Title: PLANETARY VOLCANISM  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Standard Letter  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Introduction to volcanoes and associated physical processes. Conceptual and quantitative discussion of topics related to magma transport, magma storage, and volcanic eruptions. The course includes a 4-6 day field trip to California and Oregon. Graduate/Undergraduate Equivalency: EEPS 468.  
EEPS 671 - EARTH SYSTEMS MODELING I: PHILOSOPHY AND FUNDAMENTALS  
Short Title: EARTH SYSTEMS MODELING I  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Standard Letter  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Introduction to volcanoes and associated physical processes. Conceptual and quantitative discussion of topics related to magma transport, magma storage, and volcanic eruptions. The course includes a 4-6 day field trip to California and Oregon. Graduate/Undergraduate Equivalency: EEPS 468.  
EEPS 668 - VOLCANOES  
Short Title: VOLCANOES  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Standard Letter  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Introduction to volcanoes and associated physical processes. Conceptual and quantitative discussion of topics related to magma transport, magma storage, and volcanic eruptions. The course includes a 4-6 day field trip to California and Oregon. Graduate/Undergraduate Equivalency: EEPS 468.  
EEPS 669 - INTRODUCTION TO THE HEAT AND MASS TRANSPORT PROCESSES OF PLANETARY INTERIORS  
Short Title: GEODYNAMICS  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Standard Letter  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Advanced course in the foundations of fluid mechanics and its application to Earth science. Aspects of continuum mechanics, heat and mass transfer, and the rheologic behavior of materials will be covered in developing the fundamental laws that describe fluid motion. Applications include atmospheric dynamics, mantle and lithospheric dynamics, and hydrogeology. Graduate/Undergraduate Equivalency: EEPS 465.  
EEPS 671 - EARTH SYSTEMS MODELING I: PHILOSOPHY AND FUNDAMENTALS  
Short Title: EARTH SYSTEMS MODELING I  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Standard Letter  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Advanced course in the foundations of fluid mechanics and its application to Earth science. Aspects of continuum mechanics, heat and mass transfer, and the rheologic behavior of materials will be covered in developing the fundamental laws that describe fluid motion. Applications include atmospheric dynamics, mantle and lithospheric dynamics, and hydrogeology. Graduate/Undergraduate Equivalency: EEPS 465.  
EEPS 667 - GEOMECHANICS  
Short Title: GEOMECHANICS  
Department: Earth/Environmnt/Planetary Sci  
Grade Mode: Standard Letter  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: An examination of deformation and failure processes within the Earth's shallow crust, with a focus on rock and sediment mechanics, and associated fluid processes. Emphasis will be on geologic applications, including sediment consolidation, slope stability, fault mechanics, and earthquake nucleation and rupture. Graduate/Undergraduate Equivalency: EEPS 467.
EEPS 672 - EARTH SYSTEMS MODELING: NUMERICAL TECHNIQUES AND APPLICATIONS
Short Title: NUMERICAL METHODS EARTH SYSTEM
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Introduction to numerical methods with applications in Earth Science using Matlab and COMSOL. Much of the class is spent in the computer lab learning Matlab and COMSOL, followed by hands-on exercises. Graduate/Undergraduate Equivalency: EEPS 472. Mutually Exclusive: Cannot register for EEPS 672 if student has credit for EEPS 472/ESCI 472/ESCI 672. Repeatable for Credit.

EEPS 677 - SPECIAL TOPICS
Short Title: SPECIAL TOPICS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Seminar, Independent Study, Internship/Practicum, Laboratory, Lecture, Lecture/Laboratory
Credit Hours: 1-4
Course Level: Graduate
Description: Topics and credit hours vary each semester. Contact department for current semester's topic(s). Repeatable for Credit.

EEPS 684 - DECISION MAKING AND ECONOMICS IN THE ENERGY INDUSTRY
Short Title: DECISION MAKING AND ECONOMICS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: This course will provide students with an understanding of how energy projects are evaluated. Topics include resource-size determination, geologic and economic risk, discounted cash-flow economics, and other common methods used in decision making. Emphasis will be placed on working in teams to understand basic concepts and sensitivities. Graduate/Undergraduate Equivalency: EEPS 484.

EEPS 686 - PETROLEUM INDUSTRY ECONOMICS AND MANAGEMENT
Short Title: PETROLEUM IND ECONOMICS MGMT
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Topics covered include resource size determination; geologic risk analysis; establishing minimum economic thresholds; economic chance factors; the concepts of present worth, investment efficiency, rates of return. Price forecasting, cost inflation are discussed. Graduate/Undergraduate Equivalency: EEPS 486.

EEPS 688 - ECONOMIC GEOLOGY MINERAL DEPOSITS
Short Title: ECON GEOL MINERAL DEPOSITS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: An overview of metallic and nonmetallic mineral deposits, theories of their origin, and classification. The impact of government regulation, economics, production practices, and exploration will be considered. Graduate/Undergraduate Equivalency: EEPS 488.

EEPS 695 - GRAPHIC AND VISUAL DESIGN FOR SCIENTISTS
Short Title: VISUAL DESIGN FOR SCIENTISTS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Seminar
Credit Hours: 3
Course Level: Graduate
Description: A significant portion of a scientist's time is spent solving visual design problems (graphics for papers, visual layouts for seminars, posters, teaching). Effective communication of scientific information is part of a scientist's skill set. This class is designed to enhance that skill set in terms of presenting visual information clearly, simply, and effectively. Graduate/Undergraduate Equivalency: EEPS 495. Repeatable for Credit.

EEPS 699 - GRAPHIC AND VISUAL DESIGN FOR SCIENTISTS
Short Title: VISUAL DESIGN FOR SCIENTISTS
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Standard Letter
Course Type: Seminar
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: A significant portion of a scientist's time is spent solving visual design problems (graphics for papers, visual layouts for seminars, posters, teaching). Effective communication of scientific information is part of a scientist's skill set. This class is designed to enhance that skill set in terms of presenting visual information clearly, simply, and effectively. Graduate/Undergraduate Equivalency: EEPS 499. Repeatable for Credit.

EEPS 800 - THESIS RESEARCH
Short Title: THESIS RESEARCH
Department: Earth/Environmnt/Planetary Sci
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Research
Credit Hours: 1-15
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Thesis research. Recommended Prerequisite(s): Students must pass the preliminary exam before taking this course. Repeatable for Credit.

Description and Code Legend
Note: Internally, the university uses the following descriptions, codes, and abbreviations for this academic program. The following is a quick reference:

Course Catalog/Schedule
- Course offerings/subject code: EEPS
Department Description and Code
• Earth, Environmental, and Planetary Sciences: EEPS

Undergraduate Degree Description and Code
• Bachelor of Arts degree: BA
• Bachelor of Science degree: BS

Undergraduate Major Description and Code
• Major in Earth, Environmental, and Planetary Sciences (for both the BA and BS degrees): EEPS

Undergraduate Minor Description and Code
• Minor in Earth, Environmental, and Planetary Sciences: EEPM

Graduate Degree Descriptions and Codes
• Master of Science degree: MS
• Doctor of Philosophy degree: PhD

Graduate Degree Program Description and Code
• Degree Program in Earth Science: ESCI

CIP Code and Description
• EEPS Major/Program: CIP Code/Title: 40.0601 - Geology/Earth Science, General
• ESCI Major/Program: CIP Code/Title: 40.0601 - Geology/Earth Science, General
• EEPM Minor: CIP Code/Title: 40.0601 - Geology/Earth Science, General

Classification of Instructional Programs (CIP) 2020 Codes and Descriptions from the National Center for Education Statistics: https://nces.ed.gov/ipeds/cipcode/