



ER Credit 7: Sustainability-Related Courses

Total Stanford Courses Offered, 2010-2011: 8,646

Sustainability-Related Courses: 343

List of Sustainability-Related Courses:

AA 100: Introduction to Aeronautics and Astronautics

The principles of fluid flow, flight, and propulsion; the creation of lift and drag, aerodynamic performance including takeoff, climb, range, and landing performance, structural concepts, propulsion systems, trajectories, and orbits. The history of aeronautics and astronautics. Prerequisites: MATH 41, 42; elementary physics.

Terms: Aut | Units: 3 | UG Reqs: GER:DBEngrAppSci | Grading: Letter or Credit/No Credit

AA 113N: Structures: Why Things Don't (and Sometimes Do) Fall Down

Preference to freshmen. How structures created by nature or built by human beings keep things up and keep things in. Topics: nature's structures from microorganisms to large vertebrae; buildings from ancient dwellings to modern skyscrapers; spacecraft and airplanes; boats from ancient times to America's Cup sailboats, and how they win or break; sports equipment; and biomedical devices including bone replacements and cardiovascular stents. How composite materials are used to make a structure light and strong.

Terms: Win | Units: 3 | UG Reqs: GER:DBEngrAppSci | Grading: Letter (ABCD/NP)

AA 236A: Spacecraft Design

The design of unmanned spacecraft and spacecraft subsystems emphasizing identification of design drivers and current design methods. Topics: spacecraft configuration design, mechanical design, structure and thermal subsystem design, attitude control, electric power, command and telemetry, and design integration and operations.

Terms: Aut | Units: 3-5 | Grading: Letter (ABCD/NP)

AA 253: Product and Systems Development (MS&E 205)

Modern approaches to aerospace design development for life cycle value. Concepts of air and space systems development in a systems context. Stakeholder value issues and requirements through manufacturing and delivery. Processes and practices for

functional analysis, concept and architecture development, trades, domain criteria, interfaces, and verification and validation. Reliability, risk, and safety. Value stream analysis, integrated product and process development, key characteristics, and hardware/software integration aimed at information systems. Tools involve quality function deployment, design structure matrices, and decision mechanisms.

Terms: Spr | Units: 3 | Grading: Letter (ABCD/NP)

AA 272C: Global Positioning Systems

The principles of satellite navigation using GPS. Positioning techniques using code tracking, single and dual frequency, carrier aiding, and use of differential GPS for improved accuracy and integrity. Use of differential carrier techniques for attitude determination and precision position determination. Prerequisite: familiarity with matrix algebra and MatLab (or another mathematical programming language).

Terms: Win | Units: 3 | Grading: Letter (ABCD/NP)

AFRICAAM 16N: African Americans and Social Movements (CSRE 16N, SOC 16N)

Theory and research on African Americans' roles in post-Civil Rights, US social movements. Topics include women's right, LGBT rights, environmental movement, and contemporary political conservatism.

Terms: Spr | Units: 3 | UG Reqs: GER:DBSocSci | Grading: Letter or Credit/No Credit

AFRICAAM 47: History of South Africa (HISTORY 47)

(Same as HISTORY 147. History majors and others taking 5 units, register for 147.) Introduction, focusing particularly on the modern era. Topics include: precolonial African societies; European colonization; the impact of the mineral revolution; the evolution of African and Afrikaner nationalism; the rise and fall of the apartheid state; the politics of post-apartheid transformation; and the AIDS crisis.

Terms: Aut | Units: 3 | UG Reqs: GER:DBSocSci | Grading: Letter or Credit/No Credit

AFRICAST 112: AIDS, Literacy, and Land: Foreign Aid and Development in Africa (AFRICAST 212)

Public policy issues, their roots, and the conflicts they engender. The policy making process: who participates, how, why, and with what results? Innovative approaches to contested policy issues. Foreign roles and their consequences. Case studies such as: a clinic in Uganda that addresses AIDS as a family and community problem; and strategies in Tanzania to increase girls' schooling.

Terms: Win | Units: 5 | UG Reqs: GER:ECGlobalCom | Grading: Letter or Credit/No Credit

ANTHRO 102A: Ancient Civilizations: Complexity and Collapse (ANTHRO 202A)

How archaeology contributes to understanding prehistoric civilizations. How and why complex social institutions arose, and the conditions and processes behind their collapse. The development of monumental architecture, craft specialization, trade and exchange, and social stratification using examples from the archaeological record. (HEF II, III; DA-B)

Terms: Aut | Units: 3-5 | UG Reqs: GER:DBSocSci, GER:ECGlobalCom | Grading: Letter (ABCD/NP)

ANTHRO 113: Faunal Analysis: Animal Remains for the Archaeologist (ANTHRO 213, BIO 166, BIO 266)

The analysis of fossil animal bones and shells to illuminate the behavior and ecology of prehistoric collectors, especially ancient humans. Theoretical and methodological issues. The identification, counting, and measuring of fossil bones and shells. Labs. Methods of numerical analysis.

Terms: Spr | Units: 5 | Grading: Letter or Credit/No Credit

ANTHRO 14: Introduction to Anthropological Genetics

For upper division undergraduates. The extent and pattern of variation among human genomes, the origin of these patterns in human evolution, and the social and medical impact of recent discoveries. Topics include: the Human Genome Project; human origins; ancient DNA; genetic, behavioral, linguistic, cultural, and racial diversity; the role of disease in shaping genetic diversity; DNA forensics; genes and reproductive technology.

Terms: Win | Units: 3 | UG Reqs: GER:DBNatSci | Grading: Letter or Credit/No Credit

ANTHRO 15: Sex and Gender

Commonality and diversity of gender roles in crosscultural perspective. Cultural, ecological, and evolutionary explanations for such diversity. Theory of the evolution of sex and gender, changing views about men's and women's roles in human evolution, conditions under which gender roles vary in contemporary societies, and issues surrounding gender equality, power, and politics.

Terms: Win | Units: 3 | UG Reqs: GER:DBSocSci, GER:ECGender | Grading: Letter (ABCD/NP)

ANTHRO 172: Seminar on Cultural Evolution and Coevolution (ANTHRO 272)

Upper division/graduate seminar on recent approaches to the study of cultural evolution and coevolution. Critical evaluation of Darwinian and non-Darwinian theories, with special attention to the interplay of culture, genes, environment and society. Students will undertake projects of their own design to review, test, or improve current theoretical formulations. Prerequisite: a university-level course in evolution, ecology, or human behavioral biology.

Terms: Spr | Units: 3-5 | Repeatable for credit | Grading: Letter or Credit/No Credit

ANTHRO 181A: Gender in the Middle East: Iran, Turkey, and Egypt

This course explores the construction of gender in the Middle East. Drawing on the historical, sociological and anthropological research in the region, the course aims to question the stereotypes about the subordination of Muslim women and to offer students a systematic reading and analytical discussion of the political, economic and cultural structures that inform gender relations and practices in the region. The course starts with an examination of early Islam and religious sources with regard to women's status, then moves on to nationalist and modernization movements in the 19th and 20th centuries, and finally explores women's and men's lives in contemporary Egypt, Tu... [more description for ANTHRO 181A »](#)

Terms: Spr | Units: 3-5 | Grading: Letter or Credit/No Credit

ANTHRO 185A: Race and Biomedicine (ASNAMST 185A)

Race, identity, culture, biology, and political power in biomedicine. Biological theories of racial ordering, sexuality and the medicalization of group difference. Sources include ethnography, film, and biomedical literature. Topics include colonial history and medicine, the politics of racial categorization in biomedical research, the protection of human subjects and research ethics, immigration health and citizenship, race-based models in health disparities research and policy, and recent developments in human genetic variation research.

Terms: Aut | Units: 3-5 | Grading: Letter or Credit/No Credit

ANTHRO 22: Archaeology of North America

Why and how people of N. America developed. Issues and processes that dominate or shape developments during particular periods considering the effects of history and interactions with physical and social environment. Topics include the peopling of the New World, explaining subsequent diversity in substance and settlement adaptations, the development of social complexity, and the impact of European contact.

Terms: Win | Units: 3-5 | UG Reqs: GER:DBSocSci, GER:ECAmerCul | Grading: Letter or Credit/No Credit

ANTHRO 320A: Race, Ethnicity, and Language (EDUC 389X, LINGUIST 253)

This seminar explores the linguistic construction of race and ethnicity across a wide variety of contexts and communities. Throughout the course, we will take a comparative perspective and highlight how different racial/ethnic formations participate in similar, yet different, ways of "doing race" through language, interaction and culture. Readings draw heavily from perspectives in (linguistic) anthropology and sociolinguistics.

Terms: Win | Units: 3-4 | Grading: Letter or Credit/No Credit

ANTHRO 322: From Biopolitics to Necropolitics and Beyond

Scholarship produced and informed by Michel Foucault. Focus is on the final period of Foucault's life; how his discussions of biopolitics, subjectification, governmentality, and death have served as touchstones for recent empirical research. Key interventions initially made under these rubrics; how anthropologists and others have applied, challenged, and extended them.

Prerequisite: consent of instructor.

Terms: Spr | Units: 5 | Grading: Letter (ABCD/NP)

ANTHRO 332: Transformative Design (ENGR 231)

Project-based. How interactive technologies can be designed to encourage behavioral transformation. Topics such as self-efficacy, social support, and mechanism of cultural change in domains such as weight-loss, energy conservation, or safe driving. Lab familiarizes students with hardware and software tools for interaction prototyping. Students teams create functional prototypes for self-selected problem domains. Prerequisite: consent of instructor. Design Institute class; see <http://dschool.stanford.edu>.

Terms: Spr | Units: 3-5 | Grading: Letter or Credit/No Credit

ANTHRO 373: Things: An Archaeology of the Relationships Between Humans and Things

This course examines a variety of approaches that claim to explore the relationships between humans and things. Some of the approaches include Marx and material culture studies; Heidegger; cognitive and phenomenological; Actor Network Theory. But there is a need also to examine behavioral and ecological and Darwinian approaches. Many of these approaches do not adequately deal with the physicality of things as objects and there is a need to seek a way to incorporate such aspects of things into social theory.

Terms: Spr | Units: 5 | Grading: Letter (ABCD/NP)

ANTHRO 380B: Gender Bias in the Past and Future of Asia: Kinship & Society

Topics vary. May be repeated for credit. Prerequisite: consent of instructor.

Terms: Win | Units: 1-3 | Repeatable for credit | Grading: Letter or Credit/No Credit

ANTHRO 380C: Gender Bias in the Past and Future of Asia: Governance

Topics vary. May be repeated for credit. Prerequisite: consent of instructor.

Terms: Spr | Units: 1-3 | Repeatable for credit | Grading: Letter or Credit/No Credit

ANTHRO 82: Medical Anthropology (ANTHRO 282)

Emphasis is on how health, illness, and healing are understood, experienced, and constructed in social, cultural, and historical contexts. Topics: biopower and body politics, gender and reproductive technologies, illness experiences, medical diversity and social suffering, and the interface between medicine and science.

Terms: Aut | Units: 5 | UG Reqs: GER:DBSocSci, GER:ECGlobalCom | Grading: Letter (ABCD/NP)

ARCHLGY 133: LANDSCAPE ARCHAEOLOGIES (ARCHLGY 333)

People shape the world around them and are shaped by it. How is this essential interaction examined by archaeologists? And how can a meaningful engagement with space and place be discovered in the archaeological record? Landscape foundations, human ecology, typologies, perception and bodily experience, monuments, networks, settlement systems, political landscapes, frontiers, placelessness and mobility, place histories, and the effects of revolutionary advances in data collection and organization on how archaeologists and anthropologists approach spatial data and human interaction with space and landscape will be discussed in lecture and seminar format and studied through... [more description for ARCHLGY 133 »](#)

Terms: Spr | **Units:** 3-5 | **Grading:** Letter (ABCD/NP)

ARTSTUDI 184: Art and Biology

The relationship between biology and art. Rather than how art has assisted the biological sciences as in medical illustration, focus is on how biology has influenced art making practice. New technologies and experimental directions, historical shifts in artists' relationship to the living world, the effects of research methods on the development of theory, and changing conceptions of biology and life. Projects address these themes and others that emerge from class discussions and presentations. (upper level)

Terms: Spr | **Units:** 4 | **Grading:** Letter or Credit/No Credit

BIO 105A: Jasper Ridge Docent Training (EARTHSYS 105A)

Formerly 96A. First of two-quarter sequence training program to join the Jasper Ridge education program. The scientific basis of ecological research in the context of a field station, hands-on field research, field ecology and the natural history of plants and animals, archaeology, geology, hydrology, land management, multidisciplinary environmental education; and research projects, as well as management challenges of the preserve presented by faculty, local experts, and staff. Participants lead research-focused educational tours, assist with classes, and attend continuing education classes available to members of the JRBP community after the course.

Terms: Win | **Units:** 4 | **Grading:** Satisfactory/No Credit

BIO 105B: Jasper Ridge Docent Training (EARTHSYS 105B)

Formerly 96B. Second of two-quarter sequence training program to join the Jasper Ridge education program. Multidisciplinary environmental education; hands-on field research. Field ecology and the natural history of plants and animals, archaeology, geology, hydrology, land management, and research projects of the preserve presented by faculty, local experts, and staff. Participants lead research-focused educational tours, assist with classes, and attend continuing education classes available to members of the JRBP community after the course. Prerequisite: 96A.

Terms: Spr | **Units:** 4 | **Grading:** Satisfactory/No Credit

BIO 136: Evolutionary Paleobiology

A paleontological approach to evolutionary theory. Topics: history of life, speciation, heterochrony, evolutionary constraint, coevolution, macroevolution, the Cambrian Explosion, mass extinctions, taphonomy, life on land, life in the sea, life in the air. Satisfies Central Menu Area 4. Prerequisite: Biology Core.

Terms: Win | **Units:** 4 | **UG Reqs:** GER:DBNatSci | **Grading:** Letter or Credit/No Credit

BIO 137: Plant Genetics (BIO 237)

Gene analysis, mutagenesis, transposable elements; developmental genetics of flowering and embryo development; biochemical genetics of plant metabolism; scientific and societal lessons from transgenic plants. Satisfies Central Menu Area 2. Prerequisite: Biology core or consent of instructor.

Terms: Spr | **Units:** 3-4 | **UG Reqs:** GER:DBNatSci | **Grading:** Letter or Credit/No Credit

BIO 139: Biology of Birds

How birds interact with their environments and each other, emphasizing studies that had impact in the fields of population biology, community ecology, and evolution. Local bird communities. Emphasis is on field research. Enrollment limited to 20. Prerequisites: 43 or equivalent, and consent of instructor. Recommended: birding experience.

Terms: Spr, alternate years, not given next year | **Units:** 3 | **UG Reqs:** GER:DBNatSci | **Grading:** Letter or Credit/No Credit

BIO 143: Evolution (BIO 243)

The basic facts and principles of the evolution of all life. The logic of and evidence for the correctness of Darwin's argument for evolution by natural selection. How Mendelian genetics was integrated into evolutionary thinking. The integration of physiological and ecological perspectives into the study of evolutionary adaptation within species. Species formation and evolutionary divergence among species. Patterns of evolution over long time scales. Satisfies Central Menu Area 4.

Terms: Aut | **Units:** 3 | **UG Reqs:** GER:DBNatSci | **Grading:** Letter or Credit/No Credit

BIO 145: Behavioral Ecology (BIO 245)

Animal behavior from an evolutionary and ecological perspective. Topics: foraging, territoriality, reproductive behavior, social groups. Lecture/seminar format; seminars include discussion of journal articles. Independent research projects. Satisfies Central Menu Area 4. Prerequisites: Biology or Human Biology core, or consent of instructor. Recommended: statistics.

Terms: Spr | **Units:** 4 | **UG Reqs:** GER:DBNatSci | **Grading:** Letter (ABCD/NP)

BIO 14N: Plants and Civilization

Preference to freshmen. The role of plants in the development of civilization. Topics: the use of forests, woodlands, and grazing lands; centers of origins and spread of crops; viticulture, and wine and beer making; the spice route and the age of exploration; the use of plants as medicine; the global spread of weeds; engineering plants for the future; the importance of tea, coffee,

chocolate, sugar, potatoes, natural dyes, and rubber in societal affairs and change.

Terms: Win | Units: 3 | UG Reqs: GER:DBNatSci | Grading: Letter or Credit/No Credit

BIO 164: Biosphere-Atmosphere Interactions (BIO 264)

Physiological, ecological, and physical aspects of ecosystem function, emphasizing how ecosystems influence and are influenced by the atmosphere. Prerequisites: 42, 43; or consent of instructor.

Terms: Win, alternate years, not given next year | Units: 4 | UG Reqs: GER:DBNatSci | Grading: Letter or Credit/No Credit

BIO 196A: Biology Senior Reflection

Capstone course series for seniors. Creative, self-reflective and scientifically relevant projects conceived, produced and exhibited over the course of three quarters. Explore scientific content of personal interest through creative forms including but not limited to writing, music, fine arts, performing arts, photography, film or new media. A written essay on the creative process and scientific significance of the selected topic will accompany the creative work. Completed projects may be included in a creative portfolio. Required enrollment in 196A,B,C.

Terms: Aut | Units: 3 | Grading: Letter (ABCD/NP)

BIO 196B: Biology Senior Reflection

Capstone course series for seniors. Creative, self-reflective and scientifically relevant projects conceived, produced and exhibited over the course of three quarters. Explore scientific content of personal interest through creative forms including but not limited to writing, music, fine arts, performing arts, photography, film or new media. A written essay on the creative process and scientific significance of the selected topic will accompany the creative work. Completed projects may be included in a creative portfolio. Required enrollment in 196A,B,C.

Terms: Win | Units: 3 | Grading: Letter (ABCD/NP)

BIO 196C: Biology Senior Reflection

Capstone course series for seniors. Creative, self-reflective and scientifically relevant projects conceived, produced and exhibited over the course of three quarters. Explore scientific content of personal interest through creative forms including but not limited to writing, music, fine arts, performing arts, photography, film or new media. A written essay on the creative process and scientific significance of the selected topic will accompany the creative work. Completed projects may be included in a creative portfolio. Required enrollment in 196A,B,C.

Terms: Spr | Units: 3 | Grading: Letter (ABCD/NP)

BIO 227: Foundations of Community Ecology

Discussion of classic papers in community ecology (Forbes, Clements, Gleason, Grinnell, Lindeman, Preston, Elton, Hutchinson,

May, MacArthur, Odum, Connell, Paine, Tilman, etc.) and contemporary papers on related topics, to develop historical perspectives to understand current issues and identify future directions. Prerequisite for undergraduates: consent of instructor.

Terms: Win, alternate years, not given next year | **Units:** 2 | **Grading:** Letter (ABCD/NP)

BIO 275: Ecological Modeling

Develop literacy in ecological models and modeling; understand how to critically evaluate models as well as make a start at framing one's own models. Topics include: classical models of interacting species and ecosystems; global models used to develop future scenarios; resource use and human impact models for improved management decisions; techniques for analyzing and validating models and characterizing uncertainty.

Terms: Spr | **Units:** 3 | **Grading:** Letter or Credit/No Credit

BIO 342: Plant Biology Seminar

Topics announced at the beginning of each quarter. Current literature. May be repeated for credit. See

<http://carnegiedpb.stanford.edu/seminars/seminars.php>.

Terms: Aut, Win, Spr | **Units:** 1-3 | **Repeatable for credit** | **Grading:** Letter or Credit/No Credit

BIOHOPK 161H: Invertebrate Zoology (BIOHOPK 261H)

(Graduate students register for 261H.) Survey of invertebrate diversity emphasizing form and function in a phylogenetic framework. Morphological diversity, life histories, physiology, and ecology of the major invertebrate groups, concentrating on local marine forms as examples. Current views on the phylogenetic relationships and evolution of the invertebrates. Lectures, lab, plus field trips. Satisfies Central Menu Area 3 for Bio majors. Prerequisite: Biology core or consent of instructor.

Terms: Win | **Units:** 5 | **UG Reqs:** GER:DBNatSci | **Grading:** Letter or Credit/No Credit

BIOHOPK 164H: Marine Botany (BIOHOPK 264H)

(Graduate students register for 264H.) Introduction to plants in the sea. Phytoplankton and oceanic productivity; macrophytes and nearshore ecology; marine angiosperms from taxonomical, physiological, and ecological perspectives. Lectures, lab.

Prerequisite: Biology core or consent of instructor.

Terms: Win, alternate years, not given next year | **Units:** 5 | **UG Reqs:** GER:DBNatSci | **Grading:** Letter or Credit/No Credit

BIOHOPK 171H: Ecological and Evolutionary Physiology (BIOHOPK 271H)

(Graduate students register for 271H.) The interplay between environmental factors, such as temperature, light, nutrient supply, salinity, and oxygen availability, and adaptive change at the physiological level. Emphasis is on marine species and the roles played by physiological adaptations in establishing their distribution and performance. Satisfies Central Menu Area 3 for Bio

majors. Prerequisite: Biology core or consent of instructor.

Terms: Spr | Units: 4 | UG Reqs: GER:DBNatSci | Grading: Letter or Credit/No Credit

BIOHOPK 172H: Marine Ecology (BIOHOPK 272H)

(Graduate students register for 272H.) Focus is on quantitative approaches to questions in marine ecology and ecophysiology. Statistical methods, including multivariate statistical approaches and meta-analysis. Satisfies Central Menu Area 4 for Bio majors. Prerequisite: Biology core or consent of instructor.

Terms: Win | Units: 5 | UG Reqs: GER:DBNatSci | Grading: Letter or Credit/No Credit

BIOHOPK 175H: Problems in Kelp Forest Ecology and Microbial Ecology

Intensive field and lab-based course to gain practical experience in experimental design and analysis. Learn field and laboratory techniques in focal areas to conduct original research integrated with on-going research in the Hopkins Marine Life Observatory. Focal areas include kelp-herbivore interactions and microbial ecology of kelp forests. Prerequisites: Biology core or equivalent, Statistics, or concurrent enrollment in BIOHOPK 174H, consent of instructor.

Terms: Spr | Units: 10-12 | UG Reqs: GER:DBNatSci | Grading: Letter or Credit/No Credit

BIOHOPK 187H: Sensory Ecology (BIOHOPK 287H)

(Graduate students register for 287H.) Topics: the ways animals receive, filter, and process information gleaned from the environment, sensory receptor mechanisms, neural processing, specialization to life underwater, communication within and between species, importance of behavior to ecosystem structure and dynamics, impact of acoustic and light pollution on marine animals. Emphasis is on the current scientific literature. The laboratory portion of the class explores sensory mechanisms using neurobiological methods and methods of experimental animal behavior.

Terms: Win | Units: 4 | Grading: Letter or Credit/No Credit

BIOMEDIN 156: Economics of Health and Medical Care (BIOMEDIN 256, ECON 126, HRP 256)

Graduate students with research interests should take ECON 248. Institutional, theoretical, and empirical analysis of the problems of health and medical care. Topics: institutions in the health sector; measurement and valuation of health; nonmedical determinants of health; medical technology and technology assessment; demand for medical care and medical insurance; physicians, hospitals, and managed care; international comparisons. Prerequisites: ECON 50 and ECON 102A or equivalent statistics. Recommended: ECON 51.

Terms: Aut | Units: 5 | Grading: Letter or Credit/No Credit

CEE 161A: Rivers, Streams, and Canals (CEE 264A)

Introduction to the movement of water through natural and engineered channels, streams, and rivers. Basic equations and

theory (mass, momentum, and energy equations) for steady and unsteady descriptions of the flow. Application of theory to the design of flood- control and canal systems. Flow controls such as weirs and sluice gates; gradually varied flow; Saint-Venant equations and flood waves; and method of characteristics. Open channel flow laboratory experiments: controls such as weirs and gates, gradually varied flow, and waves. Limited enrollment in lab section.

Terms: Aut, Sum | **Units:** 3-4 | **UG Reqs:** GER:DBEngrAppSci | **Grading:** Letter (ABCD/NP)

CEE 164: Introduction to Physical Oceanography (CEE 262D, EARTHSYS 164)

The dynamic basis of oceanography. Topics: physical environment; conservation equations for salt, heat, and momentum; geostrophic flows; wind-driven flows; the Gulf Stream; equatorial dynamics and ENSO; thermohaline circulation of the deep oceans; and tides. Prerequisite: PHYSICS 41 (formerly 53).

Terms: Win | **Units:** 4 | **UG Reqs:** GER:DBNatSci | **Grading:** Letter (ABCD/NP)

CEE 166A: Watersheds and Wetlands (CEE 266A)

Introduction to the occurrence and movement of water in the natural environment and its role in creating and maintaining terrestrial, wetland, and aquatic habitat. Hydrologic processes, including precipitation, evaporation, transpiration, snowmelt, infiltration, subsurface flow, runoff, and streamflow. Rivers and lakes, springs and swamps. Emphasis is on observation and measurement, data analysis, modeling, and prediction. Prerequisite: 101B or equivalent. (Freyberg)

Terms: Aut | **Units:** 3 | **UG Reqs:** GER:DBEngrAppSci | **Grading:** Letter or Credit/No Credit

CEE 166B: Floods and Droughts, Dams and Aqueducts (CEE 266B)

Sociotechnical systems associated with human use of water as a resource and the hazards posed by too much or too little water. Potable and non-potable water use and conservation. Irrigation, hydroelectric power generation, rural and urban water supply systems, storm water management, flood damage mitigation, and water law and institutions. Emphasis is on engineering design. Prerequisite: 166A or equivalent. (Freyberg)

Terms: Win | **Units:** 3 | **UG Reqs:** GER:DBEngrAppSci | **Grading:** Letter or Credit/No Credit

CEE 166D: Water Resources and Water Hazards Field Trips (CEE 266D)

Introduction to water use and water hazards via weekly field trips to local and regional water resources facilities (dams, reservoirs, fish ladders and hatcheries, pumping plants, aqueducts, hydropower plants, and irrigation systems) and flood damage mitigation facilities (storm water detention ponds, channel modifications, flood control dams, and reservoirs). Each trip preceded by an orientation lecture.

Terms: Win | **Units:** 2 | **Grading:** Satisfactory/No Credit

CEE 172A: Indoor Air Quality (CEE 278C)

Factors affecting the levels of air pollutants in the built indoor environment. The influence of ventilation, office equipment, floor coverings, furnishings, cleaning practices, and human activities on air quality including carbon dioxide, VOCs, resuspended dust, and airborne molds and fungi. Recommended: 172 or 278A.

Terms: Spr | Units: 2-3 | Grading: Letter or Credit/No Credit

CEE 176S: Instrumental Analysis of Microconstituents in the Environment (CEE 276S)

Current research, practice, and thinking in environmental engineering and science. Featuring presentations by invited faculty, researchers and professionals to share their insight and perspectives on environmental issues. Students will prepare brief summaries of seminar presentations and associated readings. For 2-unit option, students will also prepare and give a short presentation on a relevant environmental topic.

Terms: Sum | Units: 3 | Grading: Letter or Credit/No Credit

CEE 177: Aquatic Chemistry and Biology

Introduction to chemical and biological processes in the aqueous environment. Basic aqueous equilibria; the structure, behavior, and fate of major classes of chemicals that dissolve in water; redox reactions; the biochemistry of aquatic microbial life; and biogeochemical processes that govern the fate of nutrients and metals in the environment and in engineered systems.

Prerequisite: CHEM 31.

Terms: Aut | Units: 4 | UG Reqs: GER:DBEngrAppSci | Grading: Letter or Credit/No Credit

CEE 178: Introduction to Human Exposure Analysis (CEE 276)

(Graduate students register for 276.) Scientific and engineering issues involved in quantifying human exposure to toxic chemicals in the environment. Pollutant behavior, inhalation exposure, dermal exposure, and assessment tools. Overview of the complexities, uncertainties, and physical, chemical, and biological issues relevant to risk assessment. Lab projects.

Recommended: MATH 51. Apply at first class for admission.

Terms: Spr, Sum | Units: 3 | UG Reqs: GER:DBEngrAppSci | Grading: Letter (ABCD/NP)

CEE 206: Decision Analysis for Civil and Environmental Engineers

Current challenges in selecting an appropriate site, alternate design, or retrofit strategy based on environmental, economic, and social factors can be best addressed through applications of decision science. Basics of decision theory, including development of decision trees with discrete and continuous random variables, expected value decision making, utility theory value of information, and elementary multi-attribute decision making will be covered in the class. Examples will cover many areas of civil and environmental engineering problems. Prerequisite: CEE 203 or equivalent.

Terms: Spr | Units: 3 | Grading: Letter or Credit/No Credit

CEE 217: Renewable Energy Infrastructure

coming later

Terms: Win | Units: 3 | Grading: Letter (ABCD/NP)

CEE 226: Life Cycle Assessment for Complex Systems

Life cycle modeling of products, industrial processes, and infrastructure/building systems; material and energy balances for large interdependent systems; environmental accounting; and life cycle costing. These methods, based on ISO 14000 standards, are used to examine emerging technologies, such as biobased products, building materials, building integrated photovoltaics, and alternative design strategies, such as remanufacturing, dematerialization, LEED, and Design for Environment: DfE. Student teams complete a life cycle assessment of a product or system chosen from industry.

Terms: Aut | Units: 3-4 | Grading: Letter (ABCD/NP)

CEE 227: Global Project Finance

Public and private sources of finance for large, complex, capital-intensive projects in developed and developing countries. Benefits and disadvantages, major participants, risk sharing, and challenges of project finance in emerging markets. Financial, economic, political, cultural, and technological elements that affect project structures, processes, and outcomes. Case studies. Limited enrollment.

Terms: Win | Units: 3-5 | Grading: Letter (ABCD/NP)

CEE 241A: Infrastructure Project Development (CEE 141A)

Infrastructure is critical to the economy, global competitiveness and quality of life. Topics include energy, transportation, water, public facilities, and communications sectors. Analysis of the condition of the nation's infrastructure and how projects are planned and financed. Focus is on public works projects in the U.S.. The role of public and private sectors through a step-by-step study of the project development process. Case studies of real infrastructure projects. Industry guest speakers. Field trips to real world of project development.

Terms: Aut | Units: 3 | Grading: Letter or Credit/No Credit

CEE 241B: Infrastructure Project Delivery (CEE 141B)

Infrastructure is critical to the economy, global competitiveness and quality of life. Topics include energy, transportation, water, public facilities, and communications sectors. Analysis of how projects are designed, constructed, operated, and maintained. Focus is on public works projects in the U.S. Alternative project delivery approaches and organizational strategies. Case studies of real infrastructure projects. Industry guest speakers. Field trips to real world of project delivery.

Terms: Win | Units: 3 | Grading: Letter or Credit/No Credit

CEE 241C: Global Infrastructure Projects Seminar (CEE 141C)

Infrastructure is critical to the economy, global competitiveness, and quality of life. Course analyzes and compares the development and delivery of mega-projects around the world. Alternative project delivery methods, the role of public and private sector, different project management strategies, and lessons learned. Case studies of real infrastructure projects. Industry guest speakers. Field trips to local projects.

Terms: Spr | Units: 1-2 | Grading: Credit/No Credit

CEE 243: Predicting and Measuring Building Energy Use

Energy modeling has entered commercial use and can help evaluate the impact of potential energy-saving interventions in commercial building design. Methods to create building information models to enable energy analysis, use energy analysis tools and interpret their results for commercial buildings, analyze measured building performance and relate prediction to measurement, and develop guidance for owners on how to use these methods in practice. May be repeated for credit.

Prerequisites: Revit or Digital Project competence or CEE 210, CEE 211, or CEE 135 with equivalent experience. Recommended: energy modeling experience, CEE 176A, CEE 226E, or CEE 256.

Terms: Spr | Units: 2-3 | Grading: Letter or Credit/No Credit

CEE 256: Building Systems (CEE 156)

HVAC, lighting, and envelope systems for commercial and institutional buildings, with a focus on energy efficient design. Knowledge and skills required in the development of low-energy buildings that provide high quality environment for occupants.

Terms: Spr | Units: 4 | Grading: Letter (ABCD/NP)

CEE 262B: Transport and Mixing in Surface Water Flows

Application of fluid mechanics to problems of pollutant transport and mixing in the water environment. Mathematical models of advection, diffusion, and dispersion. Application of theory to problems of transport and mixing in rivers, estuaries, and lakes and reservoirs. Recommended: 262A and CME 102 (formerly ENGR 155A), or equivalents.

Terms: Win | Units: 3-4 | Grading: Letter or Credit/No Credit

CEE 262F: Ocean Waves

The fluid mechanics of surface gravity waves in the ocean of relevance to engineers and oceanographers. Topics include irrotational waves, wave dispersion, wave spectra, effects of bathymetry (shoaling), mass transport, effects of viscosity, and mean currents driven by radiation stresses. Prerequisite: CEE 262A or a graduate class in fluid mechanics.

Terms: Spr | Units: 3 | Grading: Letter or Credit/No Credit

CEE 263B: Numerical Weather Prediction

Numerical weather prediction. Continuity equations for air and water vapor, the thermodynamic energy equation, and momentum equations derived for the atmosphere. Numerical methods of solving partial differential equations, including finite-difference, finite-element, semi-Lagrangian, and pseudospectral methods. Time-stepping schemes: the forward-Euler, backward-Euler, Crank-Nicolson, Heun, Matsuno, leapfrog, and Adams-Bashforth schemes. Boundary-layer turbulence parameterizations, soil moisture, and cloud modeling. Project developing a basic weather prediction model. Prerequisite: CS 106A or equivalent.

Terms: Spr | Units: 3-4 | Grading: Letter or Credit/No Credit

CEE 265D: Water and Sanitation in Developing Countries

Economic, social, political, and technical aspects of sustainable water supply and sanitation service provision in developing countries. Case studies from Asia, Africa, and Latin America. Service pricing, alternative institutional structures including privatization, and the role of consumer demand and community participation in the planning process. Environmental and public health considerations, and strategies for serving low-income households. Limited enrollment. Prerequisite: consent of instructor.

Terms: Win | Units: 1-3 | Grading: Letter (ABCD/NP)

CEE 266C: Advanced Topics in Hydrology and Water Resources

Graduate seminar. Focus is on one or more hydrologic processes or water resources systems. Topics vary based on student and instructor interest. Examples include freshwater wetland hydrology, watershed-scale hydrologic modeling, renaturalization of stream channels, reservoir sediment management, and dam removal. Enrollment limited. Prerequisites: 266A,B, or equivalents. Recommended: 260A or equivalent.

Terms: Spr | Units: 3 | Grading: Letter (ABCD/NP)

CEE 268E: Engineered Subsurface Systems: Geothermal, Carbon Sequestration & Nuclear Waste Storage.

Overview of the science and fundamentals behind Enhanced Geothermal Systems (EGSs), Geological Carbon Sequestration (GCS), and Nuclear Waste Disposal (NWD) in the subsurface. Subjects covered include: Geological, hydrological, geophysical, and geomechanical site characterization; fundamentals of single and multi-phase flow, heat and mass transport in porous and fractured media; stimulation of fractures; circulation cells and flow barriers; induced seismicity; surface and subsurface monitoring and verification techniques; US regulations. Several worked technical examples and real site illustrations will be presented. Reading assignments about real cases will be given. Stu... [more description for CEE 268E »](#)

Terms: Win, offered once only | Units: 3-4 | Grading: Letter or Credit/No Credit

CEE 270: Movement and Fate of Organic Contaminants in Waters

Transport of chemical constituents in surface and groundwater including advection, dispersion, sorption, interphase mass

transfer, and transformation; impacts on water quality. Emphasis is on physicochemical processes and the behavior of hazardous waste contaminants. Prerequisites: undergraduate chemistry and calculus. Recommended: 101B.

Terms: Aut, Sum | Units: 3 | Grading: Letter (ABCD/NP)

CEE 271A: Physical and Chemical Treatment Processes

Physical and chemical unit operations for water treatment, emphasizing process combinations for drinking water supply.

Application of the principles of chemistry, rate processes, fluid dynamics, and process engineering to define and solve water treatment problems by flocculation, sedimentation, filtration, disinfection, oxidation, aeration, and adsorption. Investigative paper on water supply and treatment. Prerequisites: 101B, 270. Recommended: 273.

Terms: Win | Units: 3 | Grading: Letter (ABCD/NP)

CEE 271B: Environmental Biotechnology

Stoichiometry, kinetics, and thermodynamics of microbial processes for the transformation of environmental contaminants.

Design of dispersed growth and biofilm-based processes. Applications include treatment of municipal and industrial waste waters, detoxification of hazardous chemicals, and groundwater remediation. Prerequisites: 270; 177 or 274A or equivalents.

Terms: Win | Units: 4 | Grading: Letter or Credit/No Credit

CEE 271D: Introduction to Wastewater Treatment Process Modeling

The course will present a structured protocol for simulator application comprising project definition, data collection and reconciliation, model set-up, calibration and validation, and simulation and result interpretation. This course will include a series of guided simulation exercises evaluating resource consumption (e.g., electrical energy, natural gas, chemicals) and resource recovery (e.g., biogas, struvite, biosolids, recycled water) from a variety of treatment plant configurations. Coursework for all students will comprise guided simulation exercises begun in class. Students may elect to take the course for 2 units by completing a group project evaluating an assign... [more description for CEE 271D »](#)

Terms: Spr | Units: 1-2 | Grading: Satisfactory/No Credit

CEE 272: Coastal Contaminants

Coastal pollution and its effects on ecosystems and human health. The sources, fate, and transport of human pathogens and nutrients. Background on coastal ecosystems and coastal transport phenomena including tides, waves, and cross shelf transport. Introduction to time series analysis with MATLAB. Undergraduates require consent of instructor.

Terms: Aut | Units: 3-4 | Grading: Letter or Credit/No Credit

CEE 272R: Modern Power Systems Engineering

Focus is on Power Engineering from a systems point of view. Topics covered may include modeling of generation, transmission

and distribution systems, load flow analysis, transient and steady-state stability analysis. Special emphasis given to modern market operations and dispatch, modeling intermittent controllable power sources, storage technologies, mechanisms for demand response, sensing the grid and the role of market mechanisms for deep integration. Course content may vary year to year.

Terms: Spr | Units: 3 | Grading: Letter or Credit/No Credit

CEE 273: Aquatic Chemistry

Chemical principles and their application to the analysis and solution of problems in aqueous geochemistry (temperatures near 25° C and atmospheric pressure). Emphasis is on natural water systems and the solution of specific chemical problems in water purification technology and water pollution control. Prerequisites: CHEM 31 and 33, or equivalents.

Terms: Aut | Units: 3 | Grading: Letter (ABCD/NP)

CEE 274B: Metabolic Biochemistry of Microorganisms (CHEMENG 456)

Microbial metabolism, biochemical and metabolic principles, unity and diversity of metabolic pathways, evolution of enzymes and metabolic pathways, microbial degradation of natural and anthropogenic organic compounds, predicting biodegradation, and metabolic origin of life.

Terms: Win | Units: 3 | Grading: Letter or Credit/No Credit

CEE 276: Introduction to Human Exposure Analysis (CEE 178)

(Graduate students register for 276.) Scientific and engineering issues involved in quantifying human exposure to toxic chemicals in the environment. Pollutant behavior, inhalation exposure, dermal exposure, and assessment tools. Overview of the complexities, uncertainties, and physical, chemical, and biological issues relevant to risk assessment. Lab projects.

Recommended: MATH 51. Apply at first class for admission.

Terms: Spr, Sum | Units: 3 | Grading: Letter (ABCD/NP)

CEE 277D: Water, Sanitation and Health in Developing Countries

Graduate seminar focused on emerging research in the areas of water supply, sanitation, hygiene and health in developing countries. Limited enrollment; instructor permission required.

Terms: Spr | Units: 1-3 | Repeatable for credit | Grading: Credit/No Credit

CEE 278A: Air Pollution Physics and Chemistry

The sources and health effects of pollutants. The influence of meteorology on pollution: atmospheric energy balance, temperature profiles, stability classes, inversion layers, turbulence. Atmospheric diffusion equations, downwind dispersion of emissions from point and line sources. Tropospheric chemistry: mechanisms for ozone formation, photochemical reactions,

radical chain mechanisms, heterogeneous chemical reactions. Prerequisites: MATH 51, CHEM 31, or equivalents. Recommended: 101B, 273 or CHEM 135, or equivalents.

Terms: Aut | Units: 3 | Grading: Letter or Credit/No Credit

CEE 363C: Ocean and Estuarine Modeling

Advanced topics in modeling for ocean and estuarine environments, including methods for shallow water, primitive, and nonhydrostatic equations on Cartesian, curvilinear, and unstructured finite-volume grid systems. Topics include free-surface methods, nonhydrostatic solvers, and advanced Eulerian and Lagrangian advection techniques. Focus is on existing techniques and code packages, and their methodologies, including POM, ROMS, TRIM, ELCOM, and SUNTANS. Prerequisites: CME 200, 206, or equivalents.

Terms: Win | Units: 3 | Grading: Letter or Credit/No Credit

CEE 363F: Oceanic Fluid Dynamics (EESS 363F)

Dynamics of rotating stratified fluids with application to oceanic flows. Topics include: inertia-gravity waves; geostrophic and cyclogeostrophic balance; vorticity and potential vorticity dynamics; quasi-geostrophic motions; planetary and topographic Rossby waves; inertial, symmetric, barotropic and baroclinic instability; Ekman layers; and the frictional spin-down of geostrophic flows. Prerequisite: CEE 262A or a graduate class in fluid mechanics.

Terms: Spr | Units: 3 | Grading: Letter or Credit/No Credit

CEE 363G: Field Techniques in Coastal Oceanography

This course focuses on the design and implementation of coastal oceanographic field studies from implementation through analysis. A wide range of field instrumentation and techniques, including AUVs and scientific diving is covered. Field studies. Data collection and analysis under instructor guidance.

Terms: Spr | Units: 3 | Grading: Letter (ABCD/NP)

CEE 365A: Advanced Topics in Environmental Fluid Mechanics and Hydrology

Students must obtain a faculty sponsor.

Terms: Aut | Units: 2-6 | Repeatable for credit | Grading: Letter (ABCD/NP)

CEE 374A: Introduction to Physiology of Microbes in Biofilms

Diversification of biofilm populations, control of gene expression in biofilm environments, and evolution of novel genetic traits in biofilms.

Terms: Aut | Units: 1-6 | Grading: Satisfactory/No Credit

CEE 374S: Advanced Topics in Microbial Pollution

May be repeated for credit. Prerequisite: consent of instructor.

Terms: Aut, Win, Spr, Sum | Units: 1-5 | Repeatable for credit | Grading: Satisfactory/No Credit

CEE 374T: Advanced Topics in Coastal Pollution

May be repeated for credit. Prerequisite: consent of instructor.

Terms: Aut, Win, Spr, Sum | Units: 1-5 | Repeatable for credit | Grading: Satisfactory/No Credit

CEE 374U: Advanced Topics in Submarine Groundwater Discharge

May be repeated for credit. Prerequisite: consent of instructor.

Terms: Aut, Win, Spr, Sum | Units: 1-5 | Repeatable for credit | Grading: Satisfactory/No Credit

CEE 374V: Advanced Topics in Microbial Source Tracking

May be repeated for credit. Prerequisite: consent of instructor.

Terms: Aut, Win, Spr, Sum | Units: 1-5 | Repeatable for credit | Grading: Satisfactory/No Credit

CEE 374W: Advanced Topics in Water, Health and Development

Advanced topics in water, health and development. Emphasis on low-and-middle-income countries. Class content varies according to interests of students. Instructor consent required.

Terms: Aut, Win, Spr, Sum | Units: 1-6 | Repeatable for credit | Grading: Letter or Credit/No Credit

CEE 385: Performance-Based Earthquake Engineering

Synthesis and application of approaches to performance-based design and assessment that recently have been developed or are under development. Emphasis is on quantitative decision making based on life-cycle considerations that incorporate direct losses, downtime losses, and collapse, and the associated uncertainties. Hazard analysis, response simulation, damage and loss estimation, collapse prediction. Case studies. Prerequisites: 282, 287, and 288.

Terms: Aut | Units: 2-3 | Grading: Letter (ABCD/NP)

CEE 63: Weather and Storms (CEE 263C)

Daily and severe weather and global climate. Topics: structure and composition of the atmosphere, fog and cloud formation,

rainfall, local winds, wind energy, global circulation, jet streams, high and low pressure systems, inversions, el Niño, la Niña, atmosphere/ocean interactions, fronts, cyclones, thunderstorms, lightning, tornadoes, hurricanes, pollutant transport, global climate and atmospheric optics.

Terms: Aut | Units: 3 | UG Reqs: GER:DBNatSci | Grading: Letter or Credit/No Credit

CEE 64: Air Pollution: From Urban Smog to Global Change (CEE 263D)

Survey of urban- through global-scale air pollution. Topics: the evolution of the Earth's atmosphere, indoor air pollution, urban smog formation, history of discovery of atmosphere chemicals, visibility, acid rain, the greenhouse effect, historical climate, global warming, stratospheric ozone reduction, Antarctic ozone destruction, air pollution transport across political boundaries, the effects of air pollution on ultraviolet radiation, and impacts of energy systems on the atmosphere.

Terms: Win | Units: 3 | UG Reqs: GER:DBNatSci | Grading: Letter or Credit/No Credit

CEE 70N: Water, Public Health, and Engineering

Preference to sophomores. Linkages between water, wastewater and public health, with an emphasis on engineering interventions. Topics include the history of water and wastewater infrastructure development in the U.S. and Europe; evolution of epidemiological approaches for water-related health challenges; biological and chemical contaminants in water and wastewater and their management; and current trends and challenges in access to water and sanitation around the world. How to identify ways in which freshwater contributes to human health; exposure routes for water- and sanitation-illness; how to classify these illnesses by pathogen type and their geographic distribution; ... [more description for CEE 70N »](#)

Terms: Spr | Units: 3 | UG Reqs: GER:DBEngrAppSci | Grading: Letter or Credit/No Credit

CHEM 24N: Nutrition and History

Preference to freshmen. Intended to broaden the introductory chemistry experience. The biochemical basis of historically important nutritional deficiencies (vitamins, minerals, starvation, metabolic variants that predispose to disease) and environmental toxins is related to physiological action and the sociological, political, and economic consequences of its effect on human populations. Prerequisite: high school chemistry. Recommended: 31A,B, or 31X, or 33.

Terms: Spr | Units: 3 | Grading: Letter or Credit/No Credit

CHEMENG 140: Micro and Nanoscale Fabrication Engineering (CHEMENG 240)

(Same as CHEMENG 140) Survey of fabrication and processing technologies in industrial sectors, such as semiconductor, biotechnology, and energy. Chemistry and transport of electronic and energy device fabrication. Solid state materials, electronic devices and chemical processes including crystal growth, chemical vapor deposition, etching, oxidation, doping, diffusion, thin film deposition, plasma processing. Micro and nanopatterning involving photolithography, unconventional soft lithography and self assembly. Recommended: CHEM 33, 171, and PHYSICS 55

Terms: Win | Units: 3 | Grading: Letter (ABCD/NP)

CHEMENG 174: Environmental Microbiology I (CEE 274A, CHEMENG 274)

Basics of microbiology and biochemistry. The biochemical and biophysical principles of biochemical reactions, energetics, and mechanisms of energy conservation. Diversity of microbial catabolism, flow of organic matter in nature: the carbon cycle, and biogeochemical cycles. Bacterial physiology, phylogeny, and the ecology of microbes in soil and marine sediments, bacterial adhesion, and biofilm formation. Microbes in the degradation of pollutants. Prerequisites: CHEM 33, 35, and BIOSCI 41, CHEMENG 181 (formerly 188), or equivalents.

Terms: Aut, Sum | Units: 3 | Grading: Letter or Credit/No Credit

CHEMENG 183: Biochemistry II (BIO 189, BIO 289, CHEM 183, CHEMENG 283)

Focus on metabolic biochemistry: the study of chemical reactions that provide the cell with the energy and raw materials necessary for life. Topics include glycolysis, gluconeogenesis, the citric acid cycle, oxidative phosphorylation, photosynthesis, the pentose phosphate pathway, and the metabolism of glycogen, fatty acids, amino acids, and nucleotides as well as the macromolecular machines that synthesize RNA, DNA, and proteins. Medical relevance is emphasized throughout. Satisfies Central Menu Area 1 for Bio majors. Prerequisite: BIO 188/288 or CHEM 181 or CHEMENG 181/281 (formerly 188/288).

Terms: Spr | Units: 3 | UG Reqs: GER:DBNatSci | Grading: Letter or Credit/No Credit

CHEMENG 25B: Biotechnology (ENGR 25B)

Biology and chemistry fundamentals, genetic engineering, cell culture, protein production, pharmaceuticals, genomics, viruses, gene therapy, evolution, immunology, antibodies, vaccines, transgenic animals, cloning, stem cells, intellectual property, governmental regulations, and ethics. Prerequisites: CHEM 31 and MATH 41 or equivalent courage.

Terms: Spr | Units: 3 | UG Reqs: GER:DBEngrAppSci | Grading: Letter or Credit/No Credit

CHEMENG 25E: Energy: Chemical Transformations for Production, Storage, and Use (ENGR 25E)

An introduction and overview to the challenges and opportunities of energy supply and consumption. Emphasis on energy technologies where chemistry and engineering play key roles. Review of energy fundamentals along with historical energy perspectives and current energy production technologies. In depth analyses of solar thermal systems, biofuels, photovoltaics and electrochemical devices (batteries and fuel cells). Prerequisites: high school chemistry or equivalent.

Terms: Win | Units: 3 | UG Reqs: GER:DBEngrAppSci | Grading: Letter or Credit/No Credit

CHEMENG 70Q: Masters of Disaster

Preference to sophomores. For students interested in science, engineering, politics, and the law. Learn from past disasters to

avoid future ones. How disasters can be tracked to failures in the design process. The roles of engineers, artisans, politicians, lawyers, and scientists in the design of products. Failure as rooted in oversight in adhering to the design process. Student teams analyze real disasters and design new products presumably free from the potential for disastrous outcomes.

Terms: Aut | Units: 3 | UG Reqs: GER:DBEngrAppSci | Grading: Letter (ABCD/NP)

CHICANST 201B: From Racial Justice to Multiculturalism: Movement-based Arts Organizing in the Post Civil Rights Era (CSRE 201B)

How creative projects build and strengthen communities of common concern. Projects focus on cultural reclamation, multiculturalism, cultural equity and contemporary cultural wars, media literacy, independent film, and community-based art. Guest artists and organizers, films, and case studies.

Terms: Aut | Units: 5 | Grading: Letter (ABCD/NP)

CLASSGEN 5N: The Nile and its Life-cycles

Studying the Nile River, in all its aspects involving antiquity. Particular focus on the period between 500 BC and AD 500, with limited materials before and after said period. Is it useful or misleading to think of the river itself as ancient? What happens when we consider the Nile spatially as a whole? Since only a part of the river flows through Egypt we will also focus on Ethiopia, the Sudan and equatorial Africa, which were also objects of ancient Greek and Roman fascination.

Terms: Aut | Units: 3-5 | Grading: Letter (ABCD/NP)

COMM 131: Media Ethics and Responsibility (COMM 231)

(Graduate students register for COMM 231.) The development of professionalism among American journalists, emphasizing the emergence of objectivity as a professional and the epistemological norm. An applied ethics course where questions of power, freedom, and truth autonomy are treated normatively so as to foster critical thinking about the origins and implications of commonly accepted standards of responsible journalism.

Terms: Win | Units: 4-5 | UG Reqs: GER:DBSocSci | Grading: Letter (ABCD/NP)

COMP MED 81N: Comparative Anatomy and Physiology of Mammals

Preference to freshmen. Emphasis is on a comparative approach to anatomy and physiology of a wide range of mammals, the unique adaptations of each species in terms of its anatomical, and behavioral characteristics, and how these species interact with human beings and other animals. Dissection required. Class size is limited to 16.

Terms: Win | Units: 3 | UG Reqs: GER:DBNatSci | Grading: Letter or Credit/No Credit

COMP MED 83N: Horse Medicine

Preference to freshmen. The most common equine diseases, ranging from colic to lameness are reviewed using problem-oriented approach. Topics include: equine infectious diseases, care of the newborn foal, medical emergencies, and neurological disorders. A lab on the physical and neurological examination of the horse at the Red Barn.

Terms: Spr | **Units:** 1-2 | **Grading:** Letter or Credit/No Credit

COMPMED 84Q: Globally Emerging Zoonotic Diseases

Preference to sophomores. Infectious diseases impacting veterinary and human health around the world today. Mechanisms of disease, epidemiology, and underlying diagnostic, treatment and control principles associated with these pathogens.

Terms: Spr | **Units:** 3 | **Grading:** Letter or Credit/No Credit

COMPMED 87Q: Introduction to the Mouse in Biomedical Research

Preference to sophomores. Focus is on the laboratory mouse, one of the most widely used models for biomedical research. Topics include the natural history and origin of the laboratory mouse; characteristics of commonly used strains; mouse anatomy, physiology, and husbandry; common mouse diseases and their effects on research; coat color genetics; and genetically engineered mouse technology. Demonstrations and hands-on experience with necropsy, mouse handling, and research techniques.

Terms: Aut | **Units:** 3 | **Grading:** Letter or Credit/No Credit

CS 181: Computers, Ethics, and Public Policy

(Formerly 201.) Primarily for majors entering computer-related fields. Ethical and social issues related to the development and use of computer technology. Ethical theory, and social, political, and legal considerations. Scenarios in problem areas: privacy, reliability and risks of complex systems, and responsibility of professionals for applications and consequences of their work.

Prerequisite: 106B or X.

Terms: Spr | **Units:** 4 | **UG Reqs:** GER:ECEthicReas | **Grading:** Letter or Credit/No Credit

CTL 312: Science and Engineering Course Design (ENGR 312)

For students interested in an academic career and who anticipate designing science courses at the undergraduate or graduate level. Goal is to apply research on science learning to the design of effective course materials. Topics include syllabus design, course content and format decisions, assessment planning and grading, and strategies for teaching improvement.

Terms: Win | **Units:** 2-3 | **Grading:** Satisfactory/No Credit

DUC 324X: The Ecology of Equality

This seminar is designed for doctoral students. One of the claims of American educational policy and practice is the desire to achieve equitable educational results across society. But what does "equity" really entail? This course will survey a range of

research and literature that examines the landscape of myriad social institutions known to influence educational processes. The course will take an interdisciplinary approach to deconstructing the main issues afflicting schools today and to discussing effective policies and practices.

Terms: Spr, alternate years, not given next year | **Units:** 4 | **Grading:** Letter or Credit/No Credit

EARTHSYS 113: Earthquakes and Volcanoes (GEOPHYS 113)

Earthquake location, magnitude and intensity scales, seismic waves, styles of eruptions and volcanic hazards, tsunami waves, types and global distribution of volcanoes, volcano forecasting. Plate tectonics as a framework for understanding earthquake and volcanic processes. Forecasting; earthquake resistant design; building codes; and probabilistic hazard assessment. For non-majors and potential earth scientists.

Terms: Win | **Units:** 3 | **UG Reqs:** GER:DBEngrAppSci | **Grading:** Letter or Credit/No Credit

EARTHSYS 122: Paleobiology (GES 123)

Introduction to the fossil record with emphasis on marine invertebrates. Major debates in paleontological research. The history of animal life in the oceans. Topics include the nature of the fossil record, evolutionary radiations, mass extinctions, and the relationship between biological evolution and environmental change. Fossil taxa through time. Exercises in phylogenetics, paleoecology, biostratigraphy, and statistical methods.

Terms: Spr | **Units:** 4 | **UG Reqs:** GER:DBNatSci | **Grading:** Letter or Credit/No Credit

EARTHSYS 130: Soil Physics and Hydrology (GES 130)

The occurrence, distribution, circulation, and reaction of water at the surface and within the near surface. Topics: precipitation, evapotranspiration, infiltration and vadose zone, groundwater, surface water and streamflow generation, and water balance estimates. Current and classic theory in soil physics and hydrology. Urban, rangeland, and forested environments.

Terms: Aut | **Units:** 3 | **UG Reqs:** GER:DBNatSci | **Grading:** Letter (ABCD/NP)

EARTHSYS 131H: Hydrologically-Driven Landscape Evolution (GES 131)

Materials of the Earth and hydrologically driven landscape processes. Topics: hillslope hydrology, weathering of rocks and soils, erosion, flow failures, mass wasting, and conceptual models of landscape evolution. Current and classic theory in geomorphology.

Terms: Win | **Units:** 3 | **UG Reqs:** GER:DBNatSci | **Grading:** Letter (ABCD/NP)

EARTHSYS 141: Remote Sensing of the Oceans (EARTHSYS 241, EESS 141, EESS 241)

How to observe and interpret physical and biological changes in the oceans using satellite technologies. Topics: principles of satellite remote sensing, classes of satellite remote sensors, converting radiometric data into biological and physical quantities,

sensor calibration and validation, interpreting large-scale oceanographic features.

Terms: Win | Units: 3-4 | UG Reqs: GER:DBNatSci | Grading: Letter or Credit/No Credit

EARTHSYS 142: Remote Sensing of Land (EARTHSYS 242, EESS 162, EESS 262)

The use of satellite remote sensing to monitor land use and land cover, with emphasis on terrestrial changes. Topics include pre-processing data, biophysical properties of vegetation observable by satellite, accuracy assessment of maps derived from remote sensing, and methodologies to detect changes such as urbanization, deforestation, vegetation health, and wildfires.

Terms: Win | Units: 4 | Grading: Letter or Credit/No Credit

EARTHSYS 143: Marine Biogeochemistry (EARTHSYS 243, EESS 143, EESS 243)

(Graduate students register for 243.) Processes that control the mean concentration and distribution of biologically utilized elements and compounds in the ocean. Processes at the air-sea interface, production of organic matter in the upper ocean, remineralization of organic matter in the water column, and processing of organic matter in the sediments. Cycles of carbon, oxygen, and nutrients; the role of the ocean carbon cycle in interannual to decadal variability, paleoclimatology, and the anthropogenic carbon budget.

Terms: Spr | Units: 3-4 | UG Reqs: GER:DBNatSci | Grading: Letter (ABCD/NP)

EARTHSYS 144: Fundamentals of Geographic Information Science (GIS) (EESS 164)

Survey of geographic information including maps, satellite imagery, and census data, approaches to spatial data, and tools for integrating and examining spatially-explicit data. Emphasis is on fundamental concepts of geographic information science and associated technologies. Topics include geographic data structure, cartography, remotely sensed data, statistical analysis of geographic data, spatial analysis, map design, and geographic information system software. Computer lab assignments.

Terms: Aut | Units: 4 | UG Reqs: GER:DBNatSci | Grading: Letter or Credit/No Credit

EARTHSYS 146A: Atmosphere, Ocean, and Climate Dynamics: The Atmospheric Circulation (EARTHSYS 246A, EESS 146A, EESS 246A, GEOPHYS 146A, GEOPHYS 246A)

Introduction to the physics governing the circulation of the atmosphere and ocean and their control on climate with emphasis on the atmospheric circulation. Topics include the global energy balance, the greenhouse effect, the vertical and meridional structure of the atmosphere, dry and moist convection, the equations of motion for the atmosphere and ocean, including the effects of rotation, and the poleward transport of heat by the large-scale atmospheric circulation and storm systems.

Prerequisites: MATH 51 or CME100 and PHYSICS 41.

Terms: Win | Units: 3 | Grading: Letter or Credit/No Credit

EARTHSYS 146B: Atmosphere, Ocean, and Climate Dynamics: the Ocean Circulation

(EARTHSYS 246B, EESS 146B, EESS 246B, GEOPHYS 146B, GEOPHYS 246B)

Introduction to the physics governing the circulation of the atmosphere and ocean and their control on climate with emphasis on the large-scale ocean circulation. This course will give an overview of the structure and dynamics of the major ocean current systems that contribute to the meridional overturning circulation, the transport of heat, salt, and biogeochemical tracers, and the regulation of climate. Topics include the tropical ocean circulation, the wind-driven gyres and western boundary currents, the thermohaline circulation, the Antarctic Circumpolar Current, water mass formation, atmosphere-ocean coupling, and climate variability. Prere... [more description for EARTHSYS 146B »](#)

Terms: Spr | Units: 3 | Grading: Letter or Credit/No Credit

EARTHSYS 155: Science of Soils (EESS 155)

Physical, chemical, and biological processes within soil systems. Emphasis is on factors governing nutrient availability, plant growth and production, land-resource management, and pollution within soils. How to classify soils and assess nutrient cycling and contaminant fate. Recommended: introductory chemistry and biology.

Terms: Spr | Units: 4 | UG Reqs: GER:DBNatSci | Grading: Letter or Credit/No Credit

EARTHSYS 170: Environmental Geochemistry (GES 170)

Solid, aqueous, and gaseous phases comprising the environment, their natural compositional variations, and chemical interactions. Contrast between natural sources of hazardous elements and compounds and types and sources of anthropogenic contaminants and pollutants. Chemical and physical processes of weathering and soil formation. Chemical factors that affect the stability of solids and aqueous species under earth surface conditions. The release, mobility, and fate of contaminants in natural waters and the roles that water and dissolved substances play in the physical behavior of rocks and soils. The impact of contaminants and design of remediation strategies. Case studie... [more description for EARTHSYS 170 »](#)

Terms: Win | Units: 4 | UG Reqs: GER:DBNatSci | Grading: Letter (ABCD/NP)

EARTHSYS 177: Interdisciplinary Research Survival Skills (EARTHSYS 277)

Learning in interdisciplinary situations. Framing research questions. Developing research methods that benefit from interdisciplinary understanding. Writing for multiple audiences and effectively making interdisciplinary presentations. Discussions with interdisciplinary experts from across campus regarding interdisciplinary research projects.

Terms: Spr | Units: 2 | Grading: Letter (ABCD/NP)

EARTHSYS 2: Earth System History (EESS 2)

The evolution of Earth's systems from formation to the present. Couplings and relationships among biosphere, lithosphere, hydrosphere, and atmosphere. Topics include the evolution of life, origin of the oceans, atmosphere and continents, and changes

in climate. Modern climate change and anthropogenic effects.

Terms: Win | Units: 3 | UG Reqs: GER:DBNatSci | Grading: Letter or Credit/No Credit

EARTHSYS 298: Earth Systems Book Review

For Earth Systems master's students and advanced undergraduates only. Analysis and discussion of selected literary nonfiction books relevant to Earth systems topics. Examples of previous topics include political presentations of environmental change in the popular press, review of the collected works of Aldo Leopold, disaster literature, and global warming.

Terms: Spr | Units: 2 | Repeatable for credit | Grading: Satisfactory/No Credit

EARTHSYS 38N: The Worst Journey in the World: The Science, Literature, and History of Polar Exploration (EESS 38N, GES 38N)

Preference to freshmen. The isolation of polar explorers under the harshest conditions on Earth, and the chronicles of their explorations and hardships dating to the 1500s for the Arctic and the 1700s for the Antarctic. Focus is on scientific and geographic achievements. Sources include *The Worst Journey in the World* by Apsley Cherry-Garrard who in 1911 participated in a midwinter Antarctic sledging trip to recover emperor penguin eggs. Class jointly authors essay on themes from such literature. Optional field trip into the high Sierra in December. (Dunbar)

Terms: Win | Units: 3 | UG Reqs: GER:DBNatSci | Grading: Letter (ABCD/NP)

EARTHSYS 46N: Exploring the Critical Interface between the Land and Monterey Bay: Elkhorn Slough (EESS 46N)

Preference to freshmen. Field trips to sites in the Elkhorn Slough, a small agriculturally impacted estuary that opens into Monterey Bay, a model ecosystem for understanding the complexity of estuaries, and one of California's last remaining coastal wetlands. Readings include Jane Caffrey's *Changes in a California Estuary: A Profile of Elkhorn Slough*. Basics of biogeochemistry, microbiology, oceanography, ecology, pollution, and environmental management.

Terms: Spr | Units: 3 | Grading: Letter or Credit/No Credit

EARTHSYS 8: The Oceans: An Introduction to the Marine Environment (EESS 8)

For non-majors and majors in earth science or environmental science. Students will learn about the major ocean ecosystems and how they function both naturally and under the influence of human activities. Emphasis will be placed on the dominant organisms of each ecosystem and how they interact with each other and their physical and chemical environment. The types of ecosystems discussed will include coral reefs, deep-sea hydrothermal vents, coastal upwelling systems, blue-water oceans, estuaries, near-shore dead zones, etc. The course will incorporate a mix of lectures, multi-media presentations, and group activities.

Terms: Spr | Units: 3 | Grading: Letter or Credit/No Credit

EASTASN 70SI: Critical Issues in U.S.-China Relations Today

Multidisciplinary approach to historical factors, current events, and key issues that drive relations between the United States and China today, including: economic reform and the current financial crisis; security concerns over Taiwan, North Korea and Tibet; energy and the environment; role of NGOs and media in society; and human rights and prospects for political liberalization. Guest lectures from faculty and personal experiences from individuals who have lived or worked in China.

Terms: Spr | Units: 2 | Grading: Satisfactory/No Credit

ECON 118: Development Economics

The economic problems and policy concerns of developing countries. Theories of growth and development; inequality and poverty; credit and labor markets; health and education; politics and corruption. Emphasis is on economic models and econometric evidence rather than case studies. Prerequisites: 52, 102B.

Terms: Aut | Units: 5 | UG Reqs: GER:ECGlobalCom | Grading: Letter or Credit/No Credit

ECON 19N: The Economics of Cities

In most countries of the world, urban areas tend to have the highest per-worker productivity and generate most of the economic output and economic innovation. In this class, we will explore what economics has to say about the costs and benefits of urbanization. We will discuss a number of classic topics in urban economics, including agglomeration advantages, human capital externalities, the economics of congestion, and efficient economic development policies. Prerequisite: Econ 1A

Terms: Spr | Units: 2 | Grading: Letter or Credit/No Credit

ECON 216: Development Economics III

Use of quantitative theory to understand various aspects of the growth and development process. Emphasis on family and demographic issues and their importance for development. Theoretical models of fertility and marriage decisions, and their empirical relevance. Unified growth theories: demographic transition and industrial revolution. Family institutions such as marriage payments and polygamy. The political economy of family-related institutions, e.g. the evolution of women's and children's rights. Female labor supply and development. Theories of disease and development. Prerequisite: 202, 203, 204, 210, 211, 212, 270, 271, 272.

Terms: Spr | Units: 2-5 | Grading: Letter or Credit/No Credit

ECON 341: Public Economics and Environmental Economics Seminar

Issues in measuring and evaluating the economic performance of government tax, expenditure, debt, and regulatory policies; their effects on levels and distribution of income, wealth, and environmental quality; alternative policies and methods of

evaluation. Workshop format combines student research, faculty presentations, and guest speakers. Prerequisite: 241 or consent of instructor.

Terms: Aut, Win, Spr | **Units:** 1-10 | **Repeatable for credit** | **Grading:** Satisfactory/No Credit

EDUC 102: Examining Social Structures, Power, and Educational Access

Goal is to prepare Education and Youth Development fellows for their work with adolescents in the Haas Center's pre-college summer programs and to define their role in addressing educational inequities in the summer programs and beyond.

Terms: Spr | **Units:** 2-3 | **Repeatable for credit** | **Grading:** Letter or Credit/No Credit

EDUC 205X: The Impact of Social and Behavioral Science Research on Educational Issues

Ways in which research intersects with educational policy and practice. Emphasis is on behavioral, social, and cognitive traditions. Topics include early childhood education, early reading, science education, bilingual education, school desegregation, class size reduction, classroom organization, violence and juvenile crime, and affirmative action in higher education. Policy debates and how research informs or fails to inform deliberations and decisions in these areas.

Terms: Spr | **Units:** 3 | **Grading:** Letter or Credit/No Credit

EDUC 216X: Education, Race, and Inequality in African American History, 1880-1990 (CSRE 216X, HISTORY 255E)

Seminar. The relationship among race, power, inequality, and education from the 1880s to the 1990s. How schools have constructed race, the politics of school desegregation, and ties between education and the late 20th-century urban crisis.

Terms: Aut | **Units:** 3-5 | **Grading:** Letter or Credit/No Credit

EDUC 247: Moral Education

Contemporary scholarship and educational practice related to the development of moral beliefs and conduct in young people. The psychology of moral development; major philosophical, sociological, and anthropological approaches. Topics include: natural capacities for moral awareness in the infant; peer and adult influences on moral growth during childhood and adolescence; extraordinary commitment during adulthood; cultural variation in moral judgment; feminist perspectives on morality; the education movement in today's schools; and contending theories concerning the goals of moral education. (PSE)

Terms: Spr | **Units:** 3 | **Grading:** Letter or Credit/No Credit

EDUC 267E: Development of Scientific Reasoning and Knowledge

For STEP elementary teacher candidates. Theories and methods of teaching and learning science. How to develop curricula and criteria for critiquing curricula. Students design a science curriculum plan for a real setting. State and national science

frameworks and content standards. Alternative teaching approaches; how to select approaches that are compatible with learner experience and lesson objectives. Focus is on the linguistic and cultural diversity of California public school students.

Terms: Aut | **Units:** 2 | **Grading:** Letter (ABCD/NP)

EDUC 267F: Development of Scientific Reasoning and Knowledge II

Continuation of 267E. Scientific knowledge and pedagogical skills for supporting science instruction. Topics include: how children build scientific understandings and what that understanding might look and sound like in young children; what school science is and how concepts are connected to the doing of it; physical, life, and earth science constructs.

Terms: Spr | **Units:** 2 | **Grading:** Letter (ABCD/NP)

EDUC 306A: Economics of Education in the Global Economy

Case material considers development problems in the U.S. and abroad. Discussion sections on economic aspects of educational development. (SSPEP/ICE)

Terms: Aut | **Units:** 5 | **Grading:** Letter or Credit/No Credit

EDUC 306D: World, Societal, and Educational Change: Comparative Perspectives (EDUC 136, SOC 231)

Theoretical perspectives and empirical studies on the structural and cultural sources of educational expansion and differentiation, and on the cultural and structural consequences of educational institutionalization. Research topics: education and nation building; education, mobility, and equality; education, international organizations, and world culture.

Terms: Win | **Units:** 4-5 | **Grading:** Letter or Credit/No Credit

EDUC 362X: The Science Curriculum: Values and Ideology in a Contested Terrain

The issue of what should be taught in schools is a site of contestation where issues of beliefs, values and ideologies emerge. This course will use the school science curriculum and the history of its development to explore the common positions adopted and argued for in approaching curriculum development. Course will help students develop a knowledge of curriculum reform in school science and a deeper understanding of the arguments that have shaped its present form and their historical antecedents.

Terms: Spr | **Units:** 3-5 | **Grading:** Letter or Credit/No Credit

EE 237: Solar Energy Conversion

Basics of solar energy conversion in photovoltaic devices and solar thermal systems. Solar cell device physics: electrical and optical. Solar system issues including module assembly, inverters, and micro-inverters. Concentrated solar power. Students design solar cells. Prerequisite: EE 116 or EE 216.

Terms: Win | Units: 3 | Grading: Letter or Credit/No Credit

EE 293A: Fundamentals of Energy Processes (ENERGY 293A)

For seniors and graduate students. Thermodynamics, heat engines, thermoelectrics, biomass. Recommended: MATH 41, 43; PHYSICS 41, 43, 45

Terms: Aut | Units: 3-4 | Grading: Letter or Credit/No Credit

EE 293B: Fundamentals of Energy Processes (ENERGY 293B)

For seniors and graduate students. Fuel cells. Production of hydrogen: electrolytic, chemical, thermolytic, photolytic. Hydrogen storage: hydrides. Photoelectric converters; photo-thermovoltaic converters. Wind turbines. Recommended: EE 293A; MATH 41; PHYSICS 41, 43, 45

Terms: Win | Units: 3 | Grading: Letter or Credit/No Credit

EE 327: Properties of Semiconductor Materials

Modern semiconductor devices and integrated circuits are based on unique energy band, carrier transport, and optical properties of semiconductor materials. How to choose these properties for operation of semiconductor devices. Emphasis is on quantum mechanical foundations of the properties of solids, energy bandgap engineering, semi-classical transport theory, semi-conductor statistics, carrier scattering, electro-magneto transport effects, high field ballistic transport, Boltzmann transport equation, quantum mechanical transitions, optical absorption, and radiative and non-radiative recombination that are the foundations of modern transistors and optoelectronic devices. ... [more description for EE 327 »](#)

Terms: Spr | Units: 3 | Grading: Letter or Credit/No Credit

EE 60N: Man versus Nature: Coping with Disasters Using Space Technology (GEOPHYS 60N)

Stanford Introductory Seminar. Preference to freshman. Natural hazards, such as earthquakes, volcanoes, floods, hurricanes, and fires, affect the lives of thousands of people worldwide everyday. Over the past twenty years developments in spaceborne imaging technology have made it possible to monitor and respond to such disasters much more rapidly than in the past, saving lives and money. Additionally, greater understanding of the physical processes involved allows us to anticipate and plan for mitigation of the consequences of the disasters. In this course we will explore these new tools, how they are applied to natural disasters, and learn how the remotely-sensed data... [more description for EE 60N »](#)

Terms: Aut | Units: 4 | UG Reqs: GER:DBEngrAppSci | Grading: Letter or Credit/No Credit

EES 213: Spatial Statistics and Analysis for Environmental Data

Introduction to common algorithms and concepts of data analysis and spatial statistics as used in environmental sciences. The first part of the class focuses on methods usually performed on remote sensing data set such as clustering, classification, and

landscape fragmentation. The second part of the class focuses on spatial statistics such as, variogram, kriging estimators and change of support models. Each algorithm will be coded using the python language with an emphasis on programming styles and designs to foster a collaborative research environment. No programming experience is required. Open to graduates. Open to undergrads with consent from the instructor.

Terms: Win | Units: 3-4 | Grading: Letter (ABCD/NP)

EESS 215: Earth System Dynamics

This is a graduate level course that examines the dynamics of the Earth System from an integrated perspective. Lectures introduce the physical, biogeochemical, ecological, and human dimensions of the Earth System, with emphasis on feedbacks, thresholds and tipping points. Human interactions with climate and land systems are emphasized in order to enable in-depth exploration of Earth System dynamics. Lab projects focus on a region of the globe for which rich coordinated data sources exist and complex Earth System dynamics dominate the environment

Terms: Spr | Units: 4 | Grading: Letter or Credit/No Credit

EESS 220: Physical Hydrogeology (CEE 260A)

(Formerly GES 230.) Theory of underground water occurrence and flow, analysis of field data and aquifer tests, geologic groundwater environments, solution of field problems, and groundwater modeling. Introduction to groundwater contaminant transport and unsaturated flow. Lab. Prerequisite: elementary calculus.

Terms: Aut | Units: 4 | Grading: Letter (ABCD/NP)

EESS 221: Contaminant Hydrogeology (CEE 260C)

(Formerly GES 231.) For earth scientists and engineers. Environmental and water resource problems involving contaminated groundwater. The processes affecting contaminant migration through porous media including interactions between dissolved substances and solid media. Conceptual and quantitative treatment of advective-dispersive transport with reacting solutes. Predictive models of contaminant behavior controlled by local equilibrium and kinetics. Modern methods of contaminant transport simulation and optimal aquifer remediation. Prerequisite: GES 230 or CEE 260A or equivalent.

Terms: Spr | Units: 4 | Grading: Letter or Credit/No Credit

EESS 240: Advanced Oceanography

For upper-division undergraduates and graduate students in the earth, biologic, and environmental sciences. Topical issues in marine science/oceanography. Topics vary each year following or anticipating research trends in oceanographic research. Focus is on links between the circulation and physics of the ocean with climate in the N. Pacific region, and marine ecologic responses. Participation by marine scientists from research groups and organizations including the Monterey Bay Aquarium Research Institute.

Terms: Aut | Units: 3 | Repeatable for credit | Grading: Satisfactory/No Credit

EESS 244: Marine Ecosystem Modeling

Practical background necessary to construct and implement a 2-dimensional (space and time) numerical model of a simple marine ecosystem. Computer programming, model design and parameterization, and model evaluation. Students develop and refine their own multi-component marine ecosystem model.

Terms: Aut | Units: 3 | Grading: Letter or Credit/No Credit

EESS 250: Elkhorn Slough Microbiology

(Formerly GES 270.) The microbial ecology and biogeochemistry of Elkhorn Slough, an agriculturally-impacted coastal estuary draining into Monterey Bay. The diversity of microbial lifestyles associated with estuarine physical/chemical gradients, and the influence of microbial activity on the geochemistry of the Slough, including the cycling of carbon, nitrogen, sulfur, and metals. Labs and field work. Location: Hopkins Marine Station.

Terms: Sum | Units: 3 | Grading: Letter or Credit/No Credit

EESS 259: Environmental Microbial Genomics

The application of molecular and environmental genomic approaches to the study of biogeochemically-important microorganisms in the environment without the need for cultivation. Emphasis is on genomic analysis of microorganisms by direct extraction and cloning of DNA from natural microbial assemblages. Topics include microbial energy generation and nutrient cycling, genome structure, gene function, physiology, phylogenetic and functional diversity, evolution, and population dynamics of uncultured communities.

Terms: Win | Units: 1-3 | Grading: Letter or Credit/No Credit

EESS 330: Advanced Topics in Hydrogeology

Topics: questioning classic explanations of physical processes; coupled physical, chemical, and biological processes affecting heat and solute transport. May be repeated for credit.

Terms: Win | Units: 1-2 | Repeatable for credit | Grading: Letter or Credit/No Credit

ENERGY 155: Undergraduate Report on Energy Industry Training

On-the-job practical training under the guidance of on-site supervisors. Required report detailing work activities, problems, assignments and key results. Prerequisite: written consent of instructor.

Terms: Aut, Win, Spr, Sum | Units: 1-3 | Repeatable for credit | Grading: Letter or Credit/No Credit

ENERGY 160: Modeling Uncertainty in the Earth Sciences (ENERGY 260)

Whether Earth Science modeling is performed on a local, regional or global scale, for scientific or engineering purposes, uncertainty is inherently present due to lack of data and lack of understanding of the underlying phenomena. This course highlights the various issues, techniques and practical modeling tools available for modeling uncertainty of complex 3D/4D Earth systems. The course focuses on a practical breath rather than theoretical depth. Topics covered are: the process of building models, sources of uncertainty, probabilistic techniques, spatial data analysis and geostatistics, grid and scale, spatio-temporal uncertainty, visualizing uncertainty in large dimens... [more description for ENERGY 160 »](#)

Terms: Win | **Units:** 3 | **Grading:** Letter (ABCD/NP)

ENERGY 167: Engineering Valuation and Appraisal of Oil and Gas Wells, Facilities, and Properties (ENERGY 267)

Appraisal of development and remedial work on oil and gas wells; appraisal of producing properties; estimation of productive capacity, reserves; operating costs, depletion, and depreciation; value of future profits, taxation, fair market value; original or guided research problems on economic topics with report. Prerequisite: consent of instructor.

Terms: Win | **Units:** 3 | **UG Reqs:** GER:DBEngrAppSci | **Grading:** Letter or Credit/No Credit

ENERGY 180: Oil and Gas Production Engineering (ENERGY 280)

Design and analysis of production systems for oil and gas reservoirs. Topics: well completion, single-phase and multi-phase flow in wells and gathering systems, artificial lift and field processing, well stimulation, inflow performance. Prerequisite: 120.

Terms: Spr | **Units:** 3 | **UG Reqs:** GER:DBEngrAppSci | **Grading:** Letter (ABCD/NP)

ENERGY 191: OPTIMIZATION OF ENERGY SYSTEMS (ENERGY 291)

Introductory mathematical programming and optimization using examples from energy industries. Emphasis on problem formulation and solving, secondary coverage of algorithms. Problem topics include optimization of energy investment, production, and transportation; uncertain and intermittent energy resources; energy storage; efficient energy production and conversion. Methods include linear and nonlinear optimization, as well as multi-objective and goal programming. Tools include Microsoft Excel and AMPL mathematical programming language. Prerequisites: MATH 41, MATH 51, or consent of instructor. Programming experience helpful (e.g, CS 106A-B).

Terms: Win | **Units:** 3 | **Grading:** Letter (ABCD/NP)

ENERGY 194: Special Topics in Energy and Mineral Fluids

May be repeated for credit.

Terms: Aut, Win, Spr, Sum | Units: 1-3 | Repeatable for credit | Grading: Satisfactory/No Credit

ENERGY 240: Geostatistics for Spatial Phenomena (GES 240)

Probabilistic modeling of spatial and/or time dependent phenomena. Kriging and cokriging for gridding and spatial interpolation. Integration of heterogeneous sources of information. Multiple-point geostatistics and training image-based stochastic imaging of reservoir/field heterogeneities. Introduction to GSLIB and SGEMS software. Case studies from the oil and mining industry and environmental sciences. Prerequisites: introductory calculus and linear algebra, STATS 116, GES 161, or equivalent.

Terms: Spr | Units: 2-3 | Grading: Letter (ABCD/NP)

ENGLISH 103Q: Reading and Writing Poetry about Science (STS 103Q)

Preference to sophomores. Students will study recent poetry inspired by the phenomena and history of the sciences in order to write such poems themselves. These poems bring sensuous human experience to bear on biology, ecology, neuroscience, physics, astronomy, and geology, as well as on technological advances and missteps. Poets such as Mark Doty, Jody Gladding, Albert Goldbarth, Jorie Graham, Sarah Lindsay, Adrienne Rich, W.S. Merwin, and C. K. Williams. Grounding in poetics, research in individually chosen areas of science, weekly analytical and creative writing. Enrollment limited to 12.

Terms: Win | Units: 4 | Grading: Letter or Credit/No Credit

ENGR 120: Fundamentals of Petroleum Engineering (ENERGY 120)

Lectures, problems, field trip. Engineering topics in petroleum recovery; origin, discovery, and development of oil and gas. Chemical, physical, and thermodynamic properties of oil and natural gas. Material balance equations and reserve estimates using volumetric calculations. Gas laws. Single phase and multiphase flow through porous media.

Terms: Aut | Units: 3 | UG Reqs: GER:DBEngrAppSci | Grading: Letter or Credit/No Credit

ENGR 131: Ethical Issues in Engineering (STS 115)

Moral rights and responsibilities of engineers in relation to society, employers, colleagues, and clients; cost-benefit-risk analysis, safety, and informed consent; the ethics of whistle blowing; ethical conflicts of engineers as expert witnesses, consultants, and managers; ethical issues in engineering design, manufacturing, and operations; ethical issues arising from engineering work in foreign countries; and ethical implications of the social and environmental contexts of contemporary engineering. Case studies, guest practitioners, and field research. Limited enrollment.

Terms: Spr | Units: 4 | UG Reqs: GER:DBHum | Grading: Letter (ABCD/NP)

ENGR 150: Social Innovation and Entrepreneurship (ENGR 250)

(Graduate students register for 250.) The art of innovation and entrepreneurship for social benefit. Project team develops, tests, and iteratively improves technology-based social innovation and business plan to deploy it. Feedback and coaching from domain

experts, product designers, and successful social entrepreneurs. Limited enrollment; application required. See <http://sie.stanford.edu> for course information.

Terms: Aut, Win, Spr | Units: 1-6 | Grading: Letter or Credit/No Credit

ENGR 204: Research Ethics for Engineers and Scientists

Explores ethical responsibilities of engineering and science researchers in relation to laboratory safety, data acquisition and management, experiment and product design, collaborative research, authorship and peer review, mentorship, human subjects research, funding applications and funded research, media accounts of research, and new and emerging technologies (e.g., in nanotechnology and bioengineering). Responsibilities of researchers toward society at large, and Stanford and government policies regarding the conduct of engineering and science research will also be addressed. Lectures, discussion, guest researchers, and real case studies. Primarily for graduate student... [more description for ENGR 204 »](#)

Terms: Spr | Units: 1-2 | Grading: Letter (ABCD/NP)

ENVRES 220D: Agricultural Systems in Emerging Economies (EESS 320)

Agricultural Systems in Emerging Economies. This interdisciplinary seminar examines the social, economic, institutional, and ecological aspects of agricultural systems in emerging economies. Begins with an overview of global agricultural systems and then focuses on the agricultural systems in Brazil, India, Indonesia and China. Short lectures by guest Stanford faculty and discussion topics based on the questions posed by lecturers, as well as readings. Students are expected to attend regularly, to summarize the content and relevance of one assigned reading, and to assist in leading discussion for the week that reading is discussed. The goal of the course is to provide ... [more description for ENVRES 220D »](#)

Terms: Spr, offered once only | Units: 2 | Grading: Credit/No Credit

ENVRES 260: Global Water: Challenges and Opportunities

Explores challenges in the global supply, quality, and accessibility of freshwater. Speakers from Stanford and outside organizations on key topics such as threats due to climate change, agriculture demands, challenges of urbanization, water and sanitation, as well as discussion of policy, market, technology, and other potential solutions. Weekly readings in advance of speaker. Active participation expected of all enrolled students; those enrolled for 2-3 units will have one or more additional written assignments and will facilitate one or more discussions.

Terms: Spr | Units: 1-3 | Repeatable for credit | Grading: Credit/No Credit

ENVRES 270: Graduate Practicum in Environment and Resources

Opportunity for E-IPER students to pursue areas of specialization in an institutional setting such as a laboratory, clinic, research institute, governmental agency, non-governmental organization, or multilateral organization. Meets US CIS requirements for off-campus employment with endorsement from designated school official.

Terms: Aut, Win, Spr, Sum | Units: 1-9 | Repeatable for credit | Grading: Letter or Credit/No Credit

ETHICSOC 136R: Introduction to Global Justice (INTNLREL 136R, PHIL 76, POLISCI 136R, POLISCI 336)

Recent work in political theory on global justice. Topics include global poverty, human rights, fair trade, immigration, climate change. Do developed countries have a duty to aid developing countries? Do rich countries have the right to close their borders to economic immigrants? When is humanitarian intervention justified? Readings include Charles Beitz, Thomas Pogge, John Rawls.

Terms: Spr | Units: 5 | Grading: Letter or Credit/No Credit

ETHICSOC 171: Justice (IPS 208, PHIL 171, PHIL 271, POLISCI 3P, POLISCI 136S, POLISCI 336S, PUBLPOL 103C, PUBLPOL 307)

Focus is on the ideal of a just society, and the place of liberty and equality in it, in light of contemporary theories of justice and political controversies. Topics include protecting religious liberty, financing schools and elections, regulating markets, assuring access to health care, and providing affirmative action and group rights. Issues of global justice including human rights and global inequality.

Terms: Aut | Units: 4-5 | UG Reqs: GER:ECEthicReas, GER:DBHum | Grading: Letter or Credit/No Credit

ETHICSOC 177M: HUMAN RIGHTS & MORAL QUESTIONS (ETHICSOC 277M, PHIL 177M, PHIL 277M)

The proliferation of human rights in the discourse of international justice has raised a number of important questions in both moral and legal theory. What are human rights? How should they be conceptualized? Who ought to bear the duties associated with them? Can their protection justify military interventions into sovereign states? This course will cover topics in moral and legal theory surrounding human rights. The course has three main focuses. The first concerns the question of what these rights are. The second focus is on the various substantive moral justifications for the protection of human rights. The third is on the moral issues raised by the dominance of human ... [more description for ETHICSOC 177M »](#)

Terms: Aut | Units: 4-5 | UG Reqs: GER:ECEthicReas | Grading: Letter (ABCD/NP)

ETHICSOC 198: Community Engagement Internship

Restricted to Ethics in Society minors with the citizenship option. Opportunities for students to engage in community work via the Haas Center for Public Service. Students work with Haas Center staff to design an internship involving community-based research or supported by a Haas Center fellowship or community service work/study, or to serve for an academic year as a tutor in one of the Haas Center's several K-12 programs in East Palo Alto. May be repeated for credit.

Terms: Aut, Win, Spr, Sum | Units: 3-5 | Repeatable for credit | Grading: Letter or Credit/No Credit

FEMST 101: Introduction to Feminist Studies (ANTHRO 144A)

What is feminism and why does it matter today? Debates over the status and meaning of feminism in the 21st century. Feminist theories and practices across topics that intersect with gender inequality such as race, health, socioeconomics, sexual orientation, international perspectives, new media, civil rights, and political change. Perspectives from philosophy, education, visual culture, literary and ethnic studies, performance and expressive arts, and social sciences.

Terms: Aut | Units: 5 | UG Reqs: GER:DBSocSci, GER:ECGender | Grading: Letter (ABCD/NP)

GEOPHYS 150: Geodynamics: Our Dynamic Earth

In this course we cover the dynamic forces acting upon the Earth. We will investigate how geophysical forces effect the bending of tectonic plates, the flow of heat, sea level topography, the breaking point of rocks, porous flow, and how faults store and release energy. Math 52 or CME 102, GP 107 or permission from instructor. \n\nMore detailed course description to come.

Terms: Spr | Units: 3 | UG Reqs: GER:DBNatSci | Grading: Letter or Credit/No Credit

GEOPHYS 170: Global Tectonics

The architecture of the Earth's crust; regional assembling of structural or deformational features and their relationship, origin and evolution. The plate-tectonic cycle: rifting, passive margins, sea-floor spreading, subduction zones, and collisions. Case studies.

Terms: Aut | Units: 3 | Repeatable for credit | Grading: Letter or Credit/No Credit

GEOPHYS 187: Environmental Soundings Image Estimation (GEOPHYS 211)

Imaging principles exemplified by means of imaging geophysical data of various uncomplicated types (bathymetry, altimetry, velocity, reflectivity). Adjoints, back projection, conjugate-gradient inversion, preconditioning, multidimensional autoregression and spectral factorization, the helical coordinate, and object-based programming. Common recurring issues such as limited aperture, missing data, signal/noise segregation, and nonstationary spectra. See <http://sep.stanford.edu/sep/prof/>. Offered every year, autumn quarter.

Terms: Aut | Units: 3 | Grading: Letter or Credit/No Credit

GEOPHYS 190: Near-Surface Geophysics

Introduction to the integration of geophysical field measurements and laboratory measurements for imaging and characterizing the top 100 meters of Earth. Examples will focus on applications related to water resource management. The link between the measured geophysical properties of rocks, soils, and sediments, and their material properties. Forward modeling and inversion of geophysical data sets. Each week includes two hours of lectures; plus one two-hour lab that involves acquisition of field or lab

data, or computer modeling/analysis of data. Pre-requisite: CME 100 or Math 51, or co-registration in either. Offered every year, spring quarter.

Terms: Spr | Units: 3 | UG Reqs: GER:DBEngrAppSci | Grading: Letter or Credit/No Credit

GEOPHYS 210: Basic Earth Imaging

Echo seismogram recording geometry, head waves, moveout, velocity estimation, making images of complex shaped reflectors, migration by Fourier and integral methods. Anti-aliasing. Dip moveout. Computer labs. See <http://sep.stanford.edu/sep/prof/>. Offered every year, autumn quarter.

Terms: Aut | Units: 3-4 | Grading: Letter or Credit/No Credit

GEOPHYS 255: Report on Energy Industry Training

On-the-job-training for master's and doctoral degree students under the guidance of on-site supervisors. Students submit a report detailing work activities, problems, assignment, and key results. May be repeated for credit. Prerequisite: written consent of adviser.

Terms: Aut, Win, Spr, Sum | Units: 1-3 | Repeatable for credit | Grading: Satisfactory/No Credit

GEOPHYS 257: Introduction to Computational Earth Sciences

Techniques for mapping numerically intensive algorithms to modern high performance computers such as the Center for Computational Earth and Environmental Science's (CEES) high productivity technical computing (HPTC). Topics include: debugging, performance analysis, and concepts of parallel programming; efficient serial and parallel programs; OpenMP; and MPI. Exercises using SMP and cluster computers. See <http://pangea.stanford.edu/research/cees/>. Recommended: familiarity with MATLAB, C, or Fortran. May be repeated for credit. Offered every other year, winter quarter.

Terms: Win | Units: 2-4 | Repeatable for credit | Grading: Letter or Credit/No Credit

GEOPHYS 262: Rock Physics

Properties of and processes in rocks as related to geophysical exploration, crustal studies, and tectonic processes. Emphasis is on wave velocities and attenuation, hydraulic permeability, and electrical resistivity in rocks. Application to in situ problems, using lab data and theoretical results. Offered every year, autumn quarter.

Terms: Aut | Units: 3 | Grading: Letter (ABCD/NP)

GEOPHYS 280: 3-D Seismic Imaging

The principles of imaging complex structures in the Earth subsurface using 3-D reflection seismology. Emphasis is on processing methodologies and algorithms, with examples of applications to field data. Topics: acquisition geometrics of land and marine 3-D

seismic surveys, time vs. depth imaging, migration by Kirchhoff methods and by wave-equation methods, migration velocity analysis, velocity model building, imaging irregularly sampled and aliased data. Computational labs involve some programming. Lab for 3 units. Offered every year, winter quarter.

Terms: Win | **Units:** 2-3 | **Grading:** Letter or Credit/No Credit

GEOPHYS 284: Hydrogeophysics

The use of geophysical methods for imaging and characterizing the top 100 meters of Earth for hydrogeologic applications. Includes material properties, forward modeling, data acquisition, inversion, and integration with other forms of measurement. Each week includes three hours of lectures; plus one three-hour lab that involves acquisition of data at campus or near-by sites, or computer modeling of data.

Terms: Spr | **Units:** 3 | **Grading:** Letter (ABCD/NP)

GEOPHYS 286: Global Seismology

This course investigates how waves propagate through the whole Earth. This course examines the questions „How do body waves and surface waves behave within the Earth?“ and „What does that tell us about the Earth?“ The course delves into both theory and how we apply that theory to understand seismic observations. Requirements: Math 52 or CME 102, GP130 or permission from instructor.

Terms: Win | **Units:** 3 | **Grading:** Letter (ABCD/NP)

GEOPHYS 287: Earthquake Seismology

Theorems in elastodynamics, Green's functions, attenuation, wave propagation in layered media, ray theory, seismic moment tensors, finite-source effects, kinematics and dynamics of earthquakes, and engineering aspects of seismology.

Terms: Spr | **Units:** 3 | **Grading:** Letter (ABCD/NP)

GEOPHYS 385B: Environmental Geophysics

Research on the use of geophysical methods for near-surface environmental problems. May be repeated for credit.

Terms: Aut, Win, Spr, Sum | **Units:** 1-5 | **Repeatable for credit** | **Grading:** Letter or Credit/No Credit

GERGEN 235: Survival and the Biopolitics of Bare Life

Michel Foucault's concept of biopolitics refers to a modern form of political reign that drags corporeity, biological processes of life and the natural foundations of society into its control zone. Recently, Giorgio Agamben has tried to use Foucault's concept of biopolitics for the benefit of the analysis of phenomenons of the present. He sees the crucial turn towards biopolitics rather in the constitution of forms of survival than in the politicization of life. His works contribute essentially to the upward trend of the concept of survival, which „ under the sign of international terrorism, ecological crisis or the intensifying struggle for resources „

seems to become an approach more and more influential for the interpretation of the present. In this seminar, classic texts concerning the history and topicality of the relation between biopower and survival shall be read and discussed, amongst them texts by Giorgio Agamben, Hannah Arendt, Bruno Bettelheim, Cathy Caruth, Michel Foucault, Sigmund Freud, Lawrence Langer, Jay Robert Lifton, Terrence DesPres and others. [less description for GERGEN 235](#) «

Terms: Spr | Units: 3-5 | Grading: Letter (ABCD/NP)

GERGEN 265: Art and Nature

The role of nature in aesthetic experience and artistic creativity; the historically changing relation between aesthetic attitudes toward nature and art. Readings in English by Winckelmann, Kant, Schelling, Hegel, and Adorno.

Terms: Spr | Units: 3-5 | Grading: Letter or Credit/No Credit

GES 102: Earth Materials: Introduction to Mineralogy

The minerals and materials that comprise the earth and their uses in modern society. How to identify, classify, and interpret rock-forming minerals. Emphasis is on information provided by common minerals about the nature of the Earth's interior and processes such as magmatism and metamorphism that operate there, as well as the major processes of weathering and erosion that link plate tectonics to earth cycles. Prerequisite: introductory geology course. Recommended: introductory chemistry.

Terms: Aut | Units: 3 | UG Reqs: GER:DBNatSci | Grading: Letter or Credit/No Credit

GES 103: Earth Materials: Rocks in Thin Section

Use of petrographic microscope to identify minerals and common mineral associations in igneous, metamorphic, and sedimentary rocks. Crystallization histories, mineral growth and reaction relations, deformation textures in metamorphic rocks, and provenance of siliciclastic rocks. Prerequisite 102.

Terms: Win | Units: 3 | Grading: Letter (ABCD/NP)

GES 104: Earth Materials: Introduction to Petrology

The origin of different rock types as a function of geologic and plate tectonic setting. How mineral and energy resources occur in rocks. Prerequisite: introductory geology course. Recommended: GES102.

Terms: Spr | Units: 3 | Grading: Letter or Credit/No Credit

GES 105: Introduction to Field Methods

Two-week, field-based course in the White Mountains of eastern California. Introduction to the techniques for geologic mapping and geologic investigation in the field: systematic observations and data collection for lithologic columns and structural cross-sections. Interpretation of field relationships and data to determine the stratigraphic and deformational history of the region.

Prerequisite: GES 1. Recommended: GES 102.

Terms: Aut | Units: 3 | Grading: Letter or Credit/No Credit

GES 110: Structural Geology and Tectonics

Theory, principles, and practical techniques to measure, describe, analyze, and interpret deformation-related structures on Earth. Collection of fault and fold data in the field followed by lab and computer analysis; interpretation of geologic maps and methods of cross-section construction; structural analysis of fault zone and metamorphic rocks; measuring deformation; regional structural styles and associated landforms related to plate tectonic convergence, rifting, and strike-slip faulting; the evolution of mountain belts and formation of sedimentary basins. Prerequisite: GES 1, calculus. Recommended: 102.

Terms: Spr | Units: 3-5 | UG Reqs: GER:DBNatSci | Grading: Letter (ABCD/NP)

GES 111A: Fundamentals of Structural Geology (CEE 195A)

Techniques for structural mapping; using differential geometry to characterize structures; dimensional analysis and scaling relations; kinematics of deformation and flow; measurement and analysis of stress. Sources include field and laboratory data integrated with conceptual and mechanical models. Models of tectonic processes are constructed and solutions visualized using MATLAB. Prerequisites: GES 1, MATH 51, 52.

Terms: Aut | Units: 3 | UG Reqs: GER:DBNatSci | Grading: Letter or Credit/No Credit

GES 111B: Fundamentals of Structural Geology (CEE 195B)

Continuation of GES 111A/CEE 195A. Conservation of mass and momentum in a deformable continuum; linear elastic deformation and elastic properties of rock; brittle deformation including fracture and faulting; linear viscous flow including folding and magma dynamics; model development and methodology. Sources include field and laboratory data integrated with conceptual and mechanical models. Models of tectonic processes are constructed and solutions visualized using MATLAB. Prerequisite: GES 111A/CEE 195B.

Terms: Win | Units: 3 | Grading: Letter or Credit/No Credit

GES 121: What Makes a Habitable Planet? (GES 221)

Physical processes affecting habitability such as large impacts and the atmospheric greenhouse effect, comets, geochemistry, the rise of oxygen, climate controls, and impact cratering. Detecting and interpreting the spectra of extrasolar terrestrial planets. Student-led discussions of readings from the scientific literature. Team taught by planetary scientists from NASA Ames Research Center.

Terms: Aut | Units: 3 | Grading: Letter or Credit/No Credit

GES 150: Senior Seminar: Issues in Earth Sciences

Focus is on written and oral communication in a topical context. Topics from current frontiers in earth science research and issues of concern to the public. Readings, oral presentations, written work, and peer review.

Terms: Aut | Units: 3 | Grading: Letter (ABCD/NP)

GES 151: Sedimentary Geology and Petrography: Depositional Systems

Topics: weathering, erosion and transportation, deposition, origins of sedimentary structures and textures, sediment composition, diagenesis, sedimentary facies, tectonics and sedimentation, and the characteristics of the major siliciclastic and carbonate depositional environments. Lab: methods of analysis of sediments in hand specimen and thin section. Field trips.

Prerequisites: 1, 102, 103.

Terms: Win | Units: 4 | UG Reqs: GER:DBNatSci | Grading: Letter or Credit/No Credit

GES 171: Geochemical Thermodynamics

Introduction to the application of chemical principles and concepts to geologic systems. The chemical behavior of fluids, minerals, and gases using simple equilibrium approaches to modeling the geochemical consequences of diagenetic, hydrothermal, metamorphic, and igneous processes. Topics: reversible thermodynamics, solution chemistry, mineral-solution equilibria, reaction kinetics, and the distribution and transport of elements by geologic processes. Prerequisite: GES 102.

Terms: Aut | Units: 3 | UG Reqs: GER:DBNatSci | Grading: Letter or Credit/No Credit

GES 182: Field Seminar on Continental-Margin Volcanism

For juniors, seniors, and graduate students in the earth sciences and archeology. One weekend-long, and two one-day field trips to study Cenozoic volcanism associated with subduction and with passage of the Mendocino Triple Junction off the west coast of California: Mt. Lassen/Mt. Shasta/Modoc plateau; Clear Lake/Sonoma volcanics; Pinnacles National Monument. Andesite and basalt lavas, cinder cones, mixed magmas, blast deposit, debris avalanches, volcanic mudflows, hydrologic controls of springs in volcanic terrains, hydrothermal alteration and modern geothermal systems, Hg mineralization, obsidian source. Prerequisite: 1, 104 or equivalent.

Terms: offered occasionally | Units: 2 | Grading: Letter or Credit/No Credit

GES 190: Research in the Field

Two to three-week long courses that provide students with the opportunity to collect data in the field as part of a team-based investigation of research questions or topics under the expert guidance of knowledgeable faculty and graduate students. Topics and locations vary. May be taken multiple times for credit. Prerequisites: GES 1, GES 102, GES 105.

Terms: Aut, Win, Spr, Sum | Units: 2-4 | Repeatable for credit | Grading: Letter (ABCD/NP)

GES 192: Undergraduate Research in Geological and Environmental Sciences

Field-, lab-, or literature-based. Faculty supervision. Written reports. May be repeated for credit.

Terms: Aut, Win, Spr, Sum | Units: 1-10 | Repeatable for credit | Grading: Letter or Credit/No Credit

GES 198: Special Problems in Geological and Environmental Sciences

Reading and instruction under faculty supervision. Written reports. May be repeated for credit.

Terms: Aut, Win, Spr, Sum | Units: 1-10 | Repeatable for credit | Grading: Letter or Credit/No Credit

GES 1A: Introduction to Geology: The Physical Science of the Earth

For non-majors or prospective majors in the Earth Sciences. Lectures, hands-on laboratories, and three one-day weekend field trips. Focus is on the physical and chemical processes of heat and mass transfer within the earth and its fluid envelopes, including deep-earth, crustal, surface, and atmospheric processes. Topics include the dynamics of and interactions between the inner earth, plate tectonics, surface processes, and atmospheric processes such as climate change and global warming. Only one of GES 1A, 1B, or 1C may be taken for credit. Prerequisites: MATH 19 or equivalent.

Terms: Aut | Units: 5 | UG Reqs: GER:DBNatSci | Grading: Letter or Credit/No Credit

GES 1BN: Introduction to Geology: California Desert Field Geology

California's Death Valley and Owens Valley are used as natural laboratories for studying active geologic processes and a billion years of earth history: ancient ocean sediments, mountain building, earthquake faulting, glacial landscapes, volcanic eruptions, hot springs and ore deposits, prehistoric climate changes, and historic human impacts. The course culminates in a 6-day field trip to these areas during Spring Break. Class lectures provide the basics of plate tectonics and physical geology. Laboratory exercises involve rock identification and interpreting topographic and geologic maps and remote sensing imagery. Camping and moderate hiking required. Limited enrollment... [more description for GES 1BN »](#)

Terms: Win | Units: 4 | UG Reqs: Writing2, GER:DBNatSci | Grading: Letter (ABCD/NP)

GES 1C: Introduction to Geology: Dynamic Earth

For non-majors or prospective majors in the Earth Sciences. Integrated lecture-lab includes hands-on activities and local field trips. Focus is on reading the dynamic geological landscape, with an emphasis on California;primarily Bay Area;geology. Topics include plate tectonics, earthquakes and volcanoes, Earth materials, geologic time, stream processes, and climate change over geologic time. Only one of GES 1A, 1B, or 1C may be taken for credit.

Terms: Spr | Units: 4 | UG Reqs: GER:DBNatSci | Grading: Letter or Credit/No Credit

GES 211: Topics in Regional Geology and Tectonics

May be repeated for credit.

Terms: Aut, Win, Spr | Units: 2-3 | Repeatable for credit | Grading: Letter or Credit/No Credit

GES 212: Topics in Tectonic Geomorphology

For upper-division undergraduates and graduate students. Topics vary and may include coupling among erosional, tectonic, and chemical weathering processes at the scale of orogens; historical review of tectonic geomorphology; hillslope and fluvial process response to active uplift; measures of landscape form and their relationship to tectonic uplift and bedrock lithology. May be repeated for credit.

Terms: Aut | Units: 2 | Repeatable for credit | Grading: Satisfactory/No Credit

GES 213: Topics in Sedimentary Geology

For upper division undergraduates and graduate students. Topics vary each year but the focus is on current developments and problems in sedimentary geology, sedimentology, and basin analysis. These include issues in deep-water sediments, their origin, facies, and architecture; sedimentary systems on the early Earth; and relationships among tectonics, basin development, and basin fill. May be repeated for credit.

Terms: by arrangement | Units: 2 | Repeatable for credit | Grading: Letter or Credit/No Credit

GES 214: Topics in Paleobiology

For upper division undergraduates and graduate students. Topics vary each year; focus is on paleontological, sedimentological, and geochemical approaches to the history of life. Topics may include: mass extinction events; evolutionary radiations; the history of global biodiversity; links between evolutionary histories of primary producers and consumers; and the quality of the fossil record. Term paper. May be repeated for credit.

Terms: offered occasionally | Units: 2 | Repeatable for credit | Grading: Satisfactory/No Credit

GES 216: Rock Fracture Mechanics

Principles and tools of elasticity theory and fracture mechanics are applied to the origins and physical behaviors of faults, dikes, joints, veins, solution surfaces, and other natural structures in rock. Field observations, engineering rock fracture mechanics, and the elastic theory of cracks. The role of natural fractures in brittle rock deformation, and fluid flow in the earth's crust with applications to crustal deformation, structural geology, petroleum geology, engineering, and hydrogeology. Prerequisite: 215 or equivalent.

Terms: Spr | Units: 3-5 | Grading: Letter or Credit/No Credit

GES 217: Faults, Fractures, and Fluid Flow

Process-based approach to rock failure; the microstructures and overall architectures of the failure products including faults, joints, solution seams, and types of deformation bands. Fluid flow properties of these structures are characterized with emphasis

on sealing and transmitting of faults and their role in hydrocarbon flow, migration, and entrapment. Case studies of fracture characterization experiments in aquifers, oil and gas reservoirs, and waste repository sites. Guest speakers; weekend field trip. Prerequisite: first-year graduate student in Earth Sciences.

Terms: Win | **Units:** 3 | **Grading:** Letter or Credit/No Credit

GES 224: Modeling Transport and Transformations in the Environment

An introduction to geochemical and reactive transport modeling using Geochemist's Workbench and other appropriate models. Students required to participate in a weekend-long short course at the beginning of the quarter. Throughout the quarter the students will use the principles and tools presented in the class to develop and analyze an environmental problem as part of a simulated consulting exercise. Topics covered include contaminant transport, mineral dissolution/precipitation and aquifer microbiology. Prerequisites: Either EESS 221 (CEE 260C) or EESS 220 (CEE 260A) and either GES 90, 170, or 171, or permission from instructors.

Terms: Aut | **Units:** 2-3 | **Grading:** Letter (ABCD/NP)

GES 238: Soil Physics

Physical properties of the soil solid phase emphasizing the transport, retention, and transformation of water, heat, gases, and solutes in the unsaturated subsurface. Field experiments.

Terms: Aut | **Units:** 3 | **Grading:** Letter or Credit/No Credit

GES 252: Sedimentary Petrography

Siliciclastic sediments and sedimentary rocks. Research in modern sedimentary mineralogy and petrography and the relationship between the composition and texture of sediments and their provenance, tectonic settings, and diagenetic histories. Topics vary yearly. Prerequisite: 151 or equivalent.

Terms: Aut | **Units:** 4 | **Grading:** Letter or Credit/No Credit

GES 253: Petroleum Geology and Exploration

The origin and occurrence of hydrocarbons. Topics: thermal maturation history in hydrocarbon generation, significance of sedimentary and tectonic structural setting, principles of accumulation, and exploration techniques. Prerequisites: 110, 151. Recommended: GEOPHYS 223.

Terms: Spr | **Units:** 3 | **Grading:** Letter or Credit/No Credit

GES 256: Quantitative Methods in Paleobiology

Introduction to statistical methods relevant to the analysis of paleobiological data. Methods include principles of inference, linear and logistic regression, principal components analysis, time-series, and re-sampling methods. Paleobiological problems

include assessment of spatial and temporal patterns in biodiversity, selectivity of extinction and origination, and evolutionary trends. Readings, examples, and problems from the primary literature. Term paper. Prerequisite: Previous course in paleobiology or permission of the instructor.

Terms: offered occasionally | **Units:** 3 | **Grading:** Letter or Credit/No Credit

GES 277: Flood Basalts and Mass Extinctions

Recent work in geochronology and paleobiology supports the temporal coincidence of the eruption of continental flood basalts with mass extinction in the marine and terrestrial realms. The mechanisms and timescale of flood basalt eruptions, their likely environmental and biological consequences, and the evidence for flood basalt eruptions as the triggers of many mass extinction events. Sources include recent primary literature.

Terms: offered occasionally | **Units:** 3 | **Grading:** Letter or Credit/No Credit

GES 292: Directed Reading with Geological and Environmental Sciences Faculty

May be repeated for credit.

Terms: Aut, Win, Spr, Sum | **Units:** 1-10 | **Repeatable for credit** | **Grading:** Letter or Credit/No Credit

GES 299: Field Research

Two-three week field research projects. Written report required. May be repeated three times.

Terms: Aut, Win, Spr, Sum | **Units:** 2-4 | **Repeatable for credit** | **Grading:** Letter

GES 311: Interpretation of Tectonically Active Landscapes

Focuses on interpreting various topographic attributes in terms of horizontal and vertical tectonic motions. Topics include identification, mapping, and dating of geomorphic markers, deducing tectonic motions from spatial changes in landscape steepness, understanding processes that give rise to different landscape elements, interrogating the role of climate and lithology in producing these landscape elements, and understanding relationships between tectonic motions, surface topography, and the spatial distribution of erosion. Consists of two one hour lectures per week and one laboratory section that help students gain proficiency in Quaternary mapping and interpretation... [more description for GES 311 »](#)

Terms: Spr | **Units:** 3 | **Grading:** Letter (ABCD/NP)

GES 40N: Diamonds

Preference to freshmen. Topics include the history of diamonds as gemstones, prospecting and mining, and their often tragic politics. How diamond samples provide clues for geologists to understand the Earth's deep interior and the origins of the solar system. Diamond's unique materials properties and efforts in synthesizing diamonds.

Terms: Spr | Units: 3 | UG Reqs: GER:DBNatSci | Grading: Letter or Credit/No Credit

GES 55Q: The California Gold Rush: Geologic Background and Environmental Impact

Preference to sophomores. Topics include: geologic processes that led to the concentration of gold in the river gravels and rocks of the Mother Lode region of California; and environmental impact of the Gold Rush due to population increase, mining operations, and high concentrations of arsenic and mercury in sediments from hard rock mining and milling operations.

Recommended: introductory geology.

Terms: Win | Units: 3 | UG Reqs: Writing2, GER:DBNatSci | Grading: Letter or Credit/No Credit

GES 90: Introduction to Geochemistry

The chemistry of the solid earth and its atmosphere and oceans, emphasizing the processes that control the distribution of the elements in the earth over geological time and at present, and on the conceptual and analytical tools needed to explore these questions. The basics of geochemical thermodynamics and isotope geochemistry. The formation of the elements, crust, atmosphere and oceans, global geochemical cycles, and the interaction of geochemistry, biological evolution, and climate.

Recommended: introductory chemistry.

Terms: Win | Units: 3-4 | UG Reqs: GER:DBNatSci | Grading: Letter or Credit/No Credit

GSBGEN 356: Dynamics of the World Wine Industry

This seminar will examine the impact of the globalization of the wine industry on competitive strategies of wine producers. It builds on on-going field research on the role of organizational identity in creating sustainable advantage of niche producers in the Italian wine industry. This research concentrates on the contest between modernist and traditionalist identities and practices. This contest is being played out, to a greater or lesser degree, in most wine producing countries. Participants in the seminar will carry out research on the dynamics of the wine industry in one or a few countries. Collectively the seminar will attempt to provide an integrated account of ind... [more description for GSBGEN 356 »](#)

Units: 4 | Grading: GSB Letter Graded

GSBGEN 358: The Power of Social Technology

The goal of the class is simple: to marshal social technology in support of a clear social objective. This course is a Bass Seminar, and thus project-based - i.e. owned and driven by the students (rather than a more traditional class based on lectures and cases). The focus of this project-based seminar is to explore how social technology (e.g. the use of blogs, websites, podcasts, widgets, community groups, social network feeds) can change attitudes and behaviors in ways that cultivate social change and improve the lives of others. Students will study the strategies and tactics used by companies and causes that have successfully catalyzed active social persuasion (e... [more description for GSBGEN 358 »](#)

Units: 4 | Grading: GSB Letter Graded

GSBGEN 394: Global Project Finance

The course covers principles of project finance as well as fundamentals of infrastructure project development, public-private partnerships, and principal investment in the burgeoning infrastructure asset class. The course provides a conceptual framework for how to think about structuring, de-risking, and financing large, complex, capital-intensive projects in the transportation, energy, communications, and social infrastructure sectors. The course examines the range of public and private sources of finance currently available for infrastructure projects in developed and developing countries. It covers benefits and disadvantages of project finance as a financing style... [more description for GSBGEN 394 »](#)

Units: 4 | Grading: GSB Letter Graded

GSBGEN 522: Ethical Issues in the Biotech Industry

This course focuses on the bioscience industry (biotechnology, pharmaceutical, medical device, genomics, and vaccine) with an emphasis on the ethical and social challenges of running these companies. Additionally, it will introduce students to the processes and decision-making with regard to new biotechnology product development, clinical research (both in developed and developing countries), responsibilities to human research subjects, regulatory hurdles, market timing decisions, interactions with customer physicians, product safety, data publication, direct-to-consumer marketing of prescription drugs, and product litigation. Students in the class will be representative ... [more description for GSBGEN 522 »](#)

Units: 2 | Grading: GSB Student Option LTR/PF

GSBGEN 566: Real-Life Ethics

GSBGEN 566 will be an elective course offered to 2nd-year MBA and Sloan students. The goal of this course is to improve students' judgment in confronting ethical situations encountered in the normal course of business activities. The course will be taught by Mark Leslie, Lecturer, and will include additional guest lecturers in many of the specific areas. The course, which will be case-based, will involve frequent student-to-student and student-to-instructor role-playing. Cases will be drawn from a wide selection of business situations, including such topics as raising venture capital, managing major industrial customers, product introduction through major retailers, ... [more description for GSBGEN 566 »](#)

Units: 2 | Grading: GSB Pass/Fail

GSBGEN 585: Social Innovation through Corporate Social Responsibility

This course accepts that the (CSR) movement linking business, communities and sustainability has moved past the stage of debate. The last decade has seen an increased awareness in regard to environmental and social issues that has found its way up the corporate ladder and into company boardrooms. How companies incorporate CSR programs and strategies, however, is varied and diverse. The course will utilize reading assignments, case analysis and/or company presentations to provide an overview of CSR, the frameworks and models for developing a CSR strategy and the growing utilization of cross-sector partnerships in CSR and innovation efforts. Particular focus will be on current... [more description for GSBGEN 585 »](#)

Units: 2 | Grading: GSB Pass/Fail

GSBGEN 586: Poverty, Entrepreneurship, and Development

Global poverty is a problem that persists on a massive scale, and its persistence may itself be a major impediment to growth in emerging economies. Recent years have seen a blossoming interest in socially innovative approaches to alleviating poverty and stimulating economic growth in emerging economies. In this short course, we will explore different conceptualizations of the problem of global poverty, the potential role of entrepreneurship in helping to address it, as well as the strengths and weaknesses of different approaches. Some possible areas of focus include:\n\n- Different conceptualizations of the main drivers of persistent, extreme poverty\n\n- The challenges t... [more description for GSBGEN 586 »](#)

Units: 2 | Grading: GSB Pass/Fail

HISTORY 102: The History of the International System since 1914

After defining the characteristics of the international system at the beginning of the twentieth century, this course reviews the primary developments in its functioning in the century that followed. Topics include the major wars and peace settlements; the emergence of Nazism and Communism; the development of the Cold War and nuclear weapons; the rise of China, India, and the EU; and the impact of Islamic terrorism. The role of international institutions and international society will also be a focus as will the challenge of environment, health, poverty, and climate issues to the functioning of the system.

Terms: Spr | Units: 5 | UG Reqs: GER:DBSocSci | Grading: Letter or Credit/No Credit

HISTORY 106A: Global Human Geography: Asia and Africa

Global patterns of demography, economic and social development, geopolitics, and cultural differentiation, covering E. Asia, S. Asia, S.E. Asia, Central Asia, N. Africa, and sub-Saharan Africa. Use of maps to depict geographical patterns and processes.

Terms: Aut | Units: 5 | UG Reqs: GER:DBSocSci, GER:ECGlobalCom | Grading: Letter or Credit/No Credit

HISTORY 106B: Global Human Geography: Europe and Americas

Patterns of demography, economic and social development, geopolitics, and cultural differentiation. Use of maps to depict geographical patterns and processes.

Terms: Win | Units: 5 | UG Reqs: GER:DBSocSci, GER:ECGlobalCom | Grading: Letter or Credit/No Credit

HISTORY 206: History and Geography of Contemporary Global Issues

The historical background and geographical context of contemporary global issues and events. Texts are a world atlas and regular reading of *The New York Times* and *The Economist*. Topics vary according to what is happening in the world. Student presentations.

Terms: Aut | Units: 5 | UG Reqs: GER:DBSocSci | Grading: Letter (ABCD/NP)

HISTORY 231A: Charles Darwin and the Global 19th Century (HISTORY 331A)

Uses the writings, life, and legacy of Charles Darwin as a vehicle for exploring the nature of global change in the nineteenth century. Examines the relationship between modern science, imperialism, and world travel by tracking Darwin's experiences and those of his contemporaries, focusing both of the emergence of evolutionary theory as well as the popular reception and political controversies surrounding Darwin's work.

Terms: Aut | Units: 4-5 | Grading: Letter (ABCD/NP)

HISTORY 60S: Beyond the Nation: International Social Movements in the U.S. from World War I to World War II

Anarchism, socialism, feminism, pacifism, Pan-Africanism. These and other international social movements thrived in the United States between World War I and World War II, a period usually characterized as "isolationist." How did these movements' members, including Emma Goldman, Jane Addams, W.E.B. DuBois, and John DosPassos, articulate their goals both to themselves and to a broader public that was often suspicious of "internationalism"? Sources include speeches and manifestos, national and international newspapers letters, novels, film, archival documents, and international decrees.

Terms: Aut, offered once only | Units: 5 | Grading: Letter (ABCD/NP)

HISTORY 61S: California Politics since the 1960s

The rise of modern political conservatism and its interplay with liberalism and the liberal state. Metropolitan development, civil rights, the welfare state, law and order, and immigration. Grassroots, spatial, cultural, institutional, and biographical approaches to political history. The methodological challenges of writing academic history about the recent past. Media sources, public ballot proposition campaign materials, political speeches and essays, oral histories, government documents, court cases, maps, photographs, film, television, and music.

Terms: Aut, offered once only | Units: 5 | Grading: Letter (ABCD/NP)

HRP 214: Scientific Writing

Step-by-step through the process of writing and publishing a scientific manuscript. How to write effectively, concisely, and clearly. Preparation of an actual scientific manuscript. Students are encouraged to bring a manuscript on which they are currently working to develop and polish throughout the course.

Terms: Win | Units: 2-3 | Grading: Medical Satisfactory/No Credit

HRP 216: Analytical and Practical Issues in the Conduct of Clinical and Epidemiologic Research

Topics include: advanced aspects of study design and data analyses; development of health measurement instruments; methods of summarizing literature and quantifying effect sizes; and multivariable nature of health events in human populations. 3 units requires a term paper. Prerequisites: 225, and 258 or 261, or consent of instructor.

Terms: Spr | **Units:** 2-3 | **Grading:** Medical Option (Med-Ltr-CR/NC)

HRP 223: Epidemiologic Analysis: Data Management and Statistical Programming

The skills required for management and analysis of biomedical data. Topics include importing and exporting data from multiple database systems, visualizing and cleaning data, data management for multicenter projects, and data security. Introduction to applied statistical programming relevant to epidemiologic and clinical research. No previous programming experience required.

Terms: Aut | **Units:** 2-3 | **Grading:** Medical Satisfactory/No Credit

HRP 225: Design and Conduct of Clinical and Epidemiologic Studies

Intermediate-level. The skills to design, carry out, and interpret epidemiologic studies, particularly of chronic diseases. Topics: epidemiologic concepts, sources of data, cohort studies, case-control studies, cross-sectional studies, sampling, estimating sample size, questionnaire design, and the effects of measurement error. Prerequisite: A basic/introductory course in statistics or consent of instructor.

Terms: Aut | **Units:** 3-4 | **Grading:** Letter or Credit/No Credit

HRP 226: Advanced Epidemiologic and Clinical Research Methods

The principles of measurement, measures of effect, confounding, effect modification, and strategies for minimizing bias in clinical and epidemiologic studies. Prerequisite: 225 or consent of instructor.

Terms: Win | **Units:** 3-4 | **Grading:** Letter or Credit/No Credit

HRP 231: Epidemiology of Infectious Diseases

Principles of the transmission of the infectious agents (viruses, bacteria, rickettsiae, mycoplasma, fungi, and protozoan and helminth parasites). The role of vectors, reservoirs, and environmental factors. Pathogen and host characteristics that determine the spectrum of infection and disease. Endemicity, outbreaks, and epidemics of selected infectious diseases. Principles of control and surveillance.

Terms: Win | **Units:** 3 | **Grading:** Medical Option (Med-Ltr-CR/NC)

HRP 240: Rethinking Global Health (MED 230)

Challenges for those seeking to improve global health: contending with a dynamic balance between infectious and chronic non-communicable disease that differs across and within countries; issues relating to the proximate and more removed causes of disease and illness, including nutrition, infrastructure, governance, economic development, and environmental changes; diverse

proposed responses with arguments for particular courses of action appealing to cost-effectiveness, egalitarian, and rights-based principles. Course goal is to begin to make sense of these challenging issues, requiring data and evidence derived via multiple methodologies, critical thinking, and sound reas... [more description for HRP 240 >](#)

Terms: Spr | Units: 3 | Grading: Medical Option (Med-Ltr-CR/NC)

HRP 299: Directed Reading in Health Research and Policy

Epidemiology, health services research, preventive medicine, medical genetics, public health, economics of medical care, occupational or environmental medicine, international health, or related fields. May be repeated for credit. Prerequisite: consent of instructor.

Terms: Aut, Win, Spr, Sum | Units: 1-18 | Repeatable for credit | Grading: Medical Satisfactory/No Credit

HUMBIO 113: The Biologies of Humans and Plants

The biological interdependence of humans and plants, particularly the ways in which people have imposed selection pressures and ecological change on one another. Topics include: evolution and basic plant structure; plant characteristics and genetic variants allowing domestication; effects of plant domestication on human biology; plants in traditional and contemporary diets; and human influences on plant biology through genetic manipulation and environmental change. Class meetings center on discussing journal articles.

Terms: Aut | Units: 3 | Grading: Letter or Credit/No Credit

HUMBIO 122M: Challenges of Human Migration: Health and Health Care of Migrants and Autochthonous Populations (PEDS 212)

An emerging area of inquiry. Topics include: global migration trends, health Issues/aspects of migration, healthcare and the needs of immigrants in the US, and migrants as healthcare providers: a new area of inquiry in the US. Class is structured to include: lectures lead by the instructor and possible guest speakers; seminar, discussion and case study sessions led by students.

Terms: Spr | Units: 3 | Grading: Letter or Credit/No Credit

HUMBIO 151: Introduction to Epidemiology

Principles of epidemiology: the distribution and determinants of disease; the control of health problems; and the medical detective work required to understand disease outbreaks. Case studies from developed and developing countries to explore the use of epidemiological techniques in describing disease dynamics of human, emerging and zoonotic (animal to human) diseases such as SARS, plague, HIV, and influenza; the impacts of changes in policy, law, and behavior on disease control and eradication, such as hepatitis vaccination; and modern challenges in epidemiology such as global disease transmission, environmental change, and bioterrorism threats.

Terms: Aut | Units: 4 | Grading: Letter or Credit/No Credit

HUMBIO 152: Viral Lifestyles

Contemporary topics related to microorganism. Relevance of microorganisms to disciplines beyond molecular biology and medicine. Public health implications of human/viral interactions, and the human behaviors that bring about such interactions. The ecological role played by viruses and their role in environmental health. Prerequisite: familiarity with biological systems, evolutionary biology, and microbiology.

Terms: Spr | Units: 3 | Grading: Letter or Credit/No Credit

HUMBIO 153: Parasites and Pestilence: Infectious Public Health Challenges

Parasitic and other pestilence of public health importance. Pathogenesis, clinical syndromes, complex life cycles, and the interplay among environment, vectors, hosts, and reservoirs in historical context. Public health policy initiatives aimed at halting disease transmission. World Health Organization tropical disease targets including river blindness, sleeping sickness, leishmaniasis, schistosomiasis, mycobacterial disease (tuberculosis and leprosy), malaria, toxoplasmosis, dracunculiasis, and intestinal helminthes. Guest lecturers with expertise in disease control. Prerequisite: Human Biology core or equivalent, or consent of instructor.

Terms: Win | Units: 4 | Grading: Letter or Credit/No Credit

HUMBIO 156: Global HIV/AIDS (MED 256)

Public health, policy, and research issues. Identify resources at Stanford, and from government, NGOs, and pharmaceutical, advocacy, and international organizations. Sources include biomedical, social, and behavioral sciences. Emphasis on student projects which feature methodologies in the development and design of Operational Research and Implementation Science in AIDS/TB and Malaria in response to PEPFAR and Global Fund programs. Guest lectures. Prerequisite: Human Biology core or equivalent, or consent of instructor.

Terms: Aut | Units: 3 | UG Reqs: GER:ECGlobalCom, GER:DBNatSci | Grading: Letter or Credit/No Credit

HUMBIO 166: Food and Society: Exploring Eating Behaviors in Social, Environmental, and Policy Context

The array of forces that affect the foods human beings eat, and when, where, and how we eat them, including economics, business, agriculture, law, politics, trade, ideology, culture, biology, and psychology. The impact of current policies, and actions that might be taken to improve human nutrition and health. Macro-scale influences on food, nutrition, and eating behavior.

Terms: Win | Units: 4 | Grading: Letter (ABCD/NP)

HUMBIO 174: Foundations of Bioethics

Classic articles, legal cases, and foundational concepts. Theoretical approaches derived from philosophy. The ethics of medicine and research on human subjects, assisted reproductive technologies, genetics, cloning, and stem cell research. Ethical issues at the end of life. Prerequisite: Human Biology core or equivalent, or consent of instructor.

Terms: Win | **Units:** 3 | **UG Reqs:** GER:ECEthicReas | **Grading:** Letter or Credit/No Credit

HUMBIO 2A: Genetics, Evolution, and Ecology

Introduction to the principles of classical and modern genetics, evolutionary theory, and population biology. Topics: micro- and macro-evolution, population and molecular genetics, population dynamics, and community ecology, emphasizing the genetics of the evolutionary process and applications to human populations.

Terms: Aut | **Units:** 5 | **UG Reqs:** GER:DBNatSci | **Grading:** Letter (ABCD/NP)

HUMBIO 2B: Culture, Evolution, and Society

Introduction to the evolutionary study of human diversity. Hominid evolution, the origins of social complexity, social theory, and the emergence of the modern world system, emphasizing the concept of culture and its influence on human differences.

Terms: Aut | **Units:** 5 | **UG Reqs:** GER:DBSocSci | **Grading:** Letter (ABCD/NP)

HUMBIO 3A: Cell and Developmental Biology

The principles of the biology of cells: principles of human developmental biology, biochemistry of energetics and metabolism, the nature of membranes and organelles, hormone action and signal transduction in normal and diseased states (diabetes, cancer, autoimmune diseases), drug discovery, immunology, and drug addiction. Prerequisite: college chemistry or completion of the HumBio chemistry lecture series during the fall quarter. Required evening midterm for 3A, Monday, 7-9:00 PM. See syllabus for date.

Terms: Win | **Units:** 5 | **UG Reqs:** GER:DBNatSci | **Grading:** Letter (ABCD/NP)

HUMBIO 3B: Behavior, Health, and Development

Research and theory on human behavior, health, and life span development. How biological factors and cultural practices influence cognition, emotion, motivation, personality, and health in childhood, adolescence, and adulthood.

Terms: Win | **Units:** 5 | **UG Reqs:** GER:DBSocSci | **Grading:** Letter (ABCD/NP)

HUMBIO 84Q: Social Justice, Responsibility, Health

Preference to sophomores. Reducing health disparities among segments of the US population is an over-arching goal of the Centers for Disease Control and Prevention (CDC). Evidence for and cause of existing health disparities; criteria for calling a health disparity unjust; and assignment of responsibility for maintaining or recovering good health. Service Learning Course

(certified by Haas Center).

Terms: Aut | Units: 4 | Grading: Letter (ABCD/NP)

HUMBIO 86Q: Love as a Force for Social Change

Preference to sophomores. Biological, psychological, religious, social and cultural perspectives on the concept of love. How love is conceptualized across cultures; love as the basis of many religions; different kinds of love; the biology of love; love as sickness; love and sex; the languages of love including art, literature, music, and poetry. Emphasis is on writing. Oral presentation. A requirement of this class is participation in public blogs.

Terms: Win | Units: 3 | Grading: Letter (ABCD/NP)

IPS 203: Issues in International Economics

Topics in international trade and international trade policy: trade, growth and poverty, the World Trade Organization (WTO), regionalism versus multilateralism, the political economy of trade policy, trade and labor, trade and the environment, and trade policies for developing economies. Prerequisite: ECON 51, ECON 166.

Terms: Win | Units: 5 | Grading: Letter (ABCD/NP)

IPS 206A: Politics and Collective Action (POLISCI 331S, PUBLPOL 304A)

Classic theories for why collective action problems occur and how they can be solved. Politics of aggregating individual decisions into collective action, including voting, social protest, and competing goals and tactics of officials, bureaucrats, interest groups, and other stakeholders. Economic, distributive, and moral frameworks for evaluating collective action processes and outcomes. Applications to real-world policy problems involving collective action.

Terms: Spr | Units: 4 | Grading: Letter (ABCD/NP)

IPS 210: The Politics of International Humanitarian Action

The relationship between humanitarianism and politics in international responses to civil conflicts and forced displacement. Focus is on policy dilemmas and choices, and the consequences of action or inaction. Case studies include northern Iraq (Kurdistan), Bosnia, Rwanda, Kosovo, and Darfur.

Terms: Aut | Units: 3-5 | Grading: Letter or Credit/No Credit

LAW 212: Introduction to Social Entrepreneurship

Introduction to Social Entrepreneurship examines the challenges of starting, counseling and funding an early stage social venture through the eyes of the entrepreneur, investor, attorney and community leader. It explores the intricacies of managing and sustaining growth, the changing role of corporate governance, and leveraging private sector partnerships and resources. It also explores innovative public / private sector partnerships and the challenges and opportunities of engaging diverse partners with

differing agendas. The course includes guest speakers from the fields of law and business assisting organizations as well the practitioners who run them. Throughout, stude... [more description for LAW 212 »](#)

Terms: Spr | Units: 3 | Grading: Law Honors/Pass/R credit/Fail

LAW 338: Land Use

In the context of a private property system, land use planning and land use control raise interesting philosophical and political questions. This course focuses on the pragmatic aspects of contemporary land use law and policy and explores the following: nuisance as a land use tool and foundation for modern land use law; use and abuse of the "police power" (the legal basis for land use control); zoning flexibility; vested property rights, development agreements, and takings; redevelopment; growth control; and direct democracy. Throughout, the course explores how land use decisions affect environmental quality and how land use decision-making addresses environmental impacts... [more description for LAW 338 »](#)

Terms: Win | Units: 3 | Grading: Law Honors/Pass/R credit/Fail

LAW 440: Biotechnology Law and Policy

This course is an interdisciplinary exploration of many of the legal and policy issues raised by the biotechnology industry. It is also intended to give law students and scientists the opportunity to learn more about each other's disciplines by working together. The course covers issues of patenting, corporate organization and financing, conflicts of interest, regulatory approvals, health care financing issues, and tort liability, as well as examining the prospects for and implications of the biotechnology revolution. The course includes materials and presentations for non-scientists on background knowledge about the science and technologies involved, as well as materials... [more description for LAW 440 »](#)

Terms: Spr | Units: 3 | Grading: Law Honors/Pass/R credit/Fail

LAW 622A: Environmental Law Clinic: Clinical Practice

Students enrolled in the Clinic provide legal assistance to national, regional and grassroots non-profit organizations on a variety of environmental issues, with a focus on complex natural resource conservation and biodiversity matters at the interface of law, science and policy. Working under the direct supervision of practicing environmental attorneys, Clinic students help screen new matters and potential clients; formulate strategies; research and develop factual and legal issues; and prosecute administrative and litigation proceedings. During the term, students may meet with clients, opposing counsel or agency decision makers; review administrative records; develop ... [more description for LAW 622A »](#)

Terms: Aut, Win | Units: 4 | Repeatable for credit | Grading: Law Honors/Pass/R credit/Fail

LAW 622B: Environmental Law Clinic: Clinical Methods

Students enrolled in the Clinic provide legal assistance to national, regional and grassroots non-profit organizations on a variety of environmental issues, with a focus on complex natural resource conservation and biodiversity matters at the interface of law, science and policy. Working under the direct supervision of practicing environmental attorneys, Clinic students help screen new

matters and potential clients; formulate strategies; research and develop factual and legal issues; and prosecute administrative and litigation proceedings. During the term, students may meet with clients, opposing counsel or agency decision makers; review administrative records; develop ... [more description for LAW 622B »](#)

Terms: Aut, Win | Units: 4 | Repeatable for credit | Grading: Law Honors/Pass/R credit/Fail

LAW 622C: Environmental Law Clinic: Clinical Coursework

Students enrolled in the Clinic provide legal assistance to national, regional and grassroots non-profit organizations on a variety of environmental issues, with a focus on complex natural resource conservation and biodiversity matters at the interface of law, science and policy. Working under the direct supervision of practicing environmental attorneys, Clinic students help screen new matters and potential clients; formulate strategies; research and develop factual and legal issues; and prosecute administrative and litigation proceedings. During the term, students may meet with clients, opposing counsel or agency decision makers; review administrative records; develop ... [more description for LAW 622C »](#)

Terms: Aut, Win | Units: 4 | Repeatable for credit | Grading: Law Honors/Pass/R credit/Fail

LAW 623: Advanced Environmental Law Clinic

The Advanced Environmental Law Clinic provides an opportunity for students who have already taken the Environmental Law Clinic to continue intense individual project work on cases or matters in which they have previously been involved. Advanced students will work closely with the supervising clinic attorney on their designated projects and are expected to take increasing responsibility for managing the necessary work and representation of clients. In addition, advanced students are expected to serve as mentors to less experienced clinic students enrolled in the basic Environmental Law Clinic course and will thereby receive additional training in basic team building and su... [more description for LAW 623 »](#)

Units: 2-7 | Repeatable for credit | Grading: Law Honors/Pass/R credit/Fail

LAW 626: Legislative Simulation: The Cap and Trade Debate

Terms: Aut | Units: 3 | Grading: Law Mandatory P/R/F

MATSCI 303: Principles, Materials and Devices of Batteries

Thermodynamics and electrochemistry for batteries. Emphasis on lithium ion batteries, but also different types including lead acid, nickel metal hydride, metal air, sodium sulfur and redox flow. Battery electrode materials, electrolytes, separators, additives and electrode-electrolyte interface. Electrochemical techniques; advanced battery materials with nanotechnology; battery device structure. Prerequisites: undergraduate chemistry.

Terms: Aut | Units: 3 | Grading: Letter or Credit/No Credit

MATSCI 316: Nanoscale Science, Engineering, and Technology

Sample application areas: renewable energy including nanoscaled photovoltaic cells, hydrogen storage, fuel cells, and nanoelectronics. Nanofabrication techniques including: self-assembly of amphiphilic molecules, block copolymers, organic-inorganic mesostructures, colloidal crystals, organic monolayers, proteins, DNA and abalone shells; biologically inspired growth of materials; photolithography, electron beam lithography, and scanning probe lithography; and synthesis of carbon nanotubes, nanowire, and nanocrystals. Other nanotechnology topics may be explored through a group project. SCPD offering.

Terms: Spr | **Units:** 3 | **Grading:** Letter or Credit/No Credit

ME 185: Electric Vehicle Design

This project based class focuses on the design and prototyping of electric vehicles. Students learn the fundamentals of vehicle design in class and apply the knowledge as they form teams and work on projects involving concept, specifications, structure, systems, integration, assembly, testing, etc. The class meets once a week to learn about the fundamentals, exchange their experiences, and coordinate between projects. The teams of 3-5 will work on their projects independently.

Terms: Spr | **Units:** 3 | **Grading:** Letter (ABCD/NP)

ME 260: Fuel Cell Science and Technology

Emphasis on proton exchange membrane (PEM) and solid oxide fuel cells (SOFC), and principles of electrochemical energy conversion. Topics in materials science, thermodynamics, and fluid mechanics. Prerequisites: MATH 43, PHYSICS 55, and ENGR 30 or ME 140, or equivalents.

Terms: Spr | **Units:** 3 | **Grading:** Letter (ABCD/NP)

ME 314: Good Products, Bad Products (ME 214)

The characteristics of industrial products that cause them to be successes or failures: the straightforward (performance, economy, reliability), the complicated (human and cultural fit, compatibility with the environment, craftsmanship, positive emotional response of the user), the esoteric (elegance, sophistication, symbolism). Engineers and business people must better understand these factors to produce more successful products. Projects, papers, guest speakers, field trips.

Terms: Win | **Units:** 4 | **Grading:** Letter or Credit/No Credit

ME 370A: Energy Systems I: Thermodynamics

Thermodynamic analysis of energy systems emphasizing systematic methodology for and application of basic principles to generate quantitative understanding. Availability, mixtures, reacting systems, phase equilibrium, chemical availability, and modern computational methods for analysis. Prerequisites: undergraduate engineering thermodynamics and computer skills such as Matlab.

Terms: Aut | **Units:** 3 | **Grading:** Letter or Credit/No Credit

ME 370B: Energy Systems II: Modeling and Advanced Concepts

Development of quantitative device models for complex energy systems, including fuel cells, reformers, combustion engines, and electrolyzers, using thermodynamic and transport analysis. Student groups work on energy systems to develop conceptual understanding, and high-level, quantitative and refined models. Advanced topics in thermodynamics and special topics associated with devices under study. Prerequisite: 370A.

Terms: Win | Units: 4 | Grading: Letter or Credit/No Credit

ME 370C: Energy Systems III: Projects

Refinement and calibration of energy system models generated in ME 370B carrying the models to maturity and completion. Integration of device models into a larger model of energy systems. Prerequisites: 370A,B, consent of instructor.

Terms: Spr | Units: 3-5 | Grading: Letter or Credit/No Credit

ME 371: Combustion Fundamentals

Heat of reaction, adiabatic flame temperature, and chemical composition of products of combustion; kinetics of combustion and pollutant formation reactions; conservation equations for multi-component reacting flows; propagation of laminar premixed flames and detonations. Prerequisite: 362A or 370A, or consent of instructor.

Terms: Win | Units: 3 | Grading: Letter or Credit/No Credit

MED 262: Economics of Health Improvement in Developing Countries (ECON 127)

Application of economic paradigms and empirical methods to health improvement in developing countries. Emphasis is on unifying analytic frameworks and evaluation of empirical evidence. How economic views differ from public health, medicine, and epidemiology; analytic paradigms for health and population change; the demand for health; the role of health in international development. Prerequisites: ECON 50 and 102B.

Terms: Win | Units: 5 | Grading: Medical Option (Med-Ltr-CR/NC)

MED 274: Design for Service Innovation (HRP 274)

(Same as OIT 344) Open to graduate students from all schools and departments. An experiential course in which students work in multidisciplinary teams to design new services (including, but not limited to, web services) to address the needs of an underserved population of users. Students learn to identify the key needs of the target population and to design services to address these needs. Projects in 2011 will focus on services for young adult survivors of severe childhood diseases such as cystic fibrosis, rheumatoid arthritis, major cardiac repairs, organ transplants, genetic metabolic disorders, and cancer. The first wave of survivors is reaching young adulthood (ages ... [more description for MED 274 »](#))

Terms: Spr | Units: 4 | Grading: Medical Option (Med-Ltr-CR/NC)

MED 83Q: Ethical, Legal, and Social Dimensions of Stem Cell Research

Preference to sophomores. Ethical, legal, social, and economic dimensions of stem cell research such as the discovery of human embryonic stem cells and the international landscape of public policy. How stem cells work, their role in the upkeep of the human body, and current and future uses in medicine. Issues at the intersection of science and society such as human-animal hybrids, notions of justice in intellectual property law, distribution of health care, and the major ethical frameworks defining the debate.

Terms: Spr | **Units:** 3 | **Grading:** Letter or Credit/No Credit

MGTECON 300: Growth and Stabilization in the Global Economy

This course gives students the background they need to understand the broad movements in the global economy. Key topics include long-run economic growth, technological change, wage inequality, international trade, interest rates, inflation, exchange rates, and monetary policy. By the end of the course, students should be able to read and understand the discussions of economic issues in *The Economist*, the *Wall Street Journal*, the *New York Times*, or the Congressional Budget Office.

Units: 4 | **Grading:** GSB Letter Graded

MGTECON 331: Political Economy of Health Care in the United States

This course provides the legal, institutional, and economic background necessary to understand the financing and production of health services in the US. Potential topics include: health reform, health insurance (Medicare and Medicaid, employer-sponsored insurance, the uninsured), medical malpractice and quality regulation, pharmaceuticals, the corporate practice of medicine, regulation of fraud and abuse, and international comparisons. \n\n\nThis course is cross-listed with the GSB, and the Health Research Policy and Public Policy Departments (Same as MGTECON 331, HRP 391 and PUBLPOL 231).

Units: 4 | **Grading:** GSB Student Option LTR/PF

MGTECON 332: Analysis of Costs, Risks, and Benefits of Health Care

For graduate students. The principal evaluative techniques for health care, including utility assessment, cost-effectiveness analysis, cost-benefit analysis, and decision analysis. Emphasis is on the practical application of these techniques. Group project presented at end of quarter. Guest lectures by experts from the medical school, pharmaceutical industry, health care plans, and government.

Units: 4 | **Grading:** GSB Student Option LTR/PF

MS&E 181: Issues in Technology and Work for a Postindustrial Economy

How changes in technology and organization are altering work and lives. Approaches to studying and designing work. How understanding work and work practices can assist engineers in designing better technologies and organizations. Topics include job design, distributed and virtual organizations, the blurring of boundaries between work and family life, computer supported

cooperative work, trends in skill requirements and occupational structures, monitoring and surveillance in the workplace, downsizing and its effects on work systems, project work and project-based lifestyles, the growth of contingent employment, telecommuting, electronic commerce, and the changing nature of... [more description for MS&E 181 »](#)

Terms: Spr | Units: 3 | Grading: Letter (ABCD/NP)

MS&E 185: Global Work

Issues, challenges, and opportunities facing workers, teams, and organizations working across national boundaries. Topics include geographic distance, time zones, language and cultural differences, technologies to support distant collaboration, team dynamics, and corporate strategy. Limited enrollment.

Terms: Spr | Units: 4 | Grading: Letter (ABCD/NP)

MS&E 248: Economics of Natural Resources

Intertemporal economic analysis of natural resource use, particularly energy, and including air, water, and other depletable mineral and biological resources. Emphasis is on an integrating theory for depletable and renewable resources. Stock-flow relationships; optimal choices over time; short- and long-run equilibrium conditions; depletion/extinction conditions; market failure mechanisms (common-property, public goods, discount rate distortions, rule-of-capture); policy options. Prerequisite: 241 or ECON 51.

Terms: Aut | Units: 3-4 | Grading: Letter or Credit/No Credit

MS&E 250A: Engineering Risk Analysis

The techniques of analysis of engineering systems for risk management decisions involving trade-offs (technical, human, environmental aspects). Elements of decision analysis; probabilistic risk analysis (fault trees, event trees, systems dynamics); economic analysis of failure consequences (human safety and long-term economic discounting); and case studies such as space systems, nuclear power plants, and medical systems. Public and private sectors. Prerequisites: ENGR 60 or equivalent, probability, decision analysis, stochastic processes, and convex optimization.

Terms: Win | Units: 3 | Grading: Letter or Credit/No Credit

MS&E 250B: Project Course in Engineering Risk Analysis

Students, individually or in groups, choose, define, formulate, and resolve a real risk management problem, preferably from a local firm or institution. Oral presentation and report required. Scope of the project is adapted to the number of students involved. Three phases: risk assessment, communication, and management. Emphasis is on the use of probability for the treatment of uncertainties and sensitivity to problem boundaries. Limited enrollment. Prerequisites: MS&E 250A and consent of instructor.

Terms: Spr | Units: 3 | Grading: Letter or Credit/No Credit

MS&E 271: Global Entrepreneurial Marketing

Skills needed to market new technology-based products to customers around the world. Case method discussions. Cases include startups and global high tech firms. Course themes: marketing toolkit, targeting markets and customers, product marketing and management, partners and distribution, sales and negotiation, and outbound marketing. Team-based take-home final exam. Limited enrollment.

Terms: Win, Spr | Units: 3-4 | Grading: Letter (ABCD/NP)

MS&E 299: Voluntary Social Systems

Ethical theory, feasibility, and desirability of a social order in which coercion by individuals and government is minimized and people pursue ends on a voluntary basis. Topics: efficacy and ethics; use rights for property; contracts and torts; spontaneous order and free markets; crime and punishment based on restitution; guardian-ward theory for dealing with incompetents; the effects of state action-hypothesis of reverse results; applications to help the needy, armed intervention, victimless crimes, and environmental protection; transition strategies to a voluntary society.

Terms: Win | Units: 1-3 | Grading: Letter or Credit/No Credit

MS&E 93Q: Nuclear Weapons, Energy, Proliferation, and Terrorism

Preference to sophomores. What are nuclear weapons; what do they do? How are they different from other weapons? What drives proliferation of nuclear weapons? Why do countries want them? Can they be eliminated? What about Iran and North Korea? What role does nuclear energy play? Can it help combat global climate change? What are the risks of nuclear terrorism? Recommended: a course in international relations, engineering, or physical science.

Terms: Spr | Units: 3 | UG Reqs: GER:DBEngrAppSci | Grading: Letter or Credit/No Credit

NBIO 101: Social and Ethical Issues in the Neurosciences (NBIO 201)

Influences on public debate and policy of scientific advances in the study of the brain and behavior: theories of brain function; philosophical and scientific approaches; advances in the neurosciences, possible uses in medical therapy, and interventions involving genetic screening, genetic selection, enhancement of neurological functioning, and manipulation of behavior; questions related to medical therapy, social policy, and broader considerations of human nature such as consciousness, free will, personal identity, and moral responsibility. May be taken for 2 units without a research paper. Prerequisite: Neuroscience, Biology, or Symbolic Systems major; or Human Biology ... [more description for NBIO 101 »](#)

Terms: Spr | Units: 2-4 | Grading: Medical Option (Med-Ltr-CR/NC)

OIT 333: Entrepreneurial Design for Extreme Affordability

This course is a Bass Seminar. Project course jointly offered by School of Engineering and Graduate School of Business. Students apply engineering and business skills to design product prototypes, distribution systems, and business plans for entrepreneurial

ventures in developing countries for challenges faced by the world's poor. Topics include user empathy, appropriate technology design, rapid prototype engineering and testing, social technology entrepreneurship, business modeling, and project management. Weekly design reviews; final course presentation. Industry and adviser interaction. Limited enrollment via application; see <http://extreme.stanford.edu/index.html> for ... [more description for OIT 333 »](#)

Units: 4 | Grading: GSB Letter Graded

OIT 344: Design for Service Innovation

Design for service innovation is an experiential course in which students work in multidisciplinary teams to design new services (including but not limited to web services) that will address the needs of an underserved population of users. Through a small number of lectures and guided exercises, but mostly in the context of specific team projects, students will learn to identify the key needs of the target population and to design services that address these needs. Our projects this year will focus on services for young adult survivors of severe childhood diseases. For the first time ever, children who have cystic fibrosis, rheumatoid arthritis, major cardiac repairs, org... [more description for OIT 344 »](#)

Units: 4 | Grading: GSB Letter Graded

OIT 522: Field Trips to Grassroots Innovators in Health Care: Improving Access & Outcomes for the Underserved

Some of the most impressive innovations in health care are developed at hospitals and other non-profit organizations by dedicated health care professionals (drs, nurses, administrators) who are not afraid to roll up their sleeves and work hard to solve an important health care problem they face in their everyday patient encounters. Because of limited financial resources and because they often target underserved market segments, these innovations lack a validated business model and commercialization pathway. In this seminar we will gain hands-on experience of some of these grassroots innovations through field trips to a local public hospital (a candidate hospital is San Fr... [more description for OIT 522 »](#)

Units: 2 | Grading: GSB Pass/Fail

OSPAUSTL 10: Coral Reef Ecosystems

Key organisms and processes, and the complexity of coral reef ecosystems. Students explore the Great Barrier Reef from the southern end which demonstrates the physical factors that limit coral reefs, to the northern reef systems which demonstrate key aspects of these high biodiversity ecosystems. Human-related changes. Emphasis is on research experiences and development of analytical skills. Two units only counted for Biological Sciences major.

Terms: Aut | Units: 3 | UG Reqs: GER:DBEngrAppSci | Grading: Letter (ABCD/NP)

OSPAUSTL 30: Coastal Forest Ecosystems

Prehistory of Australian rainforest and how rainforest structure and biodiversity change with altitude, latitude, and geology. Tropical coastal marine wetlands, mangrove forests, and the relationship between land- and sea-based biota. Biology and

ecology of marine plants, mangroves, and tropical salt marsh. Introduction to specialized fields of marine plant biology and ecology including biogeography and evolution, aquatic plant ecophysiology, water quality and bioindicator techniques, pollution and eutrophication, and environmental control of marine plant distribution and productivity. Two units only counted for Biological Sciences major.

Terms: Aut | **Units:** 3 | **UG Reqs:** GER:DBEngrAppSci | **Grading:** Letter (ABCD/NP)

OSPAUSTL 40: Australian Studies

Introduction to Australian society, history, culture, politics, and identity. Social and cultural framework and working understanding of Australia in relationship to the focus on coastal environment in other program courses. Field trips.

Terms: Aut | **Units:** 3 | **UG Reqs:** GER:DBSocSci, GER:ECGlobalCom | **Grading:** Letter (ABCD/NP)

OSPAUSTL 50: Targeted Research Project

Prior to arriving in Australia, students establish a link with University of Queensland faculty to develop project ideas that combine personal interests and career goals with opportunities presented by the Australian Coastal Studies program, such as how mangrove roots find sediment rich zones of the shore, or the dynamics of ecotourism in southern and northern coastal Queensland. Project report and presentation in Australia.

Terms: Aut | **Units:** 4 | **Grading:** Letter (ABCD/NP)

OSPBEIJ 27: Topics in China's Development

Independent study in one of: finding balance between growth and the environment; finding balance between urban and rural; finding balance between incentives in work and social welfare; China's elections at the grassroots; China's education system; or China's health system.

Terms: Aut | **Units:** 2-4 | **Grading:** Letter or Credit/No Credit

OSPBER 47: Ethics in Medicine and Everyday Life

Ethical conflicts in relation to life situations. Moral questions in the conduct of science. Collaboration of physicians and academics with Nazi medical experiments; Milgram's experiments on obedience; Stanford's prison experiments; misleading marketing strategies used by the tobacco industry; ethics of placebo controlled clinical trials; decisions related to stem cell research and reproductive technologies.

Terms: Spr | **Units:** 4 | **UG Reqs:** GER:ECEthicReas | **Grading:** Letter or Credit/No Credit

OSPBER 48: Topics in Medicine and Ethics

Independent study with weekly meetings. Topics: comparative analysis of legislation of human fertilization and embryology in the U.S. and UK; history and structure of the health care systems in Germany, Canada, and the U.S.; lives of admirable precepts

but dubious practice such as Seneca, the Stoics, and Rousseau; promise and pitfalls of genetically modified plant and animal food. Do ethnic, national, and professional stereotypes serve a function? Primarily in English, but some topics might require German.

Terms: Spr | Units: 2-4 | Grading: Letter or Credit/No Credit

OSPCPTWN 24A: Targeted Research Project in Community Health and Development

Two-quarter sequence for students engaging in Cape Town-sponsored community based research. Introduction to approaches, methods and critical issues of partnership-based, community-engaged research and to the community-based research partners. Qualitative data gathering and analysis methods in community-based research; effective collaboration with community partners and data sources; race and privilege in community-based research. Preparation of research proposals and plans for research carried out during spring quarter through OSPCPTWN 24B.

Terms: Win | Units: 3 | Grading: Letter (ABCD/NP)

OSPCPTWN 24B: Targeted Research Project in Community Health and Development

Two-quarter sequence for students engaging in Cape Town-sponsored community-based research. Substantive community health or development investigations in collaboration with the Stanford Centre's community partners: Western Cape NGOs or government agencies, or community-based organizations or groups. Students' research supported through methods workshops, sharing of progress and problems, and data and findings presentations. Prerequisite: OSPCPTWN 24A.

Terms: Spr | Units: 5 | Grading: Letter (ABCD/NP)

OSPCPTWN 26: Managing Global Projects

Challenges associated with planning and managing both commercial and governmental/non-profit global projects; theory, methods, and tools to enhance global project outcomes. Student teams model and simulate cross-cultural teams engaged in global projects. Opportunities to participate in research in the Collaboratory for Research on Global Projects involving faculty from Stanford departments and schools; see <http://crgp.stanford.edu>.

Terms: Win | Units: 3-4 | Grading: Letter (ABCD/NP)

OSPCPTWN 31: Theory and Politics of Foreign Aid

Political economy approach to foreign aid. Context of debate on development: differences between developed and less developed countries, concept of poverty, how to measure development. History of foreign aid; main actors and characteristics of official development assistance. Theoretical and empirical impact of aid with regard to economic growth and governance. Benefits and problems associated with aid.

Terms: Win | Units: 3 | Grading: Letter (ABCD/NP)

OSPCPTWN 32: Learning, Development, and Social Change: Service Learning in the Contemporary South African Context-

Adult learning and its role in community social action; development; service learning. Micro contexts of people's daily lives and experiences in the context of an emergent democracy; understanding possibilities of community action and mobilisation for social change. Service in a historically marginalised community near Cape Town to understand realities of everyday life in informal settlements, to engage with education in a developmental context, and to gain insight into sociopolitical factors that shape social action and learning.

Terms: Win, Spr | **Units:** 3-5 | **UG Reqs:** GER:DBSocSci, GER:ECGlobalCom | **Grading:** Letter (ABCD/NP)

OSPCPTWN 43: Public and Community Health in Sub-Saharan Africa

Introduction to concept of public health as compared with clinical medicine. Within a public health context, the broad distribution of health problems in sub-Saharan Africa as compared with U.S. and Europe. In light of South Africa's status as a new democracy, changes that have occurred in health legislation, policy, and service arenas in past 16 years. Topics include: sector health care delivery, current distribution of infectious and chronic diseases, and issues related to sexual and reproductive health in South Africa. Site visits to public sector health services and health related NGOs.

Terms: Win | **Units:** 4 | **Grading:** Letter (ABCD/NP)

OSPFLOR 38: Water Resources Engineering in Italy: Ancient Rome, Medieval Siena, and Modern Florence and Venice

Examination of significant examples of water resources development in Italian history as an introduction to the basic concepts of water resources engineering and management. Observation of results of application of basic ideas from hydrology and hydraulics to problems of water supply, waste water disposal and flood control. Topics include aqueducts of ancient Rome, water supply of Siena, flooding in Florence, and high water in Venice.

Terms: Aut | **Units:** 4-5 | **UG Reqs:** GER:DBEngrAppSci | **Grading:** Letter or Credit/No Credit

OSPGEN 70: Indigenous Australia

Culture and ecology of desert Aboriginal people living in a remote region of W. Australia. Students live with their Martu hosts. Issues in greater Australian human prehistory; social, ecological, and political factors that shape contemporary relationships between rural Aborigines, their urban counterparts, and the broader Australian society. Location: Newman, Parnngurr Community, Western Australia.

Terms: Aut | **Units:** 2 | **Grading:** Letter (ABCD/NP)

OSPMADRD 32: Health Care Systems Design: Spain, Europe, and the United States

Principles of health care system design; examples from Spain, other European systems, and the United States. Central goals of health care systems in industrialized countries and the demographic, economic, and related challenges facing them. Approaches to system design. Tradeoffs between public sector and private sector approaches; financing issues; provider payment; care management; quality improvement. Operation of physician practices and hospitals. Economic concepts with themes from sociology, political science, demography, and related disciplines.

Terms: Win | Units: 4 | UG Reqs: GER:DBSocSci | Grading: Letter (ABCD/NP)

OSPMADR 57: Health Care: A Contrastive Analysis between Spain and the U.S.

History of health care and evolution of the concept of universal health care based on need not wealth. Contrast with system in U.S. Is there a right to health care and if so, what does it encompass? The Spanish health care system; its major successes and shortcomings. Issues and challenges from an interdisciplinary perspective combining scientific facts with moral, political, and legal philosophy.

Terms: Spr | Units: 5 | UG Reqs: GER:DBSocSci | Grading: Letter (ABCD/NP)

OSPMADR 72: Issues in Bioethics Across Cultures

Ethical dilemmas concerning the autonomy and dignity of human beings and other living creatures; principles of justice that rule different realms of private and public life. Interdisciplinary approach to assessing these challenges, combining scientific facts, health care issues, and moral philosophy. Sources include landmark bioethics papers.

Terms: Win | Units: 5 | Grading: Letter (ABCD/NP)

OSPSANTG 27: Humans and the Environment: The Great Transitions

Environmental conditions and major environmental changes that accompanied the major transitions: the change from hunter-gatherers to agriculture ca. 10000 years ago; the spread of farming over the next 6000 years; the early development of science and technology; the industrial revolution and the first demographic transition; the second demographic transition to low fertility; and the third demographic transition to long lives. Focus on four main dimensions: demography, culture and choice, environment, and technology, using an evolutionary perspective. 3 units may be counted toward Biology major.

Terms: Win | Units: 3-5 | UG Reqs: GER:DBNatSci | Grading: Letter (ABCD/NP)

OSPSANTG 28: Independent Study Projects in Ecology, Evolution, and Demography

Choice of one of the following questions, working with the instructor to narrow the focus and select appropriate resources: Why is there a Birth Dearth in so many industrialized nations today? Discuss the pattern and causes of inequalities between mortality in different economic classes in Chile. What are the known and prospective effects of climate warming on natural populations? What are the known and prospective effects of climate warming on human populations?

Terms: Win | Units: 1-3 | Grading: Letter or Credit/No Credit

OSPSANTG 85: Marine Ecology of Chile and the South Pacific

Relationships among physical processes in the ocean, biological productivity, and the exploitation of resources by high-trophic-level predators including human beings. Characterization of ecological patterns; identification of processes operating on marine systems. Open ocean ecosystems, intertidal and benthic regions of the world's oceans, and ecological research developed along coastal regions, focusing on Chile's 4,000 km coastline.

Terms: Spr | Units: 5 | UG Reqs: GER:DBNatSci | Grading: Letter (ABCD/NP)

PEDS 250: Social and Environmental Determinants of Health

How race/ethnicity and SES contribute to health disparities, how vulnerable populations are uniquely at health risk, and how the built environment relates to health and wellness. Topics include: gender, age, race/ethnicity, language, education, individual SES and neighborhood SES as related to health; individual and structural race bias; health needs of vulnerable populations (e.g., the homeless, the incarcerated, immigrant populations, children, and uninsured/underinsured); and environmental forces (e.g., urban design/planning, traffic/car culture, green space, housing, food access/culture, law enforcement, and media).

Terms: Aut | Units: 3 | Grading: Medical Option (Med-Ltr-CR/NC)

PHIL 167B: Philosophy, Biology, and Behavior (PHIL 267B)

(Graduate students register for 267B.) Continuation of 167A/267A. Further philosophical study of key theoretical ideas in biology, focusing on problems involving explanation of behavior. Topics: evolutionary versus proximate causal explanations of behavior; genetic and other determinisms; and classification and measurement of behavior. Prerequisites: 167A; or one PHIL course and either one BIO course or Human Biology core; or equivalent with consent of instructor.

Terms: Aut | Units: 4 | UG Reqs: GER:DBHum | Grading: Letter or Credit/No Credit

PHYSICS 15: The Nature of the Universe

The structure, origin, and evolution of the major components of the Universe: planets, stars, and galaxies. Emphasis is on the formation of the Sun and planets, the evolution of stars, and the structure and content of the Milky Way galaxy. Topics: cosmic enigmas (dark matter, black holes, pulsars, x-ray sources), star birth and death, and the origins of and search for life in the solar system and beyond.

Terms: Aut, Sum | Units: 3 | UG Reqs: GER:DBNatSci | Grading: Letter or Credit/No Credit

PHYSICS 240: Introduction to the Physics of Energy

Energy as a consumable. Forms and interconvertability. World joule budget. Equivalents in rivers, oil pipelines and nuclear weapons. Quantum mechanics of fire, batteries and fuel cells. Hydrocarbon and hydrogen synthesis. Fundamental limits to mechanical, electrical and magnetic strengths of materials. Flywheels, capacitors and high pressure tanks. Principles of AC and DC power transmission. Impossibility of pure electricity storage. Surge and peaking. Solar constant. Photovoltaic and thermal

solar conversion. Physical limits on agriculture.

Terms: Aut | Units: 3 | Grading: Letter or Credit/No Credit

PHYSICS 241: Introduction to Nuclear Energy

Radioactivity. Elementary nuclear processes. Energetics of fission and fusion. Cross-sections and resonances. Fissionable and fertile isotopes. Neutron budgets. Light water, heavy water and graphite reactors. World nuclear energy production. World reserves of uranium and thorium. Plutonium, reprocessing and proliferation. Half lives of fission decay products and actinides made by neutron capture. Nuclear waste. Three Mile Island and Chernobyl. Molten sodium breeders. Generation-IV reactors. Inertial confinement and magnetic fusion. Laser compression. Fast neutron production and fission-fusion hybrids. PREREQUISITES: Strong undergraduate background in elementary chem... [more description for PHYSICS 241 »](#)

Terms: Win | Units: 3 | Grading: Letter or Credit/No Credit

POLISCI 1: Introduction to International Relations (INTNLREL 1)

Approaches to the study of conflict and cooperation in world affairs. Applications to war, terrorism, trade policy, the environment, and world poverty. Debates about the ethics of war and the global distribution of wealth.

Terms: Spr | Units: 5 | UG Reqs: GER:DBSocSci | Grading: Letter or Credit/No Credit

POLISCI 222R: Culture, Identity, and Diversity

This course explores a naturalistic approach to democratic values. Democratic values are written about as abstractions. But they are not lived in the abstract. They take on their character because they are held (or rejected) by actual individuals who themselves are embedded in particular cultural contexts. The objective of the course is therefore to explore, in an open-ended way, how core democratic values are understood by both those who study them and by those who live them. \n \n\nThe course explores understandings of equality, identity, multiculturalism, but most especially the nature of tolerance in liberal societies. It examines two bodies of scholarship. One i... [more description for POLISCI 222R »](#)

Terms: Win | Units: 5 | UG Reqs: GER:DBSocSci | Grading: Letter (ABCD/NP)

PSYCH 265: Social Psychology and Social Change (EDUC 371X)

The course is intended an exploration of the major ideas, theories, and\n\nfindings of social psychology and their applied status. Special attention will be given to historical issues, classic experiments, and seminal theories, and their implications for topics relevant to education. Contemporary research will also be discussed. Advanced undergraduates and graduate students from other disciplines are welcome.

Terms: Spr | Units: 2-3 | Grading: Letter or Credit/No Credit

PWR 1AT: Writing & Rhetoric 1: A Mountain for Itself: The Rhetoric of \nWilderness

Rhetorical and contextual analysis of readings; research; and argument. Focus is on development of a substantive research-based argument using multiple sources. Individual conferences with instructor. See

http://ual.stanford.edu/AP/univ_req/PWR/Courses.html.

Terms: Win, Spr | Units: 4 | UG Reqs: Writing1 | Grading: Letter (ABCD/NP)

PWR 1JB: Writing & Rhetoric 1: From Mad Cow to Mad Corn: The Rhetoric of Food Science and Politics

Rhetorical and contextual analysis of readings; research; and argument. Focus is on development of a substantive research-based argument using multiple sources. Individual conferences with instructor. Topics include how activists, nutritionists, food scientists, chemical companies, and legislative bodies articulate their concerns and argue their positions and how agribusiness and government respond to consumer concerns about food produced with the aid of chemicals. See

http://ual.stanford.edu/AP/univ_req/PWR/Req.html.

Terms: Aut, Spr | Units: 4 | UG Reqs: Writing1 | Grading: Letter (ABCD/NP)

PWR 1JL: Writing & Rhetoric 1: Rhetoric and Humanitarian Intervention

Rhetorical and contextual analysis of readings; research; and argument. Focus is on development of a substantive research-based argument using multiple sources. Individual conferences with instructor. Examination of how media representations of world crises are crafted to persuade us to action, appealing to our senses of justice, pragmatism, outrage, and compassion. See

http://www.stanford.edu/dept/undergrad/cgi-bin/drupal_ual/AP_univ_req_PWR_Courses.html

Terms: Spr | Units: 4 | UG Reqs: Writing1 | Grading: Letter (ABCD/NP)

PWR 2JB: Writing & Rhetoric 2: Rhetoric of Ethics in Research and Technology

Prerequisite: PWR 1. Further work in developing skills in argument and research-based writing, with emphasis on both written and oral/multimedia presentation of research. Study of the rhetoric of ethical discourse, including the ethical standards guiding research at Stanford and examples of ethical misconduct. See http://ual.stanford.edu/AP/univ_req/PWR/Courses.html.

Terms: Win, Spr | Units: 4 | UG Reqs: Writing2 | Grading: Letter (ABCD/NP)

STRAMGT 341: Achieving Social Impact

Social Enterprise explores a range of leading issues focused on the challenges and opportunity for impact through social entrepreneurship. Students explore a range of organizations from nonprofits, to for-profits, to hybrid forms of organization, and examine issues from a variety of different perspectives, including those of entrepreneur, CEO, funder, and board member.

Designed to appeal to students who seek to take on leadership roles in social value creation throughout their careers, whether as leaders in the private, nonprofit, or government sectors, or some combination thereof. Social Enterprise focuses on innovative approaches for creating social value th... [more description for STRAMGT 341 »](#)

Units: 4 | Grading: GSB Letter Graded

STRAMGT 369: Social Entrepreneurship

This course is about the efforts of private citizens to create effective responses to social needs and innovative solutions to social problems. History is full of examples of this kind of activity, though its character continues to evolve. Social entrepreneurs are increasingly blurring the lines between the sectors, using for-profit and hybrid forms of organization to achieve social objectives. This creates new opportunities for applying business skills in the social sector. Despite its prominence and complexity, this combination of private initiative and public purpose is not well understood. The objectives of this course are: (1) to introduce students to the concepts, p... [more description for STRAMGT 369 »](#)

Units: 4 | Grading: GSB Student Option LTR/PF

STRAMGT 567: Social Entrepreneurship and Social Innovation

This course examines individuals and organizations that use entrepreneurial skills and approaches to develop innovative responses to social problems. Entrepreneurship has traditionally been seen as a way of creating wealth for the entrepreneur and for those who back her/his work. Social entrepreneurs employ "entrepreneurial skills," such as finding opportunities, inventing new approaches, securing and focusing resources and managing risk, in the service of creating a social value. As the intensity and complexity of social and environmental problems has grown in recent years social entrepreneurship, defined as innovative, social value creating activity that can occur withi... [more description for STRAMGT 567 »](#)

Units: 2 | Grading: GSB Letter Graded

STS 115: Ethical Issues in Engineering (ENGR 131)

Moral rights and responsibilities of engineers in relation to society, employers, colleagues, and clients; cost-benefit-risk analysis, safety, and informed consent; the ethics of whistle blowing; ethical conflicts of engineers as expert witnesses, consultants, and managers; ethical issues in engineering design, manufacturing, and operations; ethical issues arising from engineering work in foreign countries; and ethical implications of the social and environmental contexts of contemporary engineering. Case studies, guest practitioners, and field research. Limited enrollment.

Terms: Spr | Units: 4 | UG Reqs: GER:DBHum | Grading: Letter (ABCD/NP)

URBANST 110: Introduction to Urban Studies

The study of cities and urban civilization. History of urbanization and current issues such as suburbanization, racial discrimination, globalization, terrorism, and the environment. Public policies designed to address these issues.

Terms: Aut, Win, Spr | Units: 4 | UG Reqs: GER:DBSocSci, GER:ECAmerCul | Grading: Letter (ABCD/NP)

URBANST 163: Land Use Control

Methods of land use control related to the pattern and scale of development and the protection of land and water resources. Emphasis is on the relationship between the desired land use goal and geographical landscape, physical externalities, land use law, and regulatory agencies. Topics include the historical roots of modern land use controls; urban reforms of the 19th century; private ownership of land; zoning; local, state, and federal land use regulation; and land trusts preservation. Smart growth, environmental impact consideration, private property rights, and special purpose agencies are related to current issues.

Terms: Spr | Units: 4 | UG Reqs: GER:DBSocSci | Grading: Letter or Credit/No Credit