

Stanford University Inventory of Sustainability Courses, 2017-18

AC-1: Academic Courses

Note: All courses below the 200-level are considered undergraduate courses, while all courses at the 200-level or above are considered graduate courses

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
ANTHRO 1	Introduction to Cultural and Social Anthropology	X		This course introduces basic anthropological concepts and presents the discipline's distinctive perspective on society and culture. The power of this perspective is illustrated by exploring vividly-written ethnographic cases that show how anthropological approaches illuminate contemporary social and political issues in a range of different cultural sites.
ANTHRO 34	Animals and Us	X		The human-animal relationship is dynamic, all encompassing and durable. Without exception, all socio-cultural groups have evidenced complex interactions with the animals around them, both domesticated and wild. However, the individual circumstances of these interactions are hugely complicated, and involve much more than direct human-animal contact, going far beyond this to incorporate social, ecological and spiritual contexts. This course delves into this complexity, covering the gamut of social roles played by animals, as well as the methods and approaches to studying these, both traditional and scientific. While the notion of 'animals as social actors' is well acknowledged, their use as proxies for human autecology (the relationship between a species and its environment) is also increasingly recognized as a viable mechanism for understanding our cultural and economic past. It will piece together the breadth of human-animal relationships using a wide geographic range of case studies.
ANTHRO 82	Medical Anthropology	X		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.
ARTHIST 147	Modernism and Modernity	X		The development of modern art and visual culture in Europe and the US, beginning with Paris in the 1860s, the period of Haussmann, Baudelaire and Manet, and ending with the Bauhaus and Surrealism in the 1920s and 30s. Modernism in art, architecture and design (e.g., Gauguin, Picasso, Duchamp, Mondrian, Le Corbusier, Breuer, Dali) will be explored as a compelling dream of utopian possibilities involving multifaceted and often ambivalent, even contradictory responses to the changes brought about by industrialization, urbanization, and the rise of mass culture.
BIO 115	The Hidden Kingdom - Evolution, Ecology and Diversity of Fungi	X		Fungi are critical, yet often hidden, components of the biosphere. They regulate decomposition, are primary partners in plant symbiosis and strongly impact agriculture and economics. Students will explore the fascinating world of fungal biology, ecology and evolution via lecture, lab, field exercises and Saturday field trips that will provide traditional and molecular experiences in the collection, analysis and industrial use of diverse fungi. Students will chose an environmental niche, collect and identify resident fungi, and hypothesize about their community relationship. Prerequisite: Bio 43 or BIO 81, 85 recommended.
BIO 138	Ecosystem Services: Frontiers in the Science of Valuing Nature		X	This advanced course explores the science of valuing nature, beginning with its historical origins, and then its recent development in natural (especially ecological), economic, psychological, and other social sciences. We will use the ecosystem services framework (characterizing benefits from ecosystems to people) to define the state of knowledge, core methods of analysis, and research frontiers, such as at the interface with biodiversity, resilience, human health, and human development. Intended for diverse students, with a focus on research and real-world cases. To apply, please email the instructor (gdaily@stanford.edu) with a brief description of your background and research interests.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
BIO 238	Ecosystem Services: Frontiers in the Science of Valuing Nature		X	This advanced course explores the science of valuing nature, beginning with its historical origins, and then its recent development in natural (especially ecological), economic, psychological, and other social sciences. We will use the ecosystem services framework (characterizing benefits from ecosystems to people) to define the state of knowledge, core methods of analysis, and research frontiers, such as at the interface with biodiversity, resilience, human health, and human development. Intended for diverse students, with a focus on research and real-world cases. To apply, please email the instructor (gdaily@stanford.edu) with a brief description of your background and research interests.
BIO 239	The Hidden Kingdom - Evolution, Ecology and Diversity of Fungi	X		Fungi are critical, yet often hidden, components of the biosphere. They regulate decomposition, are primary partners in plant symbiosis and strongly impact agriculture and economics. Students will explore the fascinating world of fungal biology, ecology and evolution via lecture, lab, field exercises and Saturday field trips that will provide traditional and molecular experiences in the collection, analysis and industrial use of diverse fungi. Students will chose an environmental niche, collect and identify resident fungi, and hypothesize about their community relationship. Prerequisite: Bio 43 or BIO 81, 85 recommended.
CEE 220A	Building Information Modeling Workshop	X		The foundational Building Information Modeling course introduces techniques for creating, managing, and applying of building information models in the building design and construction process. The course covers processes and tools for creating, organizing, and working with 2D and 3D computer representations of building components and geometries to produce models used in architectural design, construction planning and documentation, rendering and visualization, simulation and analysis.
CEE 260C	Contaminant Hydrogeology and Reactive Transport		X	Decades of industrial activity have released vast quantities of contaminants to groundwater, threatening water resources, ecosystems and human health. What processes control the fate and transport of contaminants in the subsurface? What remediation strategies are effective and what are the tradeoffs among them? How are these processes represented in models used for regulatory and decision-making purposes? This course will address these and related issues by focusing on the conceptual and quantitative treatment of advective-dispersive transport with reacting solutes, including modern methods of contaminant transport simulation. Some Matlab programming / program modification required. Prerequisite: Physical Hydrogeology ESS 220 / CEE 260A (Gorelick) or equivalent and college-level course work in chemistry.
CHEMENG 20	Introduction to Chemical Engineering	X		Overview of chemical engineering through discussion and engineering analysis of physical and chemical processes. Topics: overall staged separations, material and energy balances, concepts of rate processes, energy and mass transport, and kinetics of chemical reactions. Applications of these concepts to areas of current technological importance: biotechnology, energy, production of chemicals, materials processing, and purification. Prerequisite: CHEM 31.
CHILATST 180E	Introduction to Chicana/Latinx Studies	X		This course draws on intersectional and interdisciplinary approaches to introduce students to the range of issues, experiences, and methodologies that form the foundation of Latina/o/x studies. By considering the relationship between the creation of "Latinx" and "American" identities, students will critically reconsider the borders that constitute the U.S. as a political and cultural formation. The course balances depth and breadth in its study of the variety of perspectives and experiences that come to be associated with U.S. Latinxs. Thus, we will analyze the histories of predominant U.S. Latinx sub-groups, such as Mexicans/Chicanxs and Puerto Ricans, while also incorporating considerations of the ways in which broader populations with ties to Central America, South America, and the Caribbean play crucial roles in constituting U.S. Latinx identities. Topics include the U.S./Mexico border and the borderlands; (im)migration and diaspora; literary and cultural traditions; music and expressive practices; labor and structural inequality; social movements; Latinx urbanism; gender and sexuality; political and economic shifts; and inter- and intra-group relations. Sources include a range of social science and humanities scholarship. This course will meet at Sequoia High School. Transportation will be provided.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
EARTHSYS 11	Introduction to Geology	X		Why are earthquakes, volcanoes, and natural resources located at specific spots on the Earth surface? Why are there rolling hills to the west behind Stanford, and soaring granite walls to the east in Yosemite? What was the Earth like in the past, and what will it be like in the future? Lectures, hands-on laboratories, in-class activities, and one field trip will help you see the Earth through the eyes of a geologist. Topics include plate tectonics, the cycling and formation of different types of rocks, and how geologists use rocks to understand Earth's history.
EARTHSYS 112	Human Society and Environmental Change		X	Interdisciplinary approaches to understanding human-environment interactions with a focus on economics, policy, culture, history, and the role of the state. Prerequisite: ECON 1.
EARTHSYS 144	Fundamentals of Geographic Information Science (GIS)		X	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. All students are required to attend a weekly lab session.
EARTHSYS 149	Wild Writing		X	What is wilderness and why does it matter? In this course we will interrogate answers to this question articulated by influential and diverse American environmental thinkers of the 19th, 20th, and 21st centuries, who through their writing transformed public perceptions of wilderness and inspired such actions as the founding of the National Park System, the passage of the Wilderness Act and the Clean Air and Water Acts, the establishment of the Environmental Protection Agency, and the birth of the environmental and climate justice movements. Students will also develop their own responses to the question of what is wilderness and why it matters through a series of writing exercises that integrate personal narrative, wilderness experience, and environmental scholarship, culminating in a ~3000 word narrative nonfiction essay. This course will provide students with knowledge, tools, experience, and skills that will empower them to become more persuasive environmental storytellers and advocates. If you are interested in signing up for the course, complete this pre-registration form https://stanforduniversity.qualtrics.com/jfe/form/SV_9XqZeZs036Wlvop
EARTHSYS 151	Biological Oceanography	X		Required for Earth Systems students in the oceans track. Interdisciplinary look at how oceanic environments control the form and function of marine life. Topics include distributions of planktonic production and abundance, nutrient cycling, the role of ocean biology in the climate system, expected effects of climate changes on ocean biology. Local weekend field trips. Designed to be taken concurrently with Marine Chemistry (ESS/EARTHSYS 152/252). Prerequisites: BIO 43 and ESS 8 or equivalent.
EARTHSYS 152	Marine Chemistry	X		Introduction to the interdisciplinary knowledge and skills required to critically evaluate problems in marine chemistry and related disciplines. Physical, chemical, and biological processes that determine the chemical composition of seawater. Air-sea gas exchange, carbonate chemistry, and chemical equilibria, nutrient and trace element cycling, particle reactivity, sediment chemistry, and diagenesis. Examination of chemical tracers of mixing and circulation and feedbacks of ocean processes on atmospheric chemistry and climate. Designed to be taken concurrently with Biological Oceanography (ESS/EARTHSYS 151/251)
EARTHSYS 155	Science of Soils	X		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.
EARTHSYS 180	Principles and Practices of Sustainable Agriculture		X	Field-based training in ecologically sound agricultural practices at the Stanford Community Farm. Weekly lessons, field work, and group projects. Field trips to educational farms in the area. Topics include: soils, composting, irrigation techniques, IPM, basic plant anatomy and physiology, weeds, greenhouse management, and marketing. Application required. Deadline: September 12 for Autumn. Application: https://stanforduniversity.qualtrics.com/jfe/form/SV_6Md7jndIBcHV8V

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
EARTHSYS 191	Concepts in Environmental Communication		X	Introduction to the history, development, and current state of communication of environmental science and policy to non-specialist audiences. Includes fundamental principles, core competencies, and major challenges of effective environmental communication in the public and policy realms and an overview of the current scope of research and practice in environmental communication. Intended for graduate students and advanced undergraduates, with a background in Earth or environmental science and/or policy studies, or in communication or journalism studies with a specific interest in environmental and science communication. Prerequisite: Earth Systems core (EarthSys 111 and EarthSys 112) or equivalent. (Meets Earth Systems WIM requirement.)
EARTHSYS 242	Remote Sensing of Land	X		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.
EARTHSYS 251	Biological Oceanography	X		Required for Earth Systems students in the oceans track. Interdisciplinary look at how oceanic environments control the form and function of marine life. Topics include distributions of planktonic production and abundance, nutrient cycling, the role of ocean biology in the climate system, expected effects of climate changes on ocean biology. Local weekend field trips. Designed to be taken concurrently with Marine Chemistry (ESS/EARTHSYS 152/252). Prerequisites: BIO 43 and ESS 8 or equivalent.
EARTHSYS 252	Marine Chemistry	X		Introduction to the interdisciplinary knowledge and skills required to critically evaluate problems in marine chemistry and related disciplines. Physical, chemical, and biological processes that determine the chemical composition of seawater. Air-sea gas exchange, carbonate chemistry, and chemical equilibria, nutrient and trace element cycling, particle reactivity, sediment chemistry, and diagenesis. Examination of chemical tracers of mixing and circulation and feedbacks of ocean processes on atmospheric chemistry and climate. Designed to be taken concurrently with Biological Oceanography (ESS/EARTHSYS 151/251)
EDUC 197	Gender and Education in Global and Comparative Perspectives	X		Theories and perspectives from the social sciences relevant to the role of education in changing, modifying, or reproducing structures of gender differentiation and hierarchy. Cross-national research on the status of girls and women and the role of development organizations and processes. As class meets just nine times, attendance at the first class meeting is required and no more than one absence is allowed in order to pass.
ENERGY 120	Fundamentals of Petroleum Engineering		X	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.
ENERGY 121	Fundamentals of Multiphase Flow		X	Multiphase flow in porous media. Wettability, capillary pressure, imbibition and drainage, Leverett J-function, transition zone, vertical equilibrium. Relative permeabilities, Darcy's law for multiphase flow, fractional flow equation, effects of gravity, Buckley-Leverett theory, recovery predictions, volumetric linear scaling, JBN and Jones-Rozelle determination of relative permeability. Frontal advance equation, Buckley-Leverett equation as frontal advance solution, tracers in multiphase flow, adsorption, three-phase relative permeabilities.
ENERGY 221	Fundamentals of Multiphase Flow		X	Multiphase flow in porous media. Wettability, capillary pressure, imbibition and drainage, Leverett J-function, transition zone, vertical equilibrium. Relative permeabilities, Darcy's law for multiphase flow, fractional flow equation, effects of gravity, Buckley-Leverett theory, recovery predictions, volumetric linear scaling, JBN and Jones-Rozelle determination of relative permeability. Frontal advance equation, Buckley-Leverett equation as frontal advance solution, tracers in multiphase flow, adsorption, three-phase relative permeabilities.
ENGR 20	Introduction to Chemical Engineering	X		Overview of chemical engineering through discussion and engineering analysis of physical and chemical processes. Topics: overall staged separations, material and energy balances, concepts of rate processes, energy and mass transport, and kinetics of chemical reactions. Applications of these concepts to areas of current technological importance: biotechnology, energy, production of chemicals, materials processing, and purification. Prerequisite: CHEM 31.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
ESS 155	Science of Soils	X		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.
ESS 164	Fundamentals of Geographic Information Science (GIS)		X	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. All students are required to attend a weekly lab session.
ESS 221	Contaminant Hydrogeology and Reactive Transport		X	Decades of industrial activity have released vast quantities of contaminants to groundwater, threatening water resources, ecosystems and human health. What processes control the fate and transport of contaminants in the subsurface? What remediation strategies are effective and what are the tradeoffs among them? How are these processes represented in models used for regulatory and decision-making purposes? This course will address these and related issues by focusing on the conceptual and quantitative treatment of advective-dispersive transport with reacting solutes, including modern methods of contaminant transport simulation. Some Matlab programming / program modification required. Prerequisite: Physical Hydrogeology ESS 220 / CEE 260A (Gorelick) or equivalent and college-level course work in chemistry.
ESS 251	Biological Oceanography	X		Required for Earth Systems students in the oceans track. Interdisciplinary look at how oceanic environments control the form and function of marine life. Topics include distributions of planktonic production and abundance, nutrient cycling, the role of ocean biology in the climate system, expected effects of climate changes on ocean biology. Local weekend field trips. Designed to be taken concurrently with Marine Chemistry (ESS/EARTHSYS 152/252). Prerequisites: BIO 43 and ESS 8 or equivalent.
ESS 252	Marine Chemistry	X		Introduction to the interdisciplinary knowledge and skills required to critically evaluate problems in marine chemistry and related disciplines. Physical, chemical, and biological processes that determine the chemical composition of seawater. Air-sea gas exchange, carbonate chemistry, and chemical equilibria, nutrient and trace element cycling, particle reactivity, sediment chemistry, and diagenesis. Examination of chemical tracers of mixing and circulation and feedbacks of ocean processes on atmospheric chemistry and climate. Designed to be taken concurrently with Biological Oceanography (ESS/EARTHSYS 151/251)
ESS 262	Remote Sensing of Land	X		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.
ESS 280	Principles and Practices of Sustainable Agriculture		X	Field-based training in ecologically sound agricultural practices at the Stanford Community Farm. Weekly lessons, field work, and group projects. Field trips to educational farms in the area. Topics include: soils, composting, irrigation techniques, IPM, basic plant anatomy and physiology, weeds, greenhouse management, and marketing. Application required. Deadline: September 12 for Autumn. Application: https://stanforduniversity.qualtrics.com/jfe/form/SV_6Md7jndIBIcHV8V
ESS 8	The Oceans: An Introduction to the Marine Environment		X	The course will provide a basic understanding of how the ocean functions as a suite of interconnected ecosystems, both naturally and under the influence of human activities. Emphasis is on the interactions between the physical and chemical environment and the dominant organisms of each ecosystem. The types of ecosystems discussed include coral reefs, deep-sea hydrothermal vents, coastal upwelling systems, blue-water oceans, estuaries, and near-shore dead zones. Lectures, multimedia presentations, group activities, and tide-pooling day trip.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
ETHICSOC 136R	Introduction to Global Justice	X		<p>This course provides an overview of core ethical problems in international politics, with special emphasis on the question of what demands justice imposes on institutions and agents acting in a global context. It is divided into three sections. The first investigates the content of global justice, and comprises of readings from contemporary political theorists and philosophers who write within the liberal contractualist, utilitarian, cosmopolitan, and nationalist traditions. The second part looks at the obligations which global justice generates in relation to a series of real-world issues of international concern: global poverty, human rights, poverty and development, climate change and natural resources, international migration, and the well-being of women. The final section asks whether a democratic international order is necessary for global justice to be realized.</p>
ETHICSOC 234R	Ethics on the Edge: Business, Non-Profit Organizations, Government, and Individuals	X		<p>(PUBLPOL 134, PUBLPOL 234&3 credits Ways--ER) (Same as LAW 7020) The objective of the course is to explore the increasing ethical challenges in a world in which technology, global risks, and societal developments are accelerating faster than our understanding and the law can keep pace. We will unravel the factors contributing to the seemingly pervasive failure of ethics today among organizations and leaders across all sectors: business, government, non-profit, and academia. A framework for ethical decision-making underpins the course. There is significant space for personal reflection and forming your own views on a wide range of issues. Prominent guest speakers will attend certain sessions interactively.</p> <p>The relationship between ethics and culture, leadership, law, and global risks (inequality, privacy, financial system meltdown, cyber-terrorism, climate change, etc.) will inform discussion. A broad range of international topics might include: designer genetics; civilian space travel (Elon Musk's Mars plans); social media (e.g. Facebook Cambridge Analytica, on-line sex trafficking, monopolies); new devices (e.g. Amazon Alexa in hotel rooms); free speech on University campuses; opioid addiction; AI (from racism to the work challenge and beyond); corporate and financial sector scandals (Epi pen pricing, Theranos, Wells Fargo fraudulent account creation, Volkswagen emissions testing manipulation); and non-profit sector ethics challenges (e.g. NGOs engagement with ISIS and sexual misconduct in humanitarian aid (Oxfam case)). Final project in lieu of exam on a topic of student's choice. Attendance required. Class participation important (with multiple opportunities to earn participation credit beyond speaking in class). Strong emphasis on rigorous analysis, critical thinking and testing ideas in real-world contexts. Please note that this course will require one evening session on a Wednesday or Thursday in lieu of the final class session the first week of June, so the course will end before Memorial Day. Students wishing to take the course who are unable to sign up within the enrollment limit should contact Dr. Susan Liautaud at susan1@stanford.edu. The course offers credit toward Ethics in Society, Public Policy core requirements (if taken in combination with PUBLPOL 103E or PUBLPOL 103F), and Science, Technology and Society majors and satisfies the undergraduate Ways of Thinking&Ethical Reasoning requirement. The course is open to undergraduate and graduate students. Undergraduates will not be at a disadvantage. Everyone will be challenged. Distinguished Career Institute Fellows are welcome and should contact Dr. Susan Liautaud directly at susan1@stanford.edu. *Students taking the course for Ways credit and Public Policy majors taking the course to complete the core requirements must obtain a letter grade. Other students may take the course for a letter grade or C/NC. Students seeking credit for other majors should consult their departments.</p>
GS 1	Introduction to Geology	X		<p>Why are earthquakes, volcanoes, and natural resources located at specific spots on the Earth surface? Why are there rolling hills to the west behind Stanford, and soaring granite walls to the east in Yosemite? What was the Earth like in the past, and what will it be like in the future? Lectures, hands-on laboratories, in-class activities, and one field trip will help you see the Earth through the eyes of a geologist. Topics include plate tectonics, the cycling and formation of different types of rocks, and how geologists use rocks to understand Earth's history.</p>
GS 103	Earth Materials: Rocks in Thin Section	X		<p>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. Required lab section. Prerequisite 102.</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
GS 123	Evolution of Marine Ecosystems	X		Life originally evolved in the ocean. When, why, and how did the major transitions occur in the history of marine life? What triggered the rapid evolution and diversification of animals in the Cambrian, after more than 3.5 billion years of Earth's history? What caused Earth's major mass extinction events? How do ancient extinction events compare to current threats to marine ecosystems? How has the evolution of primary producers impacted animals, and how has animal evolution impacted primary producers? In this course, we will review the latest evidence regarding these major questions in the history of marine ecosystems. We will develop familiarity with the most common groups of marine animal fossils. We will also conduct original analyses of paleontological data, developing skills both in the framing and testing of scientific hypotheses and in data analysis and presentation.
GS 150	Senior Seminar: Issues in Earth Sciences		X	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.
GS 180	Igneous Processes	X		For juniors, seniors and beginning graduate students in Earth Sciences. Structure and physical properties of magmas; use of phase equilibria and mineral barometers and thermometers to determine conditions of magmatic processes; melting and magmatic lineages as a function of tectonic setting; processes that control magma composition including fractional crystallization, partial melting, and assimilation; petrogenetic use of trace elements and isotopes. Optional labs emphasize identification of volcanic and plutonic rocks in thin section and interpretation of rock textures. Students taking the lab component should enroll in 4 units, as required for the Geological Sciences major; for the lab, GS 102, 103, or consent of instructor are prerequisites.
GS 190	Research in the Field		X	Month 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: GS 1, GS 102, GS 105.
GS 280	Igneous Processes	X		For juniors, seniors and beginning graduate students in Earth Sciences. Structure and physical properties of magmas; use of phase equilibria and mineral barometers and thermometers to determine conditions of magmatic processes; melting and magmatic lineages as a function of tectonic setting; processes that control magma composition including fractional crystallization, partial melting, and assimilation; petrogenetic use of trace elements and isotopes. Optional labs emphasize identification of volcanic and plutonic rocks in thin section and interpretation of rock textures. Students taking the lab component should enroll in 4 units, as required for the Geological Sciences major; for the lab, GS 102, 103, or consent of instructor are prerequisites.
GS 4	Coevolution of Earth and Life		X	Earth is the only planet in the universe currently known to harbor life. When and how did Earth become inhabited? How have biological activities altered the planet? How have environmental changes affected the evolution of life? Are we living in a sixth mass extinction? In this course, we will develop and use the tools of geology, paleontology, geochemistry, and modeling that allow us to reconstruct Earth's 4.5 billion year history and to reconstruct the interactions between life and its host planet over the past 4 billion years. We will also ask what this long history can tell us about life's likely future on Earth. We will also use One half-day field trip.
GS 42	Landscapes and Tectonics of the San Francisco Bay Area	X		Active faulting and erosion in the Bay Area, and its effects upon landscapes. Earth science concepts and skills through investigation of the valley, mountain, and coastal areas around Stanford. Faulting associated with the San Andreas Fault, coastal processes along the San Mateo coast, uplift of the mountains by plate tectonic processes, and landsliding in urban and mountainous areas. Field excursions; student projects.
GS 5	Living on the Edge	X		A weekend field trip along the Pacific Coast. Tour local beaches, geology, and landforms with expert guides from the School of Earth, Energy & Environmental Sciences. Enjoy a BBQ dinner and stay overnight in tents along the Santa Cruz coast. Get to know faculty and graduate students in Stanford Earth. Requirements: Two campus meetings and weekend field trip (Fall Quarter: section 01, October 13-14 OR section 02, November 17-18) to Pacific Coast. Enrollment limited to 25. Freshman have priority. If you are interested in signing up for the course, complete this form: https://goo.gl/forms/AJHCoqPJ1rQgJyLD2 . The form will open August 1, 2018.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
GS 90	Introduction to Geochemistry	X		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.
HISTORY 147	History of South Africa	X		(Same as HISTORY 47. 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.
HISTORY 150B	Nineteenth Century America	X		(Same as HISTORY 50B. History majors and others taking 5 units, register for 150B.) Territorial expansion, social change, and economic transformation. The causes and consequences of the Civil War. Topics include: urbanization and the market revolution; slavery and the Old South; sectional conflict; successes and failures of Reconstruction; and late 19th-century society and culture.
HUMBIO 122S	Social Class, Race, Ethnicity, and Health	X		Examines health disparities in the U.S., looking at the patterns of those disparities and their root causes. Explores the intersection of lower social class and ethnic minority status in affecting health status and access to health care. Compares social and biological conceptualizations of race and ethnicity. Upper division course with preference given to upperclassmen.
HUMBIO 176A	Medical Anthropology	X		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.
PHIL 170	Ethical Theory	X		This course serves as a rigorous introduction to moral philosophy for students with little or no background. We will examine ideas from four important figures in moral thought: Plato, David Hume, Immanuel Kant, and John Stuart Mill. Each of these philosophers played an integral role in the development of moral philosophy, because each offers thoughtful, compelling answers to some of the discipline's most central questions. These questions include: What is involved in being a good person or living a good life? What should we value, and why? How are we motivated by morality? How (if at all) is morality a matter of what is customary or conventional? How (much) do the consequences of our actions matter? Importantly, this course is not only about learning what others have thought about the answers to these (and related) questions. By considering and criticizing the ideas and arguments of these philosophers, the aim is to cultivate our own ability to think systematically, rationally, and reflectively, and to make up our own minds about how to answer these kinds of questions.
PHIL 72	Contemporary Moral Problems	X		Conflict is a natural part of human life. As human beings we represent a rich diversity of conflicting personalities, preferences, experiences, needs, and moral viewpoints. How are we to resolve or otherwise address these conflicts in a way fair to all parties? In this course, we will consider the question as it arises across various domains of human life, beginning with the classroom. What are we to do when a set of ideas expressed in the classroom offends, threatens, or silences certain of its members? What is it for a classroom to be safe? What is it for a classroom to be just? We will then move from the classroom to the family, considering a difficult set of questions about how we are to square the autonomy rights of children, elderly parents, and the mentally ill with our desire as family members to keep them safe. Finally, we will turn to the conflicts of citizenship in a liberal democratic society in which the burdens and benefits of citizenship have not always been fairly distributed. We will consider, among others, the question of whether or not civil disobedience is ever morally permissible, of whether there is a right to healthcare, and of whether or not some citizens are owed reparations for past injustices.
SOC 114	Economic Sociology	X		(Graduate students register for 214.) The sociological approach to production, distribution, consumption, and markets, emphasizing the impact of norms, power, social structure, and institutions on the economy. Comparison of classic and contemporary approaches to the economy among the social science disciplines. Topics: consumption, labor markets, organization of professions such as law and medicine, the economic role of informal networks, industrial organization, including the structure and history of the computer and popular music industries, business alliances, capitalism in non-Western societies, and the transition from state socialism in E. Europe and China.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
SOC 149	The Urban Underclass	X		(Graduate students register for 249.) Recent research and theory on the urban underclass, including evidence on the concentration of African Americans in urban ghettos, and the debate surrounding the causes of poverty in urban settings. Ethnic/racial conflict, residential segregation, and changes in the family structure of the urban poor.
AFRICAST 195	Shifting Frames	X		This is a student driven, dialogue based, and intellectual community focused course. We will explore and challenge the taken-for-granted framing of key African issues and debates. Engagement with discussion leaders drawing on their own research and case studies from across the African continent will guide us across shifting terrain. This course centers the scholarship and voices of African students. Topics include: Afropolitanism, Brain Drain/ Gain, Education, Leadership, Global Health, AI Application in Africa, Economic Development, Industrial Policy, LGBTQ Rights, Gender and Sexuality.
ANTHRO 445	Anthropology Brown Bag Series	X		Current topics and trends in cultural/social anthropology, archaeology, and environmental and ecological anthropology. Enrollment in this noon-time series is restricted to the Department of Anthropology Master's students and First and Second-year PhD students.
BIO 30	Ecology for Everyone		X	Everything is connected, but how? Ecology is the science of interactions and the changes they generate. This project-based course links individual behavior, population growth, species interactions, and ecosystem function. Introduction to measurement, observation, experimental design and hypothesis testing in field projects, mostly done in groups. The goal is to learn to think analytically about everyday ecological processes involving bacteria, fungi, plants, animals and humans. The course uses basic statistics to analyze data; there are no math prerequisites except arithmetic. Open to everyone, including those who may be headed for more advanced courses in ecology and environmental science.
BIO 46	Introduction to Research in Ecology and Evolutionary Biology	X		The goal of this course is to develop an understanding of how to conduct biological research, using a topic in Ecology, Evolutionary Biology, and Plant Biology as a practical example. This includes the complete scientific process: assessing background literature, generating testable hypotheses, learning techniques for field- and lab-based data collection, analyzing data using appropriate statistical methods, and writing and sharing results. To build these skills, this course focuses on the microorganisms associated with lichen epiphytes. Students, working in teams, develop novel research hypotheses and execute the necessary experiments and measurements to test these hypotheses. In addition, students will learn how to manipulate, visualize and analyze data in R. The capstone of the course is an oral defense of students' findings, as well as a research paper in the style of a peer-reviewed journal article. Labs are completed both on campus and at Jasper Ridge. Lab fee. Information about this class is available at http://bio44.stanford.edu . Satisfies WIM in Biology.
BIO 47	Introduction to Research in Ecology and Evolutionary Biology	X		The goal of this course is to develop an understanding of how to conduct biological research, using a topic in Ecology, Evolutionary Biology, and Plant Biology as a practical example. This includes the complete scientific process: assessing background literature, generating testable hypotheses, learning techniques for field- and lab-based data collection, analyzing data using appropriate statistical methods, and finally writing and sharing results. To build these skills, this course will focus on nectar microbes at Stanford's nearby Jasper Ridge Biological Preserve. Students, working in teams, will develop novel research hypotheses and execute the necessary experiments and measurements to test these hypotheses. The capstone of the course will be an oral defense of students' findings, as well as a research paper in the style of a peer-reviewed journal article. Labs will be completed both on campus and at Jasper Ridge. Lab fee. Information about this class is available at http://bio44.stanford.edu . Satisfies WIM in Biology.
BIO 53	Conservation Photography		X	Introduction to the field of conservation photography and the strategic use of visual communication in addressing issues concerning the environment and conservation. Students will be introduced to basic digital photography, digital image processing, and the theory and application of photographic techniques. Case studies of conservation issues will be examined through photographs and multimedia platforms including images, video, and audio. Lectures, tutorials, demonstrations, and optional field trips will culminate in the production of individual and group projects. This course is identical to Bio 7N, so students enrolled in the former should not take this course. Open to undergraduates and graduate students. Students must have access to a DSLR camera and lenses - we can accept up to 20 students who can share 10 course-provided cameras and lenses, by application.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
BIOE 141B	Senior Capstone Design II	X		Lecture/Lab. Second course of two-quarter capstone sequence. Team based project introduces students to the process of designing new biological technologies to address societal needs. Emphasis is on implementing and testing the design from the first quarter with the at least one round of prototype iteration. Guest lectures and practical demonstrations are incorporated. Prerequisites: BIOE123 and BIOE44. This course is open only to seniors in the undergraduate Bioengineering program. IMPORTANT NOTE: class meets in Shriram 112.
BIOE 393	Bioengineering Departmental Research Colloquium	X		Required Bioengineering department colloquium for first year Ph.D. and M.S. students. Topics include applications of engineering to biology, medicine, biotechnology, and medical technology, including biodesign and devices, molecular and cellular engineering, regenerative medicine and tissue engineering, biomedical imaging, and biomedical computation.
BIOHOPK 299H	Advanced Topics in Marine Conservation		X	Graduate students only. Topics will change from year to year but will include such topics as sustainable fisheries, protected areas, ocean planning, social-ecological systems, dynamic management, sustainable seafood, and impacts of climate change
CEE 100	Managing Sustainable Building Projects		X	Managing the life cycle of buildings from the owner, designer, and contractor perspectives emphasizing sustainability goals; methods to define, communicate, coordinate, and manage multidisciplinary project objectives including scope, quality, life cycle cost and value, schedule, safety, energy, and social concerns; roles, responsibilities, and risks for project participants; virtual design and construction methods for product, organization, and process modeling; lifecycle assessment methods; individual writing assignment related to a real world project.
CEE 199	Undergraduate Research in Civil and Environmental Engineering	X		Written report or oral presentation required. Students must obtain a faculty sponsor.
CEE 224A	Sustainable Development Studio		X	(Undergraduates, see 124.) Project-based. Sustainable design, development, use and evolution of buildings; connections of building systems to broader resource systems. Areas include architecture, structure, materials, energy, water, air, landscape, and food. Projects use a cradle-to-cradle approach focusing on technical and biological nutrient cycles and information and knowledge generation and organization. May be repeated for credit.
CEE 224S	Sustainable Urban Systems Seminar		X	The Sustainable Urban Systems (SUS) Seminar Series will feature speakers from academia, practice, industry, and government who are on the forefront of research and innovation in sustainable urban systems. The SUS Seminar will be open to the public; students will have the option of obtaining 1 unit of course credit based on attendance and completion of writing assignments.
CEE 263S	Atmosphere/Energy Seminar		X	Interdisciplinary seminar with talks by researchers and practitioners in the fields of atmospheric science and renewable energy engineering. Addresses the causes of climate, air pollution, and weather problems and methods of addressing these problems through renewable and efficient energy systems. May be repeated for credit.
CEE 273	Aquatic Chemistry	X		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.
CEE 299	Independent Study in Civil Engineering for CEE-MS Students	X		Directed study for CEE-MS students on subjects of mutual interest to students and faculty. Student must obtain faculty sponsor.
CEE 299L	Independent Project in Civil and Environmental Engineering	X		Prerequisite: Consent of Instructor
CEE 300	Thesis (Engineer Degree)	X		Research by Engineer candidates.
CEE 398	Report on Civil Engineering Training	X		On-the-job training under the guidance of experienced, on-site supervisors; meets the requirements for Curricular Practical Training for students on F-1 visas. Students submit a concise report detailing work activities, problems worked on, and key results. Prerequisite: qualified offer of employment and consent of adviser as per I-Center procedures.
CHEMENG 191H	Undergraduate Honors Seminar	X		For Chemical Engineering majors approved for B.S. with Honors research program. Honors research proposal must be submitted and unofficial transcript document BSH status prior to required concurrent registration in 190H and 191H. May be repeated for credit. Corequisite: 190H
CHEMENG 516	Special Topics in Energy and Catalysis	X		Recent developments and current research. May be repeated for credit. Prerequisite: graduate standing and consent of instructor.
CHEMENG 699	Colloquium	X		Weekly lectures by experts from academia and industry in the field of chemical engineering. Course may be repeated for credit.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
COMP MED 202	Research Biomethodology for Laboratory Animal Science	X		Emphasis is on providing introductory training and practical, hands-on research animal biomethodology. Topics include basic care and principals guiding the use of research animals, animal health and welfare, enrichment, basic mouse handling, rodent breeding, and the principals of rodent aseptic surgery and anesthesia. The objective of this course is to teach basic skills in animal handling, animal care and biomethodological research techniques. Content delivered online and in-person.
COMP MED 80N	Animal behavior: sex, death, and sometimes food!	X		Preference to freshman. Behavior is what makes animals special (thirsty plants don't walk to water), but why do animals behave the way they do? What does their behavior tell us about their inner lives, and about ourselves? What do lipstick and cuckoos and fireflies have in common? Why would nobody want to be a penguin? What do mice say to each other in their pee-mail? Learning how to think about questions like these gives us a unique perspective on the natural world. Format: Discussion and criticism of video examples, documentaries, and research papers. Topics: History and approaches to animal behavior; development of behavior, from genetics to learning; mechanisms of behavior, from neurons to motivation; function of behavior, from honest signals to selfish genes; the phylogeny of behavior, from domestication to speciation; and modern applications of behavior, from abnormal behavior, to conservation, to animal welfare, and animal consciousness.
CS 106S	Coding for Social Good	X		Survey course on applications of fundamental computer science concepts from CS 106B/X to problems in the social good space (such as health, government, education, and environment). Each week consists of in-class activities designed by student groups, local tech companies, and nonprofits. Introduces students to JavaScript and the basics of web development. Topics have included mental health chatbots, tumor classification with basic machine learning, sentiment analysis of tweets on refugees, and storytelling through virtual reality. Corequisite: 106B or 106X.
CS 181W	Computers, Ethics, and Public Policy (WIM)	X		Writing-intensive version of CS181. Satisfies the WIM requirement for Computer Science, Engineering Physics, STS, and Math/Comp Sci undergraduates. To take this course, students need permission of instructor and may need to complete an assignment due at the first day of class.
CS 50	Using Tech for Good	X		Students in the class will work in small teams to implement high-impact projects for partner organizations. Taught by the CS+Social Good team, the aim of the class is to empower you to leverage technology for social good by inspiring action, facilitating collaboration, and forging pathways towards global change. Recommended: CS 106B, CS 42 or 142. Class is open to students of all years. May be repeated for credit. Cardinal Course certified by the Haas Center.
EARTH 400	Directed Research		X	Independent research for graduate student projects.
EARTH 5	Geokids: Earth Sciences Education		X	Service learning through the Geokids program. Eight weeks of supervised teaching to early elementary students about Earth sciences. Hands-on teaching strategies for science standards-based instruction.
EARTHSYS 10	Introduction to Earth Systems		X	For non-majors and prospective Earth Systems majors. Multidisciplinary approach using the principles of geology, biology, engineering, and economics to describe how the Earth operates as an interconnected, integrated system. Goal is to understand global change on all time scales. Focus is on sciences, technological principles, and sociopolitical approaches applied to solid earth, oceans, water, energy, and food and population. Case studies: environmental degradation, loss of biodiversity, and resource sustainability.
EARTHSYS 148	Grow it, Cook it, Eat it. An Experiential Exploration of How and Why We Eat What We Eat		X	This course provides an introductory exploration of the social, cultural, and economic forces that influence contemporary human diets. Through the combination of interrelated lectures by expert practitioners and hands-on experience planting, tending, harvesting, cooking, and eating food from Stanford's dining hall gardens, students will learn to think critically about modern agricultural practices and the relationship between cuisine and human and ecological health outcomes. Students will also learn and apply basic practices of human-centered design to develop simple frameworks for understanding various eating behaviors in Stanford's dining halls and to develop and test hypotheses for how R&DE Stanford Dining might influence eating behaviors to effect better health outcomes for people and the planet. This class, which is offered through the FEED Collaborative in the School of Earth, Energy and Environmental Sciences, requires an application. For more information about the FEED Collaborative, application procedures and deadlines, and other classes we teach, please visit our website at http://feedcollaborative.org .

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
EARTHSYS 187	FEED the Change: Redesigning Food Systems		X	FEED the Change is a project-based course focused on solving real problems in the food system. Targeted at upper-class undergraduates, this course provides an opportunity for students to meet and work with thought-leading innovators, to gain meaningful field experience, and to develop connections with faculty, students, and others working to create impact in the food system. Students in the course will develop creative confidence by learning and using the basic principles and methodologies of human-centered design, storytelling, and media design. Students will also learn basic tools for working effectively in teams and for analyzing complex social systems. FEED the Change is taught at the d.school and is offered through the FEED Collaborative in the School of Earth. This class requires an application. For application information and more information about our work and about past class projects, please visit our website at http://feedcollaborative.org/classes/
EARTHSYS 210A	Senior Capstone and Reflection	X		The Earth Systems Senior Capstone and Reflection, required of all seniors, provides students with opportunities to synthesize and reflect on their learning in the major. Students participate in guided career development and planning activities and initiate work on an independent or group capstone project related to an Earth Systems problem or question of interest. In addition, students learn and apply principles of effective oral communication through developing and giving a formal presentation on their internship. Students must also take EARTHSYS 210P, Earth Systems Capstone Project, in the quarter following the Senior Capstone and Reflection Course. Prerequisite: Completion of an approved Earth Systems internship (EARTHSYS 260).
EARTHSYS 210P	Earth Systems Capstone Project		X	Students work independently or in groups to complete their Senior Capstone Projects. They will participate in regular advising meetings with the instructor(s), and will give a final presentation on their projects at the end of the quarter in a special Earth Systems symposium. Prerequisite: EARTHSYS 210A, B, or C.
EARTHSYS 289A	FEED Lab: Food System Design & Innovation		X	FEED Lab is a 3-4 unit introductory course in design thinking and food system innovation offered through the FEED Collaborative. Targeted at graduate students interested in food and the food system, this course provides a series of diverse, primarily hands-on experiences (design projects with industry-leading thinkers, field work, and collaborative leadership development) in which students both learn and apply the process of human-centered design to projects of real consequence in the food system. The intent of this course is to develop students' creative confidence, collaborative leadership ability, and skills in systems thinking to prepare them to be more effective as innovators and leaders in the food system. This course is mandatory for any student wishing to qualify for the FEED Collaborative's summer Leadership and Innovation Program, in which select students participate in full-time, paid, externship roles with collaborating thought-leaders in the industry. Admission is by application: http://feedcollaborative.org/classes/ .
EARTHSYS 292	Multimedia Environmental Communication		X	Introductory theory and practice of effective, accurate and engaging use of photography, audio and video production in communicating environmental science and policy concepts to the public. Emphasis on fundamental techniques, storytelling and workflow more than technical how to or gear. Includes extensive instructor and peer critiquing of work and substantial out-of-class group project work. Limited class size, preference to Earth Systems master's students. No previous multimedia experience necessary.
EARTHSYS 293	Environmental Communication Practicum		X	Students complete an internship or similar practical experience in a professional environmental communication setting. Potential placements include environmental publications, environmental or outdoor education placements, NGOs, government agencies, on-campus departments, programs, or centers, and science centers and museums. Restricted to students admitted to the Earth Systems Master of Arts, Environmental Communication Program. Can be completed in any quarter.
EARTHSYS 294	Environmental Communication Capstone		X	The Earth Systems Master of Arts, Environmental Communication capstone project provides students with an opportunity to complete an ambitious independent project demonstrating mastery of an area of environmental communication. Capstone projects are most often applied communication projects such as writing, photography, or video projects; expressive or artistic works; or student-initiated courses, workshops, or curriculum materials. Projects focused on academic scholarship or communication theory research may also be considered. Restricted to students enrolled in the Earth Systems Master of Arts, Environmental Communication Program.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
EARTHSYS 41N	The Global Warming Paradox		X	Preference to freshman. Focus is on the complex climate challenges posed by the substantial benefits of energy consumption, including the critical tension between the enormous global demand for increased human well-being and the negative climate consequences of large-scale emissions of carbon dioxide. Topics include: Earth's energy balance; detection and attribution of climate change; the climate response to enhanced greenhouse forcing; impacts of climate change on natural and human systems; and proposed methods for curbing further climate change. Sources include peer-reviewed scientific papers, current research results, and portrayal of scientific findings by the mass media and social networks.
ECON 118	Development Economics	X		The microeconomic problems and policy concerns of less developed countries. Topics include: health and education; risk and insurance; microfinance; agriculture; technology; governance. Emphasis is on economic models and empirical evidence. Prerequisites: ECON 50, ECON 102B.
ECON 125	Economic Development, Microfinance, and Social Networks	X		An introduction to the study of the financial lives of households in less developed countries, focusing on savings, credit, informal insurance, the expansion of microfinance, and social networks. Prerequisites- Econ 51 or Publpol 51 and Econ 102B.
ECON 136	Market Design	X		Use of economic theory and analysis to design allocation mechanisms and market institutions. Course focuses on three areas: the design of matching algorithms to solve assignment problems, with applications to school choice, entry-level labor markets, and kidney exchanges; the design of auctions to solve general resource allocation problems, with applications to the sale of natural resources, financial assets, radio spectrum, and advertising; and the design of platforms and exchanges, with applications to internet markets. Emphasis on connecting economic theory to practical applications. Students must write term paper.
ECON 155	Environmental Economics and Policy		X	Economic sources of environmental problems and alternative policies for dealing with them (technology standards, emissions taxes, and marketable pollution permits). Evaluation of policies addressing local air pollution, global climate change, and the use of renewable resources. Connections between population growth, economic output, environmental quality, sustainable development, and human welfare. Prerequisite: ECON 50. May be taken concurrently with consent of the instructor.
ECON 315	Development Workshop	X		-
ECON 341	Public Economics and Environmental Economics Seminar		X	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: ECON 241 or consent of instructor.
ECON 47	Media Markets and Social Good	X		This class will apply tools from economics and related social sciences to study the functioning of media markets and their impact on society. The guiding question will be: when and how do media best serve the social good? Topics will include the economics of two-sided markets, media bias, polarization, social media, fake news, advertising, propaganda, effects of media on children, media and crime, and the role of media in corruption, protests and censorship. The course will give students a non-technical introduction to social science empirical methods, including regression analysis, causal inference, experimental and quasi-experimental methods, and machine learning.
EDUC 98	Service Learning Practicum	X		For Alternative Spring Break program leaders. The skills and philosophical framework to develop and lead an ASB experience. May be repeat for credit
EE 216	Principles and Models of Semiconductor Devices	X		Carrier generation, transport, recombination, and storage in semiconductors. Physical principles of operation of the p-n junction, heterojunction, metal semiconductor contact, bipolar junction transistor, MOS capacitor, MOS and junction field-effect transistors, and related optoelectronic devices such as CCDs, solar cells, LEDs, and detectors. First-order device models that reflect physical principles and are useful for integrated-circuit analysis and design. Prerequisite: 116 or equivalent.
ENERGY 104	Sustainable Energy for 9 Billion		X	This course explores the transition to a sustainable energy system at large scales (national and global), and over long time periods (decades). Explores the drivers of global energy demand and the fundamentals of technologies that can meet this demand sustainably. Focuses on constraints affecting large-scale deployment of technologies, as well as inertial factors affecting this transition. Problems will involve modeling global energy demand, deployment rates for sustainable technologies, technological learning and economics of technical change. Recommended: ENERGY 101, 102.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
ENERGY 160	Uncertainty Quantification in Data-Centric Simulations	X		This course provides a brief survey of mathematical methods for uncertainty quantification. It highlights various issues, techniques and practical tools available for modeling uncertainty in quantitative models of complex dynamic systems. Specific topics include basic concepts in probability and statistics, spatial statistics (geostatistics and machine learning), Monte Carlo simulations, global and local sensitivity analyses, surrogate models, and computational alternatives to Monte Carlo simulations (e.g., quasi-MC, moment equations, the method of distributions, polynomial chaos expansions). Prerequisites: algebra (CME 104 or equivalent), introductory statistics course (CME 106 or equivalent).
ENERGY 175	Well Test Analysis		X	Lectures, problems. Application of solutions of unsteady flow in porous media to transient pressure analysis of oil, gas, water, and geothermal wells. Pressure buildup analysis and drawdown. Design of well tests. Computer-aided interpretation.
ENERGY 193	Undergraduate Research Problems	X		Original and guided research problems with comprehensive report. May be repeated for credit.
ENERGY 203	The Energy Transformation Collaborative		X	Solving the global energy challenge will require the creation and successful scale-up of hundreds of new ventures. This project-based course provides a launchpad for the development and creation of transformational energy ventures and innovation models. Interdisciplinary teams will research, analyze, and develop detailed launch plans for high-impact opportunities in the context of the new energy venture development framework offered in this course.
ENERGY 222	Advanced Reservoir Engineering		X	Lectures, problems. General flow equations, tensor permeabilities, steady state radial flow, skin, and succession of steady states. Injectivity during fill-up of a depleted reservoir, injectivity for liquid-filled reservoirs. Flow potential and gravity forces, coning. Displacements in layered reservoirs. Transient radial flow equation, primary drainage of a cylindrical reservoir, line source solution, pseudo-steady state. May be repeated for credit. Prerequisite: 221.
ENERGY 223	Reservoir Simulation		X	Fundamentals of petroleum reservoir simulation. Equations for multicomponent, multiphase flow between gridblocks comprising a petroleum reservoir. Relationships between black-oil and compositional models. Techniques for developing black-oil, compositional, thermal, and dual-porosity models. Practical considerations in the use of simulators for predicting reservoir performance. Class project. Prerequisite: 221 and 246, or consent of instructor. Recommended: CME 206.
ENERGY 230	Advanced Topics in Well Logging		X	State of the art tools and analyses; the technology, rock physical basis, and applications of each measurement. Hands-on computer-based analyses illustrate instructional material. Guest speakers on formation evaluation topics. Prerequisites: 130 or equivalent; basic well logging; and standard practice and application of electric well logs.
ENERGY 359	Teaching Experience in Energy Resources Engineering	X		For TAs in Energy Resources Engineering. Course and lecture design and preparation; lecturing practice in small groups. Classroom teaching practice in an Energy Resources Engineering course for which the participant is the TA (may be in a later quarter). Taught in collaboration with the Center for Teaching and Learning.
ENERGY 360	Advanced Research Work in Energy Resources Engineering	X		Graduate-level work in experimental, computational, or theoretical research. Special research not included in graduate degree program. May be repeated for credit.
ENERGY 361	Master's Degree Research in Energy Resources Engineering	X		Experimental, computational, or theoretical research. Advanced technical report writing. Limited to 6 units total. (Staff)
ENERGY 363	Doctoral Degree Research in Energy Resources Engineering	X		Graduate-level work in experimental, computational, or theoretical research for Ph.D. students. Advanced technical report writing.
ENGR 131	Ethical Issues in Engineering	X		Fundamental ethical responsibilities of engineers. Ethical responsibilities to society, employers, colleagues, and clients; ethics, cost-benefit-risk analysis, and safety; informed consent; ethical responsibilities of radical engineering design; the ethics of whistleblowing; ethical issues engineers face as expert witnesses, consultants, and managers; ethical issues in engineering research, design, testing, and manufacturing; ethical issues arising from engineering work in foreign countries; and ethical issues arising from the social, cultural, and environmental contexts of contemporary engineering work. Contemporary case studies. Enrollment limited to 24. Each student seeking admission to the class must send an application to the instructor at mcginn@stanford.edu by 5 PM, Monday, September 24. The application must contain her/his name, year of study, major, and case, limited to 300 words, for why s/he should be given a slot in the seminar. Students will be emailed whether they have been admitted by 9AM, Tuesday, September 25.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
ENGR 40M	An Intro to Making: What is EE	X		Is a hands-on class where students learn to make stuff. Through the process of building, you are introduced to the basic areas of EE. Students build a "useless box" and learn about circuits, feedback, and programming hardware, a light display for your desk and bike and learn about coding, transforms, and LEDs, a solar charger and an EKG machine and learn about power, noise, feedback, more circuits, and safety. And you get to keep the toys you build. Prerequisite: CS 106A.
ENVRES 221	New Frontiers and Opportunities in Sustainability		X	Interdisciplinary exploration of how companies, government and non-profit organizations address some of the world's most significant environmental & resource sustainability challenges. Each week we will explore with an experienced sustainability practitioner new frontiers and opportunities in clean tech, policy, energy, transportation, consumer goods, agriculture, food, and sustainable built environments..
ENVRES 290	Capstone Project Seminar in Environment and Resources	X		Required for and limited to E-IPER Joint M.S. students. Propose, conduct and publicly present final individual or team projects demonstrating the integration of professional (M.B.A., J.D., or M.D.) and M.S. in Environment and Resources degrees. Presentation and submission of final product required. 3 total units required; can all be taken during one quarter or divided over two sequential quarters.
ENVRES 398	Directed Reading in Environment and Resources	X		Under supervision of an E-IPER affiliated faculty member on a subject of mutual interest. Joint M.S. students must submit an Independent Study Agreement for approval. May be repeat for credit
ENVRES 399	Directed Research in Environment and Resources	X		For advanced graduate students. Under supervision of an E-IPER affiliated faculty member. Joint M.S. students must submit an Independent Study Agreement for approval.
ESS 135	Community Leadership	X		Offered through Residential Education to residents of Castano House, Manzanita Park. Topics include: emotional intelligence, leadership styles, listening, facilitating meetings, group dynamics and motivation, finding purpose, fostering resilience. Students will lead discussions on personal development, relationships, risky behaviors, race, ethnicity, spirituality, integrity.
ESS 210	Techniques in Environmental Microbiology	X		Fundamentals and application of laboratory techniques to study the diversity and activity of microorganisms in environmental samples, including soil, sediment, and water. Emphasis is on culture-independent approaches, including epifluorescence microscopy, extraction and analysis of major biomolecules (DNA, RNA, protein, lipids), stable isotope probing, and metabolic rate measurements. Format will include lectures, laboratory exercises, and discussions. Students will learn how to collect, analyze, and understand common and cutting-edge datasets in environmental microbiology. Permission from instructor is required to enroll as C/NC or for 3 units.
ESS 292	Directed Individual Study in Earth System Science		X	Under supervision of an Earth System Science faculty member on a subject of mutual interest.
ESS 301	Topics in Earth System Science		X	Current topics, issues, and research related to interactions that link the oceans, atmosphere, land surfaces and freshwater systems. May be repeated for credit.
ESS 306	From Freshwater to Oceans to Land Systems: An Earth System Perspective to Global Challenges	X		Within this class we will have cover Earth System processes ranging from nutrient cycles to ocean circulation. We will also address global environmental challenges of the twenty-first century that include maintaining freshwater resources, land degradation, health of our oceans, and the balance between food production and environmental degradation. Weekly readings and problem sets on specific topics will be followed by presentations of Earth System Science faculty and an in-depth class discussion. ESS first year students have priority enrollment.
GEOPHYS 385A	Reflection Seismology	X		Research in reflection seismology and petroleum prospecting. May be repeated for credit.
GEOPHYS 385B	Environmental Geophysics	X		Research on the use of geophysical methods for near-surface environmental problems. May be repeated for credit.
GEOPHYS 385D	Theoretical Geophysics	X		Research on physics and mechanics of earthquakes, volcanoes, ice sheets, and glaciers. Emphasis is on developing theoretical understanding of processes governing natural phenomena.
GEOPHYS 385E	Tectonics	X		Research on the origin, major structures, and tectonic processes of the Earth's crust. Emphasis is on use of deep seismic reflection and refraction data. May be repeated for credit.
GEOPHYS 385G	Radio Glaciology	X		Research on the acquisition, processing, and analysis of radio geophysical signals in observing the subsurface conditions and physical processes of ice sheets, glaciers, and icy moons.
GEOPHYS 385L	Earthquake Seismology, Deformation, and Stress	X		Research on seismic source processes, crustal stress, and deformation associated with faulting and volcanism. May be repeated for credit.
GEOPHYS 385R	Physical Volcanology	X		Research on volcanic processes. May be repeat for credit
GEOPHYS 385Z	Radio Remote Sensing	X		Research applications, especially crustal deformation measurements. Recent instrumentation and system advancements. May be repeated for credit.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
GS 102	Earth Materials: Introduction to Mineralogy	X		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. Required lab section. Prerequisite: introductory geology course. Recommended: introductory chemistry.
GS 106	Sedimentary Geology and Depositional Systems	X		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. Required Lab Section: methods of analysis of sediments in hand specimen and thin section. There is a required field problem trips to the field site(s) during the quarter, data collection and analysis, and preparation of a final written and oral report. Prerequisites: 1, 102, 103.
GS 250	Sedimentation Mechanics	X		The mechanics of sediment transport and deposition and the origins of sedimentary structures and textures as applied to interpreting modern sediments and ancient rock sequences. Dimensional analysis, fluid flow, drag, boundary layers, open channel flow, particle settling, erosion, sediment transport, sediment gravity flows, soft sediment deformation, and fluid escape. Required field trip and lab section.
GS 259	Stratigraphic Architecture	X		The stratigraphic architecture of deposits associated with a spectrum of depositional environments, using outcrop and subsurface data. Participants read and discuss selected literature.
GS 290	Departmental Seminar in Geological Sciences	X		Current research topics. Presentations by guest speakers from Stanford and elsewhere. May be repeated for credit.
GS 385	Practical Experience in the Geosciences	X		On-the-job training in the geosciences. May include summer internship; emphasizes training in applied aspects of the geosciences, and technical, organizational, and communication dimensions. Meets USCIS requirements for F-1 curricular practical training. (Staff)
HUMBIO 129S	Global Public Health	X		The class is an introduction to the fields of international public health and global medicine. It focuses on resource poor areas of the world and explores major global health problems and their relation to policy, economic development and human rights. The course is intended for students interested in global health, development studies, or international relations, and provides opportunities for in-depth discussion and interaction with experts in the field. Prerequisite: Human Biology Core or Biology Foundations or equivalent or consent of the instructor.
HUMBIO 2A	Genetics, Evolution, and Ecology	X		Introduction to the principles of classical and modern genetics, evolutionary theory, and population biology. Topics: micro- and macro-evolution, population and molecular genetics, biodiversity, and ecology, emphasizing the genetics and ecology of the evolutionary process and applications to human populations. HUMBIO 2A and HUMBIO 2B are designed to be taken concurrently and exams for both sides may include material from joint module lectures. Concurrent enrollment is strongly encouraged and is necessary for majors in order to meet declaration deadlines. Please note Human Biology majors are required to take the Human Biology Core Courses for a letter grade.
HUMBIO 4B	Environmental and Health Policy Analysis	X		Connections among the life sciences, social sciences, public health, and public policy. The economic, social, and institutional factors that underlie environmental degradation, the incidence of disease, and challenges facing the health care system including high spending and inequalities in access to health care. Public policies to address these problems. Topics include pollution regulation, climate change policy, biodiversity protection, health insurance, health care regulation, health disparities, and health care reform. HUMBIO 4B, with HUMBIO 2B and HUMBIO 3B, satisfies the Writing in the Major (WIM) requirement for students in Human Biology. HUMBIO 4A and HUMBIO 4B are designed to be taken concurrently and exams for both sides may include material from joint module lectures. Concurrent enrollment is strongly encouraged and is necessary for majors in order to meet declaration deadlines. Please note Human Biology majors are required to take the Human Biology Core Courses for a letter grade.
HUMRTS 199	Capstone Project: Human Rights Minor	X		Students completing a required capstone project for the Minor in Human Rights must enroll in this course for units with their capstone adviser selected as the instructor. Students must agree with their capstone advisor how many units (3-5) their proposed capstone project is worth, and enroll accordingly. This course is open only to Human Rights Minors.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
LAW 2513	Climate: Politics, Finance, and Infrastructure		X	<p>While climate change is often considered an 'environmental problem', the risks and opportunities embedded in a changing climate go well beyond the frame of the natural environment. This course will reframe climate as a macroeconomic challenge, one in which multilateral politics, global investment and physical and institutional infrastructure must be understood and reconsidered. Based on scholarly analysis and guest speakers, this interdisciplinary course will frame the arc of climate past, present and future on the pillars of politics, finance and infrastructure. Starting with the policy framework established by past global climate negotiations, the bulk of the course will investigate current innovations at the intersection of finance and policy, including risk metrics, management and disclosure, liability litigation, blended finance, new investment vehicles and intermediaries, and resilience measures. The final sessions will consider the future, taking a look at how future leaders might solve the greatest challenge of our time. Elements used in grading: Students may take the course for 2 units (section 1) or 3 units (section 2). Section 1 and 2 students will both receive grades for attendance, in class participation and guest-speaker questions. Section 1 students will also complete a group presentation on the design of a financial, business, legal or policy intervention with the potential to reduce emissions on a large scale. Section 2 students will be required to write a research paper meeting the Law School's R paper requirements. This class is limited to 30 students, with an effort made to have students from SLS (15 students will be selected by lottery) and 15 non-law students by consent of instructor. After the term begins, students accepted into the course can transfer from section (01) into section (02), which meets the R requirement, with consent of the instructor.</p>
LAW 7071	Philanthropy and Civil Society	X		<p>(Formerly Law 781) Associated with the Center for Philanthropy and Civil Society (PACS). Year-long workshop for doctoral students and advanced undergraduates writing senior theses on the nature of civil society or philanthropy. Focus is on pursuit of progressive research and writing contributing to the current scholarly knowledge of the nonprofit sector and philanthropy. Accomplished in a large part through peer review. Readings include recent scholarship in aforementioned fields. May be repeated for credit for a maximum of 3 units. Cross-listed with Education (EDUC 374), Political Science (POLISCI 334) and Sociology (SOC 374).</p>
LAW 8002	Environmental Law and Policy Colloquium		X	<p>(Formerly Law 706) The Environmental Law & Policy Colloquium offers students the opportunity to learn about cutting-edge legal topics related to environmental law, broadly defined to include, among other areas, pollution control, natural resources management, and energy development. The colloquium meets in two quarters. During the autumn quarter, students will learn about core concepts that underlie the administration of environmental law, exploring ideas from economics, philosophy, natural science, and law. In the autumn quarter, students will begin to develop a capstone research paper on a contemporary environmental law issue. During the spring quarter, the students will write and present their research papers. Elements used in grading include attendance and participation, problem sets, small writing assignments, and a final paper. This course is required for students in the Environmental Law & Policy LL.M. Program. All other students are welcome but will need instructor permission to enroll.</p>
LAW 908	Advanced Environmental Law Clinic		X	<p>(Formerly Law 623) The Advanced Environmental Law Clinic provides students who have already taken the Environmental Law Clinic the opportunity to continue intense individual project work. Advanced students often work on matters they worked on as full-time students, but they also have the chance to work on new matters and develop new skills. Advanced students work closely with supervising faculty on their designated projects and are expected to take increasing responsibility for managing their work and representing clients. In addition, advanced students often serve as mentors to less experienced full-time students and thereby receive training in basic team building and supervision. Advanced students may arrange to receive between two and seven units. No student may receive more than 27 total clinical units during the course of the student's law school career. Elements used in grading: TBA.</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
LAW 912A	International Human Rights and Conflict Resolution Clinic: Clinical Practice	X		<p>(Formerly Law 658A) In the past half-century, human rights advocates have transformed a marginal utopian ideal into a central element of global discourse, if not practice. This course examines the actors and organizations behind this remarkable development, as well as the vast challenges faced by advocates in the recent past and today. Increasingly, human rights as a framework has become essential to a broad range of situations of tension and conflict. This course interrogates the nature of engagement by human rights practitioners, as well as approaches adopted by those focused on the management of violent conflict. What are the origins of the human rights movement and where is it headed? What does it mean to be a human rights activist? What are the main challenges and dilemmas facing those engaged in rights promotion and defense? How is conflict resolution consistent with human rights advocacy? When and where are these approaches in tension? The course also develops advocacy skills through in-class sessions, role play exercises and engagement in, and critical assessment of clinical projects in human rights. Class sessions introduce students to human rights advocacy and conflict management techniques through discussion of the readings and related issues, as well as through student presentations critiquing their participation in supervised clinical projects. The readings and seminar sessions expose students to some of the practical manifestations of the main debates and dilemmas within the human rights and conflict resolution movement(s). These include several of the ethical and strategic issues that arise in the course of doing fact-finding and advocacy and balancing the often differing agendas of western international nongovernmental organizations (INGOs) and their counterparts in the (frequently non-western) developing world. The readings also consider tensions within the field of conflict resolution, as well as between conflict resolution and human rights. Several class sessions will focus on fact-finding and advocacy skills. One or more of these sessions will be full-day, role play exercises. In these full-day sessions, students will engage in human rights research, documentation, negotiation and dispute management exercises, and advocacy role-playing. In some sessions, part of the class will be devoted to presentations by students and clinical 'rounds'. These presentations will consider one or more issues that arise in the course of students' own engagement in advocacy projects through the International Human Rights and Conflict Resolution Clinic. During the course of the quarter, students will also be required to draft several brief fact-finding/advocacy pieces (these will be explained in class), and write short, critical reflection papers (2-4 pages, double-spaced, or 500-1,000 words, thought pieces) on the readings. Special Instructions: -- General Structure of Clinical Courses. The Law School's clinical courses are offered on a full-time basis for 12 units. This allows students to immerse themselves in the professional experience without the need to balance clinical projects with other classes, exams and papers. Students enrolled in a clinic are not permitted to enroll in any other classes, seminars, directed research or other credit-yielding activities within the Law School or University during the quarter in which they are enrolled in a clinic. Nor are they allowed to serve as teaching assistants who are expected to attend a class on a regular basis. There is a limited exception for joint degree students who are required to take specific courses each quarter and who would be foreclosed from ever taking a clinic unless allowed to co-register. These exceptions are approved on a case-by-case basis. Clinic students are expected to work in their clinical office during most business hours Monday through Friday. Students are also expected to be available by e-mail or cell phone when elsewhere during those hours.</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
LAW 912B	International Human Rights and Conflict Resolution Clinic: Clinical Methods	X		<p>(Formerly Law 658B) In the past half-century, human rights advocates have transformed a marginal utopian ideal into a central element of global discourse, if not practice. This course examines the actors and organizations behind this remarkable development, as well as the vast challenges faced by advocates in the recent past and today. Increasingly, human rights as a framework has become essential to a broad range of situations of tension and conflict. This course interrogates the nature of engagement by human rights practitioners, as well as approaches adopted by those focused on the management of violent conflict. What are the origins of the human rights movement and where is it headed? What does it mean to be a human rights activist? What are the main challenges and dilemmas facing those engaged in rights promotion and defense? How is conflict resolution consistent with human rights advocacy? When and where are these approaches in tension? The course also develops advocacy skills through in-class sessions, role play exercises and engagement in, and critical assessment of clinical projects in human rights. Class sessions introduce students to human rights advocacy and conflict management techniques through discussion of the readings and related issues, as well as through student presentations critiquing their participation in supervised clinical projects. The readings and seminar sessions expose students to some of the practical manifestations of the main debates and dilemmas within the human rights and conflict resolution movement(s). These include several of the ethical and strategic issues that arise in the course of doing fact-finding and advocacy and balancing the often differing agendas of western international nongovernmental organizations (INGOs) and their counterparts in the (frequently non-western) developing world. The readings also consider tensions within the field of conflict resolution, as well as between conflict resolution and human rights. Several class sessions will focus on fact-finding and advocacy skills. One or more of these sessions will be full-day, role play exercises. In these full-day sessions, students will engage in human rights research, documentation, negotiation and dispute management exercises, and advocacy role-playing. In some sessions, part of the class will be devoted to presentations by students and clinical 'rounds'. These presentations will consider one or more issues that arise in the course of students' own engagement in advocacy projects through the International Human Rights and Conflict Resolution Clinic. During the course of the quarter, students will also be required to draft several brief fact-finding/advocacy pieces (these will be explained in class), and write short, critical reflection papers (2-4 pages, double-spaced, or 500-1,000 words, thought pieces) on the readings. Special Instructions: -- General Structure of Clinical Courses. The Law School's clinical courses are offered on a full-time basis for 12 units. This allows students to immerse themselves in the professional experience without the need to balance clinical projects with other classes, exams and papers. Students enrolled in a clinic are not permitted to enroll in any other classes, seminars, directed research or other credit-yielding activities within the Law School or University during the quarter in which they are enrolled in a clinic. Nor are they allowed to serve as teaching assistants who are expected to attend a class on a regular basis. There is a limited exception for joint degree students who are required to take specific courses each quarter and who would be foreclosed from ever taking a clinic unless allowed to co-register. These exceptions are approved on a case-by-case basis. Clinic students are expected to work in their clinical office during most business hours Monday through Friday. Students are also expected to be available by e-mail or cell phone when elsewhere during those hours.</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
LAW 912C	International Human Rights and Conflict Resolution Clinic: Clinical Coursework	X		<p>(Formerly Law 658C) In the past half-century, human rights advocates have transformed a marginal utopian ideal into a central element of global discourse, if not practice. This course examines the actors and organizations behind this remarkable development, as well as the vast challenges faced by advocates in the recent past and today. Increasingly, human rights as a framework has become essential to a broad range of situations of tension and conflict. This course interrogates the nature of engagement by human rights practitioners, as well as approaches adopted by those focused on the management of violent conflict. What are the origins of the human rights movement and where is it headed? What does it mean to be a human rights activist? What are the main challenges and dilemmas facing those engaged in rights promotion and defense? How is conflict resolution consistent with human rights advocacy? When and where are these approaches in tension? The course also develops advocacy skills through in-class sessions, role play exercises and engagement in, and critical assessment of clinical projects in human rights. Class sessions introduce students to human rights advocacy and conflict management techniques through discussion of the readings and related issues, as well as through student presentations critiquing their participation in supervised clinical projects. The readings and seminar sessions expose students to some of the practical manifestations of the main debates and dilemmas within the human rights and conflict resolution movement(s). These include several of the ethical and strategic issues that arise in the course of doing fact-finding and advocacy and balancing the often differing agendas of western international nongovernmental organizations (INGOs) and their counterparts in the (frequently non-western) developing world. The readings also consider tensions within the field of conflict resolution, as well as between conflict resolution and human rights. Several class sessions will focus on fact-finding and advocacy skills. One or more of these sessions will be full-day, role play exercises. In these full-day sessions, students will engage in human rights research, documentation, negotiation and dispute management exercises, and advocacy role-playing. In some sessions, part of the class will be devoted to presentations by students and clinical 'rounds'. These presentations will consider one or more issues that arise in the course of students' own engagement in advocacy projects through the International Human Rights and Conflict Resolution Clinic. During the course of the quarter, students will also be required to draft several brief fact-finding/advocacy pieces (these will be explained in class), and write short, critical reflection papers (2-4 pages, double-spaced, or 500-1,000 words, thought pieces) on the readings. Special Instructions: -- General Structure of Clinical Courses. The Law School's clinical courses are offered on a full-time basis for 12 units. This allows students to immerse themselves in the professional experience without the need to balance clinical projects with other classes, exams and papers. Students enrolled in a clinic are not permitted to enroll in any other classes, seminars, directed research or other credit-yielding activities within the Law School or University during the quarter in which they are enrolled in a clinic. Nor are they allowed to serve as teaching assistants who are expected to attend a class on a regular basis. There is a limited exception for joint degree students who are required to take specific courses each quarter and who would be foreclosed from ever taking a clinic unless allowed to co-register. These exceptions are approved on a case-by-case basis. Clinic students are expected to work in their clinical office during most business hours Monday through Friday. Students are also expected to be available by e-mail or cell phone when elsewhere during those hours.</p>
ME 131B	Fluid Mechanics: Compressible Flow and Turbomachinery	X		<p>Engineering applications involving compressible flow: aircraft and rocket propulsion, power generation; application of mass, momentum, energy and entropy balance to compressible flows; variable area isentropic flow, normal shock waves, adiabatic flow with friction, flow with heat addition. Operation of flow systems: the propulsion system. Turbomachinery: pumps, compressors, turbines. Angular momentum analysis of turbomachine performance, centrifugal and axial flow machines, effect of blade geometry, dimensionless performance of turbomachines; hydraulic turbines; steam turbines; wind turbines. Compressible flow turbomachinery: the aircraft engine. Prerequisites: 70, ENGR 30.</p>
ME 30	Engineering Thermodynamics	X		<p>The basic principles of thermodynamics are introduced in this course. Concepts of energy and entropy from elementary considerations of the microscopic nature of matter are discussed. The principles are applied in thermodynamic analyses directed towards understanding the performances of engineering systems. Methods and problems cover socially responsible economic generation and utilization of energy in central power generation plants, solar systems, refrigeration devices, and automobile, jet and gas-turbine engines.</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
OSPBER 40M	An Intro to Making: What is EE	X		Is a hands-on class where students learn to make stuff. Through the process of building, you are introduced to the basic areas of EE. Students build a "useless box" and learn about circuits, feedback, and programming hardware, a light display for your desk and bike and learn about coding, transforms, and LEDs, a solar charger and an EKG machine and learn about power, noise, feedback, more circuits, and safety. And you get to keep the toys you build. Prerequisite: CS 106A.
OSPPARIS 40M	An Intro to Making: What is EE	X		Is a hands-on class where students learn to make stuff. Through the process of building, you are introduced to the basic areas of EE. Students build a "useless box" and learn about circuits, feedback, and programming hardware, a light display for your desk and bike and learn about coding, transforms, and LEDs, a solar charger and an EKG machine and learn about power, noise, feedback, more circuits, and safety. And you get to keep the toys you build. Prerequisite: CS 106A.
OUTDOOR 101	Introduction to Outdoor Education	X		Examine outdoor adventure activities through the perspective of a trip leader. Discuss risk management, judgment and decision making, group facilitation, program standard operating procedures, and legal liability.
OUTDOOR 105	Outdoor Living Skills	X		Introduction to essential skills for individual and group sustainability in a backcountry setting including shelter in outdoor environments, equipment selection and use, travel techniques, water and nutrition needs, planning and preparation, and risk management. Course includes the participation in a weekend backcountry experience. Corequisite: Outdoor 101
PHYSICS 216	Back of the Envelope Physics	X		Techniques such as scaling and dimensional analysis, useful to make order-of-magnitude estimates of physical effects in different settings. Goals are to promote a synthesis of physics through solving problems, including problems that are not usually thought of as physics. Applications include properties of materials, fluid mechanics, geophysics, astrophysics, and cosmology. Prerequisites: undergraduate mechanics, statistical mechanics, electricity and magnetism, and quantum mechanics.
POLECON 230	Strategy Beyond Markets	X		Politicians, regulators, and voters place limits on - and present opportunities for - nearly every business. Firms like Uber, Airbnb, and Google do not only remain cognizant of existing laws, they also look for opportunities to change the law in ways that help their business. In this class, we will learn how businesses can influence political decision-making and develop frameworks for political strategy. We will examine firms' interactions with competitive firms, market incumbents, customers, and institutions, including interest groups, legislatures, regulatory agencies, courts, international organizations, and the public. Case studies include intellectual property, health care reform, carried interest in private equity, ride-sharing, and peer-to-peer lending. Students will complete the course with a better appreciation of how politics works, of the opportunities and perils associated with alternative political goals, and of tactics likely to achieve those goals. Special emphasis is given to beyond market strategy for start-ups and how to integrate market and beyond-market strategies.
POLISCI 101	Introduction to International Relations	X		The course provides an introduction to major factors shaping contemporary international politics, including: the origins and nature of nationalism; explanations for war; nuclear weapons and their impact of international politics; international implications of the rise of China; civil war and international peacekeeping since the end of the Cold War; understanding international institutions and how they facilitate interstate cooperation despite anarchy; and the politics of international environmental treaties.
PWR 1BK	Writing & Rhetoric 1: Writing What You Eat: The Rhetoric of Food	X		In this course, we will focus on the rhetoric of food in order to explore how our relationship to what we eat is reflected in writing about ourselves, our society, and our world. Essays, recipes, blog posts, and newspaper articles are some of the genres we will examine in order to explore how issues of identity, community, ethics, and wellness can be expressed in food writing. How does what we choose to eat reflect on how we see ourselves and the world around us? What responsibilities do we have, if any, as consumers of food in one of the world's richest nations? For more information about PWR 1, see https://undergrad.stanford.edu/programs/pwr/courses/pwr-1 . For full course descriptions, see https://vcapwr-catalog.stanford.edu . Enrollment is handled by the PWR office.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
PWR 2KM	Writing & Rhetoric 2: A Planet on the Edge: The Rhetoric of Sustainable Energy		X	Prerequisite: PWR 1. Sea-level rise, the halting of major ocean circulatory currents, outbreaks of superstorms leading to floods and droughts - can an energy revolution still save a planet on the edge? This class explores the intricacies of sustainable energy, focusing on the myths, slogans, and rhetorical narratives that surround these debates. For example, is environmentalism inherently at odds with economic prosperity? Does living an environmentally conscious lifestyle require personal sacrifice and suffering? How does rhetorical framing affect the research, implementation, and public perception of new technologies in the field of sustainable energy? For more information about PWR 2, see https://undergrad.stanford.edu/programs/pwr/courses/pwr-2 . For full course descriptions, see https://vcapwr-catalog.stanford.edu . Enrollment is handled by the PWR office.
PWR 2RL	Writing & Rhetoric 2: The Rhetoric of the Natural and Beyond		X	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. For more information about PWR 2, see https://undergrad.stanford.edu/programs/pwr/courses/pwr-2 . For full course descriptions, see https://vcapwr-catalog.stanford.edu . Enrollment is handled by the PWR office.
PWR 2SC	Writing & Rhetoric 2: Are We There Yet?: The Rhetoric of Mobility	X		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. For more information about PWR 2, see https://undergrad.stanford.edu/programs/pwr/courses/pwr-2 . For full course descriptions, see https://vcapwr-catalog.stanford.edu . Enrollment is handled by the PWR office.
SOC 1	Introduction to Sociology at Stanford	X		This course to get students to think like a sociologist; to use core concepts and theories from the field of sociology to make sense of the most pressing issues of our time: race and ethnicity; gender and sexuality; family; education; social class and economic inequality; social connectedness; social movements; and immigration. The course will draw heavily on the research and writing of Stanford's own sociologist.
SOC 341W	Workshop: Inequality	X		Causes, consequences, and structure of inequality; how inequality results from and shapes social classes, occupations, professions, and other aspects of the economy. Research presentations by students, faculty, and guest speakers. Discussion of controversies, theories, and recent writings. May be repeated for credit. Restricted to Sociology doctoral students; others by consent of instructor.
SOC 350W	Workshop: Migration, Ethnicity, Race and Nation	X		Current theories and research, recent publications, and presentations of ongoing research by faculty and students. May be repeated for credit. Prerequisite: Sociology doctoral student or consent of instructor
SOC 8	Sport, Competition, and Society	X		This course uses the tools of social science to help understand debates and puzzles from contemporary sports, and in doing so shows how sports and other contests provide many telling examples of enduring social dynamics and larger social trends. We also consider how sport serves as the entry point for many larger debates about the morality and ethics raised by ongoing social change.
STS 1	The Public Life of Science and Technology	X		The course focuses on key social, cultural, and values issues raised by contemporary scientific and technological developments through the STS interdisciplinary lens by developing and applying skills in three areas: (a) The historical analysis of contemporary global matters (e.g., spread of technologies; climate change response); (b) The bioethical reasoning around health issues (e.g., disease management; privacy rights); and (c) The sociological study of knowledge (e.g., intellectual property, science publishing). A discussion section is required and will be assigned the first week of class.
STS 200A	Food and Society: Politics, Culture and Technology	X		This course will examine how politics, culture, and technology intersect in our food practices. Through a survey of academic, journalistic, and artistic works on food and eating, the course will explore a set of key analytical frameworks and conceptual tools in STS, such as the politics of technology, classification and identity, and nature/culture boundaries. The topics covered include: the industrialization of agriculture; technology and the modes of eating (e.g., the rise of restaurants); food taboos; globalization and local foodways; food and environmentalism; and new technologies in production (e.g., genetically modified food). Through food as a window, the course intends to achieve two broad intellectual goals. First, students will explore various theoretical and methodological approaches in STS. In particular, they will pay particular attention to the ways in which politics, culture, and technology intersect in food practices. Second, student will develop a set of basic skills and tools for their own critical thinking and empirical research, and design and conduct independent research on a topic related to food. First class attendance mandatory. STS majors must have Senior status to enroll in this Senior Capstone course.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
SUST 240	Sustainability Science and Practice Practicum		X	The Practicum Program is designed to serve as a platform that will enable students to exercise and internalize the principles of social-environmental systems, leading change and innovating systems transformations. The theories, models, and methods presented during coursework ultimately should lead to a deep reflection on and development of the student's identity as a transformative leader. The practicum is designed to give students a chance to practice and embody this new leadership identity through action. Total units allowed for this course is 4. Enrollment Open to Sustainability Science & Practice MA/MS Students Only.
THINK 40	Sustainability Challenges and Transitions		X	What are the most critical sustainability challenges facing us in this century? How can natural and social sciences, humanities, and technology fields interact to contribute to their solution? How do we balance the needs and desires of current generations with the needs of future generations? The term sustainability seems to be everywhere. Businesses, cities, non-governmental organizations, individuals, and universities such as Stanford use the term to characterize decisions that make sense for the well-being of people as well as the environment. Beyond the popular use of the term is an emerging field of study that focuses on the goals of sustainable development - improving human well-being while preserving Earth's life support systems (air, water, climate, ecosystems) over the long run - and explores how science and technology can contribute to the solution of some of the most critical problems of the 21st Century. The goal of this course is to engage you in critical thinking and analysis about complex sustainability challenges and to encourage you to consider the need for integrative solutions that draw on different disciplines. We will examine some of the major problems of sustainable development (including issues related to food, water, and energy resources, climate change, and protection of ecosystem services), grapple with the complexities of problem solving in complex human-environment systems, and participate in the design of effective strategies and policies for meeting sustainability goals. You will learn to develop policy briefs addressing sustainability issues in the university, local communities, state and the nation as well as work on team projects with decision makers that address real-life challenges in your local area.
THINK 56	Health Care, Ethics, and Justice	X		Is there a right to a basic level of health care? Are there limits to how much should be spent on health care? How should resources, like human organs, be allocated? What obligations does the U.S. have regarding health care in resource-poor environments, such as underdeveloped nations? We live in a world of constrained resources. Nowhere are these constraints more controversial and significant than in health care where lives literally hang in the balance of the decisions we make. This course will provide students with the tools to address these questions through the theoretical framework of justice and ethics. We will address the question of allocation at the level of health policy and health economics before applying the concepts to the institutional and bedside level. Using real world examples, you will be asked to actively engage in debating controversial topics such as organ transplants and how to assign scarce ICU beds. Using both empirical data and the framework of ethics, you will be asked to consider how a health care committee, or a hospital, or an individual doctor might make decisions.
THINK 57	Progress: Pro and Contra	X		Where and when did we start believing in human progress? Does progress imply that history has a particular direction or end-goal? Much of our everyday thinking about politics, society, and history depends on some implicit or explicit concept of progress. Have we reached a point where we need to replace the idea of progress with that of sustainability? These are some of the questions this course will raise as it looks at how ideas of progress inform western thinking about science, history, evolution, and politics. It will engage with thinkers who argued in favor of the idea of progress as well as thinkers who attacked its presumptions. Reading and critically evaluating philosophical, scientific, and literary texts, we will investigate the different consequences of our residual belief in progress, as well as the consequences of our possible abandonment of that belief.
URBANST 110	Introduction to Urban Studies	X		Today, for the first time in history, a majority of people live in cities. By 2050, cities will hold two-thirds of the world's population. This transformation touches everyone, and raises critical questions. What draws people to live in cities? How will urban growth affect the world's environment? Why are cities so divided by race and by class, and what can be done about it? How do cities change who we are, and how can we change cities? In this class, you will learn to see cities in new ways, from the smallest everyday interactions on a city sidewalk to the largest patterns of global migration and trade. We will use specific examples from cities around the world to illustrate the concepts that we learn in class. The course is intended primarily for freshmen and sophomores.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
AA 100	Introduction to Aeronautics and Astronautics	X		<p>This class introduces the basics of aeronautics and astronautics through applied physics, hands-on activities, and real world examples. The principles of fluid flow, flight, and propulsion for aircraft will be illustrated, including the creation of lift and drag, aerodynamic performance including takeoff, climb, range, and landing. The principles of orbits, maneuvers, space environment, and propulsion for spacecraft will be illustrated. Students will be exposed to the history and challenges of aeronautics and astronautics.</p>
AA 108N	Surviving Space	X		<p>Space is dangerous. Anything we put into orbit has to survive the intense forces experienced during launch, extreme temperature changes, impacts by cosmic rays and energetic protons and electrons, as well as hits by human-made orbital debris and meteoroids. If we venture beyond Earth's sphere of influence, we must also then endure the extreme plasma environment without the protection of our magnetic field. With all of these potential hazards, it is remarkable that our space program has experienced so few catastrophic failures. In this seminar, students will learn how engineers design and test spacecraft to ensure survivability in this harsh space environment. We will explore three different space environment scenarios, including a small satellite that must survive in Low Earth Orbit (LEO), a large spacecraft headed to rendezvous with an asteroid, and a human spaceflight mission to Mars.</p>
AA 109Q	Aerodynamics of Race Cars	X		<p>Almost as soon as cars had been invented, races of various kinds were organized. In all its forms (open-wheel, touring car, sports car, production-car, one-make, stock car, etc.), car racing is today a very popular sport with a huge media coverage and significant commercial sponsorships. More importantly, it is a proving ground for new technologies and a battlefield for the giants of the automotive industry. While race car performance depends on elements such as engine power, chassis design, tire adhesion and of course, the driver, aerodynamics probably plays the most vital role in determining the performance and efficiency of a race car. Front and/or rear wings are visible on many of them. During this seminar, you will learn about many other critical components of a race car including diffusers and add-ons such as vortex generators and spoilers. You will also discover that due to the competitive nature of this sport and its associated short design cycles, engineering decisions about a race car must rely on combined information from track, wind tunnel, and numerical computations. It is clear that airplanes fly on wings. However, when you have completed this seminar, you will be able to understand that cars fly on their tires. You will also be able to appreciate that aerodynamics is important not only for drag reduction, but also for increasing cornering speeds and lateral stability. You will be able to correlate between a race car shape and the aerodynamics effects intended for influencing performance. And if you have been a fan of the Ferrari 458 Italia, you will be able to figure out what that black moustache in the front of the car was for.</p>
AA 118N	How to Design a Space Mission: from Concept to Execution	X		<p>Space exploration is truly fascinating. From the space race led by governments as an outgrowth of the Cold War to the new era of space commercialization led by private companies and startups, more than 50 years have passed, characterized by great leaps forward and discoveries. We will learn how space missions are designed, from concept to execution, based on the professional experience of the lecturer and numerous examples of spacecraft, including unique hardware demonstrations by startups of the Silicon Valley. We will study the essentials of systems engineering as applicable to a variety of mission types, for communication, navigation, science, commercial, and military applications. We will explore the various elements of a space mission, including the spacecraft, ground, and launch segments with their functionalities. Special emphasis will be given to the design cycle, to understand how spacecraft are born, from the stakeholders' needs, through analysis, synthesis, all the way to their integration and validation. We will compare the current designs with those employed in the early days of the space age, and show the importance of economics in the development of spacecraft. Finally, we will brainstorm startup ideas and apply the concepts learned to a notional space mission design as a team.</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
AA 122N	Dawn of the Drones: How Will Unmanned Aerial Systems Change Our World?	X		Unmanned aerial systems (UASs) have exploded on the scene in recent years, igniting a national debate about how to use them, how to regulate them, and how to make them safe. This seminar will dive into the many engineering challenges behind the headlines: in the future, how will we engineer UASs ranging in size from simple RC toys to highly-sophisticated autonomous scientific and military data gathering systems? This seminar will examine the key elements required to conceive, implement, deploy, and operate state-of-the-art of drone systems: What variety of problems can they help us solve? How autonomous are they and how autonomous do they need to be? What are the key technical bottlenecks preventing widespread deployment? How are they different from commercial aircraft? What kinds of companies will serve the market for UAV-related products and services? What business models will be successful and why? We will emphasize aspects of design, autonomy, reliability, navigation, sensing, and perception, as well as coordination/collaboration through a series of case studies drawn from our recent experience. Examples include imaging efforts to map the changing coral reefs in the South Pacific, using and controlling swarms of unmanned systems to perform search and rescue missions over large areas, and package delivery systems over large metropolitan areas. Hands-on experience with Stanford-developed UASs will be part of the seminar.
AA 240B	Analysis of Structures	X		Thin plate analysis. Structural stability. Material behavior: plasticity and fracture. Introduction of finite element analysis; truss, frame, and plate structures. Prerequisite: 240A or consent of instructor.
AA 241X	Autonomous Aircraft: Design/Build/Fly	X		Students grouped according to their expertise to carry out the multidisciplinary design of a solar-powered autonomous aircraft that must meet a clearly stated set of design requirements. Design and construction of the airframe, integration with existing guidance, navigation, and control systems, and development and operation of the resulting design. Design reviews and reports. Prerequisites: expertise in any of the following disciplines by having satisfied the specified courses or equivalent work elsewhere: conceptual design (241A,B); applied aerodynamics (200A,B); structures (240A); composite manufacturing experience; guidance and control (208/271, ENGR 205).
AA 252	Techniques of Failure Analysis	X		Introduction to the field of failure analysis, including fire and explosion analysis, large scale catastrophe projects, traffic accident reconstruction, aircraft accident investigation, human factors, biomechanics and accidents, design defect cases, materials failures and metallurgical procedures, and structural failures. Product liability, failure modes and effects analysis, failure prevention, engineering ethics, and the engineer as expert witness.
AA 256	Mechanics of Composites	X		Fiber reinforced composites. Stress, strain, and strength of composite laminates and honeycomb structures. Failure modes and failure criteria. Environmental effects. Manufacturing processes. Design of composite structures. Individual design project required of each student, resulting in a usable computer software. Prerequisite: ENGR 14 or equivalent.
AA 257	Design of Multifunctional Composite Structures	X		Hands-on design, analysis, and manufacturing of high-performance composite structures with multifunctional capabilities: structural health monitoring, state sensing and awareness, electrical energy storage, and built-in intelligence. Advanced composite structures will be fabricated and integrated with sensors, actuators, electronic circuits, and batteries to create multifunctional structures and devices for various applications: design of fly-by-feel UAVs and drones; self-powered electrical car frames, maintenance-free self-diagnostic structures, and intelligent structures for various engineering applications. The class will be divided into working teams (design, analysis, software, manufacturing, and testing) to design and build an intelligent structure or multifunctional device to be determined at the beginning of the course. Prerequisite: 256 or consent of instructor.
AA 279C	Spacecraft Attitude Determination and Control	X		Attitude representation and parametrization; unperturbed and perturbed attitude dynamics and stability; attitude sensors and actuators; linear and nonlinear attitude control; optimal attitude maneuvers; dynamics of flexible spacecraft and space tethers; invited lectures from industry. Prerequisites: AA 242A, ENGR 105, AA 279A, and familiarity with MatLab.
AA 279D	Spacecraft Formation-Flying and Rendezvous	X		Keplerian orbital mechanics and orbital perturbations; the general relative motion problem; linear formation flying dynamics and control; impulsive station-keeping and reconfiguration; high order relative motion equations; formulation of relative motion using orbital elements; perturbation-invariant formations; nonlinear formation control; low-thrust propulsion for formation flying; relative navigation using GNSS and optical navigation; applications: sparse-aperture imaging, remote sensing, on-orbit servicing, rendezvous, and docking. Prerequisite: AA 242A, ENGR 105, AA 279A, and familiarity with MatLab.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
AA 280	Smart Structures		X	Mechanics of smart materials and current approaches for engineering smart structures to monitor health, self heal, and adapt to environment. Definition of smart structures; constitutive models for smart materials; piezoelectric ceramics; electro-active polymers; shape memory alloys; bio-inspired materials and structures; self-healing materials; sensors and sensor networks; structural health monitoring; and energy harvesting. Prerequisite: AA 240A or consent of instructor.
AA 284A	Advanced Rocket Propulsion	X		The principles of rocket propulsion system design and analysis. Fundamental aspects of the physics and chemistry of rocket propulsion. Focus is on the design and analysis of chemical propulsion systems including liquids, solids, and hybrids. Nonchemical propulsion concepts such as electric and nuclear rockets. Launch vehicle design and optimization issues including trajectory calculations. Limited enrollment. Prerequisites: 283 or consent of instructor.
AA 284B	Propulsion System Design Laboratory	X		Propulsion systems engineering through the design and operation of a sounding rocket. Students work in small teams through a full project cycle including requirements definition, performance analysis, system design, fabrication, ground and flight testing, and evaluation. Prerequisite: 284A and consent of instructor.
AA 284C	Propulsion System Design Laboratory	X		Continuation of 284A,B. Prerequisite: 284B, and consent of instructor.
AMSTUD 155	American Constitutional History from the Civil War to the War on Poverty	X		(Same as LAW 7008.) This course addresses U.S. constitutional history from the post-Civil War Reconstruction period through the mid-20th century. Because of the breadth of the subject matter, the view will necessarily be partial. In particular we will take as our focus the way the Constitution has provided a point of political mobilization for social movements challenging economic and social inequality. Topics covered include: Civil War Reconstruction and restoration; the rise of corporate capitalism and efforts to constrain it; Progressive Era regulation; the New Deal challenge to federalism and the anti-New Deal backlash; government spending; WWII and the Japanese Internment; the Civil Rights Era, and the War on Poverty. Readings will include both legal and historical materials with a focus on the relationship between law and society. Readings will include both legal and historical materials with a focus on the relationship between law and society. Elements used in grading: Class Participation, Attendance, Written Assignments, Final Paper. Paper extensions will be granted with instructor permission. No automatic grading penalty for late papers.
ANES 70Q	Critical Illness: Patients, Physicians, and Society	X		Examines the various factors involved in shaping the critical care illness experience for three groups of people: the clinicians, the patients, and patients' families. Medical issues, economic forces and cost concerns, cultural biases, and communication errors can all influence one's perception. Helps students understand the arc of critical illness, and how various factors contribute to the interactions between those various groups. Includes an immersion experience (students are expected to round with clinicians in the ICU and to attend Schwartz rounds, a debriefing meeting about difficult emotional situation) and a mentoring experience (with critical care fellows), in addition to routine class work.
ANTHRO 135C	Moving Worlds: Anthropology of Mobility and Travel	X		This course looks at human mobility from an anthropological perspective. We will read texts that ethnographically explore the experiences of refugees, labor migrants, tourists and seafarers, among others. In particular, we will look at the intersection of physical mobility and social mobility, as people often move in order to improve their life, to increase safety or economic security, or to gain social capital. However, the mobility perspective has also been criticized for depoliticizing and celebrating movement without critical attention to its socio-political and economic context. While mobility as a term points to the ability to move, human migration is at least as often characterized by restrictions and obstacles to movement, such as borders. We will think critically about the deep inequalities that exist in terms of why and how people move, and who are able to mobilize resources to move.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
ANTHRO 139C	Anthropology of Global Health	X		<p>Global health has been the contested realm of theoretical debates and praxis in medical anthropology. Rationalities behind global health projects reflected the predominant mode of envisioning health in specific historical moments. · In this course, we will first assess the ways in which memories, materiality and institutions of the colonial past persist in the field of global health in Africa. · Secondly, we will explore how early medical anthropologists participated in international health projects in order to facilitate implementation of the Western biomedicine in developing countries by investigating cultural barriers under the post-war regime of international development in the efforts of controlling malaria and HIV/AIDS in Latin America. · Thirdly, we will examine achievements and limitations of subsequent critical medical anthropologists' shift of the focus of analysis on global health from culture to structure, larger political economic conditions that produced vast health inequalities around the world, including World Bank policies under the Cold War and neoliberal reforms that increased the prevalence of TB and other diseases in post-socialist contexts · Finally, we will question previous anthropological discourses on global health and propose potential insights by understanding moral imaginations of contemporary global health participants such as WHO or Gates Foundation and humanitarian medicine such as MSF, and continuities and discontinuities of colonial and developmental past in current global health movement.</p>
ANTHRO 140C	Mobilizing Nature		X	<p>From Brazil's Landless Worker's Movement (MST) to Water Wars of Cochabamba to Standing Rock, these moments of protest have turned into movements. This seminar will examine how theoretical framings of movements have shifted from claims about political rights to environmental ones. We will address two overarching questions: How are notions of ethnicity, gender, and class constructed in relation to the environment? And how do people understand these relationships in such a way that motivates them to mobilize? Students will explore what kinds of ecological claims are being made, who is making, how, and who benefits from them. The objective is to ultimately understand how movements not only reflect, but also (re)shape political and social practices around the environment.</p>
ANTHRO 345A	Race and Power: The Making of Human Difference in History, Biology and Capital	X		<p>This course examines how race is made. We will pay close attention to how people engage with material, economic, scientific, and cultural forces to articulate human group difference as a given, and even natural. In this seminar, we will look at the reality of race as a literally constructed phenomenon, where historical, colonial, bodily, market, penal, and humanitarian constituent elements both circulate and sediment racial understandings. To focus our readings and discussions we will divide this vast terrain into three units: race and the colonial encounter, race and biopower, and race in systems of capital accumulation.</p>
ANTHRO 349	Anthropology of Capitalism	X		<p>This advanced graduate seminar explores capitalism as an historically-situated and culturally-mediated articulation of practices rather than as an economic system or social structure governed by an internal logic. It draws on poststructural theories of culture, society and subjectivity to investigate the processes through which diverse capitalist practices are produced. Prerequisite: Graduate standing in Anthropology or permission of the instructor. Previous graduate level coursework in cultural anthropology, social theory or cultural studies is required. No auditing is permitted. Enrollment limited to 12.</p>
ANTHRO 367	The Anthropology of Science: Global Politics and Laboratory Life	X		<p>Science and technology are important cultural products that often dramatically reorganize various aspects of human life. In this course we will explore how recent innovations in the life sciences and biomedicine may reconfigure crucial elements of social institutions, lend new structures to identity politics, and often change the way we interact with and conceive of nature. We will examine these issues in various global settings to explore how everyday politics shape politics of life in different locales.</p>
ANTHRO 372	Urban Ecologies	X		<p>At the intersections of urbanism and environmental studies, political ecology, postcolonial theory and the new materialism, new fields are in formation. This seminar explores scholarship that connects cities with countrysides through questions of resources and infrastructures. We will consider questions of inequality access and community as well as unexpected urban ecologies</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
ANTHRO 39	Sense of Place	X		This course examines the life of places as shaped by environmental events and projects aimed towards rural or urban development. Drawing methodological insights from anthropology, cultural geography and environmental studies, we examine the forces that generate place problems for humans and nonhumans. Each encounter with place and displacement sets up a particular issue for us to grapple with: How would we address issues created by natural disasters, the seizure of land through legal means that fall under eminent domain or gentrification projects? Through a critical dialogue with interdisciplinary fields that inform the readings, the seminar aims to bring theoretical and methodological insights to inform our practical suggestions for how to address placeness and displaceness at different scales.
APPPHYS 79Q	Energy Options for the 21st Century		X	Preference to sophomores.. Choices for meeting the future energy needs of the U.S. and the world. Basic physics of energy sources, technologies that might be employed, and related public policy issues. Trade-offs and societal impacts of different energy sources. Policy options for making rational choices for a sustainable world energy economy.
ARTHIST 450	Art in the Age of Precarity	X		Art and precarity in the age of neoliberalism. How artists and critics engage questions of immaterial labor, human capital, structural racism, environmental crisis, the anthropocene and other current issues in their work. The question of art as activism and social practice relative to such themes. Enrollment contingent upon permission of instructor; permission numbers will be provided by staff upon professor's approval.
ARTSTUDI 164	DESIGN IN PUBLIC SPACES	X		How does our design of public spaces and elements of our built environment influence and control people's movements and expressions in these spaces? Can re-designing a trashcan or a stairway change how people throw away their trash or use the stairs? What are the principles of democracy, surveillance, or personal expression at stake in our current shared spaces? How have artists and designers used their skills to question or re-direct people's behavior in these public spheres, or in other spheres of shared cultural heritage? Strategies include re-designing components of the built environment, but also other strategies of intervention, tactical media and reality hacking.
ARTSTUDI 184	Art and Environmental Engagement		X	The aim of this course is to use the tools of art as a means to actively engage with the natural world. Students will be required to go beyond surface representations and dig deep with their work to uncover conceptual, ecological and historical meaning. Whether the focus is on a plant, animal, mineral, or an ecological system, students will be encouraged to investigate and interact with their subjects. Scientists who experiment in the field will be brought in to discuss their research and working processes. Collaborations are welcome. We will examine the work by artists, from past to present, who address the environment in a critical way. Students will work on creative projects with the goal to open new avenues of dialogue between culture and nature.
ARTSTUDI 255	Sonic Crossroads	X		Through the history of music, sound art, acoustic ecology, literature, film, visual arts and performance, this course will examine the territory where sound meets space, sight, symbol, ritual, activism, self consciousness and language. Students will engage in conversations, experiments and exercises that will enhance their awareness of the sonic phenomena and the ζtime canvasζ as a space of creation and communication.
ARTSTUDI 284	Art and Biology	X		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)
ASNAMST 110	The Development of the Southeast Asian American Communities: A comparative analysis	X		This course will examine the establishment of the Cambodian, Hmong, and Vietnamese communities in the US. We will focus on the historical events that resulted in their immigration and arrival to the US as well as the similarities and differences in the ways in which they were received. In addition, the course will focus on issues that impacted in the development of these communities focusing on the social, political, and economic processes by which new immigrant groups are incorporated into the American society. The second part of the course will be devoted to analyzing contemporary issues including but not limited to: class status, educational attainment, ethnic identity, racialization, second generation, mass media representation, poverty, and economic mobility.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
BIO 133	Network analysis for community ecology and conservation research		X	Graduate student led seminar. Plant-pollinator, predator-prey, and parasite-host are all examples of species interactions that can be analyzed using species interaction networks. Network analysis is an incredible tool to understand how ecological communities are impacted by environmental stressors like human development and climate change. In this class, we will review and discuss relevant scientific literature and learn how to manipulate, visualize, and interpret species interaction network data. Students will develop grant-writing skills by producing a culminating research proposal and we will take a field trip to practice species interaction sampling techniques. Prerequisites: BIO 43 or BIO 81 or BIO 85.
BIO 16	Conservation Storytelling: Pre-course for BOSP South Africa		X	Limited to students admitted to the BOSP South Africa overseas seminar. Through 4 workshop meetings, students will develop and pitch story ideas, form teams in which a writer and a photographer agree to collaborate on a story, and conduct background research prior to departing for South Africa.
BIO 202	Ecological Statistics	X		Intended for graduate students (and advanced undergraduates in special circumstances with consent of instructors) in biology and related environmental sciences, this course is an introduction to statistical methods for ecological data analysis, using the programming language R. The course will have lectures, discussions, and independent research projects using the students' own data or simulated or publicly available data.
BIO 21	The Science of Extreme Life of the Sea	X		Covers the way marine animals and plants live in extreme environments by examining morphological, ecological, and genetic adaptations to low temperature, high heat, deep water, etc. We also cover extreme lifestyles such as fast swimming, small and large body size, and novel reproductive systems. Lecture material is punctuated with a series of tutorials on narrative writing skills in science, especially creative non-fiction, memoirs, braided essays and short fiction. The goal is to integrate quantitative thinking about the life sciences with creative writing that brings facts to life. Prerequisites: core courses in biology, creative writing, environmental sciences or engineering. Two lectures back to back on Tuesdays with a Writing Intermezzo between.
BIO 25Q	Cystic fibrosis: from medical conundrum to precision medicine success story	X		Preference to sophomores. The class will explore cystic fibrosis (CF), the most prevalent fatal genetic disease in the US, as a scientific and medical whodunit. Through reading and discussion of medical and scientific literature, we will tackle questions that include: how was life expectancy with CF increased from weeks to decades without understanding the disease mechanism? Why is the disease so prevalent? Is there an advantage to being a carrier? Is CF a single disease or a continuum of physiological variation? or- what is a disease? How did research into CF lead to discovery of the underlying cause of most other genetic diseases as well? Through critical reading of the scientific and medical literature, class discussion, field trips and meetings with genetic counselors, caregivers, patients, physicians and researchers, we will work to build a deep understanding of this disease, from the biochemical basis to the current controversies over pathogenic mechanisms, treatment strategies and the ethics and economics of genetic testing and astronomical drug costs.
BIO 3	Frontiers in Marine Biology	X		An introduction to contemporary research in marine biology, including ecology, conservation biology, environmental toxicology, behavior, biomechanics, evolution, neurobiology, and molecular biology. Emphasis is on new discoveries and the technologies used to make them. Weekly lectures by faculty from the Hopkins Marine Station.
BIO 302	Current Topics and Concepts in Population Biology, Ecology, and Evolution	X		Required of first-year PhD students in population biology, and ecology and evolution. Major conceptual issues and developing topics. This course is open only to Biology PhD students and is not open to auditors."
BIO 303	Current Topics and Concepts in Population Biology, Ecology, and Evolution	X		Required of first-year PhD students in population biology, and ecology and evolution. Major conceptual issues and developing topics. This course is open only to Biology PhD students and is not open to auditors."
BIO 304	Current Topics and Concepts in Population Biology, Ecology, and Evolution	X		Required of first-year PhD students in population biology, and ecology and evolution. Major conceptual issues and developing topics. This course is open only to Biology PhD students and is not open to auditors."

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
BIO 35N	Climate change ecology: Is it too late?		X	This Introductory Seminar will explore the consequences of climate change on ecological communities, focusing on two emerging concepts: "disequilibrium," which emphasizes that it can take long time for communities to respond to climate change because of species interactions, and "historical contingency," which proposes that the order in which species invade and disappear as communities re-assemble in response to climate change will determine which species will persist. The seminar will involve lecture, discussion, writing, and visit to Jasper Ridge Biological Preserve.
BIO 386	Conservation and Population Genomics		X	This once a week reading and discussion group will consider how advances in genome technology have enabled new explorations in conservation and population biology. Papers to be read will include technical applications of new genome tools, the role of bioinformatics, and long-standing questions in conservation and population biology that might now be answered.
BIO 3N	Views of a Changing Sea: Literature & Science		X	The state of a changing world ocean, particularly in the eastern Pacific, will be examined through historical and contemporary fiction, non-fiction and scientific publications. Issues will include harvest and mariculture fisheries, land-sea interactions and oceanic climate change in both surface and deep waters.
BIO 60	Problem solving in infectious disease	X		Why is Lyme disease spreading? How does HIV become drug resistant? How do other animals affect our disease risk? In BIO 60 students will examine actual case studies to experience how different scientific approaches are used to battle infectious disease. They will evaluate information presented in the popular media and the scientific literature, and will directly participate in the scientific process through hands-on collection, documentation and analyses of authentic scientific data. Students will cultivate their scientific curiosity by discovering the natural world with a Foldscope, the origami paper microscope (https://microcosmos.foldscope.com). Students will build critical thinking skills by creating hypotheses, and designing experiments that pertain to problems in infectious disease. Students will work in teams to expand their thinking and will practice communicating science to different audiences.
BIO 7N	Introduction to Conservation Photography		X	Introduction to the field of conservation photography and the strategic use of visual communication in addressing issues concerning the environment and conservation. Students will be introduced to basic digital photography, digital image processing, and the theory and application of photographic techniques. Case studies of conservation issues will be examined through photographs and multimedia platforms including images, video, and audio. Lectures, tutorials, demonstrations, and optional field trips will culminate in the production of individual and group projects.
BIO 81	Introduction to Ecology	X		This course will introduce you to the first principles of the science of ecology, the study of interactions between organisms and their environment. Prerequisites: None.
BIOE 141A	Senior Capstone Design I	X		Lecture/Lab. First course of two-quarter capstone sequence. Team based project introduces students to the process of designing new biological technologies to address societal needs. Topics include methods for validating societal needs, brainstorming, concept selection, and the engineering design process. First quarter deliverable is a design for the top concept. Second quarter involves implementation and testing. Guest lectures and practical demonstrations are incorporated. Prerequisites: BIOE 123 and BIOE 44. This course is open only to seniors in the undergraduate Bioengineering program.
BIOHOPK 14	Bio-logging and Bio-telemetry	X		Bio-logging is a rapidly growing discipline that includes diverse fields such as consumer electronics, medicine, and marine biology. The use of animal-attached digital tags is a powerful approach to study the movement and ecology of individuals over a wide range of temporal and spatial scales. This course is an introduction to bio-logging methods and analysis. Using whales as a model system, students will learn how use multi-sensor tags to study behavioral biomechanics.
BIOHOPK 234H	Topics in Comparative and Environmental Physiology	X		Seminar and discussion focused on current topics and research at the interface of physiology and ecology

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
BIOHOPK 47	Introduction to Research in Ecology and Ecological Physiology		X	This course is a field-based inquiry into rocky intertidal shores that introduces students to ecology and environmental physiology and the research methods used to study them. Students will learn how to detect patterns quantitatively in nature through appropriate sampling methods & statistical analysis. Following exploration of appropriate background material in class and through exploration of the scientific literature, students will learn how to formulate testable hypotheses regarding the underlying causes of the patterns they discern. A variety of different aspects of ecology and physiology will be investigated cooperatively by the students during the quarter, culminating in development of an individual final paper in the form of a research proposal based on data collected during the course. The course will provide a broad conceptual introduction to the underlying biological principles that influence adaptation to the planet's dynamic habitats, as well as inquiry-based experience in how to explore and understand complex systems in nature. This course fulfills the same laboratory requirement as BIO 47. Satisfies WIM in Biology.
BIOHOPK 81	Introduction to Ecology	X		The course is designed to provide background on key concepts in ecology, familiarize students with key ecological processes and ecosystems, and the methods used in ecological studies. The course will further build students' skills in critical scientific thinking, reading the literature, and scientific communication. A major goal of the course is to train students to ask questions in ecology, and to design, conduct and report studies addressing these questions. Thus, emphasis is also placed, in addition to general ecological concepts, on field observations, experimental design, and the analysis, interpretation and presentation of ecological data (through computer laboratories, written assignments and presentations). Written assignments, presentations and discussions are designed to provide experience in organizing and presenting information and to expose students to multiple perspectives on ecological processes and their applications. This course fulfills the same requirement as BIO 81.
BIOHOPK 85	Evolution	X		Principles of micro- and macro-evolution from molecular genetics to the development of biological diversity. Adaptation, divergence and natural selection in the past and in contemporary ecological settings. Evolution of humans and human-caused evolution. Emphasis on major body plans in the sea and ocean examples of major evolutionary processes. This course fulfills the same requirements as BIO 85.
BIOS 225	Diversity and Inclusion in Science	X		Introduction to the social science literature on factors contributing to gender disparities in the scientific workplace (e.g. implicit bias and stereotype threat). Discussions focus on steps that individuals and institutions can take to promote the advancement of women and other underrepresented groups in science, and thus promote the advancement of science.
BIOS 258	Ethics, Science, and Society	X		This discussion focused Ethics, Science, and Society interactive mini-course will engage Biosciences graduate students and faculty in learning and conversations on topics in responsible research (including animal subjects, authorship, collaboration, conflicts of interest, data management, human subjects, mentor-mentee relationships, peer review, publication, research misconduct, and social responsibility) and diversity in science, informed by readings, case studies, individual reflections, and more. Some of the driving themes in this course include: what it means to do research well and how to and not to achieve this, why doing research well and with integrity is important, and who are researchers currently and who should they be.
BIOS 270	Planetary Health: Socioeconomic & Ecological Links Between Human Health & Earth's Natural Ecosystems		X	Two of the biggest challenges humanity has to face - promoting human health and halting environmental degradation are strongly connected and too big to be addressed in an incremental, sector-specific way. Breakthroughs can be achieved through a creative, interdisciplinary approach that fully recognizes the complex nature of links between human health and healthy, functioning ecosystems. Through a series of lectures and case-study discussions with experts from multiple Schools and Departments, students will develop an in-depth understanding of the "Planetary Health" concept, its foundation, goals, priority areas of action and methods of investigation, and the most relevant immediate and long-term challenges.
CEE 1	Introduction to Environmental Systems Engineering	X		Field trips visiting environmental systems installations in Northern California, including coastal, freshwater, and urban infrastructure. Requirements: Several campus meetings, and field trips. Enrollment limited; priority given to undergraduates who have declared Environmental Systems Engineering major.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
CEE 101B	Mechanics of Fluids	X		Physical properties of fluids and their effect on flow behavior; equations of motion for incompressible ideal flow, including the special case of hydrostatics; continuity, energy, and momentum principles; control volume analysis; laminar and turbulent flows; internal and external flows in specific engineering applications including pipes and open channels; elements of boundary-layer theory. The Tuesday lectures, which are preparation for the labs, will start at 12:30pm. Lab experiments will illustrate conservation principles and flows of real fluids, analysis of errors and modeling of simple fluid systems. Students seeking to take this course without the laboratory will need to enroll in CEE 162A but must get permission first from the instructor. Prerequisites: E14, Physics 41, Math 51, or CME 100.
CEE 101C	Geotechnical Engineering	X		Introduction to the principles of soil mechanics. Soil classification, shear strength and stress-strain behavior of soils, consolidation theory, analysis and design of earth retaining structures, introduction to shallow and deep foundation design, slope stability. Lab projects. Prerequisite: ENGR 14. Recommended: 101A.
CEE 102	Legal Principles in Design, Construction, and Project Delivery	X		Introduction to the key legal principles affecting design, construction and the delivery of infrastructure projects. The course begins with an introduction to the structure of law, including principles of contract, negligence, professional responsibility, intellectual property, land use and environmental law, then draws on these concepts to examine current and developing means of project delivery.
CEE 131C	How Buildings are Made -- Materiality and Construction Methods	X		This course will provide an introduction to the materials and methods used in building construction. A combination of in-class lectures, reading assignments, and building site visits will provide students with an awareness of construction materials and their use within building systems. All relevant building types and construction materials will be explored, including wood, steel, concrete and masonry. Building foundations and basic structural systems will be explained. Building envelope elements will be considered, with an analysis of various glass and glazing materials, cladding types, and roofing systems. Interior Floor, wall and ceiling finishes will be discussed. New and emerging building trends will also be examined, such as prefabricated and modular construction. Guest presenters, drawn from Bay Area consulting firms, will cover several topics of interest. Students will have an opportunity to experience real world material applications at local construction sites, and gain a thorough understanding of the construction process.
CEE 144	Design and Innovation for the Circular Economy	X		The last 150 years of our industrial evolution have been material and energy intensive. The linear model of production and consumption manufactures goods from raw materials, wells and uses them, and then discards the products as waste. Circular economy provides a framework for systems-level redesign. It builds on schools of thought including regenerative design, performance economy industrial ecology, blue economy, biomimicry, and cradle to cradle. This course introduces the concepts of the circular economy and applies them to case studies of consumer products, household goods, and fixed assets. Students will conduct independent projects on circular economy. Students may work alone or in small teams under the guidance of the teaching team and various collaborators worldwide. Class is limited to 14 students. All disciplines are welcome. This class fulfills the Writing & Rhetoric 2 requirement. Prerequisite: PWR 1.
CEE 162F	Coastal Processes	X		Formerly Coastal Engineering. Fluid dynamics and sediment transport processes that govern the physical behavior of the coastal ocean. Topics: waves, coastal sediment transport, tides, storm surge, sea-level rise, estuarine circulation, river plumes, and upwelling. Prerequisite: PHYSICS 41 (formerly 53).
CEE 172	Air Quality Management		X	Quantitative introduction to the engineering methods used to study and seek solutions to current air quality problems. Topics: global atmospheric changes, urban sources of air pollution, indoor air quality problems, design and efficiencies of pollution control devices, and engineering strategies for managing air quality. Prerequisites: 70, MATH 51.
CEE 174A	Providing Safe Water for the Developing and Developed World		X	This course will cover basic hydraulics and the fundamental processes used to provide and control water, and will introduce the basics of engineering design. In addition to understanding the details behind the fundamental processes, students will learn to feel comfortable developing initial design criteria (30% designs) for fundamental processes. Students should also develop a feel for the typical values of water treatment parameters and the equipment involved. The course should enable students to work competently in environmental engineering firms or on non-profit projects in the developing world such as Engineers without Borders. Pre-requisite: Chem31B/X.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
CEE 174B	Wastewater Treatment: From Disposal to Resource Recovery	X		This course builds upon CEE 174A, covering basic hydraulics and the fundamental processes used to treat wastewater. In addition to understanding the details behind the fundamental processes, students will learn to feel comfortable developing initial design criteria (30% designs) for fundamental processes. Students should also develop a feel for the typical values of water treatment parameters and the equipment involved. After covering conventional processes, the class addresses newer processes used to meet emerging treatment objectives, including nutrient removal, composting of biosolids and recycling of wastewater for beneficial uses, including potable reuse. Pre-requisites: CEE 174A.
CEE 176A	Energy Efficient Buildings		X	Quantitative evaluation of technologies and techniques for reducing energy demand of residential-scale buildings. Heating and cooling load calculations, financial analysis, passive-solar design techniques, water heating systems, photovoltaic system sizing for net-zero-energy all-electric homes. Offered for 3 or 4 units; the 4-unit option includes a lab.
CEE 176B	100% Clean, Renewable Energy and Storage for Everything		X	This course discusses elements of a transition to 100% clean, renewable energy in the electricity, transportation, heating/cooling, and industrial sectors for towns, cities, states, countries, and companies. It examines wind, solar, geothermal, hydroelectric, tidal, and wave characteristics and resources; electricity, heat, cold and hydrogen storage; transmission and distribution; matching power demand with supply on the grid; efficiency; replacing fossil with electric appliances and machines in the buildings and industry; energy, health, and climate costs and savings; land requirements; feedbacks of renewables to the atmosphere; and 100% clean, renewable energy roadmaps to guide transitions.
CEE 177	Aquatic Chemistry and Biology	X		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.
CEE 179C	Environmental Engineering Design		X	Application of engineering fundamentals including environmental engineering, hydrology, and engineering economy to a design problem. Enrollment limited; preference to seniors in Civil and Environmental Engineering.
CEE 183	Integrated Civil Engineering Design Project	X		Studio format. Design concepts for civil engineering facilities from schematic design through construction, taking into account sustainable engineering issues. Design exercises culminating in the design of a civil engineering facility, emphasizing structural systems and materials and integration with architectural, construction and other project requirements. Prerequisites: CEE 180, 181, 182; CEE 120 (or equivalent background in BIM), civil engineering major; architectural design major with instructor consent.
CEE 200A	Teaching of Civil and Environmental Engineering		X	Required of CEE Ph.D. students. Strategies for effective teaching and introduction to engineering pedagogy. Topics: problem solving techniques and learning styles, individual and group instruction, the role of TAs, balancing other demands, grading. Teaching exercises. Register for quarter of teaching assistantship. 200A. Aut, 200B. Win, 200C. Spr
CEE 200B	Teaching of Civil and Environmental Engineering		X	Required of CEE Ph.D. students. Strategies for effective teaching and introduction to engineering pedagogy. Topics: problem solving techniques and learning styles, individual and group instruction, the role of TAs, balancing other demands, grading. Teaching exercises. Register for quarter of teaching assistantship. May be repeated for credit. 200A. Aut, 200B. Win, 200C. Spr
CEE 200C	Teaching of Civil and Environmental Engineering		X	Required of CEE Ph.D. students. Strategies for effective teaching and introduction to engineering pedagogy. Topics: problem solving techniques and learning styles, individual and group instruction, the role of TAs, balancing other demands, grading. Teaching exercises. Register for quarter of teaching assistantship. May be repeated for credit. 200A. Aut, 200B. Win, 200C. Spr
CEE 222B	Computer Integrated Architecture/Engineering/Construction (AEC) Global Teamwork	X		Global AEC student teams continue their project activity focusing on the most challenging concept developed in 222A and chosen jointly with their client. Comprehensive team project focusing on design and construction, including: project development and documentation; detailing, 3D and 4D modeling, simulation, sustainable concepts, cost benefit analysis, and life-cycle cost analysis; and final project presentation of product and process. Prerequisite: CEE 222A.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
CEE 223	Materials for Sustainable Built Environments		X	In this course, students will learn about new and traditional construction materials for use in sustainable building and infrastructure projects. Materials will include cement-based materials and fiber-reinforced polymer composites for structural and non-structural applications, as well as novel materials for e.g., facades, insulation, and paving. Material properties, their performance over time and their impact on people and the environment will be discussed. Course project as well as some hands-on laboratory work. Pre-requisite: CEE 101A or equivalent.
CEE 226	Life Cycle Assessment for Complex Systems		X	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.
CEE 226E	Advanced Topics in Integrated, Energy-Efficient Building Design		X	This class explores innovative methods for designing, developing, and financing high performance, low energy buildings. Students will learn best practices to reduce building energy buildings. Students will learn best practices to reduce building energy use and integrate solar PV generation in pursuit of commercial Net Zero Energy buildings. Lectures include presentations and panels featuring leading practitioners and researchers in the field. Optional site visits to local Net Zero Energy and LEED buildings provide context to support lectures. CEE 176A and CEE 156/256 or similar courses are recommended prerequisites but not required. All students are expected to participate in a group-based, term project focused on the design and development of a Net Zero Energy building. Students taking the course for two units will not be required to complete in-class assignments for individual homework assignments.
CEE 227	Global Project Finance	X		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.
CEE 228	Methods in Urban Systems	X		Introduction to quantitative tools and methods for solving problems in urban systems, including geographic information science (GIS), modeling, data analysis, and programming methodologies.
CEE 230	Urban Development and Governance	X		Introduction to urban planning, policy, politics, and governance by a lecture team from SPUR. Focus on the U.S., California, and the Bay Area.
CEE 241P	Integrated Management of Fabrication and Construction	X		Application of the fundamental fabrication and construction management concepts covered in CEE 241T to an actual project; integrated software environments; integration of scope, schedule, and cost information for scheduling, estimating, and progress control; scope management with BIM; off-site fabrication vs. on-site construction and supply chain coordination; group project; project permitting, potential for a joint project with CEE 242P. Prerequisites: CEE 210, CEE 241T.
CEE 242R	Project Risk Analysis	X		Teaches principles and methods for quantitative modeling and mitigation of risks in project planning, design, construction and operation, using new MS Excel capabilities and standardized probability distributions. Several case studies will be covered, including ongoing work with PG&E to roll up operational risks.
CEE 243	Intro to Urban Sys Engrg		X	This course is an introduction to the interdisciplinary domain of urban systems engineering. It will provide you with a high-level understanding of the motivation for studying sustainable cities and urban systems, systems-based modeling approaches and the social actor theories embedded in the urban sustainability decision making process. Coursework will be comprised of three group mini-projects corresponding to course modules.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
CEE 246	Venture Creation for the Real Economy	X		CEE 246 is a unique course geared toward developing entrepreneurial businesses (both start-ups and internal ventures). This team, project-based class teaches students how to exploit emerging materials science, engineering and IT technologies to radically apply innovation to the real economy (e.g., new products and services that produce real economic value for society as well as for the entrepreneurs. Areas of focus include: Sustainable Buildings and Infrastructure, Digital Cities and Communities, Clean Energy, Transportation and Logistics, Advanced Manufacturing, Digital Health Care, and Education. With one-on-one support from seasoned industry mentors and influential guest speakers, the course guides students through the three key elements of new venture creation: identifying opportunities, developing business plans, and determining funding sources. The class culminates with business presentations to industry experts, VCs and other investors. The goal is to equip students with the knowledge and network to create impactful business ideas, many of which have been launched from this class. To apply for this limited enrollment course, students must submit the following application: https://goo.gl/forms/jWaTr5ZTG05WBsoE2
CEE 246B	Real Estate Development and Finance	X		Introduction to the Real Estate Development Process from conception, feasibility analysis, due diligence, entitlements, planning, financing, market analysis, contract negotiation, construction, marketing, asset management and disposition. Pro-forma and Financial modeling in Real Estate. Financing options for different types of Real Estate projects and products. Redevelopment projects. Affordable Housing. The class will combine lectures, case studies, field work (Group Project) and guest speakers. Recommended knowledge of spreadsheets. Prerequisites: highly recommended Engineering Economy (CEE 246A or ENGR 60) or any Introduction to Finance class (concepts of Present Worth and IRR). Attendance to the first class is mandatory.
CEE 258	Donald R. Watson Seminar in Construction Engineering and Management	X		Presentations from construction industry leaders. Discussions with speakers from various segments of industry regarding career options. Student groups interact with industry representatives after class.
CEE 262B	Transport and Mixing in Surface Water Flows	X		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.
CEE 262C	Modeling Environmental Flows	X		Introduction to numerical methods for modeling surface water flows in rivers, lakes, estuaries and the coastal ocean. Topics include stability and accuracy analysis, curvilinear and unstructured grids, implicit/explicit methods, transport and diffusion, shallow water equations, nonhydrostatic equations, Navier-Stokes solvers, turbulence modeling. Prerequisites: CEE 262A, CME 206, or equivalent.
CEE 263A	Air Pollution Modeling		X	The numerical modeling of urban, regional, and global air pollution focusing on gas chemistry and radiative transfer. Stratospheric, free-tropospheric, and urban chemistry. Methods for solving stiff systems of chemical ordinary differential, including the multistep implicit-explicit method, Gear's method with sparse-matrix techniques, and the family method. Numerical methods of solving radiative transfer, coagulation, condensation, and chemical equilibrium problems. Project involves developing a basic chemical ordinary differential equation solver. Prerequisite: CS 106A or equivalent.
CEE 265A	Sustainable Water Resources Development		X	Alternative criteria for judging the sustainability of projects. Application of criteria to evaluate sustainability of water resources projects in several countries. Case studies illustrate the role of political, social, economic, and environmental factors in decision making. Influence of international aid agencies and NGOs on water projects. Evaluation of benefit-cost analysis and environmental impact assessment as techniques for enhancing the sustainability of future projects. Limited enrollment. Decisions on final enrollment will be based on completion of an admissions essay detailed on the first day of class. Prerequisite: graduate standing in Environmental Engineering, or consent of instructor.
CEE 265D	Water and Sanitation in Developing Countries		X	Economic, social, political, and technical aspects of sustainable water supply and sanitation service provision in developing countries. 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, see jennadavis.stanford.edu for application.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
CEE 265E	Adaptation to Sea Level Rise and Extreme Weather Events		X	Students are introduced to basic aspects of climate change in the context of sea level rise and the intensity and frequency of extreme-weather events. Climate change adaptations are adjustments in behaviors, plans and projects to reduce society's vulnerability to climate change impacts. Major adaptation approaches relevant to civil and environmental engineers are reviewed. Adaptation measures considered include structural and ecologically-based measures for dealing with sea level rise and storm surges, as well as planned migration and managed retreat (i.e., deliberately altering flood defenses to allow flooding of presently protected areas). Strategies for adaptation to changes in extreme weather events, including floods and droughts, are also considered; examples include disaster response management systems and weather insurance. Illustrations of innovative adaptation measures taken by cities are featured as are techniques associated with climate-smart agriculture. Common barriers to climate change adaptation are also reviewed. Limited enrollment. Admission preference given to students in CEE graduate programs for Environmental Engineering, EFMH and EES followed by seniors doing the coastal focus area within the CEE Department's Environmental Systems Engineering major.
CEE 266C	Dams, Reservoirs, and their Sustainability		X	An investigation of dams and reservoirs and their short- and long-term costs, benefits, and impacts. Dam safety, operating rules and reoperation in response to change, fish passage, reservoir sediment management, fish passage and habitat, dam removal. Heavy reliance on case studies, technical literature, and discussion. Enrollment limited. Graduate status or permission of the instructor. Prerequisite: CEE 266A, 266B, or equivalents.
CEE 268	Groundwater Flow	X		Flow and mass transport in porous media. Applications of potential flow theory and numerical modeling methods to practical groundwater problems: flow to and from wells, rivers, lakes, drainage ditches; flow through and under dams; streamline tracing; capture zones of wells; and mixing schemes for in-situ remediation. Prerequisites: calculus and introductory fluid mechanics.
CEE 269A	Environmental Engineering Seminar	X		Presentations on current research in environmental engineering by Civil & Environmental Engineering faculty.
CEE 269B	Environmental Engineering Seminar	X		Presentations on current research, practice and thinking in environmental engineering by visiting academics and practitioners.
CEE 269C	Environmental Engineering Seminar	X		Presentations on current research, practice and thinking in environmental engineering by visiting academics and practitioners
CEE 270	Movement and Fate of Organic Contaminants in Waters		X	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.
CEE 270B	Environmental Organic Reaction Chemistry	X		With over 70,000 chemicals now in production worldwide, predicting their fate in the environment is a difficult task. The course focuses on developing two key skills. First, students should develop the ability to derive mass balance equations used to quantify the fate of chemicals in the environment. With so many chemicals having been introduced in the past ~60 years, many of the key parameters needed for mass balance models have not been measured experimentally. The class builds on CEE 270, which developed methods of predicting equilibrium partitioning coefficients. For many situations involving reactions of target contaminants, equilibrium is not attained. The course develops methods of predicting the reactivity of chemicals based upon their chemical structures both qualitatively and quantitatively. natural reaction processes covered include acid-base speciation, nucleophilic substitution, oxidation/reduction reactions, and photochemical reactions. Key treatment reactions (ozone, UV treatment and advanced oxidation) are also covered. Prerequisites: CEE 270, Chem 31B/X.
CEE 271B	Environmental Biotechnology	X		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.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
CEE 271D	Introduction to Wastewater Treatment Process Modeling	X		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 will consist of guided simulation exercises, an end-of-the-quarter project evaluating an assigned plant configuration, and presenting model results to the class. Enrollment will be limited, with preference to CEE graduate students.
CEE 272	Coastal Contaminants		X	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.
CEE 272R	Modern Power Systems Engineering	X		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.
CEE 273B	The Business of Water	X		One of the fastest growing economic sectors is the water field, and private water companies are playing an increasingly important role in improving water management around the world. In some cases, however, the involvement of private companies in the water sector has also proven controversial (e.g., when private companies have taken over public water supply systems in developing countries such as Bolivia). This course will look at established or emerging businesses in the water sector and the legal, economic, and social issues that they generate. These businesses include investor-owned water utilities, water technology companies (e.g., companies investing in new desalination or water recycling technologies), water-right funds (who directly buy and sell water rights), social impact funds, innovative agricultural operations, water concessionaires, and infrastructure construction companies and investors. Each week will focus on a different business and company. Company executives will attend the class session and discuss their business with the class. In most classes, we will examine (1) the viability and efficacy of the company's business plan, (2) the legal and/or social issues arising from the business' work, and (3) how the business might contribute to improved water management and policy. Each student will be expected to write (1) two short reflection papers during the course of the quarter on businesses that present to the class, and (2) a 15-page paper at the conclusion on the class on either a water company of the student's choice or a policy initiative that can improve the role that business plays in improving water management (either in a particular sector or more generally). Elements used in grading: Attendance, Class Participation, Written Assignments, Final Paper.
CEE 275K	The Practice of Environmental Consulting	X		Class consists of eight interactive two-hour seminars with discussions, and will cover the evolution of the environmental consulting business, strategic choices and alternative business models for private and public firms, a review of the key operational issues in managing firm, organizational strategies, knowledge management and innovation, and ethical issues in providing professional services. Case studies will be used to illustrate key concepts. Selected reading materials drawn from the technical and business literature on the consulting business. Student groups will prepare and present an abbreviated business plan for an environmental based business. Enrollment limited to CEE MS and PHD students.
CEE 278A	Air Pollution Fundamentals		X	The sources and health effects of gaseous and particulate air pollutants. The influence of meteorology on pollution: temperature profiles, stability classes, inversion layers, turbulence. Atmospheric diffusion equations, downwind dispersion of emissions from point and line sources. Removal of air pollutants via settling, diffusion, coagulation, precipitation, Mechanisms for ozone formation, in the troposphere versus in the stratosphere. Effects of airborne particle size and composition on light scattering/absorption, and on visual range. Prerequisites: MATH 51 or equivalent. Recommended: 101B, CHEM 31A, or equivalents.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
CEE 289	Random Vibrations	X		Introduction to random processes. Correlation and power spectral density functions. Stochastic dynamic analysis of multi-degree-of-freedom structures subjected to stationary and non-stationary random excitations. Crossing rates, first-excursion probability, and distributions of peaks and extremes. Applications in earthquake, wind, and ocean engineering. Prerequisite: 203 or equivalent.
CEE 297M	Managing Critical Infrastructure		X	Safe and effective performance of infrastructure systems is critical to our economy, quality of life and safety. This course will present topics associated with risk analysis and management of critical civil infrastructure systems, tolerable risk and community resilience. Methods of risk analysis including systems analysis, reliability analysis, expert elicitation and systems analysis for spatially distributed infrastructure systems will be presented. Aspects of seismic and flood risk analysis will also be discussed. Case histories and lessons learned from Hurricane Katrina, Tohoku earthquake, among others will be presented. The evolution of change in the risk management of civil infrastructure systems; how they are analyzed, designed and operated is discussed. Guest speakers. Student presentations. (Prerequisite: CEE 203 or equivalent)
CEE 323A	Infrastructure Finance and Governance	X		Presentation and discussion of early stage or more mature research on a variety of topics related to financing, governance and sustainability of civil infrastructure projects by researchers associated with the Global Projects Center and visiting speakers. To obtain one unit of credit, students must attend and participate in all seminars, with up to two excused absences. Seminar meets weekly during Autumn, Winter and Spring Quarters.
CEE 323B	Infrastructure Finance and Governance	X		Presentation and discussion of early stage or more mature research on a variety of topics related to financing, governance and sustainability of civil infrastructure projects by researchers associated with the Global Projects Center and visiting speakers. To obtain one unit of credit, students must attend and participate in all seminars, with up to two excused absences. Seminar meets weekly during Autumn, Winter, and Spring quarters.
CEE 323C	Infrastructure Finance and Governance	X		Presentation and discussion of early stage or more mature research on a variety of topics related to financing, governance and sustainability of civil infrastructure projects by researchers associated with the Global Projects Center and visiting speakers. To obtain one unit of credit, students must attend and participate in all seminars, with up to two excused absences. Seminar meets weekly during Autumn, Winter and Spring Quarters.
CEE 324	Industrialized Construction	X		The course will present driving forces, comprehensive concepts, technologies, and managerial aspects of Industrialized Construction. Further a series of case studies of successful and failed industry implementations in Sweden, North America and Japan will be presented, showcasing process and technology platforms; use of renewable resources and other sustainable design and construction practices. The contrast between industrialized construction practices in Sweden, the U.S. and other countries is highlighted. Project-orientated vs. product-oriented approaches are essential, along with business models and strategies for industrialized construction companies and their opportunities for innovations. The course includes lectures, case studies, and course group-project assignments with leading companies in the industry. Visiting lecturer Dr Jerker Lessing, one of Sweden's leading experts on industrialized construction with more than 15 years of experience in this field, is giving this course. This is a unique opportunity to learn about this comprehensive, emerging construction concept. Dr Lessing's research at Lund University has pioneered the area of industrialized construction and established models and strategic perspectives that are widely adopted throughout academia and industry. Dr Lessing has published articles and books and he frequently lectures on the topic in Sweden and internationally. He is the Director and General manager of Research and Development at BoKlok, an industrialized house-building company which is a joint venture of the construction company SKANSKA and furniture giant IKEA. The class will be taught as a condensed two week course. Readings and discussions will be organized in the weeks before the lecture component of the class, a group project after. During weeks 1-5, class will not meet regularly and only meet a few times for reading discussions and guest speakers. When they occur, these meetings will be held either Tuesday or Thursday 8-9am in Y2E2 292A. A detailed class schedule will be available before the start of the quarter. Notes: Attendance Mandatory. No Exam. Case and Problem Discussion. CR/NC and Auditing Not Allowed. Eligible for SDC Building & Infrastructure Development concentration area requirement. Number of students limited to 20; prerequisites: CEE100 or equivalent. Please direct questions to jerker.lessing@boklok.se or adusser@stanford.edu and co

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
CEE 329	Artificial Intelligence Applications in the AEC Industry	X		Through weekly lectures given by prominent researchers, practicing professionals, and entrepreneurs, this class will examine important industry problems and critically assess corresponding AI directions in both academia and industry. Students will gain an understanding of how AI can be used to provide solutions in the architecture, engineering, and construction industry and assess the technology, feasibility, and corresponding implementation effort. Students are expected to participate actively in the lectures and discussions, submit triweekly reflection writings, and present their own evaluation of existing solutions. Enrollment limited to 12 students.
CEE 329S	Seminar on Artificial Intelligence Applications in the AEC Industry	X		Through weekly lectures given by prominent researchers, practicing professionals, and entrepreneurs, this class will examine important industry problems and critically assess corresponding AI directions in both academia and industry. Students will gain an understanding of how AI can be used to provide solutions in the architecture, engineering, and construction industry and assess the technology, feasibility, and corresponding implementation effort. Students are expected to actively prepare for and participate in all lectures and corresponding discussions.
CEE 32V	Architectural Design Lecture Series Course	X		This seminar is a companion to the Spring Architecture and Landscape Architecture Lecture Series. Students will converse with lecturers before the lectures, attend the lecture, and prepare short documents (written, graphic, exploratory) for two of the lectures. The four course meeting dates will correspond with the lecture dates TBD. The meeting times are 4:30 PM - 5:30 PM for the seminar and 6:30 - 7:45 for the lecture.
CEE 341	Virtual Design and Construction	X		Virtual Design and Construction (VDC) starts by understanding the client's objectives for building performance and the translation of these objectives into measurable project and production objectives. Based on a culture of proactive and constructive engagement, three mutually supportive strategies are essential to achieve these objectives: (1) the knowledge of the many disciplines contributing to the design and construction of a buildable, usable, operable, and sustainable building needs to be orchestrated concurrently, (2) the information supporting the project team must be integrated and be accessible seamlessly, and (3) the workflow carried out by the project team must enable the creation of integrated knowledge and information and lead to decisions that stick. This course will teach all the essential elements of VDC. Prerequisite: 100 or consent of instructor. Recommended: CEE 240, CEE 241.
CEE 363B	Chaos and Turbulence	X		An overview of the statistical analysis of unsteady flows, with a focus on chaos and turbulence. Topics will include random variables and statistical analysis; self-similarity, scaling, and symmetries; the turbulent energy cascade and the Kolmogorov similarity hypotheses; intermittency, refined similarity, and multifractal analysis; mixing and transport in chaotic and turbulent flows; and an overview of the effects of additional conservation laws on flow statistics. Prerequisites: CEE 262A or ME 351A, or permission of instructor.
CEE 365A	Advanced Topics in Environmental Fluid Mechanics and Hydrology	X		Students must obtain a faculty sponsor.
CEE 365B	Advanced Topics in Environmental Fluid Mechanics and Hydrology	X		Students must obtain a faculty sponsor.
CEE 379	Introduction to PHD Studies in Civil and Environmental Engineering	X		This seminar course will cover important topics for students considering a PhD in Civil and Environmental Engineering. Sessions will include presentations and discussions on career development, exploring research and adviser options, and the mechanics of PhD studies, including General Qualifying Exam requirements for all CEE PHD Students. In addition, CEE faculty will give presentations on their research. This seminar is required for CEE students considering a PHD or preparing to sit for the General Qualifying Exam in Civil and Environmental Engineering.
CEE 6	Physics of Cities	X		An introduction to the modern study of complex systems with cities as an organizing focus. Topics will include: cities as interacting systems; cities as networks; flows of resources and information through cities; principles of organization, self-organization, and complexity; how the properties of cities scale with size; and human movement patterns. No particular scientific background is required, but comfort with basic mathematics will be assumed. Prerequisites: MATH 19 and 20, or the equivalent

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
CEE 70Q	The Food, Water, and Waste Nexus		X	This course will explore the connections between water access, fecal waste management, and food safety and provision in low- and middle-income countries. The interconnections between food, water, and waste will be discussed as it relates to human health and well-being. Topics that will be covered in the course include 1) farm to fork contamination pathways of food 2) food hygiene practices and barriers to implementation 3) waste water reuse practices 4) management of water for multiple uses 5) potential impact climate change may have on the connections of these systems. The students in the course will undertake individual research that explores the connections between these systems and identifies potential strategies to improve human health and well-being.
CEE 83	Seismic Design Workshop	X		Introduction to seismic design for undergraduate students. Structural design concepts are introduced based on physical and mathematical principles. General overview of mechanics of materials, structural analysis, structural systems and earthquake resistant design. The class is intended to prepare students for the EERI 2018 Seismic Design Competition, where students design, analyze and fabricate a five-foot tall balsa wood structure. Hands on workshops focus on numerical simulation using commercial software and experimental testing. All majors are welcome. Pre-requisite: Physics 41, recommended: ENGR 14.
CHEM 111	Exploring Chemical Research at Stanford	X		Preference to freshmen and sophomores. Department faculty describe their cutting-edge research and its applications.
CHEM 25N	Science in the News	X		Preference to freshmen. Possible topics include: diseases such as avian flu, HIV, and malaria; environmental issues such as climate change, atmospheric pollution, and human population; energy sources in the future; evolution; stem cell research; nanotechnology; and drug development. Focus is on the scientific basis for these topics as a basis for intelligent discussion of societal and political implications. Sources include the popular media and scientific media for the nonspecialist, especially those available on the web.
CHEM 28N	Science Innovation and Communication	X		Preference to freshmen. The course will explore evolutionary and revolutionary scientific advances; their consequences to society, biotechnology, and the economy; and mechanisms for communicating science to the public. The course will engage academic and industrial thought leaders and provide an opportunity for students to participate in communicating science to the public. This fusion of journalism and science has led to a new undergraduate organization (faSCInate), a web site and video presentations. It is an opportunity to share the fun, excitement and importance of science with others.
CHEMENG 10	The Chemical Engineering Profession	X		Open to all undergraduates. Overview of and careers in chemical engineering; opportunities to develop networks with working professionals. Panel discussions on career paths and post-graduation opportunities available. Areas include biotechnology, electronics, energy, environment, management consulting, nanotechnology, and graduate school in business, law, medicine, and engineering.
CHEMENG 120B	Energy and Mass Transport	X		General diffusive transport, heat transport by conduction, Fourier's law, conduction in composites with analogies to electrical circuits, advection-diffusion equations, forced convection, boundary layer heat transport via forced convection in laminar flow, forced convection correlations, free convection, free convection boundary layers, free convection correlations and application to geophysical flows, melting and heat transfer at interfaces, radiation, diffusive transport of mass for dilute and non-dilute transfer, mass and heat transport analogies, mass transport with bulk chemical reaction, mass transport with interfacial chemical reaction, evaporation. Prerequisite CHEMENG 120A or consent of instructor.
CHEMENG 180	Chemical Engineering Plant Design	X		Open to seniors in chemical engineering or by consent of instructor. Application of chemical engineering principles to the design of practical plants for the manufacture of chemicals and related materials. Topics: flow-sheet development from a conceptual design, equipment design for distillation, chemical reactions, heat transfer, pumping, and compression; estimation of capital expenditures and production costs; plant construction.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
CHEMENG 31N	When Chemistry Meets Engineering	X		Preference to freshmen. Chemistry and engineering are subjects that are ubiquitous around us. But what happens when the two meet? Students will explore this question by diving into experimental problems that scientists and engineers have to face on a daily basis. Many processes that are taken for granted have been developed by understanding science at a very fundamental level and then applying it to large and important industrial processes. In this seminar, students will explore some of the basic concepts that are important to address chemical engineering problems through experimental work. Students will build materials for energy and environmental applications, understand how to separate mixtures into pure compounds, produce fuels, and will learn to look at the chemical properties of molecules that are part of daily life with a different eye.
CHEMENG 60Q	Environmental Regulation and Policy		X	Preference to sophomores. How environmental policy is formulated in the U.S. How and what type of scientific research is incorporated into decisions. How to determine acceptable risk, the public's right to know of chemical hazards, waste disposal and clean manufacturing, brownfield redevelopment, and new source review regulations. The proper use of science and engineering including media presentation and misrepresentation, public scientific and technical literacy, and emotional reactions. Alternative models to formulation of environmental policy. Political and economic forces, and stakeholder discussions.
CHEMENG 90Q	Dare to Care: Compassionate Design	X		Imagine yourself with your abundant creativity, intellect, and passion, but your ability to move or speak is diminished. How would you face the world, how would you thrive at Stanford, how would you relay to people your ideas and creations? How would you share yourself and your ideas with the world? There are more than 50 million individuals in America with at least one disability, and in the current world of design, these differences are often overlooked. How do we as designers empower people of diverse physical abilities and provide them with means of self-expression? In Compassionate Design, students from any prospective major are invited to explore the engineering design process by examining the needs of persons with disabilities. Through invited guests, students will have the opportunity to directly engage people with different types of disabilities as a foundation to design products that address problems of motion and mobility, vision, speech and hearing. For example, in class, students will interview people who are deaf, blind, have cerebral palsy, or other disabling conditions. Students will then be asked, using the design tools they have been exposed to as part of the seminar, to create a particular component or device that enhances the quality of life for that user or users with similar limitations. Presentation skills are taught and emphasized as students will convey their designs to the class and instructors. Students will complete this seminar with a compassionate view toward design for the disabled, they will acquire a set of design tools that they can use to empower themselves and others in whatever direction they choose to go, and they will have increased confidence and abilities in presenting in front of an audience.
CHPR 228	Theoretical Foundations and Design of Behavioral Intervention Trials	X		Focuses on the knowledge and skills, respect and thoughtful practice of designing health promotion interventions that are relevant, theoretically-informed, have broad impacts, and can endure. Provides an in-depth review of intervention approaches for health promotion and disease prevention and covers the leading theories of behavior change. Follows an integrative model to demonstrate similarities and differences between the theoretical approaches, seeking what is useful and worthwhile in each theoretical model rather than looking primarily for what is most easily criticized. Practical in nature with emphasis on the specifics of needs assessments and intervention development and delivery and how these may vary across community settings, with diverse populations, addressing different behaviors, and leveraging traditional and emerging delivery channels. Explores intervention creation, delivery, effectiveness, and sustainability to identify and better understand the resources and other practical considerations necessary to produce, deliver, monitor, and disseminate an intervention with demonstrated effectiveness. Examples drawn from across the behavioral spectrum and include tobacco control, physical activity, healthy diet, stress and distress, as well as consideration of the complexities of extending interventions to target multiple risk behaviors. Students develop a foundational understanding of behavior change theory, rigorous research methods, and creative design strategies to advance the health of individuals and communities. Students taking 2 units only will complete all 4 homework assignments, attend 8 of 10 class sessions, and complete an abbreviated final abstract plus figures/tables instead of a final paper. The grading, in this instance, will be the medical school option of credit/no credit. CHPR master's students must enroll for 3 units and a letter grade.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
CS 131	Computer Vision: Foundations and Applications	X		Robots that can navigate space and perform duties, search engines that can index billions of images and videos, algorithms that can diagnose medical images for diseases, or smart cars that can see and drive safely: Lying in the heart of these modern AI applications are computer vision technologies that can perceive, understand and reconstruct the complex visual world. This course is designed for students who are interested in learning about the fundamental principles and important applications of computer vision. Course will introduce a number of fundamental concepts in computer vision and expose students to a number of real-world applications, plus guide students through a series of projects such that they will get to implement cutting-edge computer vision algorithms. Prerequisites: Students should be familiar with Python (i.e. have programmed in Python before) and Linux; plus Calculus & Linear Algebra.
CS 21SI	AI for Social Good	X		Students will learn about and apply cutting-edge artificial intelligence techniques to real-world social good spaces (such as healthcare, government, education, and environment). Taught jointly by CS+Social Good and the Stanford AI Group, the aim of the class is to empower students to apply these techniques outside of the classroom. The class will focus on techniques from machine learning and deep learning, including regression, support vector machines (SVMs), neural networks, convolutional neural networks (CNNs), and recurrent neural networks (RNNs). The course alternates between lectures on machine learning theory and discussions with invited speakers, who will challenge students to apply techniques in their social good domains. Students complete weekly coding assignments reinforcing machine learning concepts and applications. Prerequisites: programming experience at the level of CS107, mathematical fluency at the level of CS103, comfort with probability at the level of CS109 (or equivalent). Application required for enrollment.
CS 377E	Designing Solutions to Global Grand Challenges	X		In this course we creatively apply information technologies to collectively attack Global Grand Challenges (e.g., global warming, rising healthcare costs and declining access, and ensuring quality education for all). Interdisciplinary student teams will carry out need-finding within a target domain, followed by brainstorming to propose a quarter long project. Teams will spend the rest of the quarter applying user-centered design methods to rapidly iterate through design, prototyping, and testing of their solutions. This course will interweave a weekly lecture with a weekly studio session where students apply the techniques hands-on in a small-scale, supportive environment.
CS 51	CS + Social Good Studio: Designing Social Impact Projects	X		Introduces students to the tech + social good space. Students work in small teams to develop high-impact projects around problem domains provided by partner organizations, under the guidance and support of design/technical coaches from industry and non-profit domain experts. Main class components are workshops, community discussions, guest speakers and mentorship. Studio provides an outlet for students to create social change through CS while engaging in the full product development cycle on real-world projects. The class culminates in a showcase where students share their project ideas and Minimum Viable Product prototypes with stakeholders and the public. Prerequisite: CS 147, equivalent experience, or consent of instructors.
CS 52	CS + Social Good Studio	X		Continuation of CS51 (CS + Social Good Studio). Teams enter the quarter having completed and tested a minimal viable product (MVP) with a well-defined target user, and a community partner. Students will learn to apply scalable technical frameworks, methods to measure social impact, tools for deployment, user acquisition techniques and growth/exit strategies. The purpose of the class is to facilitate students to build a sustainable infrastructure around their product idea. CS52 will host mentors, guest speakers and industry experts for various workshops and coaching-sessions. The class culminates in a showcase where students share their projects with stakeholders and the public. Prerequisite: CS 51, or consent of instructor.
CS 53SI	Discussion in Tech for Good	X		This course introduces students to various intersections of social good and technology through a weekly discussion and speaker series. Students will be given a space to exchange ideas and experiences regarding a certain social issue. Invited speakers come from industry, academia, and non-profit organizations. They will share their career paths, what drove them to these fields, and advice for students. The topics examined will span a broad variety of social issues -- from race and class to education and sustainability -- and help students better understand how to kick off their journey in using computer science for social good.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
CSRE 1V	A History of Race	X		<p>This course will survey the idea of race and its history. We will focus our attention on the construction of the idea of race, and we will trace the ways in which this concept has changed over time. The course will start with a panel discussion on definitions of race in history, and as presented in different academic disciplines today. This discussion will be followed by two lectures tracing histories of race from Antiquity until the twentieth century. The last session will be a roundtable on the continuing role of race in the United States today. Covered topics will include explicit and implicit bias, institutionalized racism, race and criminal justice, equal justice initiatives and protests, racial stratification. The roles of politics, economics, science, religion, and nationalism, as well as the relationships between race, gender, and class will also be discussed. Course must be taken for 3 units to count toward WAYS requirement. This course will meet 5 times, starting MONDAY January 14th, and ending the last day of class Monday, February 25th.</p>
CSRE 29SI	Migration is Beautiful: Histories, Realities, and Policies of Immigrant Justice	X		<p>In the current political landscape, many political stakeholders have endorsed anti-immigrant policies using inflammatory rhetoric that has disturbed American attitudes toward immigration. This course challenges the underlying assumptions of this discourse. We will begin by analyzing the history of immigration policy and politics in the United States. We will discuss specific issues related to border control, detention, and law enforcement and then delve into the intersections of immigration, criminal justice, health, and education policies. Throughout, we will emphasize the importance of using empirical data and personal narratives when analyzing and participating in the contemporary discourse on immigration-related issues.</p>
CSRE 33SI	Examining Access for FLI Students in Higher Education	X		<p>Stanford's past two presidents have steadfastly declared Stanford as a vehicle of upwards mobility and to correct inequalities. Essentially, this means providing sufficient access to students who often are most in need: first-generation and/or low-income (FLI) students. However, what exactly is access? How can we understand different kinds of access in order to improve the holistic quality of education students receive? To answer these questions, we will define access and the forces which shape it, such as economic systems, intersectionality, and the educational pipeline. Next, to better prepare ourselves as advocates for educational improvement, we will examine the historical trend of access at colleges as case studies (Stanford, Berkeley, Foothills, and Brown). Finally, we will ask how accessibility influences how students fare after leaving the educational system. Ultimately, we will gain analytical and heuristic techniques to pinpoint and advocate for improvements to educational access for FLI students.</p>
CSRE 47Q	Heartfulness: Mindfulness, Compassion, and Responsibility	X		<p>We practice mindfulness as a way of enhancing well-being, interacting compassionately with others, and engaging in socially responsible actions as global citizens. Contemplation is integrated with social justice through embodied practice, experiential learning, and creative expression. Class activities and assignments include journaling, mindfulness practices, and expressive arts. We build a sense of community through appreciative intelligence, connected knowing, deep listening and storytelling.</p>
DESINST 280	Designing Equitable Education Ecosystems	X		<p>Education systems in this country are not serving all students equally. In this course, students and instructors will explore opportunities for increasing equity in education ecosystems through examining analogies in natural ecosystems and working with a diverse array of real world experts to develop new approaches to accelerating equity for students. Application required, see dschool.stanford.edu/classes for more information.</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
EARTH 10	Design for a Habitable Planet		X	Climate change is happening. As a society, we know we need to accommodate it, design for it, and slow its progress, yet as individuals many of us struggle to take meaningful action. This class will use the iconic landscapes of California as a lens to address this challenge. How will they differ in 2025, 2050, 2100? During the course we will learn about the science of global change and the ways in which California may dramatically differ in the future as a result of changing temperatures and rainfall patterns, rising sea levels, shifts in flora and fauna, and decisions about the built environment and infrastructure. Using methodologies of human-centered design, we will explore how iconic landscapes influence perceptions of global change. We will generate ideas for communicating the impact of projected change and experiment with different ways of creating a sense of urgency. This class is for students interested in the impacts global change and in seeking new and innovative ways to communicate it. The course will be co-taught by faculty from the School of Earth, Energy and Environmental Sciences and the d.school. Apply by September 8. You can read more about the course and apply here: https://dschool.stanford.edu/classes/design-for-a-habitable-planet . Applicants will be selected to ensure a diversity of backgrounds. Course will be limited to 16 participants. Meeting times: Tue: 4:30 to 5:50 beginning 10/24, Saturday 10/28 All day field trip.
EARTH 100	Research Preparation for Undergraduates		X	For undergraduates planning to conduct research during the summer with faculty in the School of Earth, Energy & Environmental Sciences. Readings, oral presentations, proposal development. May be repeated for credit.
EARTH 193	Natural Perspectives: Geology, Environment, and Art		X	Multi-day field trip that combines exploration of regional geology, ecology, and environmental history with guided drawing exercises in the Eastern Sierra Nevada of California. We'll visit several sites of geologic and environmental interest, discuss their formation and significance, and use drawing as tool for close observation. Students will gain an understanding of the natural processes shaping California, acquire new skills and techniques for artistic expression, and gain an appreciation for how scientific and aesthetic perspectives complement and enhance one another in the study of nature. No previous scientific or artistic experience is required. Preference for freshmen and sophomores. If you are interested in signing up for the course, complete this pre-registration form: https://stanforduniversity.qualtrics.com/SE/?SID=SV_9RF2rDopROzwOxf
EARTH 1B	Know Your Planet: Big Earth	X		Interested in Big Data and how to apply it to global environmental and sustainability challenges? This course provides an introduction to Big Data and its applications in solving global challenges such as meeting global energy needs, food and water security, climate change, and natural hazards. The first half of the course will focus on foundational concepts of Big Data; the second half of the course will focus on applications of Big Data while introducing students to Stanford Earth alumni who are currently using these concepts in their work. May be repeated for credit.
EARTH 1C	Know Your Planet: Science Outside	X		One of the most important ways to learn about the world is to go out and explore it. Over the course of two day-long field trips during the weekend of May 5 & 6, students will learn and implement hands-on skills for conducting research "in the field," that is, outdoors in the natural environment. No previous field-work experience necessary. By focusing on the local geology, geomorphology, soils, ecology, and marine biology surrounding the Stanford campus, we will use careful observation, standard methods for data collecting, and analytical tools to answer fundamental questions about earth and ecosystem function. Along the way, we will also practice basic skills, from hiking to critical thinking, essential for conducting science outside of the controlled environment of the lab. This class is all about learning by doing, so be prepared to get your hands dirty and your feet wet while enjoying the sunshine and fresh air. In addition to the field weekend (May 5 & 6), this class also includes a mandatory evening meeting on May 2 (5:30P-7:00P). 100% Attendance at all meetings is required, no exceptions. Enrollment is limited to 20 students; preference given to freshmen and sophomores; to receive a course registration code, students must complete this form: http://web.stanford.edu/~rypett/EARTH_1C.fb
EARTH 2	Climate and Society		X	How and why is the climate changing? How might a changing climate affect human society? And what can we do to alter the course of climate change and adapt to any climatic changes that do occur? This course provides an introduction to the natural science and social science of climate change. The focus is on what science tells us about the causes, consequences, and solutions to climate change, as well as on how scientific progress is made on these issues.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
EARTHSYS 106C	Why are Scientists Engineering Our Food?	X		This lecture and discussion course will review the scientific evidence on the use and impacts of genetic engineering in global food and agricultural systems. The class will cover the history and details of crop genetic improvement, ranging from primitive domestication to CRISPR technologies. We will examine the risks and benefits of crop genetic technologies in agriculture with regards to productivity, farm incomes, food safety, human health and nutrition, and environmental impacts. We will also discuss the current and future use of genetic engineering techniques for enhancing climate resilience and nutritional outcomes in agricultural systems worldwide. Finally, we will discuss the ethics of using modern genetic approaches for crop improvement, and the policy environment surrounding the use of these genetic techniques. Our expectation is that students enrolled in the course will attend all class sections and participate actively in the discussions. Students will be asked to identify peer-reviewed, scientific papers on the impacts of specific crop genetic improvements. Depending on the class size, students will also be asked to help lead class discussions. At the end of the course, students will work in groups to debate a selected topic on the use of genetic engineering in agriculture, to be announced during the course. Prerequisites: One course in biology and one course in economics are suggested. Completion of "Feeding Nine Billion" and "The World Food Economy" classes would also be helpful, as would a class in genetics, but there are no strict course requirements.
EARTHSYS 15	Gender, Land Rights, and Climate Change: An International Perspective		X	For decades, numerous and far-reaching consequences of anthropogenic climate change have disproportionately affected women, from poverty, food and water security, to land tenure and forced migration, to education and health. As a result, mitigating climate change has enormous implications for women's lives worldwide, yet too few national or international policies address this critical intersection. This weekly seminar will examine this dynamic in light of the Sustainable Development Goals and Paris Climate Treaty. The course will feature guest speakers, reading discussions, and communication exercises to spur policy reform and help students acquire relevant information for their future endeavors.
EARTHSYS 182A	Ecological Farm Systems		X	A project-based course emphasizing ways of doing in sustainable agricultural systems based at the Stanford Educational Farm. Students will work individually and in small groups on projects at the Stanford Educational Farm. This winter the course will include orchard establishment and educational garden design in addition to other topics. Instructor consent required. By Application Only (Due January 9th): https://stanforduniversity.qualtrics.com/jfe/form/SV_7714hyXJoRWGhOI
EARTHSYS 185	Feeding Nine Billion		X	Feeding a growing and wealthier population is a huge task, and one with implications for many aspects of society and the environment. There are many tough choices to be made- on fertilizers, groundwater pumping, pesticide use, organics, genetic modification, etc. Unfortunately, many people form strong opinions about these issues before understanding some of the basics of how food is grown, such as how most farmers currently manage their fields, and their reasons for doing so. The goal of this class is to present an overview of global agriculture, and the tradeoffs involved with different practices. Students will develop two key knowledge bases: basic principles of crop ecology and agronomy, and familiarity with the scale of the global food system. The last few weeks of the course will be devoted to building on this knowledge base to evaluate different future directions for agriculture.
EARTHSYS 190	The Multimedia Story	X		Stories are how we understand ourselves and the world. This course will teach how to plan, research, report and produce a long-form, rich-media science/environment feature story. Students will work in groups or individually to master the blending of text with data visualization, photos, audio, and video. Teachers are experienced digital journalists at leading national and international publications with a close eye on trends and innovations in online, investigative, and data journalism. Using the landmark New York Times story "Snow Fall" (http://nyti.ms/1eTyf2Y) as a departure point, the course will examine the questions: how do we engage and inform the public around critical environmental topics? How do we explain complex and sometimes hidden factors shaping the future of our world? Students are asked to express interest through this form: http://goo.gl/rDQogB

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
EARTHSYS 210B	Senior Capstone and Reflection		X	The Earth Systems Senior Capstone and Reflection, required of all seniors, provides students with opportunities to synthesize and reflect on their learning in the major. Students participate in guided career development and planning activities and initiate work on an independent or group capstone project related to an Earth Systems problem or question of interest. In addition, students learn and apply principles of effective oral communication through developing and giving a formal presentation on their internship. Students must also take EARTHSYS 210P, Earth Systems Capstone Project, in the quarter following the Senior Capstone and Reflection Course. Prerequisite: Completion of an approved Earth Systems internship (EARTHSYS 260).
EARTHSYS 24	Quick Capture and Questions: Practicing Natural History Through Watercolor	X		This course makes space to use art as an entry point for closer observation, deeper curiosity, and better understanding of natural systems. With a series of guest experts in art, science, and the practice of natural history, we will investigate the Jasper Ridge Biological Preserve through a number of lenses, microscopic to macroscopic. In each session, we will venture into the preserve to explore how field journaling, quick capture watercolor, and expressive language can mediate insight and sense of connection. Come build a community of practice with us! Apply at https://tinyurl.com/earthsys24 and direct further questions to Freya Chay (freyac@stanford.edu) and Hannah Black (hmcblack@stanford.edu).
EARTHSYS 243	Environmental Advocacy and Policy Communication		X	Although environmental science suggests that coordinated policy action is critically necessary to address a host of pressing issues - from global climate change to marine pollution to freshwater depletion - governments have been slow to act. This course focuses on the translation of environmental science to public discourse and public policy, with an emphasis on the causes of our current knowledge-to-action gap and policy-sphere strategies to address it. We will read classic works of environmental advocacy, map our political system and the public relations and lobbying industries that attempt to influence it, grapple with analytical perspectives on effective and ethical environmental policy communication, engage with working professionals in the field, learn effective strategies for written and oral communication with policymakers, and write and workshop op-eds. Application required. Deadline Dec. 1. Apply here: https://stanforduniversity.qualtrics.com/jfe/form/SV_4luQC5BcQdn3j6Zz
EARTHSYS 276A	Open Space Practicum Independent Study	X		Additional practicum units for students intent on continuing their projects from EARTHSYS 276. Students who enroll in 276A must have completed EARTHSYS 276: Open Space Management Practicum, or have consent of the instructors.
EARTHSYS 290	Master's Seminar	X		Required of and open only to Earth Systems master's students. Reflection on the Earth Systems cotermin experience and development of skills to clearly articulate interdisciplinary expertise to potential employers, graduate or professional schools, colleagues, business partners, etc. Hands-on projects to take students through a series of guided reflection activities. Individual and small group exercises. Required, self-chosen final project encapsulates each student's MS expertise in a form relevant to his or her future goals (ie. a personal statement, research poster, portfolio, etc.).
EARTHSYS 36N	Life at the Extremes: From the Deep Sea to Deep Space	X		Preference to freshmen. Microbial life is diverse and resilient on Earth; could it survive elsewhere in our solar system? This seminar will investigate the diversity of microbial life on earth, with an emphasis on extremophiles, and consider the potential for microbial life to exist and persist in extraterrestrial locales. Topics include microbial phylogenetic and physiological diversity, biochemical adaptations of extremophiles, ecology of extreme habitats, and apparent requirements and limits of life. Format includes lectures, discussions, lab-based activities and local field trips. Basics of microbiology, biochemistry, and astrobiology.
EARTHSYS 91	Earth Systems Writers Collective	X		Come join a community of environmental writers, publish your work, and get course credit at the same time! Are you currently working on an article, an op-ed, translating your class projects into publishable pieces or pursuing a new writing project? Are you interested in publishing your work in the quarterly Earth Systems newsletter and the annual Earth Systems magazine? In this weekly seminar, you will collaborate with others and get constructive feedback from a community of peer writers. You can enroll in the Earth Systems Writers Collective for 1 unit, or just join without signing up for course credit. May be repeated for credit.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
EASTASN 285	The United States, China, & Global Security	X		This graduate-level seminar will be taught simultaneously on the campuses of Stanford University and Peking University and will feature a lecture series in which prominent American and Chinese scholars provide presentations that focus on key global security issues. The course content will highlight topics relevant to current U.S.- China relations and their respective roles in Asian and global security. Proposed lecture topics include: an introduction to U.S.- China relations; finance, trade, and investment; cyber security; nonproliferation; maritime security; terrorism; and energy and the environment. Hosted jointly by Stanford University and Peking University, enrollment will be limited to 20 students at each campus and, at Stanford, will be restricted to graduate students and undergraduates with senior standing. Enrollment is competitive, so potential students must complete an application by March 12, 2018 at 5pm: https://web.stanford.edu/dept/CEAS/EASTASN285.fb
ECON 11N	Understanding the Welfare System	X		Welfare-reform legislation passed by the federal government in the mid-1990s heralded a dramatic step in the movement that has been termed the devolution revolution, which is again being discussed in the context of healthcare reform. The centerpiece of devolution is the transfer of more responsibilities for antipoverty programs to the states. We will explore the effects of these reforms and the role that devolution plays in the ongoing debates over the designs of programs that make up America's social safety net. In addition to discussing conventional welfare programs (e.g., Medicaid, food stamps, TANF, SSI) and other governmental policies assisting low-income families (EITC, minimum wages), we will examine the trends in governmental spending on anti-poverty programs and how our nation defines poverty and eligibility for income support. We will apply economics principles throughout to understand the effectiveness of America's antipoverty programs and their consequences on the behavior and circumstances of families. Prerequisites: A basic understanding/knowledge of introductory economics is recommended.
ECON 15Q	The Economics of Immigration in the US: Past and Present	X		The United States has long been perceived as a land of opportunity for immigrants. Yet, both in the past and today, policy makers have often expressed concerns that immigrants fail to integrate into US society and lower wages for existing workers. There is an increasingly heated debate about how strict migration policy should be. This debate is rarely based on discussion of facts about immigrants assimilation. This class will review the literature on historical and contemporary migrant flows. We will tackle three major questions in the economics of immigration: whether immigrants were positively or negatively selected from their sending countries; how immigrants assimilated into the US economy and society; and what effects that immigration may have on the economy, including the effect of immigration on native employment and wages. In each case, we will present studies covering the two main eras of US immigration history, the Age of Mass Migration from Europe (1850-1920) and the recent period of renewed mass migration from Asia and Latin America. Students will participate in a final project, which could include developing their own recommendations for how to design immigration policy in the US. Prerequisite: Completion of ECON 1 in a previous quarter; concurrent enrollment in ECON 1 in Winter Quarter; or, approved ECON 1 waiver on file with the Department of Economics.
ECON 178	Behavioral Economics	X		The field of behavioral economics draws on insights from other disciplines, especially psychology, to enrich our understanding of economic behavior. The course will discuss how people may display systematic behavioral patterns that diverge from the predictions of standard economic models, as well as the ways in which economists incorporate those considerations into their theories, and the implications of those theories for market outcomes and public policies. Prerequisites: ECON 50 and ECON 102A. Econ 51 is recommended.
ECON 17N	Energy, the Environment, and the Economy		X	Examines the intimate relationship between environmental quality and the production and consumption of energy. Assesses the economics efficiency and political economy implications of a number of current topics in energy and environmental economics. Topics include: the economic theory of exhaustible resources, Greenhouse Gas Emissions (GHG) control (cap and trade mechanisms and carbon fees), GHG emissions offsets, the Strategic Petroleum Reserve (SPR), the "smart" transmission grid for electricity, nuclear energy and nuclear waste, the real cost of renewable energy, natural gas and coal-fired electricity production, the global coal and natural gas markets, Corporate Average Fuel Efficiency (CAFE) and Low-Carbon Fuel Standards (LCFS), Energy Efficiency Investments and Demand Response, and Carbon Capture and Sequestration (CCS). For all topics, there will be reading to explain the economics and engineering behind the topic and class discussion to clarify and elaborate on this interaction. Prerequisite: Econ 1 is recommended.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
ECON 182	Honors Market Design	X		Rigorous introduction to the theory of matching and resource allocation, and its application to practical market design. Theory covers two-sided matching, "house allocation" problems, random assignment, and their variants. Applied topics include school choice, labor market, house allocation, and organ allocation for transplantation. Final paper required. Forms a sequence with ECON 180 and ECON 181, but can be taken independently. Prerequisites: Experience with abstract mathematics and willingness to work hard. No prior knowledge of economics is required, although basic knowledge in game theory is useful.
ECON 215	Development Economics II	X		This is a course focusing on development research. It will cover: productivity, market failure, and international trade; farms and firms; markets and contracts; intra-household allocation and bargaining; microfinance; and risk sharing. Prerequisites: 202 or 202N, 270.
ECON 216	Development Economics III	X		This course focuses on savings, credit, informal insurance, the expansion of microfinance, social networks, social learning and technology adoption, public finance and firm organizations. Prerequisite: 202, 203, 204, 210, 211, 212, 270, 271, 272.
ECON 22N	Causes and Consequences of the Rise in Inequality	X		In this class we will discuss the economic and institutional causes of the rise in inequality in the US and other countries over the last 40 years. We will also discuss the consequences of inequality in terms of social justice, economic welfare, aggregate economic performance, intergenerational mobility, and the possible implications of inequality for the recent global financial crisis.
ECON 231	Analytics of Global Economic Externalities under Uncertainty	X		Fundamentally important issues for theoretical analysis of macro-dynamical systems with global externalities are the focus of this course's 9 (weekly) meetings: (i) public goods (e.g., information) and public bads (uncontrolled GHG emissions), (ii) sequential decision-making under uncertainty (e.g., multi-period investment programs, and management of evolving technology portfolios), and (iii) time discounting, allowing for rare events and catastrophic risks. Novel approaches to program designs for global climate stabilization, sustainable use of resources and the future adaptation of market mechanisms (e.g., carbon markets, and markets for potable water).
ECON 241	Public Economics I	X		Design of tax systems, transfers intended to alleviate poverty, the effect of taxes on earnings, fees intended to internalize externalities like pollution, school finance and other forms of fiscal federalism, local public goods such as schools. Students will learn to apply sophisticated applications of frontier applied econometric techniques including synthetic controls, regression discontinuity, advanced instrumental variables methods. Prerequisites: ECON 202-204, ECON 210, ECON 270, ECON 271, or equivalent with consent of instructor.
ECON 242	Public Economics II	X		This course will explore the rationale for and economic effects of social insurance programs including but not limited to social security, unemployment insurance, disability insurance, and public health insurance. The course will also include four lectures on behavioral public economics. The focus of these lectures will be on developing a framework for conducting welfare analysis in settings with behavioral consumers, and then on applying that framework to issues in public economics, starting with optimal commodity taxation (including ζ sin taxes ζ), followed by policies affecting personal saving, as well as the taxation of earnings (including implications for social insurance). Additional topics covered in the course will include other important areas of government expenditure and regulation such as education, defense procurement, economic stimulus, and environmental regulation. Course will cover both theoretical and empirical evidence and prerequisites are ECON 202-204 and ECON 270-272 or similar with permission of instructor.
ECON 251	Natural Resource and Energy Economics		X	Economic theory and empirical analysis of non-renewable and renewable natural resources, with considerable attention to energy provision and use. Topics include: exhaustible resources; renewable resources; and energy industry market structure, pricing, and performance. Prerequisites: 202, 203, 204, 271, and 272, or equivalents with consent of instructor.
ECON 260	Industrial Organization III	X		Course combines individual meetings and student presentations, with an aim of initiating dissertation research in industrial organization. Prerequisites: ECON 257, ECON 258.
EDUC 102	Examining Social Structures, Power, and Educational Access	X		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.
EDUC 126A	Introduction to Public Service Leadership	X		Offered through the Haas Center for Public Service. A foundation and vision for a future of public service leadership. Students identify personal values and assess strengths as leaders. The ethics of public service and leadership theory.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
EDUC 170	Preparation for Independent Public Service Projects	X		Open only to recipients of the Haas Summer Fellowship, which offers students the opportunity to initiate and carry out an innovative service project in collaboration with a community partner. Goal is to expand upon the work fellows did during the application process with respect to the feasibility and sustainability of their field projects.
EDUC 228H	Literacy, History, and Social Science	X		How elementary school teachers can teach history and social science within a literacy framework. Topics include: historical thinking, reading, and writing; current research; applying nonfiction reading and writing strategies to historical texts; using primary sources with elementary students; adapting instruction to meet student needs; state standards; evaluating curriculum; assessing student knowledge; developing history and social science units; and embedding history and social science into the general literacy curriculum.
EDUC 232	Culture, Learning, and Poverty	X		This course examines the categories and methods used to analyze and explain educational inequalities in the United States from 1950 to present. Approaches to theories of school failure and methods of intervention are distinguished by their ideas on the play of learning, language, cognition, culture, and social class in human development. Particular attention is given to the Culture of Poverty controversies of the 1960s and their recent emergence.
EDUC 267G	Integrating the Garden into the Elementary Curriculum		X	This mini-course uses the garden and kitchen environments to provide teacher candidates with real-world contexts in which to explore some of the key issues that children face in health, nutrition, and sustainability. Teacher candidates will gain an understanding of how to integrate the various themes with content areas and standards and an appreciation for the importance of addressing children's health needs in an era when the country is facing increased obesity and other health problems.
EDUC 302	Behavior Design	X		Students learn Behavior Design and practice applying the methods to change human behavior in measurable ways. In this particular course, all projects will focus on one theme: Designing the first step.
EE 213	Digital MOS Integrated Circuits	X		Looks a little more deeply at how digital circuits operate, what makes a gate digital, and how to "cheat" to improve performance or power. To aid this analysis we create a number of different models for MOS transistors and choose the simplest one that can explain our the circuit's operation, using both hand and computer analysis. We explore static, dynamic, pulse-mode, and current mode logic, and show how they are are used in SRAM design. Topics include sizing for min delay, noise and noise margins, power dissipation. The class uses memory design (SRAM) as a motivating example. DRAM and EEPROM design issues are also covered. Formerly EE 313. Prerequisites: EE 101B, EE 108. Recommended: EE 271.
EE 218	Power Semiconductor Devices and Technology		X	This course starts by covering the device physics and technology of current silicon power semiconductor devices including power MOSFETs, IGBTs, and Thyristors. Wide bandgap materials, especially GaN and SiC are potential replacements for Si power devices because of their fundamentally better properties. This course explores what is possible in these new materials, and what the remaining challenges are for wide bandgap materials to find widespread market acceptance in power applications. Future clean, renewable energy systems and high efficiency power control systems will critically depend on the higher performance devices possible in these new materials. Prerequisites: EE 116 or equivalent.
EE 243	Semiconductor Optoelectronic Devices	X		Semiconductor physics and optical processes in semiconductors. Operating principles and practical device features of semiconductor optoelectronic materials and heterostructures. Devices include: optical detectors (p-i-n, avalanche, and MSM); light emitting diodes; electroabsorptive modulators (Franz-Keldysh and QCSE), electrorefractive (directional couplers, Mach-Zehnder), switches (SEEDs); and lasers (waveguide and vertical cavity surface emitting). Prerequisites: semiconductor devices and solid state physics such as EE 216 or equivalent.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
EE 292H	Engineering, Entrepreneurship & Climate Change		X	The purpose of this seminar series course is to help students and professionals develop the tools to apply the engineering and entrepreneurial mindset to problems that stem from climate change, in order to consider and evaluate possible stabilizing, remedial and adaptive approaches. This course is not a crash course on climate change or policy. Instead we will focus on learning about and discussing the climate problems that seem most tractable to these approaches. Each week Dr. Field and/or a guest speaker will lead a short warm-up discussion/activity and then deliver a talk in his/her area of expertise. We will wrap up with small-group and full-class discussions of related challenges/opportunities and possible engineering-oriented solutions. Class members are asked to do background reading before each class, to submit a question before each lecture, and to do in-class brainstorming. May be repeated for credit.
EE 308	Advanced Circuit Techniques	X		Design of advanced analog circuits at the system level, including switching power converters, amplitude-stabilized and frequency-stabilized oscillators, voltage references and regulators, power amplifiers and buffers, sample-and-hold circuits, and application-specific op-amp compensation. Approaches for finding creative design solutions to problems with difficult specifications and hard requirements. Emphasis on feedback circuit techniques, design-oriented thinking, and hands-on experience with modern analog building blocks. Several designs will be built and evaluated, along with associated laboratory projects. Prerequisite: EE 251 or EE 314A.
EE 356A	Resonant Converters		X	Miniaturization of efficient power converters remain a challenge in power electronics whose goal is improving energy use and reducing waste. In this course, we will study the design of Resonant converters which are capable of operating at higher frequencies than their 'hard-switch' counterparts. Resonant converter are found in high performance applications where high control bandwidth and high power density are required. We will also explore practical design issues and trade off in selecting converter topologies in high performance applications. Prerequisites: EE153/EE253.
EE 392B	Industrial Internet of Things	X		The seminar will feature guest lectures from the industry to discuss the state of the affairs in the Industrial Internet of Things (IoT) with emphasis on existing and new Data Science, analytics, and Big Data applications. The class will address several verticals. One of them is electrical power industry, which is undergoing transition to renewables and distributed generation. Another one is aerospace industry including airlines and equipment vendors. Other verticals are oil and gas, data centers, and semiconductor manufacturing.
EE 65	Modern Physics for Engineers	X		This course introduces the core ideas of modern physics that enable applications ranging from solar energy and efficient lighting to the modern electronic and optical devices and nanotechnologies that sense, process, store, communicate and display all our information. Though the ideas have broad impact, the course is widely accessible to engineering and science students with only basic linear algebra and calculus through simple ordinary differential equations as mathematics background. Topics include the quantum mechanics of electrons and photons (Schrödinger's equation, atoms, electrons, energy levels and energy bands; absorption and emission of photons; quantum confinement in nanostructures), the statistical mechanics of particles (entropy, the Boltzmann factor, thermal distributions), the thermodynamics of light (thermal radiation, limits to light concentration, spontaneous and stimulated emission), and the physics of information (Maxwell's demon, reversibility, entropy and noise in physics and information theory). Pre-requisite: Physics 41. Pre- or co-requisite: Math 53 or CME 102.
EMED 219	Catalyst For Change: Emergency Response Systems in India	X		This course will cover the basics of health care access and infrastructure in India, with a focus on emergency care and response. We will review principles of community engagement and social emergency medicine with in the India context, using maternal/child health and gender-based violence as case studies. Students participating in the course will be research assistants in the summer, as such, we will spend some classes reviewing project logistics, research protocols, and research ethics.
EMED 235	Wilderness Leadership and Mentorship Skills for Medical and PA Students	X		For MD/Master of Medicine wilderness pre-orientation trip (SWEAT) leaders and MSPA pre-orientation camping trip leaders. Training to engage with and prepare incoming first-year medical students and MSPA students for the rigors of their respective programs. Topics include: fundamentals of wilderness survival, wilderness equipment use, camping, outdoor leadership, mentorship, team building, problem-solving, risk management, cultural competency, professionalism as a physician, reflection and resiliency, first-year curricula, stress management and coping. Guest lectures from Stanford faculty and advisors, emergency medicine physicians, outdoor education specialists, and mental health personnel.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
ENERGY 101A	Energizing California		X	A weekend field trip featuring renewable and nonrenewable energy installations in Northern California. Tour geothermal, bioenergy, and natural gas field sites with expert guides from the Department of Energy Resources Engineering. Requirements: One campus meeting and weekend field trip. Enrollment limited to 25. Freshman have first choice.
ENERGY 110	Engineering Economics	X		The success of energy projects and companies is judged by technical, economic and financial criteria. This course will introduce concepts of engineering economy, e.g., time value of money, life cycle costs and financial metrics, and explore their application to the business of energy. We will use case studies, business school cases and possibly industry guest lecturers. Examples from the hydrocarbon businesses that dominate energy today will provide the framework for the analysis of both conventional and renewable energy.
ENERGY 123	When Technology Meets Reality; An In-depth Look at the Deepwater Horizon Blowout and Oil Spill		X	The Deepwater Horizon blowout and spill in April 2010 occurred on one of the most advanced deepwater drilling rigs in the world operated by one of the most experienced companies. In this course we will look at and discuss the technologies and management practices involved in deepwater drilling and discuss how an accident like this happens and what could have been done differently to avoid it. We will focus on the Horizon and also look briefly at other high profile industrial and technological accidents.
ENERGY 130	Well Log Analysis I		X	For earth scientists and engineers. Interdisciplinary, providing a practical understanding of the interpretation of well logs. Lectures, problem sets using real field examples: methods for evaluating the presence of hydrocarbons in rock formations penetrated by exploratory and development drilling. The fundamentals of all types of logs, including electric and non-electric logs.
ENERGY 155	Undergraduate Report on Energy Industry Training	X		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.
ENERGY 199	Senior Project and Seminar in Energy Resources	X		Individual or group capstone project in Energy Resources Engineering. Emphasis is on report preparation. May be repeated for credit.
ENERGY 204	Achieving Universal Energy Access by 2030: Can it be done?		X	Today 1.2 billion people have no access to electricity; many more don't have power that is reliable. Activities the developed world counts on for economic growth are severely limited where there isn't reliable electricity. Cost reductions in distributed, renewable energy generation and battery storage technologies are creating opportunities to bring affordable power to communities that have never had it. This course will examine what will need to be in place so that electricity can reach everyone by 2030.
ENERGY 20N	Technology in the Greenhouse		X	The evidence that human activities are changing the climate is overwhelming. Energy use is woven throughout the fabric of modern societies, and energy systems are also a primary way that humans interact with the global Earth systems like climate. We know enough about the potential impacts of climate change to see that we need to transform the world's energy systems to a much cleaner set of technologies with much lower greenhouse gas emissions. Economies that use energy in a clean, cost-effective way will be much more competitive in the future. The clean energy transition is now underway, with reductions in coal use and rapid growth in solar and wind deployment, but there is much more to do to limit the adverse impacts of climate change. This seminar explores technology options available to make the changes needed, in the developed and developing worlds. There is no shortage of energy available for our use. Instead, the challenge is to convert those energy resources into services like electricity and transportation, and that conversion requires technology, as well as policies and markets that enable innovation. The scale of the world's energy systems is dauntingly large, and we will need a well-diversified set of options to meet the challenge. Wind, solar, nuclear, carbon capture and storage for fossil fuel use, modified agriculture, electric (and automated) vehicles, advanced air conditioning, and many other technology options exist. We will consider these technologies and ask what barriers will have to be addressed if they are to be deployed at a scale large enough to reduce the impact climate change. The format will be discussions of technologies and their potential with a project and student presentations toward the end of the quarter.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
ENERGY 212	Environmental Aspects of Oil and Gas Production		X	This course introduces students to the major environmental aspects of oil and gas production, including law, policy, regulation, impact assessment, and mitigation. Through readings, lectures, homework, in-class activities, and case studies, students learn about the major state/federal laws and regulatory programs governing oil and gas in the U.S., industry permitting and compliance strategies, and current public stakeholder issues/challenges (with a particular focus on climate change and water management). Emerging legislative/regulatory trends, advocacy approaches, and sustainability concepts also are explored.
ENERGY 214	The Global Price of Oil		X	Understanding the current and future price of oil requires the synthesis of geologic, engineering, financial, geopolitical, and macroeconomic information. In this seminar, we will build a global supply curve for petroleum by studying the marginal and full-cycle production costs for each of the major resource categories. We will study how reserve classification varies globally, and how global petroleum resources and reserves have changed and are likely to change over time. We will further investigate how the time lag between resource discovery, project sanctioning, and full production will affect future supply. Finally, we will study the elasticity of oil demand and how that demand is likely to change over time as the developing world gets richer and as competition from other energy sources increases.
ENERGY 216	Entrepreneurship in Energy	X		The combined forces of climate change, technological development, and geopolitics are disrupting the energy industry, yet the competitiveness and regulated nature of the mature markets for fuel, power, and materials have created meaningful barriers to entry for startup companies. In this case based course, students will study real energy startups to understand what challenges they have overcome and continue to face. Each week, the course will focus on a different company and the founder or CEO of that company will present. Topics will include advanced battery technologies, photovoltaic manufacturing, solar and wind project development, oil & gas exploration & production, advanced biofuels, electric vehicles, distributed power generation, and financing energy startups.
ENERGY 224	Advanced Reservoir Simulation		X	Topics include modeling of complex wells, coupling of surface facilities, compositional modeling, dual porosity models, treatment of full tensor permeability and grid nonorthogonality, local grid refinement, higher order methods, streamline simulation, upscaling, algebraic multigrid solvers, unstructured grid solvers, history matching, other selected topics. Prerequisite: 223 or consent of instructor. May be repeated for credit.
ENERGY 226	Thermal Recovery Methods	X		Theory and practice of thermal recovery methods: steam drive, cyclic steam injections, and in situ combustion. Models of combined mass and energy transport. Estimates of heated reservoir volume and oil recovery performance. Wellbore heat losses, recovery production, and field examples.
ENERGY 251	Thermodynamics of Equilibria		X	Lectures, problems. The volumetric behavior of fluids at high pressure. Equation of state representation of volumetric behavior. Thermodynamic functions and conditions of equilibrium, Gibbs and Helmholtz energy, chemical potential, fugacity. Phase diagrams for binary and multicomponent systems. Calculation of phase compositions from volumetric behavior for multicomponent mixtures. Experimental techniques for phase-equilibrium measurements. May be repeated for credit.
ENERGY 273	Special Topics in Energy Resources Engineering	X		-
ENERGY 281	Applied Mathematics in Reservoir Engineering	X		The philosophy of the solution of engineering problems. Methods of solution of partial differential equations: Laplace transforms, Fourier transforms, wavelet transforms, Green's functions, and boundary element methods. Prerequisites: CME 204 or MATH 131, and consent of instructor.
ENERGY 289	Multiscale Methods for Transport in Porous Media	X		The concept of "tyranny of scales" in natural/engineered porous media refers to the disparity of temporal and spatial scales at which mass, momentum, and energy transport is best understood and at which predictions are needed for practical applications. Modeling approaches that incorporate process understanding at different temporal and spatial scales are often necessary to improve our predictive capabilities of natural and engineered porous media. The course focuses on the fundamental understanding of multiscale systems and corresponding modeling tools to analyze them.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
ENERGY 294	Electrochemical Energy Storage Systems: Modeling and Estimation	X		The course focuses on modeling and estimation methods as necessary tools to extract the full potential from Lithium-ion batteries, specifically used in electrified vehicles. The complex nature of a battery system requires that a physics-based approach, in the form of electrochemical models, be used as a modeling platform to develop system-level control algorithms to allow designer to maximize batteries performance and longevity while guaranteeing safety operations. In this course, we will cover 1) first-principles methods to model battery dynamics, 2) electrochemical and control-oriented models, 3) parameter identification problems, 4) estimation algorithms for real-time application. A formal exposure to state space analysis and estimation of dynamical systems will be given.
ENGLISH 360E	Futurities	X		Literary studies has long had a wide array of methods for theorizing the past. In more recent years, scholars have begun to theorize the future with equal energy. But what do we talk about when we talk about the future? Events that might happen, the way the thought of the future affects our actions today, or something more? We will discuss queer futurities, Afrofuturism, ecological futurity, revolutionary futures, reception and the futures of texts, and more.
ENGLISH 50B	A Humanist's Guide to Art, Community, Design, and the Earth	X		This short, intensive seminar features Humanities Scholar & Artist in Residence Clare Whistler (visiting from England April 12-27) will meet for dialogue, workshop, creation, and improvisation. This workshop will help students to think through methods of humanistic inquiry as ways of integrating meaning and purpose into their lives; it will focus on projects, research, collaborations, walking explorations, and relationships. In five residence-based sessions around Gerhard Quad, students will learn to develop personal and professional practices such as finding and creating apprenticeships and internships, creating a Humanities "start up," and partnering with investors, foundations, fundraisers, patrons, and community. This course will be of interest to students who would like to maintain humanistic values, make a decent living, find good mentors and collaborators, and create communities that are attentive to their constructed and natural environments.
ENGR 50E	Introduction to Materials Science, Energy Emphasis	X		Materials structure, bonding and atomic arrangements leading to their properties and applications. Topics include electronic, thermal and mechanical behavior; emphasizing energy related materials and challenges.
ENVRES 201	Designing and Evaluating Community Engagement Programs for Social and Environmental Change		X	Non-profit organizations seeking to achieve social and environmental change often run outreach and education programs to engage community members in their cause. Effective application of social science theory and methods may improve the design and evaluation of such community engagement programs. In this class, we partner with environmental and social justice organizations in the Bay Area to explore two questions: 1) How can recent findings from the social sciences be applied to design more effective community engagement programs ? 2) How can we rigorously evaluate outreach and education programs to ensure they are achieving the desired objectives? The course will include an overview of key theories from psychology, sociology, and education, field trips to partnering organizations, and a term-long community-engaged research project focused on designing and/or evaluating a local outreach or educational program that is meant to achieve social and environmental change.
ENVRES 220	The Social Ocean: Ocean Conservation, Management, and Policy		X	This interdisciplinary seminar addresses current coastal and marine topics through a series of readings, discussions, and guest lecturer presentations. Through classic and contemporary scientific literature, news articles, and multimedia sources, students will examine the challenges of coastal and marine policy and management and investigate the human dimensions of potential solutions. The course will begin with global scale topics and conclude with the individual stories of human connection to the ocean. This seminar is open to advanced undergraduate and graduate students.
ENVRES 222	Climate Law and Policy		X	This course offers an interdisciplinary, graduate-level survey of historical and current efforts to regulate emissions of greenhouse gases in the United States. Students will read primary legal documents—including statutes, regulations, and court cases—in order to evaluate the forces and institutions shaping American climate policy. Although the class will focus on the intersection of climate policy and the legal system, no specific background in law is necessary.
ENVRES 240	Environmental Decision-Making and Risk Perception		X	Mobilizing successful conservation efforts to mitigate climate change and preserve both local and global ecosystems requires a new way of thinking. This course will investigate the barriers to pro-environmental behavior and the heuristics and biases that cloud our ability to respond effectively to environmental problems, using insights from behavioral economics, neuroeconomics, and environmental risk perception. Emphasis on interdisciplinary applications of recent research, and implications for environmental policymaking and persuasive messaging.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
ENVRES 250	Environmental Governance		X	How do we work together to solve environmental problems? Across the globe, who has a voice, and who ultimately decides how to balance conservation and development? How do we build governance institutions that facilitate both environmental sustainability and social equity? This seminar on environmental governance will focus on the challenges and opportunities for managing common-pool resources, like fisheries, forests, and water. Because managing environmental resources is often about managing people, we will explore the motivations underlying human behavior towards the environment. We will discuss how institutions encode our cultural values and beliefs, and how we can reshape these institutions to achieve more sustainable outcomes. Coursework includes foundational readings and a pragmatic exploration of case studies. Teaching cases address topics in community-based conservation, international protected areas, market-based approaches, coping with environmental risk, and other themes. Interested undergraduate and graduate students from any discipline are welcome.
ENVRES 280	Topics in Environment and Resources		X	Required core course restricted to E-IPER Joint M.S. students. This course functions as a gateway to fundamental concepts in environment, energy and sustainability. Topics include climate change, ecosystem services, life cycle assessment, energy systems, food systems, and others. Students engage with affiliated faculty, and begin to develop ways to integrate science and technology with business, law and other professional skills to solve environment and resource problems.
ENVRES 300	Introduction to Resource, Energy and Environmental Economics		X	Required core course restricted to first year E-IPER Ph.D. students. Examination of environmental, energy and natural resource management problems through the lens of economics, with an emphasis on hands-on practical problem-solving. Topics include market failure, cost-benefit analysis, finance, risk & uncertainty, non-market valuation, regulation, green accounting, rent, renewable resources, exhaustible resources, including energy, and biodiversity. Prerequisite: proficiency in multivariate calculus. Knowledge of basic microeconomics helpful but not essential.
ENVRES 315	Environmental Research Design Seminar		X	Required core course restricted to first year E-IPER Ph.D. students. Series of faculty presentations and student-led discussions on interdisciplinary research design as exemplars of the research design theories discussed in ENVRES 320. Designing Environmental Research. Topics parallel the ENVRES 320 syllabus. Corequisite: ENVRES 320.
ENVRES 320	Designing Environmental Research		X	Required core course restricted to first year E-IPER Ph.D. students. Research design options for causal inference in environmentally related research. Major philosophies of knowledge and how they relate to research objectives and design choices. Identification of critical elements within a broad range of research designs. Evaluation of the types of research questions for which different designs are suited, emphasizing fit between objectives, design, methods, and argument. Development of individual research design proposals, including description and justification understandable to a non-specialist.
ENVRES 330	Research Approaches for Environmental Problem Solving	X		Required core course restricted to first year E-IPER Ph.D. students. How to develop and implement interdisciplinary research in environment and resources. Assignments include development of research questions, a preliminary literature review, and a summer funding proposal. Course is structured on peer critique and student presentations of work in progress. Corequisite: ENVRES 398 with a faculty member chosen to explore a possible dissertation topic.
ENVRES 340	E-IPER PhD Writing Seminar	X		Required core course restricted to second-year E-IPER PhD students. Actively pursue one or more writing goals relevant to this stage in their graduate studies in a structured setting. Set specific writing goals, create and follow a plan for reaching these goals, and receive substantive feedback on their written products from their peers. Examples of writing products include, but are not limited to, the student's dissertation proposal, E-IPER Fields of Inquiry essay, a literature review, or a grant or fellowship application. By the end of the course, students are expected to have completed or have made substantial progress toward their writing goal.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
ESS 185	Adaptation	X		Adaptation is the process by which organisms or societies become better suited to their environments. In this class, we will explore three distinct but related notions of adaptation. Biological adaptations arise through natural selection, while cultural adaptations arise from a variety of processes, some of which closely resemble natural selection. A newer notion of adaptation has emerged in the context of climate change where adaptation takes on a highly instrumental, and often planned, quality as a response to the negative impacts of environmental change. We will discuss each of these ideas, using their commonalities and subtle differences to develop a broader understanding of the dynamic interplay between people and their environments. Topics covered will include, among others: evolution, natural selection, levels of selection, formal models of cultural evolution, replicator dynamics, resilience, rationality and its limits, complexity, adaptive management.
ESS 240	Advanced Oceanography	X		For upper-division undergraduates and graduate students in the natural sciences and engineering. Topical issues in marine science/oceanography. Topics vary each year following or anticipating research trends in ocean research and issues. For 2018, the focus is on the Arctic Ocean, including Arctic Oceanography, Ecosystems, Resource Utilization and Geopolitics, and Environmental Change.
ESS 244	Marine Ecosystem Modeling	X		This course will provide the practical background necessary to construct and implement a 2-dimensional (space and time) numerical model of a simple marine ecosystem. Instruction on computer programming, model design and parameterization, and model evaluation will be provided. Throughout the 10-week course, each student will develop and refine their own multi-component marine ecosystem model. Instructor consent required.
ESS 275	Nitrogen in the Marine Environment	X		The goal of this seminar course is to explore current topics in marine nitrogen cycle. We will explore a variety of processes, including primary production, nitrogen fixation, nitrification, denitrification, and anaerobic ammonia oxidation, and their controls. We will use the book Nitrogen in the Marine Environment and supplement with student-led discussions of recent literature. A variety of biomes, spatial and temporal scales, and methodologies for investigation will be discussed.
ESS 305	Climate Change: An Earth Systems Perspective		X	This is an introductory graduate-level course that is intended to provide an overview of leading-edge research topics in the area of climate change. Lectures introduce the physical, biogeochemical, ecological, and human dimensions of climate change, with emphasis on understanding climate change from an Earth System perspective (e.g., nonlinearities, feedbacks, thresholds, tipping points, resilience, vulnerability, risk). The emphasis is on providing an initial introduction to the process by which researchers pose questions and analyze and interpret results.
ESS 322B	Seminar in Hydrology	X		Current topics. May be repeated for credit. Prerequisite: consent of instructor.
FAMMED 200SI	United States of Healthcare: A Geographic Survey of American Healthcare Disparities	X		This dinner seminar will describe the various ways in which healthcare is experienced and practiced across the country. Each class will focus on one region of the nation and examine the socioeconomic, geographic, historical and cultural factors that contribute to one present-day disparity localized to the region. By examining several topics in depth, this course aims to illustrate how community and state-level discrepancies affect individual experiences and the role healthcare providers can play in making healthcare more equitable and accessible to all. This year topics covered will include: Refugee/Immigrant health, Native Health, Mental Health, Women's Health + Reproductive Rights, Homeless Health, Medicare/Health Insurance Gap.
GEOPHYS 201	Frontiers of Geophysical Research at Stanford	X		Required for new students entering the department and undergraduate majors. Department faculty introduce the frontiers of research problems and methods being employed or developed in the department and unique to department faculty and students: what the current research is, why the research is important, what methodologies and technologies are being used, and what the potential impact of the results might be. Graduate students register for 1 unit (Mondays only), undergraduates for 3 units which include a discussion section (Mondays and Wednesdays). Offered every year, autumn quarter.
GEOPHYS 20N	Predicting Volcanic Eruptions	X		The physics and chemistry of volcanic processes and modern methods of volcano monitoring. Volcanoes as manifestations of the Earth's internal energy and hazards to society. How earth scientists better forecast eruptive activity by monitoring seismic activity, bulging of the ground surface, and the discharge of volcanic gases, and by studying deposits from past eruptions. Focus is on the interface between scientists and policy makers and the challenges of decision making with incomplete information. Field trip to Mt. St. Helens, site of the 1980 eruption.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
GEOPHYS 211	Environmental Soundings Image Estimation	X		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/ .
GEOPHYS 306	Topics in Multiphase Instabilities and Extreme Events	X		This Seminar will explore the role of multiphase instabilities in the onset and evolution of extreme events. We will explore the different types of instabilities that arise in different multiphase aggregates and why they might be critical for understanding the nonlinear behavior of natural systems.
GEOPHYS 385S	Wave Physics	X		Theory, numerical simulation, and experiments on seismic and electromagnetic waves in complex porous media. Applications from Earth imaging and in situ characterization of Earth properties, including subsurface monitoring. Presentations by faculty, research staff, students, and visitors. May be repeated for credit.
GS 184	Field Trip to Volcanoes of the Eastern Sierran Volcanism	X		Four-day trip over Memorial Day weekend (involving light hiking and camping) to study silicic and mafic volcanism in the eastern Sierra Nevada: basaltic lavas and cinder cones erupted along normal faults bounding Owens Valley, Long Valley caldera, postcaldera rhyolite lavas, hydrothermal alteration and hot springs, Holocene rhyolite lavas of the Inyo and Mono craters, subaqueous basaltic and silicic eruptions of Mono Basin, floating pumice blocks. If snow-level permits, granites of Yosemite and/or silicic volcanism associated with the Bodie gold district. Recommended: 1 or equivalent. Limited enrollment; preference to frosh, sophs, and undergraduates and graduates majoring in SE3.
GS 248	The Petroleum System: Investigative method to explore for conventional & unconventional hydrocarbons	X		How the petroleum system concept can be used to more systematically investigate how hydrocarbon fluid becomes an unconventional accumulation in a pod of active source rock and how this fluid moves from this pod to a conventional pool. How to identify, map, and name a petroleum system. The conventional and unconventional accumulation as well as the use of modeling.
GS 251	Sedimentary Basins	X		Analysis of the sedimentary fill and tectonic evolution of sedimentary basins. Topics: tectonic and environmental controls on depositional systems, detrital composition, burial history, and stratigraphic architecture; synthesis of basin development through time. One weekend field trip required. Prerequisites: 110, 151.
GS 260	Quantifying Uncertainty in Subsurface Systems	X		Broad conceptual overview of the various components required to uncertainty quantification (UQ) for decision making in subsurface engineering problems such as oil/gas production, groundwater management, contaminant remediation, geothermal energy and mineral deposits. The emphasis lies on learning how to synthesize rather than the details of each individual discipline. The class will cover the basic data science for UQ: dimension reduction methods, Monte Carlo & global sensitivity analysis. Introduction to Bayesianism and how it applies to subsurface prediction problems, in particular, the formulation of geological prior models and the role of geostatistics. Strategies for integrating geological science, geophysics, data science and decision science into decision making under uncertainty. Team work on real field applications.
GS 336	Stanford Alpine Project Seminar	X		Weekly student presentations on continental collision tectonics, sedimentology, petrology, geomorphology, climate, culture, and other topics of interest. Students create a guidebook of geologic stops in advance of field trip. May be repeated for credit.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
GSBGEN 305	Investing for Good	X		<p>Investing for Good will introduce students to the entire spectrum of purposeful, values-driven, and impact investing. We examine the field from the perspective of an institutional investor (i.e. fund manager, investment advisor, endowment manager, head of a family office, etc). Our goal is to have students emerge with a practical and analytical framework for: 1. evaluating impact and mission-aligned investments across multiple asset classes and sectors; 2. constructing a portfolio using impact as a lens; 3. designing an impact investment company; and 4. understanding the many practical and theoretical challenges confronting this exciting emerging field. We start by exploring some fundamental questions: what is a purposeful or impact investment; can impact investments be defined along a spectrum between conventional investing and philanthropy; whose money is it; what are the constraints and opportunities; how do we (re)define return and/or performance. We briefly analyze impact investing in the context of modern portfolio theory. We then develop a framework for portfolio construction and evaluation across four criteria: risk, return, liquidity, and impact. Through a combination of class dialogues, role plays, and case discussions, we will explore a wide variety of asset classes, impact themes, and investment challenges. A series of team-based investment committee simulations will comprise a significant portion of the course and will provide a significant experiential learning experience. Previous experience in finance, investing, social enterprise, entrepreneurship, or philanthropy is not required, but both helpful and welcomed. While first year students are encouraged to enroll, students who have limited familiarity with the basics of investing and corporate finance are strongly encouraged to purchase David Swensen's "Pioneering Portfolio Management" and cover the recommended chapters in advance of the course. It's also important to note that this class will require financial modeling and detailed investment analysis. Many of the issues we'll be tackling have no unambiguous answers. Lively discussion and debate will be necessary and expected.</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
GSBGEN 314	Creating and Scaling High Potential Ventures in Developing Economies (Cases and Team Project)	X		<p>This course addresses the distinctive challenges and opportunities of launching high-potential new ventures in developing economies. Developing economies are attractive targets for entrepreneurs because many are just starting to move up the growth curve, and they offer low-cost operating environments that can be great development labs for potentially disruptive innovations. They increase in attractiveness when their political institutions stabilize and they become more market-friendly. At the same time, developing economies pose serious challenges. Pioneering entrepreneurs take on significant risks to gain early mover advantages. Specifically, entrepreneurs will not be able to count on the same kind of supportive operating environments that we take for granted in the developed world. They often face cumbersome permit and licensing processes, poorly developed financial and labor markets, problematic import and export procedures, unreliable local supply chains, weak infrastructure, corruption, currency risks, limited investment capital, lack of financial exits and more. This course is designed to help would-be entrepreneurs - both founders and members of entrepreneurial teams - better understand and prepare for these issues as they pursue the opportunities and address the challenges to start, grow, and harvest their ventures in these environments. GSB314 combines a seminar/discussion format (Tuesdays) with a team-based project (Thursdays). For the Tuesday sessions, students will read about and discuss the key challenges described above and potential solutions. Guests will describe their own startup and investing experiences in developing economies and answer questions. A framework based on the recently published World Economic Forum (WEF) report on "Entrepreneurial Ecosystems Around the Globe and Company Growth Dynamics" will be used to structure the course. Each student will prepare a short write-up as a final assignment, for this portion of the course, on a case chosen from a selection provided by the instructors. The Thursday sessions is a team-based exercise for students who either have a specific idea or want to join a team of classmates to pursue more deeply an understanding of the team's country of focus and an initial investigation of the idea's viability. Students must come in willing to be team players and do the work necessary to complete this exercise over the full quarter. Each team member's contributions will be assessed by fellow teammates. Teams of AT LEAST 3 STUDENTS EACH will be formed before the start of class or on the first day of class at the latest so students can decide if they want to enroll. The team will describe, in a final presentation, the challenges and opportunities in their country using the WEF framework. The final presentation will also include the team's thoughts on the viability of their proposed venture and how it capitalizes on their country's assets and addresses its challenges. A detailed business plan is not required; however, specific recommendations and plans for next steps that would be carried out during a 3 to 6 month field and market research study in the country will be part of the final presentation. Note: Students who only want to participate in the seminar/discussion portion of the class and not do a team-based project (see details below) may enroll in GSB514 for 2 units.</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
GSBGEN 336	Energy Markets and Policy		X	<p>This is a course on how energy and environmental markets work, and the regulatory mechanisms that have been and can be used to achieve desired policy goals. The course uses a electricity market game as a central teaching tool. In the game, students play the role of electricity generators and retailers in order to gain an understanding of how market rules (including environmental regulations and renewable energy mandates) affect the business strategy of market participants, and in turn economic and environmental outcomes. The goal of the course is to provide students with both theoretical and hands-on understanding of important energy and environmental market concepts that are critical to market functioning but not always widely appreciated. Concepts covered include: 1) regulated price-setting versus price-setting through market mechanisms, 2) BTU arbitrage in input energy choices, 3) uniform price vs. pay-as-bid auctions, 4) the ability and incentive to exercise unilateral market power, 5) unilateral versus coordinated exercise of market power, 6) transmission congestion, 7) forward contracts and their effect on market functioning, 8) dynamic pricing of electricity and active involvement of final demand, 9) the nature of energy reserves, 10) carbon pricing mechanisms including taxes and cap-and-trade systems, 11) renewable portfolio standards and other renewable energy incentives, 12) determination of levelized cost of energy (LCOE) and its impact on new capacity investment decisions, and 13) interactions between environmental mechanisms and regulations. We will also discuss the key features of the markets for major sources of energy such as oil, natural gas, coal, nuclear, solar, wind, and biomass. The course is useful background for private sector roles in energy production, research, management, trading, investment, and government and regulatory affairs; government positions in policymaking and regulation; research and policy functions in academia, think tanks, or consultancies; and non-profit advocacy roles related to energy and the environment.</p>
GSBGEN 511	Making Social Ventures Happen by Attracting Financial and Human Capital	X		<p>Social ventures require leadership, funding, expertise, skills and networks to get off the ground, grow and scale. This course will focus on the key strategies for building and leveraging a network of champions to capitalize a social venture at early-stage, and for sustaining and growing that network as the venture grows. This class is applicable to intrapreneurs, changemakers within major institutions, (private or public), board members, impact investors, those who aspire to be senior leaders within social ventures and social entrepreneurs (founders). Co-led by a practicing venture philanthropist and a social entrepreneur, this interactive, pragmatic course will: - Discuss the critical financial and human capital needs of organizations and companies at different life stages. - Explore the concept of champions and the different types of champions including board chairs, co-founders, mentors, faculty advisors, donors, investors, community evangelists, and fellow entrepreneurs. - Learn about effective networks and how to build them, including the role of communications, relationship-building, and crisis management. - Explore the concept of a powerful vulnerability and the art of "influence without authority" in attracting financial and human capital to the mission and making social ventures happen. Special emphasis will be given to developing co-founders and founding teams, boards and funders/investors as champions. - Develop a roadmap for the ways you will support social ventures throughout your career. - Meet social entrepreneurs and their champions who promote them within various power structures (major corporations, government, the institutional funding community) to learn about the successes and failures of their partnerships. Guest speakers will be posted prior to start of class. - Invite you to join instructors, guest speakers and fellow students for casual dinner on both Wednesdays after class. - Get to know your fellow classmates who share a passion for addressing the world's intractable problems and for creating systemic change.</p>
GSBGEN 532	Clean Energy Opportunities	X		<p>This course examines business models and opportunities related to clean energy, specifically to low-carbon energy. We examine emerging trends for this sector in the context of technological change, business opportunities and the parameters set by public policy.</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
GSBGEN 569	The Open Road: Innovation in Cars, Driving, and Mobility	X		This course will look at ongoing and upcoming innovation in cars, driving, and mobility from three perspectives: (1) technology, (2) economics & business Models, and (3) policy. We'll survey changes in powering vehicles (e.g. electrification and biofuels), in vehicle connectivity and communications, and most especially changes in autonomy and self-driving vehicles. We'll look at changes in the economics of cars, vehicles, and driving new business models, shared ownership, mobility as a service, as well as who some of the major players are in this nascent field and what they're doing/developing. And we'll explore the interactions of technology and economics with policy and broader societal changes-direct effects like safety, legal liability, and who can drive; indirect effects on traffic, insurance, infrastructure needs, fuel taxes, and the environment; as well as longer-term and even bigger changes in daily life and where and how we live, work, and drive.
HISTORY 208K	Global Capitalism and the Global South	X		Is modern capitalism a European innovation or a global phenomenon? Can there be different manifestations of capitalism in different local, regional, national, and imperial contexts? What role has the Global South played in the history of capitalism? This course examines the ways that capitalism has innovated, destroyed, and matured from the 17th to 20th centuries. It explores the themes of business, trade, labor, agriculture, gender, and race with a focus on the Middle East, Africa, and East and South Asia.
HUMBIO 113	The Human-Plant Connection		X	The intertwined biologies of humans and plants, particularly the ways in which people and plants have imposed selection pressures and ecological change on one another. Topics include evolution and basic plant structure; plant domestication; effects of agriculture on human health and physiology; plants in traditional and contemporary diets; and human influences on plant biology through genetic manipulation and environmental change. Class meetings center on journal articles. Final project includes written and multimedia presentations. Prerequisites: HumBio 2A or Bio 81 and Bio 82 or consent of instructor.
HUMRTS 101	Cross-Disciplinary Perspectives on Human Rights Theory and Practice	X		In this survey human rights course, students will learn about the principal historical and philosophical bases for the modern concept of human rights, as well as the international legal frameworks meant to protect and promote these rights. Class sessions will include a mix of seminar discussions and guest lectures by distinguished Stanford faculty from departments across the university as well as practitioners from a variety of professional fields. The course seeks to illuminate for how the distinct methodologies, assumptions, and vocabulary of particular disciplinary communities affect the way scholars and practitioners trained in these fields approach, understand, and employ human rights concepts. This course fulfills the gateway course requirement for the minor in Human Rights.
INTNLREL 135A	International Environmental Law and Policy		X	This course addresses the nature, content, and structure of international environmental law. We will discuss its sources (formal and informal) and general principles, along with the emerging principles (sustainable development, precautionary principle, etc.) We will evaluate the role of international and non-governmental organizations, as well as examine the negotiation, conclusion, and implementation of international environmental agreements. Problem areas to be examined include global warming, stratospheric ozone depletion, exports of hazardous substances, transboundary pollution, trade and environment, and development and environment. RECOMMENDED PREREQ: students have completed POLISCI 101 and/or INTNLREL 140A
INTNLREL 141A	Camera as Witness: International Human Rights Documentaries	X		Rarely screened documentary films, focusing on global problems, human rights issues, and aesthetic challenges in making documentaries on international topics. Meetings with filmmakers.
LATINAM 177	Mapping Poverty, Colonialism and Nation Building in Latin America	X		This course is an introduction to the mapping of colonial and early independent Latin America, as a lens through which students may learn about the process of colonization, state building, and the legacies on those processes on poverty and underdevelopment today. Historical maps are analyzed both as GIS data sources, and as interpretative lenses through which we can glimpse the way human settlements and activity reveal social, political and economic dynamics whose legacies are still present today.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
LATINAM 248	Racial and Gender Inequalities in Latin America	X		<p>This course explores the intersection between racial and gender inequalities in Latin America focusing on the historical pattern of racism, sexism and discrimination, and on the political and social changes that have enabled Afro-descendants and women to achieve social rights in some countries of the region such as Brazil, Colombia, Ecuador, and Uruguay. The first part of this course introduces the struggle of political movements taking into consideration the historical process of race and gender discrimination. It will address not only the history of blacks and women's movements in the 20th century, but also racism and sexism as cultural and institutional elements that configure inequality in those countries. Socio-economic indicators, race and gender-based violence, and political participation will be analyzed. The second part of this course examines the most recent discourses about women and afro-descendant rights, and their political framework. It evaluates how they have changed public opinion, laws and the social, institutional and political environment of Latin America. Finally, this course discusses the ability of Afro-descendants and women movements to navigate in the current political climate and advance their rights. Course will be taught in Portuguese.</p>
LAW 2504	Environmental Law and Policy		X	<p>(Formerly Law 603) This introductory course will focus on the variety of legal mechanisms we use to address environmental harms such as air and water pollution, global climate change, and habitat destruction. We will focus on the key federal environmental statutes, including the National Environmental Policy Act, the Clean Air Act, the Clean Water Act, and the Endangered Species Act, and the leading cases in which these statutes have been interpreted by courts. The statutes will be studied in some detail so that students emerge with a basic understanding of their major regulatory provisions. Thematically, the statutes serve as illustrations of different regulatory approaches to environmental problems, from command and control standards to market-based instruments. In addition, we will discuss important matters of policy, including the Obama administration's efforts to address climate change through the use of Executive Power, and the Trump administration's efforts to rescind these policies. The course will also cover developments in constitutional law which significantly affect federal environmental law; and will cover the role of cost-benefit analysis in environmental regulation. Finally, we will discuss the political economy of environmental regulation, specifically the role played by interest groups (both industry and environmental organizations) in producing, implementing and enforcing environmental law. Students need not be self-identified "environmentalists" to be interested in this course. Nearly every area of law is now affected by environmental regulation, including private law fields such as real estate, bankruptcy and corporations. The legal issues presented by environmental problems offer ample opportunities for students to develop important and transferable legal skills, including statutory interpretation, constitutional analysis and application of administrative law doctrines. Laptops and other electronic devices will not be permitted in class. Regular attendance and participation in class discussion is expected. This class is not open to 1Ls. Elements used in grading: Attendance, Class Participation, Final Exam (8 hour, one-day take-home).</p>
LAW 2506	Natural Resources Law and Policy		X	<p>(Formerly 281) Natural resource management presents extremely difficult and contentious issues of law and public policy. Major debates continue to rage over issues such as the Endangered Species Act, whether the United States should permit drilling in the Arctic National Wildlife Refuge, and how to prevent the overfishing of the oceans. This course will focus on two major aspects of natural-resource management: biodiversity protection (including the Endangered Species Act, ocean fisheries management, and global protection of marine mammals) and public lands in the United States such as national parks and wilderness areas. The course also will examine the National Environmental Protection Act and the effectiveness of environmental impact assessments. Class sessions will include critical examinations of current law and policy and in-depth discussions of situational case studies that force you to consider how you would resolve real-life issues. Students will be expected to participate actively in class discussions. (This course will not examine either water law or energy law in any depth. Several other courses in the Law School deal with energy-law questions.) Elements used in grading: Class participation and final exam (open book). This course is taught in conjunction with Law 2516 Natural Resources Law and Policy - South Africa: Field Study (limited enrollment). See Law 2516 for details.</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
LAW 2508	The Business of Water		X	<p>One of the fastest growing economic sectors is the water field, and private water companies are playing an increasingly important role around the world in water management. In many cases, private companies have made important contributions to meeting water needs (e.g., in the development of new technologies and expanding water supplies). In other cases, however, the involvement of private companies has proven controversial (e.g., when private companies have taken over public water supply systems in developing countries such as Bolivia). This course will look at established or emerging businesses in the water sector and the legal, economic, and social issues that they generate. These businesses include investor-owned water utilities, water technology companies (e.g., companies investing in new desalination or water recycling technologies), water-right funds (who directly buy and sell water rights), social impact funds, innovative agricultural operations, water concessionaires, and infrastructure construction companies and investors. Each week will focus on a different business and company. Company executives will attend the class session and discuss their business with the class. In most classes, we will examine (1) the viability and efficacy of the company's business plan, (2) the legal and/or social issues arising from the business' work, and (3) how the business might contribute to improved water management and policy. Each student will be expected to write (1) two short reflection papers during the course of the quarter on businesses that present to the class, and (2) a 10- to15-page paper at the conclusion on the class on either a water company of the student's choice or a policy initiative that can improve the role that business plays in improving water management (either in a particular sector or more generally). Elements used in grading: Attendance, Class Participation, Written Assignments, Final Paper.</p>
LAW 2510	California Coast: Science, Policy and Law		X	<p>(Formerly Law 514) This interdisciplinary course integrates the legal, scientific, and policy dimensions of how we characterize and manage resource use and allocation along the California coast. We will use this geographic setting as the vehicle for exploring more generally how agencies, legislatures, and courts resolve resource-use conflicts and the role that scientific information and uncertainty play in the process. Our focus will be on the land-sea interface as we explore contemporary coastal land-use and marine resource decision-making, including coastal pollution, public health, ecosystem management; public access; private development; local community and state infrastructure; natural systems and significant threats; resource extraction; and conservation, mitigation and restoration. Students will learn the fundamental physics, chemistry, and biology of the coastal zone, tools for exploring data collected in the coastal ocean, and the institutional framework that shapes public and private decisions affecting coastal resources. There will be 3 to 4 written assignments addressing policy and science issues during the quarter, as well as a take-home final assignment. Special Instructions: In-class work and discussion is often done in interdisciplinary teams of students from the School of Law, the School of Engineering, the School of Humanities and Sciences, and the School of Earth, Energy, and Environmental Sciences. Students are expected to participate in class discussion and field trips. In place of weekly class meetings on Friday mornings, we will have 2-3 Saturday field trips throughout the quarter. Elements used in grading: Participation, including class session and field trip attendance, writing and quantitative assignments. Cross-listed with Civil & Environmental Engineering (CEE 175A/275A).</p>
LAW 2512	Cities and Sustainability: Current Issues, Policy, and Law		X	<p>Cities are on the front lines of solving many of society's sustainability problems, from advancing green buildings and clean energy, to preparing for the effects of climate change. With a diminishing role of the federal government on environmental policy and regulation, it is up to sub-nationals like states and cities to lead innovation and deployment of clean energy, resilience strategies, water management, and more. This class will explore the evolving role of cities in advancing sustainability from the lens of law, policy, planning, and governance. Some of the topics we will discuss in-depth include climate mitigation, clean energy, green buildings, climate adaptation and resilience, water supply and reuse, land use and transportation, and more. Case studies will focus on U.S. cities with some emphasis on California. Overarching themes across all content areas include legal constraints of city authority, governance, socioeconomic tradeoffs, and the roles of various types of institutions in developing, advancing, and advocating for local policy change. Elements used in grading: Attendance, Class Participation, Written Assignments, Exam. Cross-listed with Environment and Resources (ENVRES 212).</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
LAW 2515	Environmental Justice		X	<p>(Formerly 768) This course will introduce environmental justice as a social movement, including its central substantive concerns (the needs of humans in the built environment rather than the need to protect the environment from humans) and its methods (community-based political organizing rather than professionalized judicial or legislative action). The bulk of the course will then pursue a broader conception of environmental justice today by using social science research, theory, and case studies to investigate the civil rights and poverty aspects of environmental safety and natural resources. The course will include units on: (1) toxic exposure and public health disparities stemming from the disproportionate siting of locally-unwanted land uses in poor neighborhoods of color; (2) access to natural resources and basic public services, including clean water, wastewater disposal, and open space; (3) tools in environmental justice advocacy (including community-based lawyering, Title VI of the Civil Rights Act of 1964, the Fair Housing Act, common law nuisance actions, and transactional lawyering); (4) environmental justice issues in Indian Country, and (5) environmental justice issues in climate change policy. Much of the course material, including student presentations, will be grounded in the experiences and advocacy histories of specific communities, both urban and rural, across the country. Elements used in grading: Class participation, in-class presentation, final paper.</p>
LAW 2517	Modern Crosscurrents in Energy and Environmental Law		X	<p>This course explores the close relationship between energy and environmental law. We will work through the major energy sectors and, for each, discuss key environmental law and policy issues that are influencing energy production and use. Our focus will be on current issues. We'll explore environmental issues that are traditionally associated with the energy sector, including air emissions, waste disposal and cleanup, and oil spills, while also covering new environmental issues emerging from the energy sector including climate change-related regulatory and business risk issues, energy infrastructure permitting issues, and environmental pressure points on the utility industry and on renewable energy and conventional energy projects, more generally. Elements used in grading: Exam; one written assignment; class participation.</p>
LAW 2519	Water Law		X	<p>(Formerly Law 437) This course will study how society allocates and protects its most crucial natural resource -- water. The emphasis will be on current legal and policy debates, although we will also examine the history of water development and politics. Although the course will focus on United States law and policy, insights from the course are applicable to water regimes throughout the world, and we will occasionally look at law and policy elsewhere in the world for comparison. Among the many issues that we will consider are: how to allocate water during periods of scarcity (particularly as climate change leads to more extremes); alternative means of responding to the world's growing demands for water (including active conservation); the appropriate role for the market and private companies in meeting society's water needs; protection of threatened groundwater resources; environmental limits on water development (including the U.S. Endangered Species Act and the "public trust" doctrine); constitutional issues in water governance; Indian water rights; protection of water quality; challenges to substantively reforming existing water law; and interstate and international disputes over water. Students will be expected to participate actively in classroom discussions. Elements Used in Grading: Class participation, attendance and final exam.</p>
LAW 2520	Climate Law and Policy		X	<p>This course offers an interdisciplinary, graduate-level survey of current and historical efforts to regulate emissions of greenhouse gases in the United States and around the world. Students will read primary legal documents--including statutes, regulations, and court cases--in order to evaluate the forces and institutions shaping American climate policy. Additional perspectives from climate science, economics, and political science will provide context as students analyze the evolution of climate law and policy regimes. Elements used in grading: Grades will be based on class attendance, class participation, and either written assignments and an exam (section 01) or a final paper (section 02). After the term begins, students accepted into the course can transfer from section (01) into section (02), which meets the R requirement, with consent of the instructor. Cross-listed with Environment and Resources (ENVRES 222).</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
LAW 3009	Health Law: Improving Public Health	X		<p>(Formerly Law 762) This course examines how the law can be used to improve the public's health. The major questions explored are, what authority does the government have to regulate in the interest of public health? How are individual rights balanced against this authority? What are the benefits and pitfalls of using laws and litigation to achieve public health goals? The course investigates these issues as they operate in a range of specific contexts in public health, including the control and prevention of infectious disease; preventing obesity; reducing tobacco use; ensuring access to medical care; reducing firearm injuries; and responding to public health emergencies. In these contexts, we will ask and answer questions such as, what do the Constitution and key statutes permit? What makes a good public health law? Where do we see success stories---and failures---in public health law? What ethical and economic arguments justify government intervention to shape individuals' and companies' health-related behaviors? Instruction is through interactive lectures with a significant amount of class discussion and some group exercises. Class Participation, Written Assignments, Final Exam. Cross-listed with Medicine (MED 237).</p>
LAW 3514	Law and Inequality (Reading Group)	X		<p>This reading group will focus on the challenges presented to law by the long-term growth of economic inequality. In addition to exploring evidence of rising inequality (including the work of Thomas Piketty and others), we will examine legal and other scholarship that seeks to understand law's contribution to inequality and legal responses that might reduce inequality or ameliorate its effects. Meeting Time: Class will meet 7:00 PM to 9:00 PM, April 10, April 17, May 1, May 15, and May 22. Elements used in grading: Attendance, Class Participation.</p>
LAW 5009	International Conflict Resolution	X		<p>(Formerly Law 656) This seminar examines the challenges of managing and resolving intractable political and violent intergroup and international conflicts. Employing an interdisciplinary approach drawing on social psychology, political science, game theory, and international law, the course identifies various tactical, psychological, and structural barriers that can impede the achievement of efficient solutions to conflicts. We will explore a conceptual framework for conflict management and resolution that draws not only on theoretical insights, but also builds on historical examples and practical experience in the realm of conflict resolution. This approach examines the need for the parties to conflicts to address the following questions in order to have prospects of creating peaceful relationships: (1) how can the parties to conflict develop a vision of a mutually bearable shared future; (2) how can parties develop trust in the enemy; (3) how can each side be persuaded, as part of a negotiated settlement, to accept losses that it will find very painful; and (4) how do we overcome the perceptions of injustice that each side are likely to have towards any compromise solution? We will consider both particular conflicts, such as the Israeli-Palestinian conflict and the South African transition to majority rule, as well as cross-cutting issues, such as the role international legal rules play in facilitating or impeding conflict resolution, the ways intragroup dynamics affect intergroup conflict resolution efforts, and the role of criminal accountability for atrocities following civil wars. Special Instructions: Section 01: Grades will be based on class participation, written assignments, and a final exam. Section 02: Up to five students, with consent of the instructor, will have the option to write an independent research paper for Research (R) credit in lieu of the written assignments and final exam for Section 01. After the term begins, students (max 5) accepted into the course can transfer from section (01) into section (02), which meets the R requirement, with consent of the instructor. This class is cross-listed with International Policy (INTLPOL 250) and Psychology (PSYCH 383).</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
LAW 5025	Global Poverty and the Law	X		<p>With more than a billion people living on less than \$2 a day, global poverty is one of the biggest challenges currently facing humanity. Even though those who suffer the most are located in the developing world, many of the policies, economic opportunities, and legal actions that offer the biggest potential for global poverty alleviation are made in the United States. This course will provide an introduction to the study of global poverty. What causes poverty? Why have some parts of the developing world done better at alleviating poverty than other parts? Can the world ever be free of poverty, as the World Bank's official motto suggests? And most importantly, what can aspiring lawyers do to improve the condition of the world's impoverished? These are some of the questions this course is designed to address. This course is designed especially for future lawyers and policymakers who seek a deeper understanding of the developing world. After a brief overview that will familiarize students with the major concepts and empirical debates in poverty and development studies, we will examine a variety of 'causes' of poverty, from poor governance to lack of economic opportunity to the role of society. Since this course is just as much about what can be done, we shall also consider applied approaches to poverty alleviation. These types of interventions include political/legal reforms such as anti-corruption initiatives, 'rule of law' interventions, right to information programs, privatization, and community-driven development models; economic solutions such as cash transfers and microfinance; and technological approaches such as new methods for measuring policy impact and the application of new technologies for state identification and distribution programs. In addition to more typical scholarly readings, students will review poverty alleviation policy proposals and contracts made by various stakeholders (academics, NGOs, states, international bodies, etc.). Grading is based on participation, a presentation of research or a proposal, and, in consultation with the professor, a research paper. The research paper may be a group project (Section 01) graded MP/R/F or an individual in-depth research proposal either of which could be the basis for future field research (Section 02) graded H/P/R/F. Students approved for Section 01 or Section 02 may receive R credit. After the term begins, students accepted into the course can transfer from Section 01 into Section 02 with consent of the instructor. Automatic grading penalty waived for research paper. This course is taught in conjunction with the India Field Study component (Law 5026). Students may enroll for this course alone or for both this course and Law 5026 with consent of the instructor (12 students will come to India). See Law 5026 for application instructions. CONSENT APPLICATION: To apply for this course, students must complete and submit a Consent Application Form available on the SLS website (Click Courses at the bottom of the homepage and then click Consent of Instructor Forms). See Consent Application Form for instructions and submission deadline. Cross-listed with International Policy Studies (INTLPOL 281).</p>
LAW 5026	Global Poverty, Corruption, and the Law: India Field Study	X		<p>This is the India Field Study component of Global Poverty and the Law (Law 5025). For details, see course description for Law 5025. Corruption is one of the most difficult challenges facing societies across the developing world. Why is corruption so pervasive and what can be done to address it? During spring break 2019, this course will be held in Delhi, India and will consist of conversations with lawyers, politicians, scholars, leaders in civil society, and senior bureaucrats who are active in anti-corruption efforts. Students will also meet frontline bureaucrats (i.e., cops and government teachers) who will share their own perspectives about the problem. Enrollment is limited to 12 students. PLEASE NOTE: Students will need a passport and a visa to travel to India. Students will be required to attend two dinner meetings during the Winter Quarter in preparation for the trip. Elements used in grading: class participation and short writing assignments. CONSENT APPLICATION: To apply for this course, students must complete and submit a Consent Application Form available on the SLS website. See Consent Application Form for instructions and submission deadline.</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
LAW 682C	Discussion: Law and Development: Poverty, Institutions, and Geopolitics	X		<p>From economic grievances fueling conflict over territory to refugee emergencies to famine and health inequalities, problems of regional and global development often implicate law in its various forms. In this discussion seminar, we explore some key ideas and examples that illuminate law's role in shaping development. Among other topics, we will examine the role of institutions in perpetuating or breaking the cycle of poverty; how geopolitical pressures affect domestic political and economic conditions; the relationship of health and wealth to well-being; the role of lawyers; and ethical questions bearing on law's role in development. Readings will include selections from academic and policy-oriented books and articles, as well as fiction and documentary films. Begin in Autumn Quarter and run through Winter Quarter.</p> <p>Class will meet Tuesdays and Wednesdays from 6:30 - 8:30 p.m. (precise dates TBD). DISCUSSIONS IN ETHICAL & PROFESSIONAL VALUES COURSES RANKING FORM: To apply for this course, 2L, 3L and Advanced Degree students must complete and submit a Ranking Form available on the SLS website (Click Courses at the bottom of the homepage and then click Consent of Instructor Forms). See Consent Application Form for instructions and submission deadline. Elements used in grading: Attendance and participation.</p>
LAW 682G	Discussion: After Nature: Ecological Thinking and the Future of Democracy		X	<p>Many believe we have entered the Anthropocene -- an epoch in which humans are a force, maybe the driving force, in the development of the planet. In this new epoch of humanity, there is no more nature that stands apart from human beings. There is no place or living thing that we haven't changed. Our mark is on the cycle of weather and seasons, the global map of bioregions, and the DNA that organizes matter into life. The question is no longer how to preserve a wild world from human intrusion; it is what shape we will give to a world we can't help changing. As much as a scientific concept, the Anthropocene is a political and ethical idea. Saying that we live in the Anthropocene is a way of saying that we cannot avoid responsibility for the world we are making. Today, we have collective responsibility for, and can exercise collective intentionality about, how we move forward. These issues are explored in Jedediah Purdy's book After Nature, which looks back at the intellectual history of environmental thinking and the American landscape and forward toward the future of nature. The dawning of the Anthropocene raises political and ethical questions about what life is worth, what people owe one another, and what in the world is awesome or beautiful enough to preserve or (re)create. How society answers these questions will either reproduce and amplify existing inequalities or set in motion a different logic of democratic governance driven by notions of equity, interdependent obligations, and global justice. Using After Nature as our jumping off point, we will explore these ideas with the book's author (and visiting law professor) in a series of four meetings over the course of the spring term. Spring Quarter. Class meeting dates: Class will meet 6:00 PM to 8:30 PM, Monday, April 9, and Wednesdays, April 25, May 9, & May 23. Discussions in Ethical & Professional Values Course. Elements used in grading: Attendance at all sessions and participation. CONSENT APPLICATION: To apply for this course, students must complete and submit a Consent Application Form available on the SLS website (Click Courses at the bottom of the homepage and then click Consent of Instructor Forms). See Consent Application Form for instructions and submission deadline.</p>
LAW 7018	Disability Law	X		<p>(Formerly Law 644) This is a survey course of disability rights law, with an emphasis on federal and state statutes and case law. Areas of concentration include employment, government services, public accommodations, education, housing, mental health treatment and involuntary commitment, and personal autonomy. We will review such statutes as the Americans with Disabilities Act (ADA), Rehabilitation Act (Sec. 504), Individuals with Disabilities Education Act (IDEA), and the Fair Housing Act Amendments. The course examines disability from a civil and human rights perspective. Elements used in grading: Grades will be based on class participation (50%), and either several short reflection papers (50%) - Section 01 or a long independent research paper (50%) - Section 02. The student must consult with the instructor on the paper's topic, scope and format. After the term begins, students accepted into the course can transfer from Section 01 into Section 02, which meets the R requirement, with consent of the instructor. Non-law students may enroll with instructor consent. This class is limited to 45 students, with an effort made to have students from SLS (35 students will be selected by lottery) and 10 non-law students by consent of instructor.</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
LAW 7020	Ethics On the Edge: Business, Non-Profit Organizations, Government, and Individuals	X		<p>(Formerly Law 724) The objective of the course is to explore the increasing ethical challenges in a world in which technology, global risks, and societal developments are accelerating faster than our understanding can keep pace. We will unravel the factors contributing to the seemingly pervasive failure of ethics today among organizations and leaders across all sectors: business, government and non-profit. A framework for ethical decision-making underpins the course. The relationship between ethics and culture, global risks (poverty, cyber-terrorism, climate change, etc.) leadership, law and policy will inform discussion. Prominent guest speakers will attend certain sessions interactively. A broad range of international case studies might include: the Rohingya crisis in Myanmar; civilian space travel (Elon Musk's Mars plans); designer genetics; social media ethics (e.g. Facebook and Russia and on-line sex trafficking); free speech on University campuses (and Gawker type cases); artificial intelligence; Brexit; corporate and financial sector scandals (Epi pen pricing, hedge funds, Wells Fargo, Volkswagen emissions testing manipulation); and non-profit sector ethics challenges (e.g. should NGOs engage with ISIS). Final project in lieu of exam on a topic of student's choice. Attendance required. Class participation important (with multiple opportunities to earn participation credit beyond speaking in class). Strong emphasis on rigorous analysis, critical thinking and testing ideas in real-world contexts. Students wishing to take the course who are unable to sign up within the enrollment limit should contact Kylie De La O-Ménard at kyliedm@stanford.edu. The course is open to undergraduate and graduate students. Undergraduates will not be at a disadvantage. Everyone will be challenged. Distinguished Career Institute Fellows are welcome and should contact Dr. Susan Liautaud directly at susanl1@stanford.edu. NOTE: This course does not meet the SLS Ethics requirement. Elements used in grading: Class Participation, Attendance, Written Assignments, and Final Paper. Cross-listed with Ethics in Society (ETHICSOC 234R), Public Policy (PUBLPOL 134, PUBLPOL 234).</p>
LAW 7026	Immigration Law	X		<p>(Formerly Law 565) This survey course will provide a foundation in immigration law, the system of admission and removal, and the constitutional principles governing the regulation and rights of noncitizens. The course will also explore selected contemporary topics concerning immigrants' rights and immigration reform drawing on the instructor's extensive litigation to advance the constitutional and civil rights of noncitizens and service as a senior immigration advisor in the Obama administration. We will examine some current issues such as immigration detention; Trump executive orders; federal enforcement authority; state and local regulation of immigrants; constitutional prohibitions on 'alienage' discrimination; habeas corpus and Article III judicial review of removal orders; and the intersection of criminal and immigration law. Guest speakers may be invited for some topics. No prior course or background in immigration law is expected. Elements used in grading: Class participation and attendance (10%), final exam (90%).</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
LAW 7040	Social Justice Impact Litigation: Issues and Strategies	X		<p>(Formerly Law 572) This seminar explores strategic, legal, and ethical issues related to using law reform and social justice litigation to advance the constitutional and civil rights of vulnerable communities. The seminar is designed to allow students to understand and grapple with some of the doctrinal and strategic issues faced by social justice litigators. The course will be informed by the instructor's thirty years of litigating cases, including in the Supreme Court, to advance immigrants' rights as the founder and former national director of the ACLU Immigrants' Rights Project. Among the topics that may be included are selecting and using test cases; identifying plaintiffs; coalition litigation; strategic pleading; class action problems; the role of amicus briefs; suits for damages versus injunctive relief; standing and mootness; ethical problems; settlement strategies; use of public advocacy and media; the effect of lawsuits on policymakers and public officials; the role of government and agency lawyers; and litigation to achieve legislative change. Guest speakers will be invited. Enrollment is limited and the seminar is not open to 1L students. Students are expected to submit a series of reflections (totaling 18 pages) in response to seminar issues and guest speakers. In unusual cases, a student may be approved for Research (R) credit to write a substantial research paper on an approved topic of current significance. R credit is available only with the instructor's prior consent early in the quarter. Students approved for R credit will transfer from section (01) into section (02) after the term begins. Elements used in grading: Class participation (50%) and written submissions (50%). CONSENT APPLICATION: To apply for this course, students are asked to complete and submit a Consent Application Form available on the SLS website (Click Courses at the bottom of the homepage and then click Consent of Instructor Forms). See Consent Application Form for instructions and submission deadline.</p>
LAW 7051	Local Government Law	X		<p>(Formerly Law 427) Local governments exert tremendous influence over socioeconomic, race relations, environmental health, political power, and housing and real estate. This public law course will investigate the law of these governments (including cities, counties, and special districts) from four vantage points: (1) local governments within the federalist system, including the balance of power between local, state, and federal governments; (2) horizontal questions of power, including hierarchy and specialization among local governments; interlocal cooperation and competition; and the creation, expansion, and dissolution of local entities; (3) innovative uses and delegations of local authority to achieve state or local public policy goals; and (4) the nature of local democracy and local finance, including citizen influence of local lawmaking through initiatives and referenda, alternative voting schemes, and responses to fiscal distress. Discussions and in-class projects in the course will be situated in locations ranging from rural towns to major metropolises across the country. This class is limited to 30 students, with an effort made to have students from SLS (25 students will be selected by lottery) and up to five non-law students by consent of instructor. Elements used in grading: Class participation; in-class presentation, and one-day take home exam.</p>
LAW 7063	Youth Law and Policy	X		<p>(Formerly Law 795) This course examines current issues in youth law and policy with a focus on the potential and collateral effects of law on certain subpopulations of vulnerable youth. Substantively, the course focuses on case law and statutes in delinquency, dependency, education, public benefits, and health access with an attention to cross-section themes of poverty, economic justice, race, and youth voice. By the end of the course, students will have developed a better understanding of how litigation, legislation, and policy in youth law come about through examining recent developments in the field and the tools advocates have used to enact change. Any student may write a paper in lieu of the final exam with consent of instructor. After the term begins, students accepted into the course can transfer from the exam section (01) into paper section (02), with consent of the instructor. Elements used in grading: Class Participation, Attendance, Written Assignments; Exam or Final Paper.</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
LAW 7067	Law and Policy in the Post-Obama Era	X		<p>This course will consider a number of current issues of law and policy that achieved prominence during the Presidency of Barack Obama and remain unresolved. These issues include: 1) immigration law reform and DACA, 2) the role of the Department of Justice in reforming local and federal criminal law enforcement, 3) the role of government policy in regulating the economy and financial system, in facilitating health insurance, and in remedying economic inequality, 4) the proper balance between national security and civil liberties/human rights, as exemplified by the debates over the status of the Guantanamo Bay detention facility and drone warfare. In each of these areas, and others, debates about law and policy had reached a seeming, or potential, consensus in early 2009, but that consensus quickly fell apart. In each area, the gap between differing formulations of law and policy that had existed until recently has widened. Keeping in mind the time limitations of this course, we will briefly examine most of these of law and policy -- the governing legal doctrines and policies, their evolution since 2009, and their present and future prospects. The course will ask: What accounts for these differing visions of law and policy? What accounts for the inability of the political and legal system to resolve them? What are the possible ways forward? Class format will consist mainly of readings and class discussion, and students are encouraged to bring their own perspectives to bear on these difficult and timely issues. Class will meet Monday-Thursday, January 8-11, 7:15 PM to 9:15 PM and Tuesday of the following week, January 16, 6:20 PM to 7:20 PM. Elements used in grading: Class Participation.</p>
LAW 7818	Advanced Legal Writing: Technology Transactions	X		<p>(Formerly Law 730) This course covers the foundations of drafting contracts in a modern commercial setting, primarily through weekly hands-on writing exercises that illustrate business problems commonly found in today's technology transactions law practice. Topics to be addressed will include basic contract anatomy, common clause ambiguities, structuring for readable "flow", and drafting-for-negotiation techniques. Final examination will involve crafting a full-length technology license agreement from a rough term sheet that appears to have been pecked out on some sort of mobile device. No prior business law coursework, intellectual property background, or martial arts proficiency required. Elements used in grading: Class Participation, Attendance, Written Assignments, Final Exam.</p>
LAW 7823	Advanced Negotiation: International	X		<p>(Formerly Law 661) Understanding the fundamentals of negotiation and conflict resolution in the international domain is now more critical than ever. This hands-on, advanced seminar is designed to teach students how to prepare for, participate in, and critically evaluate complex multiparty negotiations in the public international field. Through experience-based learning and simulations, the course will expose students to various types of international conflict resolution processes, including written and oral skills, counseling, factual and legal analysis. These processes include second track negotiation and dialogue, natural resource management and extractive industries, and peace agreements. Special attention will be paid to the role of mediators and facilitators in such processes, as well as lawyers and legal advocates. Prerequisites: Negotiation Seminar, its substantial academic equivalent, or substantial experience in the field. SPILS students are especially encouraged to enroll. This course is also open to cross-registration by graduate students in a variety of departments and programs including International Policy Studies. Please describe prior negotiations coursework and experience on your Consent Form. Any student deemed to be lacking the required foundational knowledge may still be admitted to the course, but required to attend an intensive bootcamp in basic negotiation theory and methods on Saturday, January 12th. Grading Criteria: The seminar requires that students attend all classes, do the assigned reading, prepare for and actively participate in class and simulations, and write a series of short assignments. CONSENT APPLICATION: To apply for this course, students must complete and submit the Consent Form available on the SLS website (Click Courses at the bottom of the homepage and then click Consent of Instructor Forms). .</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
LAW 7824	Advanced Negotiation: Public Policy	X		<p>(Formerly Law 650) Advanced Negotiation courses are designed to take students beyond the two-party, lawyer-client negotiations that were the focus of the Negotiation Seminar, to examine many facets of negotiation complexity, both in terms of the participants and topics. This section of Advanced Negotiation will focus on multi-party negotiations, working in teams, group decision-making, coalition management, and negotiating on behalf of organizations to solve complex problems in a community setting, economic development, environmental, public-private, and land use sectors. The goals of the class are twofold, for students (1) to acquire an added theoretical base beyond what was covered in the Negotiation Seminar through which to analyze (in terms of law and facts), prepare for, participate in and facilitate more complex, multiparty negotiations, and (2) to expand skills through deeper examination of various actual negotiation cases and complex simulations, including ethical responsibilities to the client and the public, opportunities for leadership, and collaboration. Special Instructions: Attendance at and participation in the simulations is required. Passing is dependent upon active preparation and participation, submission of several assigned short reflection papers, and completion of a selected case analysis (a completed or ongoing multi-party public policy dialogue). Prerequisite: Negotiation Seminar (Law 7821) or its substantial equivalent. Advanced degree students (and graduate students in other departments and programs) are encouraged to enroll provided that they have previous negotiation training or equivalent practice experience. Elements used in grading: Class participation and engagement, including simulations; attendance; preparation for and contributions to discussion; and short written assignments.</p>
LAW 7825	Advanced Negotiation: Transactions	X		<p>(Formerly Law 659) Advanced Negotiation takes students beyond the two-party, lawyer-client negotiations that were the focus of the Negotiation Seminar. This course, Advanced Negotiation: Transactions, places the student in more difficult and more nuanced transactional simulations, working as individuals, lawyer-client pairs, and teams to negotiate on behalf of business entities, governments, unions and NGOs. Simulations may include critical-path supply agreements, vendor/collaborator contracts, cross-cultural joint ventures, airline reorganization, founder/VC deals, big pharma arbitration resolution and multi-party private sector/government negotiations. The goals of the class include developing a designer's mindset for strategic preparation and client counseling on both facts and law, and tactical adjustments to changing scenarios; ethical responsibilities; deeper analysis and work on the persuasive elements (oral and written) of negotiation; coalition formation and management; improved tactical skills, methods of questioning, response control and, ultimately, improved confidence and competence. Special Instructions: Attendance at and participation in all simulations and debriefing sessions is required. Passing is dependent upon this active participation, and a series of short papers and/or in-class presentations. Prerequisite: Negotiation Seminar or its substantial equivalent, as assessed by the instructor. This class is limited to 20 students, 16 from SLS selected by lottery, with an effort to have 4 non-law students by consent of instructor. Elements used in grading: attendance, participation in both the negotiations and the debriefings, thorough and meaningful preparation, and all other assigned work.</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
LAW 806F	Policy Practicum: Accountability for the Unintended Consequences of Impact Investing	X		<p>As the impact investing industry grows exponentially into trillions of dollars, investors, scholars, and industry leaders are increasingly focused on improving metrics and standards. They recognize the need to define impact, critically evaluate philanthropic trade-offs, and apply due diligence standards to evaluate social and environmental risk. Despite this trend, however, no accountability framework exists to manage the potential for harm to people and the environment from impact investing. To ensure that impact investing lives up to its name, a system is needed that holds investors accountable for harm to local communities and their environments. Other traditional development finance institutions -- such as OPIC or the World Bank's IFC -- have been routinely applying policy and accountability frameworks for decades to manage their social and environmental risks and to remedy harm. When these institutions invest in a project, they bring environmental and human rights standards and citizen-driven complaint systems that local communities can use to address a grievance. If an impact investor (e.g. a private foundation, individual investor, or private bank's impact fund) is funding that same project without traditional development institutions involved, chances are there is no way that communities can have their voices heard or receive remedy for harm. Yet the failure to take seriously the risks of social and environmental harm can lead to catastrophic financial, human, and environmental outcomes. In "Accountability: The Golden Opportunity in Impact Investing" https://ssir.org/articles/entry/accountability_the_golden_opportunity_in_impact_investing, Natalie Bridgeman Fields describes Accountability Counsel cases in Liberia and Mexico that demonstrate not only the importance of community-driven accountability but also concrete examples of an accountability framework. This project develops a system that enables impact project asset owners access to information about their asset's compliance, evaluation tools, and grievance systems. The practicum team will work closely with Accountability Counsel staff to develop an accountability and learning system for impact investment that guarantees that assets: (1) comply with policies to protect people and the environment, (2) have evaluation tools that assess their impact, and (3) offer grievance methods to address social or environmental harms associated when they do occur. The potential positive impact for impact investing grounded in an accountability framework is staggering. According to a recent report from Morgan Stanley, sustainable investment has grown more than 33 percent over the last two years to \$9 trillion, and will only continue to grow as impact investing becomes more accessible. If impact investing scales further without governance and accountability structures in place to prevent abuse and address harm, the consequences to local communities are dire. They will be certain to include the land grabs, contamination of water, labor rights abuses, and displacement of indigenous people that are typical of investments where there is weak rule of law and use of land and labor. Benefits of creating a robust accountability framework, if achieved, could spread beyond impact investing and could extend across global finance, including development finance, where existing frameworks could be improved based on leadership from the impact investing community. The practicum seeks interdisciplinary graduate students from law, international development, economics, project finance, impact investing, international human rights law, policy advocacy, business, and/or philanthropy. The research team will collaboratively produce a report for a sustained advocacy campaign with lessons and practices for accountability within impact investing. Elements used in grading: Attendance, Class Participation, Final Paper.</p> <p>NOTES: Students may not count more than a combined total of eight units of direct</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
LAW 908A	Environmental Law Clinic: Clinical Practice		X	<p>(Formerly Law 622A) 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 and prepare administrative records; develop expert testimony; draft comment letters, petitions, pleading or briefs; and/or attend and present arguments in administrative and court hearings. In regular one-on-one meetings with supervising faculty, there is a heavy emphasis on learning how to write persuasively and present oral arguments. Indeed, in any given quarter, our students typically prepare a mix of state and federal, and trial and appellate, court pleadings, and because all of our hearings during the academic year are conducted by students, many students also have the opportunity to present oral argument in front of one or more judges. In addition, students participate in a regular seminar where we examine strategic, ethical and substantive issues arising out of the Clinic's work. The Clinic is a particularly good place to learn how to conduct effective legal research, marshal facts in support of legal arguments, and, above all, write well. We practice at all levels of state and federal court and before many local, state and federal administrative agencies. Our work involves extensive motions practice and brief writing, and often involves administrative petitions and policy papers. Our work is inherently cross-disciplinary. No prior environmental experience or background is necessary, but an interest in learning about environmental and natural resources law is important. Special Instructions: General Structure of Clinical Courses -- The Law School's clinical courses are offered on a full-time basis for 12 units. This allows students to immerse themselves in the professional experience without the need to balance clinical projects with other classes, exams and papers. Students enrolled in a clinic are not permitted to enroll in any other classes, seminars, directed research or other credit-yielding activities within the Law School or University during the quarter in which they are enrolled in a clinic. Nor are they allowed to serve as teaching assistants who are expected to attend a class on a regular basis. There is a limited exception for joint degree students who are required to take specific courses each quarter and who would be foreclosed from ever taking a clinic unless allowed to co-register. These exceptions are approved on a case-by-case basis. Clinic students are expected to work in their clinical office during most business hours Monday through Friday. Students are also expected to be available by e-mail or cell phone when elsewhere during those hours. Because students have no other courses (and hence no exams or papers), the clinical quarter begins the first day of classes and runs through the final day of the examination period. Students should not plan personal travel during the Monday to Friday work week without prior authorization from the clinical supervisor. The work during a typical week in a clinic is divided into three components. First, as they are for practicing attorneys, most of the hours of any week are taken up by work on client matters or case work (this time includes meetings with instructors to discuss the work). Again, as is the case for practicing lawyers, in some weeks these responsibilities demand time above and beyond "normal business hours." Second, students will spend approximately five-to-seven hours per week preparing for an</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
LAW 908B	Environmental Law Clinic: Clinical Methods		X	<p>(Formerly Law 622B) 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 and prepare administrative records; develop expert testimony; draft comment letters, petitions, pleading or briefs; and/or attend and present arguments in administrative and court hearings. In regular one-on-one meetings with supervising faculty, there is a heavy emphasis on learning how to write persuasively and present oral arguments. Indeed, in any given quarter, our students typically prepare a mix of state and federal, and trial and appellate, court pleadings, and because all of our hearings during the academic year are conducted by students, many students also have the opportunity to present oral argument in front of one or more judges. In addition, students participate in a regular seminar where we examine strategic, ethical and substantive issues arising out of the Clinic's work. The Clinic is a particularly good place to learn how to conduct effective legal research, marshal facts in support of legal arguments, and, above all, write well. We practice at all levels of state and federal court and before many local, state and federal administrative agencies. Our work involves extensive motions practice and brief writing, and often involves administrative petitions and policy papers. Our work is inherently cross-disciplinary. No prior environmental experience or background is necessary, but an interest in learning about environmental and natural resources law is important. Special Instructions: General Structure of Clinical Courses -- The Law School's clinical courses are offered on a full-time basis for 12 units. This allows students to immerse themselves in the professional experience without the need to balance clinical projects with other classes, exams and papers. Students enrolled in a clinic are not permitted to enroll in any other classes, seminars, directed research or other credit-yielding activities within the Law School or University during the quarter in which they are enrolled in a clinic. Nor are they allowed to serve as teaching assistants who are expected to attend a class on a regular basis. There is a limited exception for joint degree students who are required to take specific courses each quarter and who would be foreclosed from ever taking a clinic unless allowed to co-register. These exceptions are approved on a case-by-case basis. Clinic students are expected to work in their clinical office during most business hours Monday through Friday. Students are also expected to be available by e-mail or cell phone when elsewhere during those hours. Because students have no other courses (and hence no exams or papers), the clinical quarter begins the first day of classes and runs through the final day of the examination period. Students should not plan personal travel during the Monday to Friday work week without prior authorization from the clinical supervisor. The work during a typical week in a clinic is divided into three components. First, as they are for practicing attorneys, most of the hours of any week are taken up by work on client matters or case work (this time includes meetings with instructors to discuss the work). Again, as is the case for practicing lawyers, in some weeks these responsibilities demand time above and beyond "normal business hours." Second, students will spend approximately five-to-seven hours per week preparing for an</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
LAW 908C	Environmental Law Clinic: Clinical Coursework		X	<p>(Formerly Law 622C) 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 and prepare administrative records; develop expert testimony; draft comment letters, petitions, pleading or briefs; and/or attend and present arguments in administrative and court hearings. In regular one-on-one meetings with supervising faculty, there is a heavy emphasis on learning how to write persuasively and present oral arguments. Indeed, in any given quarter, our students typically prepare a mix of state and federal, and trial and appellate, court pleadings, and because all of our hearings during the academic year are conducted by students, many students also have the opportunity to present oral argument in front of one or more judges. In addition, students participate in a regular seminar where we examine strategic, ethical and substantive issues arising out of the Clinic's work. The Clinic is a particularly good place to learn how to conduct effective legal research, marshal facts in support of legal arguments, and, above all, write well. We practice at all levels of state and federal court and before many local, state and federal administrative agencies. Our work involves extensive motions practice and brief writing, and often involves administrative petitions and policy papers. Our work is inherently cross-disciplinary. No prior environmental experience or background is necessary, but an interest in learning about environmental and natural resources law is important. Special Instructions: General Structure of Clinical Courses -- The Law School's clinical courses are offered on a full-time basis for 12 credits. This allows students to immerse themselves in the professional experience without the need to balance clinical projects with other classes, exams and papers. Students enrolled in a clinic are not permitted to enroll in any other classes, seminars, directed research or other credit-yielding activities within the Law School or University during the quarter in which they are enrolled in a clinic. Nor are they allowed to serve as teaching assistants who are expected to attend a class on a regular basis. There is a limited exception for joint degree students who are required to take specific courses each quarter and who would be foreclosed from ever taking a clinic unless allowed to co-register. These exceptions are approved on a case-by-case basis. Clinic students are expected to work in their clinical office during most business hours Monday through Friday. Students are also expected to be available by e-mail or cell phone when elsewhere during those hours. Because students have no other courses (and hence no exams or papers), the clinical quarter begins the first day of classes and runs through the final day of the examination period. Students should not plan personal travel during the Monday to Friday work week without prior authorization from the clinical supervisor. The work during a typical week in a clinic is divided into three components. First, as they are for practicing attorneys, most of the hours of any week are taken up by work on client matters or case work (this time includes meetings with instructors to discuss the work). Again, as is the case for practicing lawyers, in some weeks these responsibilities demand time above and beyond "normal business hours." Second, students will spend approximately five-to-seven hours per week preparing for</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
LAWGEN 115N	Human Rights Advocacy	X		<p>What are the origins of the human rights movement and where is it headed? What does it mean to be a human rights activist? What are the main challenges and dilemmas facing those engaged in human rights advocacy? In the space of seven decades, human rights advocates have transformed a marginal utopian ideal into a central element of global discussion, if not practice. In this seminar we will examine the actors and organizations behind this remarkable development as well as the vast challenges faced by advocates in the recent past and today. Together, we will learn to be critical of, as well as to think, and act, like human rights advocates. This seminar will introduce you to some of the main debates and dilemmas within the human rights movement. We will consider and understand the differing agendas of western international nongovernmental organizations (INGOs) and their counterparts in the frequently non-western developing world, as well as tensions between and among rights advocates along other important dimensions (civil and political vs. economic, social and cultural rights; rights promotion through engagement of powerful actors vs. challenging structures of power, etc.). The seminar seeks to develop your ability: 1) to understand human rights and social justice issues as contested political, legal and cultural phenomena; 2) to review advocacy texts, videos and other interventions critically; 3) to appreciate the political dimensions of efforts to promote human rights; 4) to understand how recent history constrains and structures options and possibilities for social intervention to promote rights and justice. During the course of the quarter you will be required to submit several short reflection papers and develop a human rights advocacy campaign.</p>
MATSCI 144	Thermodynamic Evaluation of Green Energy Technologies	X		<p>Understand the thermodynamics and efficiency limits of modern green technologies such as carbon dioxide capture from air, fuel cells, batteries, and solar-thermal power. Recommended: ENGR 50 or equivalent introductory materials science course. (Formerly 154)</p>
MATSCI 152	Electronic Materials Engineering	X		<p>Materials science and engineering for electronic device applications. Kinetic molecular theory and thermally activated processes; band structure; electrical conductivity of metals and semiconductors; intrinsic and extrinsic semiconductors; elementary p-n junction theory; operating principles of light emitting diodes, solar cells, thermoelectric coolers, and transistors. Semiconductor processing including crystal growth, ion implantation, thin film deposition, etching, lithography, and nanomaterials synthesis.</p>
MATSCI 301	Engineering Energy Policy Change		X	<p>Government policy profoundly affects all aspects of the energy ecosystem, including its supply, distribution, storage and utilization. Policy decisions also influence the pace and focus of innovation of new technologies, including through government-funded research and development programs. This course will equip graduate students, who have strong science and engineering backgrounds, with a basic ability to understand and shape the ideation and implementation of sound energy policy. Building on case studies of both aspirational and reactive US energy policy-making, students will design their own policy proposals for new, ambitious and achievable goals that advance a sustainable and prosperous future. Preference for senior graduates in engineering and the physical sciences.</p>
MATSCI 302	Solar Cells	X		<p>This course takes a comprehensive view of solar cells and what will need to be done to enable them to substantially change how the world obtains its electricity. After covering the fundamentals (light trapping, current flow in pn junctions, recombination) that are important for almost all photovoltaic technologies, the course will address technologies based on highly crystalline forms of silicon and gallium arsenide. The device simulator PC1D will be used to model solar cells. The course will then go through multijunctions cells with concentrators, low-cost thin-film solar cells, organic semiconductors, hybrid perovskites and nanowires. There will be discussions of module design and the economics of the solar industry. There will be a tour of a company that makes solar cells and guest lectures.</p>
MATSCI 303	Principles, Materials and Devices of Batteries	X		<p>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.</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
MATSCI 316	Nanoscale Science, Engineering, and Technology	X		This course covers important aspects of nanotechnology in nanomaterials synthesis and fabrication, novel property at the nanoscale, tools and applications: a variety of nanostructures including nanocrystal, nanowire, carbon nanotube, graphene, nanoporous material, block copolymer, and self-assembled monolayer; nanofabrication techniques developed over the past 20 years; thermodynamic, electronic and optical property; applications in solar cells, batteries, biosensors and electronics. Other nanotechnology topics may be explored through a group project. SCPD offering.
MATSCI 343	Organic Semiconductors for Electronics and Photonics	X		The science of organic semiconductors and their use in electronic and photonic devices. Topics: methods for fabricating thin films and devices; relationship between chemical structure and molecular packing on properties such as band gap, charge carrier mobility and luminescence efficiency; doping; field-effect transistors; light-emitting diodes; lasers; biosensors; photodetectors and photovoltaic cells.
MATSCI 347	Magnetic materials in nanotechnology, sensing, and energy	X		This course will teach the fundamentals of magnetism, magnetic materials, and magnetic nanostructures and their myriad of applications in nanotechnology, sensing, energy and related areas. The scope of the course include: atomic origins of magnetic moments, magnetic exchange and ferromagnetism, types of magnetic order, magnetic anisotropy, domains, domain walls, hysteresis loops, hard and soft magnetic materials, demagnetization factors, magnetic nanoparticles and nanostructures, spintronics, and multiferroics. The key applications include electromagnet and permanent magnet, magnetic inductors, magnetic sensors, magnetic memory, hard disk drives, energy generation and harvesting, biomagnetism, etc. Prerequisites: College level electricity and magnetism course or equivalent.
ME 105	Designing for Impact	X		This course will introduce the design thinking process and skills, and explore unique challenges of solving problems and initiating action for public good. Design skills such as need-finding, insight development, and prototyping will be learned through hands-on project work with a community partner and a particular emphasis on the elements required to be effective in the social sector. This is a Cardinal Course certified by the Haas Center for Public Service. ME101 recommended.
ME 140	Advanced Thermal Systems	X		Capstone course. Thermal analysis and engineering emphasizing integrating heat transfer, fluid mechanics, and thermodynamics into a unified approach to treating complex systems. Mixtures, humidity, chemical and phase equilibrium, and availability. Labs apply principles through hands-on experience with a turbojet engine, PEM fuel cell, and hybrid solid/oxygen rocket motor. Use of MATLAB as a computational tool. Prerequisites: ENGR 30, ME 70, and 131A,B.
ME 141	Alternative Energy Systems		X	Capstone course. Energy analysis, diagnostics and engineering of selected alternative energy systems with an integrated thermodynamic, heat transfer, and fluid mechanic approach. Mixtures, transport, reactions, electrochemical processes and photovoltaic effects. Labs apply principles through hands-on experience with selected alternative energy systems and their components. Use of MATLAB as an analysis tool.
ME 170A	Mechanical Engineering Design- Integrating Context with Engineering		X	First course of two-quarter capstone sequence. Working in project teams, design and develop an engineering system addressing a real-world problem. Projects are based on themes addressing most pressing needs of human society; for 2018-2019 the theme is clean energy. Learn and utilize industry development process; first quarter focuses on establishing requirements and narrowing to top concept. Second quarter emphasizes engineering analysis, design risk assessment, build, test and iteration. Learn and apply professional communication skills in the areas of speaking, presenting, writing, and listening. This is the first quarter of a 2-quarter course. Students must also enroll in ME 170b; completion of 170b required to earn grade in 170a. Enrollment limited, contact instructor. (Cardinal Course certified by the Haas Center)
ME 170B	Mechanical Engineering Design: Integrating Context with Engineering		X	Second course of two-quarter capstone sequence. Working in project teams, design and develop an engineering system addressing a real-world problem. Projects are based on themes, addressing most pressing needs of human society; for 2018-2019 the theme is clean energy. Learn and utilize industry development process; first quarter focuses on establishing requirements and narrowing to top concept, second quarter emphasizes engineering analysis, design risk assessment, build, test and iteration. Learn and apply professional communication skills in the areas of speaking, presenting, writing, and listening. (Cardinal Course certified by the Haas Center)

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
ME 177	Global Engineers' Education		X	A project based course for those who would like to use their engineering backgrounds to address real world challenges faced by underserved communities globally. In direct collaboration with an underserved community from a rural village in India, students will develop engineering solutions to the challenge of sanitation and hygiene. Focus will be on working with the community rather than for them. Concepts covered will include designing with what designers care about at the center, articulating and realizing individual and community aspirations, ethics of engaging with underserved communities, and methodology of working sustainably with an underserved community.
ME 182	Electric Transportation		X	Transportation accounts for nearly one-third of American energy use and greenhouse gas emissions and three-quarters of American oil consumption. It has crucial impacts on climate change, air pollution, resource depletion, and national security. Students wishing to address these issues reconsider how we move, finding sustainable transportation solutions. An introduction to the issue, covering the past and present of transportation and its impacts; examining alternative fuel proposals; and digging deeper into the most promising option: battery electric vehicles. Energy requirements of air, ground, and maritime transportation; design of electric motors, power control systems, drive trains, and batteries; and technologies for generating renewable energy. Students will also have a fun opportunity for a hands-on experience with an electric car. Prerequisites: Introduction to calculus and Physics AP or elementary mechanics.
ME 204A	Bicycle Design and Frame-Building	X		Lecture/lab. The engineering and artistic execution of designing and building a bicycle frame. Fundamentals of bicycle dynamics, handling, and sizing. Manufacturing processes. Films, guest lecturers, field trips. Each student designs and fabricates a custom bicycle frame. This course is now a two part course series ME204A&B. Limited enrollment. Prerequisite: 203 or equivalent.
ME 204B	Bicycle Design and Frame-Building	X		The engineering and artistic execution of designing and building a bicycle frame. The fundamentals of bicycle dynamics, handling, and sizing. Manufacturing processes. Films, guest lecturers, field trips. Each student designs a custom bicycle frame that they continue from ME204A in winter quarter. Limited enrollment, admission by consent of instructors. Attendance at first lecture is required. Both ME204A and ME204B must be taken. Prerequisite: 203 or equivalent.
ME 216A	Advanced Product Design: Needfinding	X		Human needs that lead to the conceptualization of future products, environments, systems, and services. Field work in public and private settings; appraisal of personal values; readings on social ethnographic issues; and needfinding for a corporate client. Emphasis is on developing the flexible thinking skills that enable the designer to navigate the future. Prerequisites for undergraduates: ME115A, ME115B and ME203, or consent of the instructor.
ME 216M	Introduction to the Design of Smart Products	X		This course will focus on the technical mechatronic skills as well as the human factors and interaction design considerations required for the design of smart products and devices. Students will learn techniques for rapid prototyping of smart devices, best practices for physical interaction design, fundamentals of affordances and signifiers, and interaction across networked devices. Students will be introduced to design guidelines for integrating electrical components such as PCBs into mechanical assemblies and consider the physical form of devices, not just as enclosures but also as a central component of the smart product. Prerequisites include: CS106A, E40, and ME 210 highly recommended, or instructor approval.
ME 250	Internal Combustion Engines	X		Internal combustion engines including conventional and turbocharged spark ignition, and diesel engines. Lectures: basic engine cycles, engine components, methods of analysis of engine performance, pollutant emissions, and methods of engine testing. Lab involves hands-on experience with engines and test hardware. Limited enrollment. Prerequisites: 140.
ME 297	Forecasting for Innovators:Technology, Tools & Social Change	X		Technologies from the steam engine to the microprocessor have been mixed gifts, at once benefitting humankind and creating many of the problems facing humanity today. This class will explore how innovators can use forecasting methods to identify new challenges, develop responsive innovations and anticipate unintended consequences. Students will produce a long-range forecast project, applying a variety of methodologies including research, expert interviews and graphical exploration.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
ME 302B	The Future of the Automobile- Driver Assistance and Automated Driving	X		<p>Automated vehicles are on the verge to productization and have been subject to a lot of news recently: GM bought a self-driving tech startup for presumably more than \$1 billion. BMW, Intel and MobilEye teamed up to "bring fully autonomous driving to streets by 2021". Uber acquired Otto (another startup) for reportedly \$680 million to lead Uber's self-driving car effort. MobilEye and Delphi announced "a partnership for Level 4/5 automated Driving solution for 2019". Ford announced to put a fleet of Level 4 autonomous vehicles on the road in 2021. Tesla is continuing to working on its Autopilot. Intel bought MobilEye. Sounds exciting Ć if you have an idea what the terms and levels mean, and what the technology actually is, which is driving the vehicle automation. This class will provide a holistic introduction to the field of vehicle automation:</p> <p>The first three lectures will provide an overview, clarify terminology and categories, and dive into the legal and policy aspects of automated driving. The next three lectures discuss the technologies enabling vehicle automation and outline applications. Students are asked to work on a class assignment in groups discussing current topics of vehicle automation. The results of the group work will be presented in the final 2 lectures of the class. This is the second course of a 3-quarter seminar series, which build on one another but can be taken independently. This course, lectured by an industry expert, will introduce students to the technology behind the systems, the benefits, challenges, and future perspectives of this exciting field. Students will develop an understanding for the interactions of the technology, business, and public policies with a specific automotive focus.</p>
ME 310A	Engineering Design Entrepreneurship and Innovation: exploring the problem space	X		<p>Reality is the best teacher. The best performers are coached. The best learners are on teams of 3-4 persons. We offer an extraordinary Coaching Team to maximize the value of your time at Stanford. Your year long mission is to create the personal self-efficacy you need to engage wicked real-world design challenges. Your team is one element in a Ćteam-of-teamsĆ that includes a corporate staff-team and in most cases, a 2nd academic team at an international university. You will be challenged to re-invent-X, to be a start-up in Silicon Valley. Expect 10 different industry funded design challenges at the human interface to Robots, AI, Internet of Things, Autonomous vehicles and Smart Cities. ME310A is dedicated to exploring the problem-space using strategic-foresight, design thinking, team-dynamics-management, rapid prototyping, and human-centric problem RE-framing. We expect you to take ME310ABC.</p>
ME 310B	Engineering Design Entrepreneurship and Innovation: exploring the solution space	X		<p>In ME310A your team RE-framed a human-centric need/problem. You have your X. Now explore the solution space. Search for the dark-horse (the impossible solution that actually might work). ME310B and ME310C are a single course with one grade in June. Your interdisciplinary team-of-teams is challenged by your industry partners to achieve break-through-innovation. In late March, Stanford students typically visit their international partners to converge on one solution path to be made REAL by June.</p>
ME 310C	Engineering Design Entrepreneurship and Innovation: make it REAL	X		<p>REAL hardware, software, and user testing are the missions for Spring Quarter. Make it REAL. Engage any discipline and any technology to succeed. Enable user testing, technical and business evaluation. Keep using strategic-foresight, design thinking, team-dynamics management, rapid prototyping, and problem/solution re-framing. Present your test results and pre-production prototype to the world at the Stanford Design EXPERience in June (760 people attended in 2017). Tell the world what you did, why you did it, and what you learned from the doing.</p>
ME 370A	Energy Systems I: Thermodynamics	X		<p>Thermodynamic analysis of energy systems emphasizing systematic methodology for and application of basic principles to generate quantitative understanding. Exergy, mixtures, reacting systems, phase equilibrium, chemical exergy, and modern computational methods for analysis. Prerequisites: undergraduate engineering thermodynamics and computer skills such as Matlab.</p>
ME 370B	Energy Systems II: Modeling and Advanced Concepts	X		<p>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.</p>
ME 370C	Energy Systems III: Projects	X		<p>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.</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
ME 410A	Introductory Foresight and Technological Innovation	X		Learn to develop long-range, technology-based innovations (5+ years based on industry). This course offers an intensive, hands-on approach using multiple engineering foresight strategies and tools. Model disruptive opportunities and create far-to-near development plans. Three quarter sequence.
ME 410B	Advanced Foresight and Technological Innovation	X		Continuation of ME410A. Students will continue developing their invention, integrate additional engineering foresight, and develop an intrinsic innovation mindset. Ongoing discussion of industry examples and contemporary events demonstrate foresight principals and engineering leadership in action.
ME 410C	Advanced Foresight and Technological Innovation	X		Continuation of ME410B. Students will continue developing their invention, integrate additional engineering foresight, and develop an intrinsic innovation mindset. Ongoing discussion of industry examples and contemporary events demonstrate foresight principals and engineering leadership in action.
MED 108Q	Human Rights and Health	X		Preference to sophomores. History of human-rights law. International conventions and treaties on human rights as background for social and political changes that could improve the health of groups and individuals. Topics such as: regional conflict and health, the health status of refugees and internally displaced persons; child labor; trafficking in women and children; HIV/AIDS; torture; poverty, the environment and health; access to clean water; domestic violence and sexual assault; and international availability of drugs. Possible optional opportunities to observe at community sites where human rights and health are issues. Guest speakers from national and international NGOs including Doctors Without Borders; McMaster University Institute for Peace Studies; UC Berkeley Human Rights Center; Kiva. PowerPoint presentation on topic of choice required.
MED 157	Foundations for Community Health Engagement	X		Open to undergraduate, graduate, and MD students. Examination and exploration of community health principles and their application at the local level. Designed to prepare students to make substantive contributions in a variety of community health settings (e.g. clinics, government agencies, non-profit organization, advocacy groups). Topics include community health assessment; health disparities; health promotion and disease prevention; strategies for working with diverse, low-income, and underserved populations; and principles of ethical and effective community engagement.
MED 159	Oaxacan Health on Both Sides of the Border	X		Required for students participating in the Community Health in Oaxaca summer program. Introduction to the health literacy and health-seeking behaviors of Oaxacan and other Mexican migrants; the health challenges these groups face. Through discussion and reflection, students prepare for clinical work and community engagement in Oaxaca, while also gaining knowledge and insight to make connections between their experiences in Mexico and their health-related work with Mexican immigrants in the Bay Area. Service Learning Course (certified by Haas Center). Prerequisite: application and acceptance into the Community Health in Oaxaca Summer Program (http://och.stanford.edu/oaxaca.html).
MED 161A	Community Health Advocacy	X		MED161 Community Health Advocacy is a three-quarter course series that provides students with knowledge and concrete skills for working with and advocating for underserved populations. Through coursework and placements in community health clinics and social service agencies, students will broaden and deepen their understanding of the structural determinants of health, how they impact underserved populations, and the various levels at which these challenges can be addressed. Students will participate in weekly activities that support the mission of their placement organization, engage in direct service with clients, and collaborate on the design and implementation of a capacity-building project. Weekly classroom sessions will serve as a forum for teaching and training, discussion of class readings and placement experiences, project development, and troubleshooting and support.
MED 161B	Community Health Advocacy	X		MED161 Community Health Advocacy is a three-quarter course series that provides students with knowledge and concrete skills for working with and advocating for underserved populations. Through coursework and placements in community health clinics and social service agencies, students will broaden and deepen their understanding of the structural determinants of health, how they impact underserved populations, and the various levels at which these challenges can be addressed. Students will participate in weekly activities that support the mission of their placement organization, engage in direct service with clients, and collaborate on the design and implementation of a capacity-building project. Weekly classroom sessions will serve as a forum for teaching and training, discussion of class readings and placement experiences, project development, and troubleshooting and support.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
MED 161C	Community Health Advocacy	X		MED161 Community Health Advocacy is a three-quarter course series that provides students with knowledge and concrete skills for working with and advocating for underserved populations. Through coursework and placements in community health clinics and social service agencies, students will broaden and deepen their understanding of the structural determinants of health, how they impact underserved populations, and the various levels at which these challenges can be addressed. Students will participate in weekly activities that support the mission of their placement organization, engage in direct service with clients, and collaborate on the design and implementation of a capacity-building project. Weekly classroom sessions will serve as a forum for teaching and training, discussion of class readings and placement experiences, project development, and troubleshooting and support.
MED 210	Principles and Practice of Healthcare Quality Improvement	X		This course will introduce students to foundational concepts in healthcare quality improvement, and provide tools for translating these principles into practice. Topics include: current state, A3, SMART goals, root-cause analysis, metrics and measures, PDCA cycles, process controls, systems, and sustainability. Students have the option of completing the course curriculum in conjunction with a quality improvement/patient safety project offered by the SMS Quality Improvement Interest Group. This course will meet for three in-class sessions throughout the quarter, with students reviewing the online materials before each session. Dinner will be served. May be repeated for credit up to three quarters with continued work on a quality improvement project, and all units count towards the Quality Improvement Scholarly Concentration.
MED 228	Physicians and Social Responsibility	X		Social and political context of the roles of physicians and health professionals in social change; policy, advocacy, and shaping public attitudes. How physicians have influenced governmental policy on nuclear arms proliferation; environmental health concerns; physicians in government; activism through research; the effects of poverty on health; homelessness; and gun violence. Guest speakers from national and international NGOs.
MED 232	Virtual Student Exchange in Global Health between Lebanon and Stanford	X		Timely topics in global health will be presented in a unique virtual student exchange with the joint participation of the Modern University for Business & Science in Beirut, Lebanon. The goal of this interactive series will be to encourage students to think about a broad range of topics in global health including coordinated responses to crises, ethical approaches to research and implementation work in low-income countries, and focused sessions on refugee health which will connect classrooms in Beirut and in Palo Alto. Complex humanitarian emergencies require cross-cultural collaboration, and this class will be structured to encourage working with overseas counterparts on the pressing Syrian refugee crisis. By integrating lectures, guest speakers, and a cross-cultural collaborative capstone project, students will gain an in-depth understanding of the global-health landscape and methods of addressing complex issues with partners abroad. Undergraduates must take this course for a letter grade and 3 units. MD students can enroll for 1-2 units, yet the course will require 2 units worth of work. Students enrolling in the course for a third unit will create a podcast related to a topic of their choice on refugee health. These students will participate in a weekly section to develop their podcast with the teaching team as well as learn from guest speakers different podcast communication skills. This extra section time will be announced based off of students' and the teaching teams' schedules. The student who makes the best podcast will travel to Beirut to meet and work with their counterparts for a week during winter break. This course will be limited to 20 students. Students will fill out an application after the first day of class to determine enrollment.
MED 237	Health Law: Improving Public Health	X		(Same as Law 762) Examines how the law can be used to improve the public's health. Major themes explored include: what authority does the government have to regulate in the interest of public health? How are individual rights balanced against this authority? What are the benefits and pitfalls of using laws and litigation to achieve public health goals? Investigates these issues in several contexts, including the control and prevention of infectious disease, laws aimed at preventing obesity and associated noncommunicable diseases, tobacco regulation, ensuring access to medical care, reproductive health, lawsuits against tobacco, food and gun companies, and public health emergencies.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
MED 242	Physicians and Human Rights	X		Weekly lectures on how human rights violations affect health. Topics include: regional conflict and health, the health status of refugees and internally displaced persons; child labor; trafficking in women and children; HIV/AIDS; torture; poverty, the environment and health; access to clean water; domestic violence and sexual assault; and international availability of drugs. Guest speakers from national and international NGOs including Doctors Without Borders; McMaster University Institute for Peace Studies; UC Berkeley Human Rights Center; Kiva.
MGTECON 331	Health Law: Finance and Insurance	X		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.
MGTECON 383	Measuring Impact in Practice	X		<p>This class will provide students practical skills for measuring impact in business and social enterprise, with a principal focus on evaluating, conducting, and analyzing experiments and quasi-experiments. How large is the impact of raising prices on sales? Is an advertising campaign working? Does a non-profit actually improve people's lives? Students will finish the course with the ability to design, analyze, and skeptically evaluate experiments that can rigorously answer questions like these. Students will learn: how to evaluate claims of causality; how to conduct and analyze experiments and quasi-experiments; the advantages and disadvantages of experiments; how to quantify uncertainty; and what can go wrong in experiments. Students will acquire a conceptual understanding of basic experimental statistics to inform these skills.</p> <p>Students will also be exposed to how leading companies, researchers, and social innovators strategically deploy experiments. Finally, students will conduct their own experiments on a topic of their choosing in small groups. The class will not assume any prior statistical or mathematical training. Completing short problem sets will require acquiring basic knowledge of R.</p>
MGTECON 515	Cryptocurrency	X		This class will provide an overview of the rapidly evolving area of distributed ledger and blockchain technologies, with a focus on economic and strategic issues. We will cover key components of the architecture that affect the products derived from cryptocurrency. We then consider tokens as a store of value and exchange, analyzing models of cryptocurrency pricing and as a vehicle for raising of capital. Next, we consider use cases including payments, micropayments, asset registries, and smart contracts. We then analyze barriers to entry in cryptocurrencies, as well as how the new products they enable affect industry structure in both the financial sector and the economy and society as a whole. For example, how might decentralized systems like the blockchain impact the sharing economy? The government? We consider the governance of these decentralized systems and how decentralization affects the potential for the management and success of platforms. We discuss the potential for national digital currencies and the end of cash. Finally, we consider consumer protection, privacy, security, regulation, and the power of governments and regulators over borderless, decentralized systems. Students will benefit from guest lectures by industry and thought leaders.
MI 70Q	Photographing Nature	X		Utilizes the idiom of photography to learn about nature, enhance observation, and explore scientific concepts. Builds upon the pioneering photographic work of Eadweard J. Muybridge on human and animal locomotion. A secondary goal is to learn the grammar, syntax, composition, and style of nature photography to enhance the use of this medium as a form of scientific communication and also to explore the themes of change across time and space. Scientific themes to be explored include: taxonomy, habitat preservation, climate change; species diversity; survival and reproductive strategies; ecological niches and coevolution, carrying capacity and sustainability, population densities, predation, and predator-prey relationships, open-space management, the physics of photography. Extensive use of field trips and class critique.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
MKTG 337	Applied Behavioral Economics	X		<p>The field of behavioral economics couples scientific research on the psychology of decision making with economic theory to better understand what motivates economic agents, including consumers, managers, public policymakers, investors, and employees. In this course, we will examine topics such as the "irrational" patterns of how people think about products, money and investments, designing strategies and offerings to change behavior, and the drivers of happiness and the role of emotions in decision-making. This highly interdisciplinary course will be particularly relevant to students with interests in general management, entrepreneurship, Marketing, Strategy, Behavioral Finance, public policy, and nonprofit.</p> <p>Topics covered will include: Rationality and choice, choice complexity, intertemporal choice, emotional influences on choice, the role of behavioral economics in marketing, spending and savings behavior, social welfare, choice architecture, and defaults. The goals of this course are threefold: a) to study the basic principles of behavioral economics, b) To learn the application of the principles to various aspects of business and policy, and c) to think about a framework for developing products, programs, and tactics that are behaviorally informed. The course is composed of a mixture of lectures, exercises, academic paper reviews, and in-class case discussions. The purpose of the lectures is to present and discuss theories, concepts, analytical techniques and empirical findings. In-class exercise will be used to apply the concepts and techniques covered in the class. We will discuss a few business cases. In addition, students working in teams will prepare an analysis and recommended behavioral strategy for a company/startup of their choice.</p>
MLA 326	Nature through Photography	X		-
MS&E 135	Networks	X		<p>This course provides an introduction to how networks underly our social, technological, and natural worlds, with an emphasis on developing intuitions for broadly applicable concepts in network analysis. The course will include: an introduction to graph theory and graph concepts; social networks; information networks; the aggregate behavior of markets and crowds; network dynamics; information diffusion; the implications of popular concepts such as "six degrees of separation", the "friendship paradox", and the "wisdom of crowds".</p>
MS&E 243	Energy and Environmental Policy Analysis		X	<p>Concepts, methods, and applications. Energy/environmental policy issues such as automobile fuel economy regulation, global climate change, research and development policy, and environmental benefit assessment. Group project. Prerequisite: MS&E 241 or ECON 50, 51.</p>
MS&E 272	Entrepreneurship without Borders	X		<p>How do you create a start-up outside of the U.S.? What are the unique issues involved in creating a successful startup in emerging economies such as China or India? What is entrepreneurial leadership in a venture that spans country borders? Is Silicon Valley-style entrepreneurship possible in other places? How does an entrepreneur act differently when creating a company in a less-developed institutional environment? Learn through forming teams, a mentor-guided startup project focused on developing students' startups in international markets, case studies, research on the international aspects of the entrepreneurial process, and networking with top entrepreneurs and venture capitalists who work across borders. For graduate students only, with a preference for engineering and science majors who seek to understand the formation of high-impact start-ups in emerging economy contexts. Limited enrollment.</p>
MS&E 294	Systems Modeling for Climate Policy Analysis		X	<p>Design and application of formal analytical methods in climate policy development. Emphasis on integrated use of modeling tools from diverse methodologies and application of these modeling tools towards policy-making. Students will work with one of several widely-used climate policy models for the course project. Issues addressed include model selection, instrument design, technology development, resource management, multiparty negotiation, and dealing with complexity and uncertainty. Links among art, theory, and practice. Prerequisites: 211, 241, 252, or equivalents, or permission of instructor.</p>
MS&E 92Q	International Environmental Policy		X	<p>Preference to sophomores. Science, economics, and politics of international environmental policy. Current negotiations on global climate change, including actors and potential solutions. Sources include briefing materials used in international negotiations and the U.S. Congress.</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
MS&E 93Q	Nuclear Weapons, Energy, Proliferation, and Terrorism	X		<p>Preference to sophomores. At least 20 countries have built or considered building nuclear weapons. However, the paths these countries took in realizing their nuclear ambitions vary immensely. Why is this the case? How do the histories, cultures, national identities, and leadership of these countries affect the trajectory and success of their nuclear programs? This seminar will address these and other questions about nuclear weapons and their proliferation. Students will learn the fundamentals of nuclear technology, including nuclear weapons and nuclear energy, and be expected to use this knowledge in individual research projects on the nuclear weapons programs of individual countries. Case studies will include France, UK, China, India, Israel, Pakistan, North Korea, South Africa, Libya, Iraq, and Iran, among others. Please note any language skills in your application. Recommended: 193 or 293.</p>
OB 512	Creating, Building, and Sustaining Breakthrough Ventures	X		<p>This course is designed to provide students with a summary of entrepreneurial processes that have successfully created, developed, and sustained breakthrough ventures. By "breakthrough" we mean ventures that have a lasting and positive impact, touching millions of lives. Examples are based on the experiences of Norman Winarsky, formerly President of SRI Ventures, Charles O'Reilly, and invited speakers who are leading investors and entrepreneurs. They include companies like Siri, Nuance, Intuitive Surgical, Sandisk, Facebook, and others. Think of this course as a 2master class. You will work with the professors and invited speakers to create and build your venture concept. We focus on all elements of building a breakthrough company, starting with the source of breakthrough venture ideas, advancing to building a great value proposition and business plan, recruiting a team, finding investors and board members, scaling the company, deciding whether to sell or go IPO, and ending with what it takes to build a company that can sustain itself through continuous innovation. At each step, we follow examples of companies we've helped build, and provide lessons of success as well as failure. The course will be highly interactive, and engage students in elements of building their own venture concepts.</p>
OB 636	Economic Sociology of Markets and Organizations	X		<p>This PhD course provides an overview of economic sociology as it pertains to the behavior of individuals as atomistic agents and collective actors, in the context of markets and organizations. Students will study foundational texts as well as recent research in order to gain an understanding of how to further advance the field. Topics include networks, categories, labor markets, product markets, inequality, and others. Throughout the course students will be expected to generate "mental maps" to demonstrate they have gained a comprehensive understanding of the field, weekly memos, and to complete a final project.</p>
OIT 384	Biodesign Innovation: Needs Finding and Concept Creation	X		<p>In this two-quarter course series (OIT 384/5), multidisciplinary student teams from medicine, business, and engineering work together to identify real-world unmet healthcare needs, invent new health technologies to address them, and plan for their development and implementation into patient care. During the first quarter (winter 2019), students select and characterize an important unmet healthcare problem, validate it through primary interviews and secondary research, and then brainstorm and screen initial technology-based solutions. In the second quarter (spring 2019), teams screen their ideas, select a lead solution, and move it toward the market through prototyping, technical re-risking, strategies to address healthcare-specific requirements (regulation, reimbursement), and business planning. Final presentations in winter and spring are made to a panel of prominent health technology industry experts and investors. Class sessions include faculty-led instruction and case studies, coaching sessions by industry specialists, expert guest lecturers, and interactive team meetings. Enrollment is by application only, and students are expected to participate in both quarters of the course. Visit http://biodesign.stanford.edu/programs/stanford-courses/biodesign-innovation.html to access the application, examples of past projects, and student testimonials. More information about Stanford Biodesign, which has led to the creation of more than 40 venture-backed healthcare companies and has helped hundreds of students launch health technology careers, can be found at http://biodesign.stanford.edu/.</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
OIT 385	Biodesign Innovation: Concept Development and Implementation	X		In this two-quarter course series (OIT 384/5), multidisciplinary student teams from medicine, business, and engineering work together to identify real-world unmet healthcare needs, invent new health technologies to address them, and plan for their development and implementation into patient care. During the first quarter (winter 2019), students select and characterize an important unmet healthcare problem, validate it through primary interviews and secondary research, and then brainstorm and screen initial technology-based solutions. In the second quarter (spring 2019), teams screen their ideas, select a lead solution, and move it toward the market through prototyping, technical re-risking, strategies to address healthcare-specific requirements (regulation, reimbursement), and business planning. Final presentations in winter and spring are made to a panel of prominent health technology industry experts and investors. Class sessions include faculty-led instruction and case studies, coaching sessions by industry specialists, expert guest lecturers, and interactive team meetings. Enrollment is by application only, and students are expected to participate in both quarters of the course. Visit http://biodesign.stanford.edu/programs/stanford-courses/biodesign-innovation.html to access the application, examples of past projects, and student testimonials. More information about Stanford Biodesign, which has led to the creation of more than 40 venture-backed healthcare companies and has helped hundreds of students launch health technology careers, can be found at http://biodesign.stanford.edu/ .
OSPAUSTL 10	Coral Reef Ecosystems	X		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 the Biology major.
OSPAUSTL 25	Freshwater Systems	X		Integrated water resource management and how this applies across the globe, comparing strategies and results in the developing and more developing world. Ethics, values and politics of water and the management of extremes such as drought and flood. Ecology and hydrology in an urban context, along with important current issues such as stormwater and water sensitive urban design. Construction of a well, a water tank, and a pit latrine. Community service working with a local catchment management group on riparian and wetland restoration work. Field work complements lectures.
OSPAUSTL 30	Coastal Forest Ecosystems	X		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 the Biology major.
OSPAUSTL 40	Australian Studies: History, Society and Culture Down Under	X		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.
OSPBER 59	Topics in Sustainability in Germany		X	Students can choose one of the following topics: Environmental management of the Rhine, water supply, water quality and ecological function; The German energy perspective, how the German energy grid functions and roles of consumption patterns and regulation; De-carbonizing German automobiles, environmental, economic, and societal implications of eliminating fossil-fuel powered cars from German roadways; Fluid mechanics of beer, physics and fluid mechanics of beer, including how this information is used in the design and operation of breweries.
OSPBER 63	Urban Engineering from a Technological and Environmental Perspective		X	Science and engineering issues related to providing a city like Berlin with water and energy, removing its waste, and moving people into, out of, or around the city. Simple analyses focused on mass balances for a city, i.e., how much energy, how much CO2 generated, how much water and for what purpose is it used. "Back-of-the-envelope" calculations typical of much engineering to understand the scale of various issues, problems or the solutions to those problems. Particular challenges faced by the city due to climate change, and to what extent Berlin (and Germany) is engaging in policies designed to adapt to or reverse climate change. What makes a city "sustainable" and livable. Field trips to particular technological and environmental features of the city.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
OSPBBER 71	EU in Crisis	X		Challenges confronting Europe as a whole and the EU in particular: impact of the sovereign debt crisis of the Eurozone, mass migration, external and internal security challenges, as well as political and social needs for reform. How the EU and its members respond and if the opportunities of these crises are constructively used for reform - or wasted (Crisis = Danger + Opportunity). Analyse institutions, interests and competing narratives to explain the current situation in Europe. Excursion to Athens or similar to get a non-German perspective on the crises.
OSPCPTWN 30	Engaging Cape Town	X		Engaged scholarship course inviting students to think critically about core concepts in engaged scholarship. Focus on issues of identity and diversity. Students are called upon to evaluate (and modulate) their time in Cape Town in relation to these concepts. Drawing on their own experiences, identity politics, prescribed reading material, applied reading material and their engagement with informal learning spaces in Cape Town, students will interrogate how their identities and those of fellow South Africans are produced and reproduced.
OSPCPTWN 38	Genocide: African Experiences in Comparative Perspective	X		Genocide as a major social and historical phenomenon, contextualized within African history. Time frame ranging from the extermination of indigenous Canary Islanders in the fourteenth and fifteenth centuries to more recent mass killings in Rwanda and Darfur. Emphasis on southern African case studies such as Cape San communities and the Herero people in Namibia. Themes include: roles of racism, colonialism and nationalism in the making of African genocides. Relevance of other social phenomena such as modernity, Social Darwinism, ethnicity, warfare and revolution. Comparative perspective to elucidate global dimensions.
OSPCPTWN 43	Public and Community Health in Sub-Saharan Africa	X		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.
OSPCPTWN 63	Socio-Ecological Systems		X	The global dynamics of biodiversity and ecosystem resilience using the mountains, farmlands and informal settlements as a living classroom. Critical ecosystem services that underpin the well-being of all societal groups and how these ecosystem services can be managed or restored to build resilience and support transitions in complex, interconnected social-ecological systems. Scientific focus on humanity's dependence on biodiversity and ecosystems as the third leg of sustainability science research, in addition to climate change and resource depletion. Deep ecology perspectives that value all life irrespective of its human utility as well as consideration of the non-quantifiable benefits of humanity's connection to nature. Limited enrollment.
OSPCPTWN 70	Youth Citizenship and Community Engagement	X		Critical thinking about core concepts in community engagement such as community, self, and identity. The course aims to cultivate a critical consciousness about the meaning of charity, caring, social justice and the aims of engagement with communities to enhance self awareness, awareness of others who are different, awareness of social issues, and an ethic of care where students can be change agents. The meaning of youth citizenship as it relates to engagement with communities will be explored.
OSPCPTWN 79	Creative Cityness in the Global South	X		Critical exploration of culture-led urban development in postapartheid Cape Town and beyond. Introduction to the rise of the creative economy in South Africa and Cape Town; current local development of Woodstock. Ways and forms of conflict but also new social interfaces between the new creative tenants and the old established community, on the one hand pointing to problematic issues like lingering gentrification, sociospatial polarisation and lopsided cultural representation while also trying to flesh out some of the opportunities for finding the right frequency of engagement between creative industries and spaces of vernacular creativity within Cape Town's post-apartheid urban realm.
OSPFLO 58	Space as History: Social Vision and Urban Change	X		A thousand years of intentional change in Florence. Phases include programmatic enlargement of ecclesiastical structures begun in the 11th century; aggressive expansion of religious and civic space in the 13th and 14th centuries; aggrandizement of private and public buildings in the 15th century; transformation of Florence into a princely capital from the 16th through the 18th centuries; traumatic remaking of the city's historic core in the 19th century; and development of new residential areas on the outskirts and in neighboring towns in the 20th and 21st centuries.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
OSPFLOR 8	Migration and Cultural Diversity in Contemporary Italy	X		Exploration of the media as an arena where Italian national and individual identities (of both migrants and natives) are being redefined in an age of globalization, massive migration flows and increasing social diversity. Over the last thirty years, Italy has been transformed from a country of exclusive emigration into a country where recent immigration is becoming one of the most controversial issues faced by Italian society and the political system today.
OSPFLOR 85	Bioethics: the Biotechnological Revolution, Human Rights and Politics in the Global Era	X		Birth and development of the philosophical field of bioethics based on advances in several fundamental fields of science and technology, including molecular and cell biology, information technology, neurosciences and converging technologies. Challenges for society and ethical and political issues created by new advances and opportunities for individuals and populations. Philosophical approaches developed in the Italian as well as in the European debate; special attention to controversy about the freedom of scientific research, new conditions of procreation, birth, cures, and death. Complexity of the challenges posed by the 'biotechnological revolution'.
OSPKYOTO 40M	An Intro to Making: What is EE	X		Is a hands-on class where students learn to make stuff. Through the process of building, you are introduced to the basic areas of EE. Students build a "useless box" and learn about circuits, feedback, and programming hardware, a light display for your desk and bike and learn about coding, transforms, and LEDs, a solar charger and an EKG machine and learn about power, noise, feedback, more circuits, and safety. And you get to keep the toys you build. Prerequisite: CS 106A.
OSPKYOTO 45	Japan's Energy-Environment Conundrum		X	Japan's energy-environment challenges and their consequences for Japan's wider society and economy. Question of how Japan's policy makers will balance energy and environmental needs and how the answers will affect the country's future as a leading regional power. Students will gain a sound understanding of the structure of Japan's energy-environment challenges and a practical analytical framework by which they can evaluate these challenges and develop their own balanced assessments.
OSPMADR 38	Global Trends: Anticipating the Future in Order to Shape It	X		Examination of "megatrends" such as globalization and interdependence, demographic change, the rise of new powers, increasing prosperity and inequality, demand for limited resources, diffusion of power, and demands on governments everywhere; how they interact, and possible implications for the international system. Also examination of potential "game changers" such as climate change, new technologies, the global economy, and what the United States does/does not do. Goal is enhanced understanding of the challenges we face, how they interact, and what can/must be done to preserve peace and prosperity, maximize benefits, and minimize risks.
OSPMADR 48	Migration and Multiculturalism in Spain	X		Dimensions of recent migratory phenomena in Spain. Changes in past decades from a country of emigration to one of immigration, and vice versa. North Africa, Latin America, and Eastern Europe on the one side and the rest of Europe on the other. Social concern and public debate resulting from these changes.
OSPMADR 55	Latin Americans in Spain: Cultural Identities, Social Practices, and Migratory Experience	X		Shift in recent decades from Spain being a country of emigration to one attractive for immigration, especially for people coming from Latin America. Transnational processes of interculturality, integration and assimilation as illustrated by the different ways that immigrant Spaniards relate to Spanish society in Spain.
OSPMADR 79	Earth and Water Resources' Sustainability in Spain		X	Interdisciplinary focus on the relationship between earth systems and human activities. Nature and distribution of natural resources, their uses and exploitation, environmental impacts associated with exploitation, and sustainable development initiatives, including the restoration and rehabilitation of the land affected by extraction activities. Water management: understanding of the resource and its location; the development of efficient tools; an associated regulatory apparatus; and economics.
OSPMADR 8A	Cities and Creativity: Cultural and Architectural Interpretations of Madrid		X	Architecture and the city, with a focus on recent currents in the progress of both, such as sustainability, environmentalism and the relationship with nature. Topics underpinned by discussion of theory, and illustrated by a study of the city of Madrid: an example of a hybrid architectural/planning experiential environment that looks to the future with an ambition for modernization.
OSPOXFRD 117W	Gender and Social Change in Modern Britain	X		Changes in the social institutions, attitudes, and values in Britain over the past 20 years with specific reference to shifts in gender relations. Demographic, economic and social factors; review of theoretical ideas. Men's and women's shifting roles in a fast-moving society.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
OSPOXFRD 19	Constructing Natures: Science and Technology in the British Landscape	X		How concepts of Nature develop through scientific practice and technological innovation. How science and technology, influenced human-nature relations through three pivotal movements in British history: the British naturalist tradition; the industrial and agricultural revolution; and the scientific turn of the late C19th and early C20th. Emphasis on how the legacy of scientific and technological practice during these historic periods continues to influence contemporary frameworks and practices
OSPOXFRD 82	Politics of Inequality: Implications of Electoral Geography for Democratic Representation Quality	X		Distribution of power in contemporary democratic societies: Beginning with an analysis of the early distribution of income within the city of London (and England, more generally), examine how electoral institutions interact with the electoral geography of income to create (or undermine) parties' and candidates' incentives to mobilize and represent the interests of voters from different social groups. How the electoral geography of income affects democratic representation at the national level of government, in the US and UK. Politics of social policies, especially anti-poverty policies, and the extent to which cross-national differences in policies reflect differences in the electoral power of low-income voters, the quality of partisan representation, and other factors.
OSPPARIS 10H	Refugee NGO Internship	X		Intern with Konexio, an association working to integrate refugees into French professional life through technology and innovation. Konexio offers regular workshops, a project incubator and a sponsorship program, all using an innovative pedagogy model based on inclusive and collaborative learning. Interact with Konexio community, including refugee participants, communicate with nation and international partners, and help develop existing initiatives. Take part in the global fight against exclusion of refugees, while developing practical skills such as communication, social media, crowd-fund, partnership development, projects coordination.
OSPPARIS 45	Comparative Politics in the Contemporary Arab World	X		Basic data and concepts of comparative politics applied to the contemporary Middle East and North African region. Key probing questions from a sociological and historical perspective, based on recent academic literature, fieldwork research and media reports: issue of state-building and welfare state; surviving authoritarian rule; role of political opposition and civil society; nature of political transitions; spread of social movements and uprisings in the Maghreb and the Mashrek; key role of Arab-Israeli conflict in transnational politics; Jihadism and terrorism and the threat of the Islamic State; the Rentier state; role of state and private armies.
OSPPARIS 92	Building Paris: Its History, Architecture, and Urban Design	X		The development of Parisian building and architecture from the 17th century to the present. Interaction of tradition and innovation in its transformation and its historical, political, and cultural underpinnings. Visits and case studies throughout Paris illustrate the formation of the city landscape and its culture.
OSPPARIS 98	Global Health Systems: the Future	X		Globalization of health the world over and consideration of its development in the future. Need to develop a system that protects the global community rather than compare different systems. Risks, illnesses, epidemics, chronic diseases and crises go beyond countries, frontiers and require countries to cooperate and coordinate their operations with one another. Best practices of each country in the fields of public health policies, medical and information technologies, health economics, social makeup and society, epistemology and ethic. Countries to be studied selected from the following: USA, Canada, Brazil, Germany, UK, Spain, Italy, Czech Republic, France, Russian Federation, South Africa, India, China and Singapore.
OSPSANTG 29	Sustainable Cities: Comparative Transportation Systems in Latin America		X	Energy and environmental challenges resulting from the growing size and complexity in Latin American cities. Key issues: way in which public authorities deal with the dynamics of urban growth and complexity; related environmental and energy issues, particularly related to different public transportation models. Systemic approach as seen in Curitiba, Bogota, Santiago, and Medellin. Analysis centering on different approaches used to tackle these related issues; different institutional strategies.
OSPSANTG 58	Living Chile: A Land of Extremes	X		Physical, ecological, and human geography of Chile. Perceptions of the Chilean territory and technologies of study. Flora, fauna, and human adaptations to regional environments. Guest lectures; field trips; workshops.
OSPSANTG 61A	Independent Study: Health and Environment		X	Life expectancy and healthy life years have increased dramatically over the past 100 years, at the same time as anthropogenic climate change and environmental degradation. Where and how can we see the effects of environmental changes on health? What are the health implications of rising temperatures, of land-use changes, of urbanization?

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
OSPSANTG 71	Santiago: Urban Planning, Public Policy, and the Built Environment	X		Santiago's growth and development over time and in comparison to other mega cities in the world; impact of urban highways on the built environment; shopping malls and the development of new urban sub-centers. Topics: brief history of the city, from 1541 to 1940; urban development since 1940; the 1960 Inter-communal Urban Plan; planning and the configuration of modern Santiago; housing policy as an instrument to combat poverty; social housing policy and Santiago's built environment.
PEDS 223	Human Rights and Global Health	X		Open to medical students, graduate students, and advanced undergraduates. Examines the newly emerging field of human rights and global health, beginning with the essential background into the field of human rights, and the recent emergence of health as a human right. Emphasis is on the pioneering work of Dr. Paul Farmer and Partners in Health and the challenge he and his organization have posed to the conventional wisdom about approaches to combating poor health and disease worldwide. Topics include the "big three" infectious diseases -- tuberculosis, malaria, and HIV/AIDS -- as well as emerging infectious diseases, clean water and sanitation, and malnutrition and famine.
PEDS 225	Humanitarian Aid and Politics	X		Open to medical students, graduate students, and undergraduate students. Examines the moral dilemmas and political realities that complicate the delivery of humanitarian aid, especially when undertaken by the United Nations and non-governmental organizations (NGOs). Emphasis is on what humanitarians call "complex humanitarian emergencies": crises often characterized by famine and/or epidemic disease and typically the result of war and/or civil war. Provides background into the history of humanitarian aid, though focus is on the post-Cold War era, up to the recent crises in Libya and Syria.
PHIL 363A	Seminar in History and Philosophy of Science: Democratic Science of the Climate, Races, H2O	X		Is the Earth's climate real? Does it exist beyond experimental data, computer simulation, and scientists' writings? This seminar considers philosophical, historical, and anthropological perspectives on the reality of scientific entities. It asks how these metaphysical questions are connected to our democratic societies and our position as scholars. We will ask whether Homo sapiens is sub-divided into races and ethnicities in the manner of a census form. And how genetics should interact with our social understanding of human diversity. Further, can the answers to these questions stand alone as isolated academic questions, or must they be tied together with our political philosophy and social norms? If democratic pluralism leads to metaphysical pluralism, what becomes of long-discarded scientific entities, such as phlogiston? Some argue that pluralism upsets our most basic scientific facts, like: water is H ₂ O. This graduate seminar examines these scientific entities - the climate, races, phlogiston - from perspectives in Philosophy, Anthropology, and History of Science. The course topics illustrate recent trends toward metaphysics in the humanistic study of science. Students will develop their ability to compare positions and arguments between disciplines. Class time will emphasize inter-disciplinary discussion. The major writing assignment is an essay with multiple drafts. This is designed to prepare students for writing and revising dissertation chapters and peer-reviewed articles. Activities may include a film screening and visit to a scientific laboratory. Students from all programs are welcome. (Advanced undergraduates by permission.)
PHYSICS 199	The Physics of Energy and Climate Change	X		Topics include measurements of temperature and sea level changes in the climate record of the Earth, satellite atmospheric spectroscopy, satellite gravity geodesy measurements of changes in water aquifers and glaciers, and ocean changes. The difference between weather fluctuations changes and climate change, climate models and their uncertainties in the context of physical, chemical and biological feedback mechanisms to changes in greenhouse gases and solar insolation will be discussed. Energy efficiency, transmission and distribution of electricity, energy storage, and the physics of harnessing fossil, wind, solar, geothermal, fission and fusion will be covered, along with prospects of future technological developments in energy use and production. Prerequisite: Physics 40 or Physics 60 series.
PHYSICS 240	Introduction to the Physics of Energy	X		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.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
PHYSICS 241	Introduction to Nuclear Energy	X		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 chemistry and physics. PHYSICS 240 and PHYSICS 252 recommended but not required. Interested undergraduates encouraged to enroll, with permission of instructor.
POLECON 515	Strategy Beyond the Market: Innovation in the Energy Industry	X		The future of the energy industry is deeply intertwined with politics and the formation of policy. What happens beyond the market shapes the rules of the game for market competition. In this class we'll take a deeper dive into the market and beyond-market strategies in the energy industry. Each session will address a business problem and analyze the interaction of market structure and the beyond-market environment. The business problem will either come from a written case or a guest speaker. Topics covered: 1) Mapping the regulated energy landscape: the politics and innovation of the renewable energy industry. 2) Working with State Regulators and Using the beyond-market to dislodge entrenched incumbents. 3) Beyond State Politics: The US & Australian Federal Government. 4) The Utilities from inside and outside. 5) Investing in a highly regulated industry.
POLECON 683	Political Development Economics	X		This course surveys emerging research in political economics as it applies to developing societies, emphasizing both theoretical and empirical approaches. Topics will include: corruption and "forensic" political economics, institutional reform and democratization, ethnicity, conflict and public goods provision, and the role of trade and financial innovations in political development. The aim of the course is to bring students to the frontier of the field and develop their own research. Graduate level proficiency in microeconomics and empirical methods will be required.
POLISCI 110G	Governing the Global Economy	X		Who governs the world economy? Why do countries succeed or fail to cooperate in setting their economic policies? When and how do international institutions help countries cooperate? When and why do countries adopt good and bad economic policies? How does the international economy affect domestic politics? This course examines how domestic and international politics determine how the global economy is governed. We will study the politics of monetary, trade, international investment, energy, environmental, and foreign aid policies to answer these questions. The course will approach each topic by examining alternative theoretical approaches and evaluate these theories using historical and contemporary evidence. There will be an emphasis on applying concepts through the analysis of case studies.
POLISCI 241A	Political Economy of Development	X		This course is an upper-level undergraduate seminar providing an introduction to the political economy of development. We explore many of the key academic debates surrounding how nations develop politically and economically. Course topics will include: theories of state development, the role of institutions, inequality and societal divisions, the impact of natural resources, the consequences of corruption, and the effect of globalization on the world's poor. The course emphasizes teaching students how to read the literature critically.
PSYCH 298	Advanced Studies in Health Psychology	X		This course provides an overview of the major concepts and questions in the field of health psychology. Through reading, lecture and interactive discussion, students have the opportunity to explore and think critically about a number of psychological and social influences in determining health including: emotions, beliefs, relationships, stress, motivation, behavior change, spirituality, culture, and social influence. Students will also discuss the role of important and current topics in the field of health psychology and medicine such as the changing role of the patient and provider relationship, health-care policy and the environment, placebo effects, wearable health devices, and the use of technology in medicine. Course is offered to graduate students and advanced undergraduates with permission from the instructor.
PUBLPOL 135	Regional Politics and Decision Making in Silicon Valley and the Greater Bay Area	X		Dynamics of regional leadership and decision making in Silicon Valley, a complex region composed of 40 cities and four counties without any overarching framework for governance. Formal and informal institutions shaping outcomes in the region. Case studies include transportation, workforce development, housing and land use, and climate change.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
PUBLPOL 154	Politics and Policy in California	X		State politics and policy making, including the roles of the legislature, legislative leadership, governor, special interests, campaign finance, advocacy groups, ballot initiatives, state and federal laws, media, and research organizations. Case studies involving budgets, education, pensions, health care, political reform, environmental reforms, water, transportation and more. Evaluation of political actions, both inside and outside of government, that can affect California policy and social outcomes. Meetings with elected officials, policymakers, and advocates in class and during a day-long field trip to Sacramento.
PWR 1EP	Writing & Rhetoric 1: The Rhetoric of Global Development and Social Change	X		Since World War II, international development projects have marked every sector of global society. We will unpack and interrogate the numerous discourses around international "development" as a strategy for achieving social change and look at how culture, history, politics, and economics have informed development's connections to capitalism, modernity, and most recently, globalization. For more information about PWR 1, see https://undergrad.stanford.edu/programs/pwr/courses/pwr-1 . For full course descriptions, see https://vcapwr-catalog.stanford.edu . Enrollment is handled by the PWR office.
PWR 1LO	Writing & Rhetoric 1: What Are We Trying to Sustain? Rhetoric of Nature's Values and Services		X	With increasing rates of environmental impacts from human activity, communities across the planet face challenges for sustainability. Given the many benefits we derive from nature - from cultural and spiritual benefits, to basic goods like food and water, to economic benefits from the use of natural resources - defining what we value and what we wish to sustain is a top priority. This class will examine diverse perspectives on the value and services we derive from nature and consider challenges for balancing multiple uses of nature in the context of sustainable resource management and conservation. For full course descriptions, see https://vcapwr-catalog.stanford.edu . For more information about PWR 1, see https://undergrad.stanford.edu/programs/pwr/courses/pwr-1 . Enrollment is handled by the PWR office.
PWR 1MGD	Writing & Rhetoric 1: Who speaks for nature? Rhetorics of environmentalism and justice		X	The last hundred years have seen organized environmentalism become a major force on the world stage. But the environment is still essentially contested. Who is at risk from environmental problems? What environmental problems should be prioritized? And who should be able to speak out as authentic protectors of the earth? In this course, we examine the ways that environmental and conservation writers from classic environmental writers to contemporary activists talk about nature to see how close readings of their work highlight fundamental disagreements about justice and politics in societies across the globe. For full course descriptions, see https://vcapwr-catalog.stanford.edu . For more information about PWR 1, see https://undergrad.stanford.edu/programs/pwr/courses/pwr-1 . Enrollment is handled by the PWR office.
PWR 2DHA	Writing & Rhetoric 2: Action Research: Making Time for Social Justice	X		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. For more information about PWR 2, see https://undergrad.stanford.edu/programs/pwr/courses/pwr-2 . For full course descriptions, see https://vcapwr-catalog.stanford.edu . Enrollment is handled by the PWR office.
PWR 2KTA	Writing & Rhetoric 2: A Rebel With A Cause: The Rhetoric of Giving a Damn	X		Prerequisite: PWR 1. In this course, we will explore a variety of movements from marriage equality and civil rights to climate change. We will also examine individuals and the manner in which they advance the causes that matter to them most, including astrophysicist Neil deGrasse Tyson, anti-racism activist Tim Wise, and equal education activist Malala Yousafzai. Ultimately, students will use knowledge gained to assist delivery of research, both in written and oral form, in cultural contexts and from the disciplinary perspective of students' choosing. For more information about PWR 2, see https://undergrad.stanford.edu/programs/pwr/courses/pwr-2 . For full course descriptions, see https://vcapwr-catalog.stanford.edu . Enrollment is handled by the PWR office.
PWR 2SN	Writing & Rhetoric 2: Rhetoric of Activism	X		Prerequisite: PWR 1. This course examines the role of rhetoric in discussions surrounding political inactivity as well as the burgeoning activism of today. Quintessential to our investigation of the rhetorical modes of activism is our exploration of varied and often contesting definitions of "democracy" and "civic engagement." For more information about PWR 2, see https://undergrad.stanford.edu/programs/pwr/courses/pwr-2 . For full course descriptions, see https://vcapwr-catalog.stanford.edu . Enrollment is handled by the PWR office.
SINY 148	Grappling with the Global: Gentrification, Immigration, and Sustainability in New York City		X	This course will examine the impacts of gentrification, immigration, and global environmental concerns on place-making in New York City, deploying ethnographic fieldwork and first-hand accounts of everyday urban life as tools to document and understand urban change.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
SINY 150	Biology, Technology, and Society: The City as a Human Life Support System		X	While environmental issues related to cities are often considered in the context of climate change, this course will use New York City as a lab to explore how dense global cities deal with their intense biological needs clean drinking water, sanitation and sewage, public health, food supply the ongoing management and maintenance of which occupy a surprising portion of the infrastructure, management, and tax expenditure of most city governments.
SOC 109	Race and Immigration in the US : Boundaries and Mobility	X		Drawing from theories and research in race/ethnicity, social psychology, inequality, and demography, and focusing on the U.S., this course examines how racial hierarchies affect immigrants' socioeconomic mobility and ethnic identities, and how immigrants and their descendants contribute to the reconstruction of racial and ethnic boundaries. Topics include: theories of international migration and assimilation; immigration and the labor market; racial and ethnic identities; immigrants and interracial relations; second-generation mobility and identities; transnationalism.
SOC 137	Global Inequality	X		Absolute world poverty has declined considerably in the last twenty years, but elites have gained disproportionately from the growth of the global economy, leading to serious concerns about inequality in several countries, as well as in global policy circles. This discussion-based seminar explores how global capitalism affects worldwide inequality. Topics include the evolution, causes, and structure of global inequality, the links between inequality and human development, and potential solutions to global inequality.
SOC 14N	Inequality in American Society	X		An overview of the major forms of inequality in American society, their causes and consequences. Special attention will be devoted to public policy associated with inequality.
SOC 328	The Sociology of Work and Employment	X		Work and employment have the ability to promote economic security as well as reinforce poverty, provide meaning as well as induce alienation, generate collaboration as well as reproduce difference. Indeed, work and employment are central components of the human experience and structure significant portions of our lives. This course introduces students to current theoretical and empirical issues in sociological scholarship on work and employment. The substantive topics covered in this course will include job search and finding work, the hiring process, changing employment relations, job loss and unemployment, racial and gender stratification at work, unpaid labor and care work, as well as work and family intersections. Theoretical and methodological innovation in recent scholarship will be highlighted throughout the course. The course will culminate with students developing a proposal for a research project designed to address a significant gap in existing scholarship on work and employment.
SOC 378	Seminar on Institutional Theory and World Society	X		Sociological analyses of the rise and impact of the expanded modern world order, with its internationalized organizations and globalized discourse. Consequences for national and local society: education, political organization, economic structure, the environment, and science. The centrality of the individual and the rationalized organization as legitimated actors.
SOMGEN 207	Theories of Change in Global Health	X		Open to graduate students studying in any discipline whose research work or interest engages global health. Upper-class undergraduates who have completed at least one of the prerequisite courses and who are willing to commit the preparatory time for a graduate level seminar class are welcome. The course undertakes a critical assessment of how different academic disciplines frame global health problems and recommend pathways toward improvements. Focuses on evaluating examples of both success and failure of different theories of change in specific global health implementations. Prerequisites: ECON 118, CEE 265D, HUMBIO 129S or HUMBIO 124C.
STRAMGT 306	Food, Health & Nutrition Entrepreneurship	X		Americans spend nearly 7% of their income on food items and another 5% on food services annually (US Census). Food spend is at the intersection of two of the most important industries in the US: health care and agriculture. Food production today supports the food consumption causing our extraordinary burden of disease; 75 cents of every dollar of the \$4.8 billion spent annually on health care is for diet-related disease. The health care system accounts for over 17% of U.S. gross domestic product (GDP). Agriculture and agriculture-related industries contributed 4.8% to the U.S. gross domestic product (GDP) in 2012. This course focuses on the shifting landscapes across these industries and subsequent market opportunities in food, health, and nutrition. The course is designed for students with a broad interest in the food or health systems and/or who are interested in careers in related fields. We will examine the food system from three points of view: the consumer, nutritional science, and policy. The class will focus on solving for consumer needs from the perspective of a health-promoting entrepreneur. The class will involve lecture, discussion, and prominent guest speakers who are entrepreneurs themselves or industry leaders.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
STRAMGT 545	Taking Social Innovation to Scale	X		<p>How do you get the best new social innovations to reach the hundreds of millions of people who need it the most? And how do ensure that they are developed, deployed and scaled in a way that is relevant, appropriate and sustainable? Innovators tackling the world's most difficult problems often ignore, misunderstand, and under-invest in the critical business challenges involved in crossing "the middle of the value chain." This is innovation's valley of death: product and system adaptation and evaluation; evidence generation and design validation; business and partnership planning; formal or informal regulatory approval and registration. How do you design, introduce, and optimize the intervention's uptake before it can be taken to scale by markets, governments or other systems? The class is taught by Steve Davis, President & CEO of PATH (www.path.org), a leader in global health innovation, and former global Director of Social Innovation at McKinsey & Company. We take an inter-disciplinary approach to look at the factors that pull innovation forward, push it from behind, and (often to the world's detriment) block its successful implementation and scaling. First grounding the discussion in research on innovation and social change, we then apply business principles, real world experiences and several important case studies in global health to examine the way good ideas get stuck, and how good ideas can turn into innovation that matters. We focus on root causes for failure, success factors, and business practices and tools to enable millions of lives to be impacted by social innovation. The seminar combines lectures, case studies, visiting practitioners and team projects focused on the business case for scaling specific social innovations. The goal is to help the next generation of social innovation leaders think more about some of the mistakes of the past, lessons for the future, and new ways of approaching old problems, all from a practitioner's point of view.</p>
STRAMGT 574	Strategic Thinking in Action - In Business and Beyond (II)	X		<p>This six-session 2-point Bass seminar will involve students (maximum 24) in analyzing the emerging global electric automotive industry by focusing on: (1) The electric automotive industry in the U.S. and Europe, (2) the electric automotive industry in Japan and Korea, and (3) the electric automotive industry in China. We will each time examine the strategies of the key automotive companies as well as that of the government and other key players such as infrastructure providers. The purpose of the seminar is to help students sharpen their skills in identifying facilitating and impeding forces of strategic change, and in assessing and estimating the direction and rate of strategic change. While the instructors will provide relevant pre-readings related to these topics, students will be expected to complement these materials with their own research of theoretical and empirical sources. They will also be expected to help structure the discussion and move it forward toward conclusions. Students will organize into three teams each focused on one of the regions and prepare a five-to-ten page group report of their most important findings and conclusions that extend current knowledge.</p>
STRAMGT 583	The Challenges in/with China	X		<p>The general objective of the course is to develop a better understanding of the changing socio-economic and political situation in China (with its challenges both for China and for the rest of the world). It should make then less difficult to define sustainable strategies for managing effectively in China and for handling the growing interdependence between China and the US; between China and the rest of the world. From assessing critically the performance of China today, students will get an insight in the current complex dynamics of China renaissance/transformation and we will discuss alternative scenarios, with their business and socio-political consequences on the medium term. From this analysis and with a prospective perspective in mind, we will explore alternative approaches and propose responsible management practices required to build, overtime, a mutually rewarding, growing interdependence. More specifically, the course will initially identify the multi-causality behind China's achievements and discuss some of the dysfunctions associated, today, with such performance. The conditions of management effectiveness required to enter and succeed overtime in the Chinese market will be identified while the challenges faced by the global expansion of Chinese firms overseas will be illustrated. The course will rely upon different pedagogical methods; it will create conditions to share and leverage participants' experience and it will make use of a number of cases and research results.</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
STRAMGT 584	Assessing High Impact Business Models in Emerging Markets	X		<p>In recent years, we've seen an explosion of innovative business models blazing new trails in emerging markets. Many of these models are achieving commercial success while transforming the lives of low-income populations. Using nine cases of both early-stage, entrepreneur-led ventures and later-stage, public or large-cap firms, this course will examine best practices for scaling new enterprises in emerging markets. It will do so primarily through the lens of a potential investor. It will also explore what is required to spark, nurture and scale entire sectors that serve rapidly growing, often low-income markets. What does it mean to work in markets with limited infrastructure? What common mistakes are made - whether in business model design, in supply chains, or in dealing with government - and how can we avoid them? Which are the best business models to serve markets that corporations have traditionally ignored, and in which government has failed to deliver? Who might be threatened by the success of these new businesses? The seminar is a good match for Stanford students interested in working or investing in emerging markets. It will be taught by Matt Bannick, who leads Omidyar Network (a \$1 billion impact investing fund) and is the former President of eBay International and of PayPal.</p>
STS 181	Techno-metabolism: Technology, Society, and the Anthropocene		X	<p>In the Anthropocene epoch, humanity has become a geological force. As the sum of all technological systems and their human components, the technosphere metabolizes energy, materials, and information. Techno-metabolism's waste products- greenhouse gases, microplastics, nuclear waste, etc. - are transforming the biosphere and the geosphere, with radically different effects on disparate peoples and places. Scientists, historians, and others have proposed new ways to conceptualize techno-metabolism in order to reduce energy requirements and material waste. Meanwhile, "data exhaust" - the "waste" data generated by individual activity, from web searches to Facebook and Instagram - is increasingly "recycled" to detect patterns, trends, and individual preferences. In this project-centered course, students will seek creative ways to visualize, understand, and change the interplay of energy, materials, information, and waste. Assignments include reading logs and a term-long group project.</p>
STS 190	Issues in Technology and the Environment		X	<p>Humans have long shaped and reshaped the natural world with technologies. Once a menacing presence to conquer or an infinite reserve for resources, nature is now understood to require constant protection from damage and loss. This course will examine humanity's varied relationship with the environment, with a focus on the role of technology. Topics include: industrialization, modernism, diversity in environmentalism, environmental justice, global-local tensions, nuclear technology, and biotechnology. Students will explore theoretical and methodological approaches in STS and conduct original research that addresses this human-nature-technology nexus. Enrollment limited to juniors and seniors, or with consent of instructor. First week attendance mandatory.</p>
SURG 234	Service Through Surgery: Surgeons with an Impact	X		<p>Surgeons with an Impact is a weekly lunch seminar course with guest lectures and facilitated workshops with the following objectives: 1) Participants will be able to understand the role of surgeons in addressing health inequities, social justice, and poverty, 2) Participants will be exposed to the potential of expert surgeons through lectures from diverse professionals, 3) Participants will reflect on how addressing inequities can align with their career goals in surgery. Health justice topics covered will include: surgery and global health, advocacy and trauma surgery, transplant justice, inequities in pediatric surgery, serving veterans through surgery, accessing surgical obstetrics and gynecology care, women in surgery, LGBTQ advocacy and surgery, and race and surgery; as well as diversity among surgeons themselves. Course open to MD and PA students only.</p>
SURG 236	Seminar in Global Surgery and Anesthesia	X		<p>Providing safe, mutually beneficial, and sustainable surgical services in low-resource settings presents a unique set of considerations. This seminar, formatted as five two-hour sessions, will explore the background rationale for the evolving field of Global Surgery and discuss the unique implications surrounding implementation of global surgical programs. Course format will blend didactic presentation, discussion-based journal clubs, and case-based study. Topics covered will include the burden of surgical disease, human and infrastructure capacity building, outcomes, ethics/equity, economics, innovation/technology, volunteerism, training, safety, and research agenda. Instructors will provide mentorship to participants, helping them to formulate feasible research or potential MedScholar project.</p>

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
SUST 210	Pursuing Sustainability: Managing Complex Social Environmental Systems		X	This course provides a systems framework for understanding and managing social-environmental systems, with the ultimate goal of intergenerational well-being. It explores the role of natural, human, social, technological and knowledge capital assets in determining sustainability, and their trade-offs, feedbacks, non-linearities and other interactions within complex systems. Through case study analyses, the course illustrates why complex systems approaches are important and some of the failures that occur without them, and provides an overview of the tools, approaches, and strategies that assist with management of assets for sustainability goals. The course draws on readings from a variety of on-line sources as well as chapters and case studies provided in the required text.
SUST 220	Case Studies in Leading Change for Sustainability		X	This course focuses on the practice of leading change for sustainability. It uses analysis and evaluation of case studies to explore different modes of leadership and processes that have allowed companies and organizations to pursue sustainability in their business models. Topics include complex systems and leadership orientations, systems thinking, decision-making under uncertainty, negotiation, circular economy, social enterprise, stakeholder engagement, multi-stakeholder partnerships, resilience theory, metrics of progress beyond GDP. The course builds understanding and capacity to lead change through conceptual frameworks, hands-on exercises, class discussion and interactions with transformative leaders. Course materials include scholarly articles in behavioral psychology, resilience theory, systems analysis, as well as business school case material and tools developed by exemplary organizations leading change for sustainability. Consent of instructor required. Please email Julia Novy-Hildesley (julia3@stanford.edu) with the answers to these 3 questions: 1. Why are you interested in this course? 2. What would you like to get out of this course? 3. What will you contribute? Permission code will be given upon review of answers.
SUST 231	Design Thinking for Sustainable Impact		X	Design Thinking is an exceptionally versatile methodology that combines creativity, human centeredness, design skills, critical thinking, and hands-on building of solutions as an approach to rapidly tackle ill-defined challenges. This boot-camp class immerses students in the cognitive modes, theory, skill-sets, mind-sets, and tools associated with Design Thinking to solve real world challenges aimed at sustainable impact. This project based class gives students an immersive experience in theory, tools, and practice of design thinking in the context of sustainability challenges.
SUST 261	Art and Science of Decision Making	X		Common-sense rules and decision-making tools to achieve clarity of action for important decisions, from personal choices to organizational decisions about business strategies and public policies. The art of qualitative framing and structuring as well as the science of quantitative modeling and analysis. The essential focus, discipline, and passion needed to make high-quality decisions, and thereby increase the probability of desired outcomes. Effective normative techniques and efficient management processes for both analyzing complex decisions and implementing them in the face of an uncertain future world. Lecture topics include practical ways to: interact collaboratively with stakeholders, craft an inspirational vision, create viable alternatives, assess unbiased probabilistic information, clarify tangible and intangible preferences, develop appropriate risk/reward and portfolio models, evaluate strategies and policies across a realistic range of uncertain scenarios, analyze key sensitivities, appraise the value of gathering additional information, and build widespread commitment to implementation plans. Student teams present insights from their analyses of real decisions currently being made by business, nonprofit, and government organizations. Case studies about: energy economics, mine remediation, ocean resource preservation, bison brucellosis, nuclear waste storage, hurricane seeding, electric power production, environmental risk management, venture capital investments, and oil & gas options trading.
UAR 43	LSP: Exploring Research, Writing, and Problem Solving at Stanford	X		This course is offered in August prior to start of fall quarter for participants of the Leland Scholars Program. This course is comprised of two parallel tracks: one focused on the development and practice of critical problem solving and study skills using wide variety of chemistry examples that illustrate the broad yet integrated nature of science; a second focused on providing an introduction to rhetorical thinking, academic writing, college-level research, and crafting well-reasoned arguments. Based on skills developed in both tracks, students will work in teams to research and present on a current issue revolving around one of five central themes: energy, climate change, water resources, medicine, and food & nutrition exploring their issue from chemical, socioeconomic and cultural perspectives.

Subject & Catalog Number	Title	Includes Sustainability	Sustainability Focused	Course Description
URBANST 104	Civic Dreams, Human Spaces: Designing Cities for People	X		<p>Cities and real estate generate lively public discussions, passionate community meetings, and political shouting matches. But how does a project actually get proposed and built? We explore the key actors and influencers in the urban built environment, ranging from urban planners to real estate developers to community advocates. This intensive d.school experience aims to deepen our insights about stakeholders, so that we gain a more empathetic understanding of how a city is built, and identify potential opportunities for improving the process of urban intervention and regeneration to be more responsive to citizens and responsible to society. Enrollment by application only. Find more info and apply at dschool.stanford.edu. (Cardinal Course certified by the Haas Center). Course meets at the d.school in Studio 2.</p>
URBANST 113	Introduction to Urban Design: Contemporary Urban Design in Theory and Practice	X		<p>Comparative studies in neighborhood conservation, inner city regeneration, and growth policies for metropolitan regions. Lect-disc and research focusing on case studies from North America and abroad, team urban design projects. Two Saturday class workshops in San Francisco: 2nd and 4th Saturdays of the quarter. Terms: Win Units: 5 UG Reqs: GER:DBSocSci Grading: Letter (ABCD/NP)</p>
URBANST 132	Concepts and Analytic Skills for the Social Sector	X		<p>How to create and grow innovative not-for-profit organizations and for-profit enterprises which have the primary goal of solving social and environmental problems. Topics include organizational mission, strategy, communications/marketing, financing and impact evaluation. Opportunities and limits of methods from the for-profit sector to meet social goals. Perspectives from the field of social entrepreneurship, design thinking and social change. Focus is on integrating theory with practical applications. Enrollment limited to 20. Prerequisite: consent of instructor. Email lalitvak@stanford.edu</p>
URBANST 138	Smart Cities & Communities	X		<p>A city is essentially an organism, a complex system of systems and its inhabitants. A nexus of forces - IoT, data, systems of insight, and systems of engagement - present an unprecedented opportunity to increase the efficiency of urban systems, improve the efficacy of public services, and to assure the resiliency of the community against both chronic stresses and acute shocks. The course will provide you with an understanding of the foundational elements of a smart city and address the breadth of systems that comprise it: built infrastructure, energy, water, transportation, food production/distribution, and public/social services. Case studies will be used to illustrate the approaches, benefits, and risks involved. It will discuss what IT can and cannot do, and most importantly given the control and privacy implications of many smart IT systems, what the smart city should and should not do. Panel discussions and guest speakers from the public sector and industry leading technology providers will give students an opportunity to engage with the architects and operators of Smart Cities.</p>
URBANST 165	Sustainable Urban and Regional Transportation Planning		X	<p>Environmental, economic, and equity aspects of urban transportation in 21st-century U.S. Expanded choices in urban and regional mobility that do not diminish resources for future generations. Implications for the global environment and the livability of communities.</p>