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Caltech courses related to science policy and science ethics

Below is a list of Caltech courses that focus on topics related to science policy and science ethics. The list is updated regularly, so we welcome suggestions and additions. In addition to the courses listed here, there are many other courses (e.g. in Environmental Science & Engineering or in the Humanities) that provide important context, whether historical, cultural or scientific, to the ethics and policy debates. Similarly, while we list courses below that focus on scientific communication to the broader public, there are further courses that address scientific writing. If we are missing something, we would be very grateful if you could make us aware of additional courses that we can list. Courses that are listed in the catalog but are not currently taught are starred (*).

Courses with a science policy or science ethics focus taught by members of CSSPP

- Hum/Pl 45. **Ethics & AI.** 9 units (3-0-6); first term. How do we reconcile the possibilities of modern machine learning with ethical and moral demands of fairness, accountability and transparency? This course will take a case study-based approach to the challenges at the interface of algorithms and human values. By exploring existing debates on algorithmic bias, explainable AI and data ownership, students will be exposed to the relevance of ethical systems of thought to modern social questions.
- Pl/HPS 183. **Bioethics.** 9 units (3-0-6); first term. A survey of issues in bioethics. Topics may include: abortion and reproductive rights; euthanasia; physician-patient relationships; use of human embryos and stem cells in research; use of human subjects in research and the concept of informed consent; research on and treatment of non-human animals; organ transplantation, distribution, and sale; genetic modification of organisms (including humans); synthetic biology; cure vs. enhancement and other issues in biotechnology and neuroethics.
- PS/Ec 128. **Introduction to Public Health Economics and Policy**. 9 units (3-0-6); third term. This course will cover the basic concepts and principles of health economics and challenges in health policy implementation. By studying this course, students will establish economic thinking and be able to flexibly use economic methods to analyze practical problems in the field of health care. Students will also learn about the application of machine learning in public health. This course combines theory and methodology. The teaching goal focuses on students' ability to analyze and solve practical problems. Interactive teaching is done through group discussions and topic debates around case studies. Each chapter consists of a theory and case analysis. The case discussion will focus on basic theories and methods and highlight the hot issues in the current medical and health system. The exam will be an open-book exam, with class discussions accounting for 40%, and the final exam accounting for 60%.

Courses that directly engage with science policy or science ethics

- *BEM/Ec/ESE 119. **Environmental Economics.** 9 units (3-0-6); first term. Prerequisites: Ec 11 or equivalent. This course provides a survey from the perspective of economics of public policy issues regarding the management of natural resources and the protection of environmental quality. The course covers both conceptual topics and recent and current applications. Included are principles of environmental and resource economics, management of nonrenewable and renewable resources, and environmental policy with the focus on air pollution problems, both local problems (smog) and global problems (climate change).
- *CS 141. **Hack Society: Projects from the Public Sector**. 9 units (0-0-9); third term. Prerequisites: CS/IDS 142, 143, CMS/CS/EE/IDS 144, or permission from instructor. There is a large gap between the public and private sectors' effective use of technology. This gap presents an opportunity for the development of innovative solutions to problems faced by society. Students will develop technology-based projects that address this gap. Course material will offer an introduction to the design, development, and analysis of digital technology with examples derived from services typically found in the public sector.
- CS/IDS 162. **Data, Algorithms and Society**. 9 units (3-0-6); second term. Prerequisites: CS 38 and CS 155 or 156 a. This course examines algorithms and data practices in fields such as machine learning, privacy, and communication networks through a social lens. We will draw upon theory and practices from art, media, computer science and technology studies to critically analyze algorithms and their implementations within society. The course includes projects, lectures, readings, and discussions. Students will learn mathematical formalisms, critical thinking and creative problem solving to connect algorithms to their practical implementations within social, cultural, economic, legal and political contexts. Enrollment by application. Taught concurrently with VC 72 and can only be taken once as CS/IDS 162 or VC 72.
- En/VC 172. **Heritage Studies.** 9 units (3-0-6); first term. What makes an old building, artifact, or custom "historic"? Which historic things are worth preserving? This course explores the aesthetic, political, social, and environmental dimensions of cultural heritage. We will examine the narratives and values associated with heritage conservation at the local level as well as within national and global contexts. From Caltech's own campus and the Watts Towers, to the national parks, UNESCO World Heritage Sites, and the culinary legacy of the Atlantic slave trade, our class will grapple with the theories, practices, and debates as they determine what gets preserved and which stories get told. Readings/screenings will be supplemented with field trips to heritage sites in Pasadena and Los Angeles.
- ESE 1. **Earth's Climate.** 9 units (3-0-6); third term. An introduction to climate on Earth. How Earth's climate has changed in the past and its evolving response to the rapid increase in carbon dioxide and methane happening today. Model projections of future climate and associated risks. Development of climate policies in face of uncertainty in

these projections and risks. Enrollment is limited. Satisfies the menu requirement of the Caltech core curriculum. Juniors and Seniors who have satisfied their menu course requirement should enroll in ESE 101.

- *ESE/ME/EST/Ec/ChE/EE 179. **Climate Change Impacts, Mitigation and Adaptation.** 3 units (3-0-0); second term. Climate change has already begun to impact life on the planet, and will continue in the coming decades. This class will explore particular causes and impacts of climate change, technologies to mitigate or adapt to those impacts, and the economic and social costs associated with them - particular focus will be paid to distributional issues, environmental and racial justice and equity intersections. The course will consist of 3-4 topical modules, each focused on a specific impact or sector (e.g. the electricity or transportation sector, climate impacts of food and agriculture, increasing fires and floods). Each module will contain lectures/content on the associated climate science background, engineering/technological developments to combat the issue, and an exploration of the economics and the inequities that exacerbate the situation, followed by group discussion and synthesis of the different perspectives.
- Ge/ESE/Bi 248. **Environmental Justice**. 6 units (2-0-4); first term. This seminar course will explore and discuss the unique intersection of environmental racism, environmental justice, and academia. Course material will primarily feature readings and videos on a case study-like basis and focus on bringing conversations typically had in humanities, social sciences and activism to the bio and geosciences. Topics will center around two primary approaches: an "outward-facing" component that looks at environmental racism through the lens of various activisms, and an "inward-facing" component addressing the biases/malpractices broadly employed in the biological and geosciences, as well as the apparent moral dilemmas of decisions involving multiple stakeholders. Out of class work will largely be based on assigned readings, some multimedia presentations, and occasional writings and thought exercises. This course is taught concurrently with Hum 61 and can only be taken once, as Ge/ESE/Bi 248 or Hum 61.
- Hum/H/HPS 15. **Waste in the World**. 9 units (3-0-6); second, third terms. The things that human beings make and throw away rarely stay where we put them. Just as humans have shaped the biological and physical world, the biological and physical world shapes human actions. In this course, we will examine how these interacting forces propel environmental and cultural change. We will explore these concepts through the lens of waste - how different groups at different points in history define waste, where discarded things go and what they become as they move through space and time. We will consider how conflicting perceptions of utility and waste in different cultural and historical contexts have factored into shifting ideas about race, class, gender, wilderness, technology, consumption, and sovereignty. In rethinking waste, we will explore the multiple meanings of "nature," assess the roots of sustainability, and evaluate past events in light of current ideas about environmental justice. While this course prioritizes reading and discussion, we will also engage with the world around us through visual analysis. Pasadena and Los Angeles will be among our most important resources, allowing us to ground global ideas in a local context.
- H/HPS 130. **Technology and Environment in America.** 9 units (3-0-6); second term. Political and professional arenas often invoke technology as both a cause and potential

solution. In much of mainstream American culture, an enthusiasm for innovation often overshadows the messier ways that humans interact with our surroundings through the artifacts and technologies that we create. In this course, we will examine the interplay between environment and technology in America, from before the arrival of Europeans on the North American continent through present debates about our changing planet. We will consider the boundaries that different groups have drawn between natural and artificial, and how these definitions have shaped the cultural, political, and material landscape of America. How useful are these boundaries? How might rethinking them also help us rethink America's history and its possible future?.

- *H 131. **History of Extinction.** 9 units (3-0-6); first term. Humans are in the midst of the sixth mass extinction-the first to be caused by human activity. Extinction has been viewed in changing ways over the past 200 years, and this course takes an interdisciplinary approach to learning about the extinction process from a historical as well as a modern perspective. Our focus will be on the extinction of biological entities, but we will also touch on other systems that have disappeared: languages, technologies, habitats, and ways of living. Central to our endeavors will be asking what it means to live in this time of loss: Should we mourn? And if so, how do we mourn for what many or most of us do not see, but only read about? Finally, we will scrutinize what the practical effects of extinction have been, are, and will be. We will also make at least one visit to a natural history museum to view some extinct species behind the scenes.
- *H 132. **Humanistic Ecology.** 9 units (3-0-6); third term. Humans' conceptions of nature have changed dramatically over time. Ecological systems influence human culture, politics, law, and many other spheres, and in turn, humans influence those systems. This class introduces students to the field of humanistic ecology-a discipline that looks to a number of cultural, political, historical and economic elements to better understand the role of ecology in a larger sphere outside of its scientific structure and uses. Humanistic ecology is designed to provide context for the study of ecology, and in a fundamental way, focuses on the appropriate role of humanity in its relationship to nature: what is ethical, or not, what is useful, or not, and a variety of other matters that should be considered when taking a fully three-dimensional view of ecological science.
- H 133. **Forests and Humans.** 9 units (3-0-6); first term. Forests - which cover 31 percent of the world's land surface - have played essential roles in enhancing the planet's biodiversity. Forests have also served humans in numerous and often controversial ways, and have also been subjected to dramatic change through human activity. How well have we served forests, as well as being served by them? The class will cover the growth and use of forests from a humanistic and historic perspective, as well as discussions about the role of fire in forests, with a particular emphasis on the unprecedented forest fires in California in the past several years and the global ecological implications.
- *H/HPS 155. **Mortality Crises and Social Change: Epidemic Disease from 1300 to the Present.** 9 units (3-0-6); third term. What do we know about epidemics in the past? What did contemporaries understand about these events? How did societies respond to periodic bouts of epidemic disease? This course examines mortality crises and epidemics from the Black Death in the 14th century to the current coronavirus pandemic,

with attention given to the impact of epidemics on societies, the ways in which such outbreaks have been understood over time and the kinds of responses they have elicited. We will draw on studies for a range of societies in order to identify patterns across space and time, and to highlight both continuity and change in the ways societies have dealt with contagious diseases.

- *H/HPS 156. **COVID-19 and Other Pandemics.** 9 units (3-0-6); second term. How do we understand the COVID pandemic and the differential responses to it around the globe? What is the best framework for proper understanding? Science, history, politics, culture? Special attention will be given to the state of medical science today and in the past, the understanding of ethology, transmission, and symptoms; the role of scientists, physicians, and "quacks"; the persistence and change in the forms of fear, superstition, and misinformation across time.
- *HPS/H 180. **Forbidden Knowledge.** 9 units (3-0-6); first term. Why does the notion of freedom of knowledge and teaching in science and engineering matter? What kinds of restrictions have been placed on scientists and engineers, their publications and institutions? Who restrained scientific and engineering knowledge of what sorts; for what reasons; and how successfully? These questions will be addressed by exploring the strategies developed by the U.S. research community to protect the international circulation of knowledge after World War II, when scientific freedom and the export of technical data had to be balanced with the needs of national security. Case studies will include the atomic bomb, the semiconductor industry in the 1970s and space technologies, notably rockets/missiles, in the 1990s. The threat to U.S. economics and military security posed by the Soviet Union in the Cold War, and by China today, has transformed the practice of research in university and in industry alike building new walls around the production and circulation of knowledge to affirm national sovereignty that is, all the while, being undermined by the global circulation of trained scientists and engineers.
- *HPS/Pl 138. **Human Nature and Society**. 9 units (3-0-6); first term. This course will investigate how assumptions about human nature shape political philosophy, social institutions, and social policy. The course will begin with a historical perspective, examining the work of such political philosophers as Plato, Locke, Rousseau, and Marx, along with such psychologists as Freud and Skinner. Against this historical perspective, it will then turn to examine contemporary views on human nature from cognitive neuroscience and evolutionary psychology and explore their potential implications for political philosophy and social policy. Among topics to be discussed will be the nature of human sociality and cooperation; economic systems and assumptions regarding production and consumption; and propaganda, marketing, and manipulation.
- *HPS/Pl 139. **Human Nature, Welfare, & Sustainability.** 9 units (3-0-6); first term. Policy makers since at least the time of Jeremy Bentham have argued that welfare maximization ought to be the goal of social policy. When this includes perfectionist notions of realizing one's capacities, economic prosperity, prosocial norms, and democratization have all coincided as key drivers of human development. Although the UN 2030 Agenda for Sustainable Development envisions worldwide inclusive and sustainable economic growth, there is substantial debate regarding the extent to which

sustainability and economic growth are compatible. This course will critically examine the links between human welfare, economic growth, and material culture to better understand why economic growth and welfare have been taken to be intertwined - and the extent to which they could be decoupled. Our starting point will be the Brundtland report, its conception of welfare based on human needs, and subsequent articulations of needs-based theories of human welfare, including evolutionary and biological accounts that include social comparison processes such as esteem, status, and recognition. This will provide us with a theoretical framework for investigating the role of material culture in satisfying these needs and whether they may be satisfied by less resource-intense routes.

- Hum/Pl 40. **Right and Wrong.** 9 units (3-0-6); first, second terms. This course addresses questions such as: Where do our moral ideas come from? What justifies them? How should they guide our conduct, as individuals and as a society? What kind of person should one aspire to be? Topics the course may deal with include meta-ethical issues (e.g., What makes an action right or wrong? When is one morally responsible for one's actions? How should society be organized?) and normative questions (e.g., Is eating meat morally acceptable? What should we tolerate and why? What are society's obligations toward the poor?). In addition, the psychological and neural substrates of moral judgment and decision making may be explored. The course draws on a variety of sources, including selections from the great works of moral and political philosophy (e.g., Aristotle's Nichomachean Ethics, Hobbes's Leviathan, Kant's Groundings for a Metaphysics of Morals, and Rawls's A Theory of Justice), contemporary discussions of particular moral issues, and the science of moral thought.
- Hum 61. **Environmental Justice.** 6 units (2-0-4); first term. This seminar course will explore and discuss the unique intersection of environmental racism, environmental justice, and academia. Course material will primarily feature readings and videos on a case study-like basis and focus on bringing conversations typically had in humanities, social sciences and activism to the bio and geosciences. Topics will center around two primary approaches: an "outward-facing" component that looks at environmental racism through the lens of various activisms, and an "inward-facing" component addressing the biases/malpractices broadly employed in the biological and geosciences, as well as the apparent moral dilemmas of decisions involving multiple stakeholders. Out of class work will largely be based on assigned readings, some multimedia presentations, and occasional writings and thought exercises. This course is taught concurrently with Ge/ESE/Bi 248 and can only be taken once, as Hum 61 or Ge/ESE/Bi 248.
- PS 123. **Regulation and Politics**. 9 units (3-0-6); second term. Prerequisites: PS 12. This course will examine the historical origins of several regulatory agencies and trace their development over the past century or so. It will also investigate a number of current issues in regulatory politics, including the great discrepancies that exist in the cost-effectiveness of different regulations, and the advent of more market-based approaches to regulations instead of traditional "command-and-control." Not offered on a pass/fail basis.

Courses that focus on science communication and outreach (not scientific writing)

- En/Wr 83. **Personal Narrative and STEM Research.** 9 units (3-0-6). This course focuses on personal narrative and memoir writing by STEM researchers. STEM research strives for objectivity and replicability, and key genres of STEM research writing require that writers repress their subjectivity and individuality. However, a researcher's experience of inquiry is often deeply personal and emotional, and some researchers choose to write about those experiences in personal essays and memoirs. We will analyze a wide variety of this narrative writing, and we will examine connections between the narratives' formal features and the rhetorical effects they might have on readers. Drawing on what we learn, students will compose an excerpt of their own memoir or a stand-alone personal narrative essay. The course will also explore current approaches to spoken storytelling sometimes utilized by researchers, such as the Moth story and the TED talk. Satisfies the Institute scientific writing requirement and the option oral communications requirement for humanities majors.
- En/Wr 84. **Communicating Science to Non-Experts.** 9 units (3-0-6); third term. This course offers instruction in writing and speaking about science and technology for non-expert audiences. Instruction focuses on how to convey complex technical information in clear, engaging prose and speech in a variety of contexts. Readings in different genres (e.g., the newspaper discovery story, the op-ed, the personal narrative, the explainer talk) raise issues for discussion and serve as models for assignments in these genres. The workshop-style nature of this course relies on drafting and revision in response to peer and instructor feedback. Satisfies the Institute scientific writing requirement and the option oral communications requirement for humanities majors.
- En 89. **Journalism and Storytelling**. 9 units (3-0-6); third term. Today's political and social turmoil have cast a sometimes harsh light on news media and the journalistic writing approach. Is the media fulfilling its role in our democracy? What should it be? And what approach should journalists take in their reporting and writing? This course will ponder these questions as it explores how to construct interesting, relevant, journalistic storytelling, including the use of new media tools. It will emphasize the foundations of the craft, such as close attention to fact, accuracy, clarity and precision, and examine its critical components, such as story form, reporting and interviewing, theme and scene, and character development. It will offer opportunities to construct a long-form journalistic piece. Students will produce numerous stories and other writing during the class, including profiles, issues, analysis and reviews. Several of these will be offered for publication in The California Tech. There will be class visits by professional journalists and a possible off-campus excursion.
- *****ChE/Ch/Bi/SEC 107. **Social Media for Scientists.** 9 units (3-0-6); An introduction to the use of social media for scientific communication. Social media platforms are discussed in the context of their use to professionally engage scientific communities and general audiences. Topics will include ethics, privacy, reputation management, ownership and the law, and will focus on the use and impact of social media for personal

and professional career development. Lectures will include presentations by invited experts in various specialties, a number of whom will have worldwide recognition.

- PVA 41 abc. **Storytelling for Scientists**. 3 units (2-0-1); first, second, third terms. Across three terms students explore/write and perform new narratives for the ever-changing 21st century global landscape. 41 a includes finding your stories. Moth to the Flame 41 b builds complex social/scientific narratives, and practices citizen science and democracy in open forums. 41 c concludes with long-form storytelling. All final classes culminate in original stories recorded in front of a live audience. May be repeated for credit.
- SEC 13. **Written Communication about Engineering and Applied Science to Non-Specialists.** 3 units (1-0-2); Terms to be arranged. Engineers and applied scientists often work on highly technical, specialized projects. However, their work is often of interest to readers with varied areas and levels of technical expertise, including investors, community stakeholders, government regulators, consumers, voters, students, and enthusiasts. This course introduces students to diverse types of writing about technical engineering and applied science topics intended for these "non-specialist" readers who lack some or all of the technical knowledge the author has. Students will compose multiple texts written for different purposes and to different types of audiences outside of their area of expertise. This course is recommended for students who may plan entrepreneurial, non-profit, or government careers, where communication to non-specialists is crucial to success. It may also interest students who enjoy public advocacy or creative writing about technical topics. Fulfills the Institute scientific writing requirement. Enrollment is limited to students in E&AS; options and priority is given to seniors. Other students may join the wait list and will be added to the class as space permits.
- SEC 111. **Effective Communication Strategies for Engineers and Scientists**. 6 units (3-0-3); third term. This graduate course is designed to increase students' effectiveness in communicating complex technical information to diverse audiences and to deepen their understanding of key tools and techniques. Students will explore scientific storytelling through multiple genres, including oral presentations, written articles, and visual narratives. In-class workshops will provide students with the opportunity to revise their work and consider feedback from others. Each student will complete the class with a portfolio of projects highlighting various aspects of their communication skills. (Registration by application only, and EAS graduate students are given priority.).
- *SEC 130. **Science Activation: Bringing Science to Society**. 6 units (3-0-3); second term. Working with policy makers is more than science communication. It requires a bilateral approach to exploring complex problems and solutions that encompass societal objectives as well as physical requirements. An intellectual understanding of the differences in communication norms in the research and policy realms can help scientists make better decisions about how to communicate about their work and engage with policy makers to get it used. This course combines analysis of the differences in communication norms with practical experience in communicating and developing relationships with elected officials and their staffs.