INTERDISCIPLINARY GRADUATE PROGRAM IN ENVIRONMENT AND RESOURCES (IPER)

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Courses given in the Interdisciplinary Program in Environment and Resources have the subject code IPER. For a complete list of subject codes, see Appendix.

Over the last 30 years, environmental and resource investigations have focused on problems with acute local impacts, such as urban air pollution, pesticide use, or groundwater depletion. These problems have been addressed principally at the national and local level through research and policies that address specific media such as air or water; threats such as toxic chemicals; or resources such as forests or wetlands. More global challenges such as climate change and biodiversity loss pose fundamental threats to the health of the planet and the people who depend upon it. Solutions to these problems must be multifaceted, addressing the interactions among threats and resources, and engaging diverse actors, including academia, national governments, international institutions, business, and civil society. The research and understanding necessary to devise such solutions thus must be both multidisciplinary and interdisciplinary, integrating the analytical tools of diverse fields to yield new insights and promising responses.

The Interdisciplinary Graduate Program in Environment and Resources (IPER) responds to these challenges by leveraging Stanford's faculty strengths in disciplines ranging from ecology and engineering to law and economics, all of which are increasingly directed toward interdisciplinary research and problem solving, and teaching that encompasses collaborative and synthetic courses that cross departmental boundaries.

Interdisciplinary work requires that individuals and groups become familiar with the concepts, methods, data, and analyses of several disciplines in order to focus research questions more sharply. It requires the integration of multidisciplinary knowledge in the formulation of research questions and hypotheses, and in the execution and analyses of results. Students in the IPER program learn through interactions with a cohort of students and a dedicated faculty who influence each other's ways of thinking and asking questions.

FOUNDATION AND FLEXIBILITY

IPER students construct an integrative graduate curriculum through shared foundational study and flexibility in a research course. Students in the program are expected to make significant progress in each of three intellectual areas:

1. The linkages between physical and biological systems, and understanding the potential environmental consequences associated with the dynamics or evolution of these joint systems.
2. The interplay between human activities and the Earth system, and how human influence on the environment, such as through methods of production or patterns of consumption, is affected by social and economic institutions, legal rules, and cultural values, and how resources and environment in turn affect human actions and decision making.
3. Skills for gauging the potential impacts of alternative public policy options for dealing with environmental problems, for evaluating such policy alternatives according to various normative criteria, and for integrating scientific research into policy formulation.

The program is flexible enough to enable students to focus on areas of greatest interest. For example, a student with a strong interest in the relationship between commercial fishing and coral reef habitat might concentrate on biology, international relations, and economics; a student aiming to understand the environmental impacts from agricultural production decisions might focus on the interplay among economics, biogeochemistry, and hydrology; and a student interested in the design and evaluation of policies to curb emissions of greenhouse gases might learn about scientific, technological, and economic issues, as well as gain skills in policy analysis, evaluation, and implementation.

RESEARCH HIGHLIGHTS

Research is the cornerstone of IPER. Faculty and graduate students are engaged in interdisciplinary research projects such as studying the effects and constraints of agricultural intensification and urbanization in the Yaqui Valley of Sonora, Mexico, and spatial analysis of land use changes in Vietnam. Students in IPER have the opportunity to work on existing projects or develop their own research directions and topics.

Research projects by students in the program address issues such as the science and policy of global climate change, environmental quality, regional security, the valuation of ecosystem services, energy development, agricultural intensification and variability, characterization and effects of land use change, and natural resource management. Examples of research projects include:

1. Investigating ecosystem services of the Hawaiian countryside by focusing on the sustainable management of native hardwood on private lands

by creating innovative financial incentives and policy mechanisms to make biodiversity conservation economically attractive to landowners.

2. Evaluating electric power sector development in China and India, and the potential for international policy mechanisms to steer these countries toward less CO^2-intensive growth paths.

For more information about integrative environmental research at Stanford, see the Stanford Institute for the Environment web site at http://environment.stanford.edu.

GRADUATE PROGRAMS

The University's basic requirements for the M.S. and Ph.D. degrees are discussed in the "Graduate Degrees" section of this bulletin.

DUAL DEGREE MASTER OF SCIENCE

The Interdisciplinary Program in Environment and Resources offers a dual program of study leading to the Master of Science degree. It provides training in interdisciplinary environmental problem solving. Only students enrolled in a professional school (Law, Business, Medicine) at the University are eligible for the dual M.S. program. IPER gives these graduate students the benefit of a rigorous interdisciplinary course of study, which complements their main degree program. Students interested in the M.S. program apply no later than the first year of their primary graduate program. To be admitted, a student needs the approval of both the interdisciplinary graduate program and his or her principal school and/or department. Applicants to the M.S. program are required to submit a statement of purpose as part of the admissions process, clearly explaining the importance of interdisciplinary studies to the student's research or career. Admission to the M.S. program depends both on the applicant's ability to successfully complete a demanding program in interdisciplinary studies and the applicant's justification for pursuing the M.S. program.

Students in the dual Master of Science program participate in a 45-unit program, to be completed over a period of three or more quarters. All students in the M.S. program take the three core courses: IPER 310, Environmental Forum Seminar, IPER 320, Case Studies in Environmental Problem Solving, and IPER 330, Interdisciplinary Research Approaches and Analysis; students also complete at least eight other graded courses at the 100 level or higher, of which at least two must be at the 200 level while maintaining a 'B' average. M.S. students need at least 45 units for graduation. Directed research may count for a maximum of eight of these units. Students design their elective courses around one or more of the program's concentration areas (economics and policy analysis; culture, law, institutions, and politics; natural sciences; and technology and engineering) chosen to complement but not duplicate their primary research or professional degree program at Stanford. A faculty advisory team reviews and approves the adequacy of each student's course of study.

DOCTOR OF PHILOSOPHY

1. The student works with faculty advisers to design a course of study that allows the student to develop and exhibit 1) depth in at least two concentration areas, 2) adequate preparation in analytical methods and skills, and 3) interdisciplinary breadth in all four concentration areas (economics and policy analysis; culture, law, institutions, and politics; natural sciences; and technology and engineering). Depth requirements are determined by the student and the student's advising team. Breadth requirements vary by concentration area and are normally satisfied through a sequences of prescribed courses, independent study, and demonstration of proficiency through prior course work and/or field experience. Additional information about breadth requirements can be found on the IPER website or obtained from the IPER office. The three core courses to be taken by all Ph.D. students are IPER 310, Environmental Forum Seminar, IPER 320, Case Studies in Environmental Problem Solving, and IPER 330, Interdisciplinary Research Approaches and Analysis. All core courses must be taken for a letter grade. Normally, IPER Ph.D. students are expected to take all courses for a letter grade unless their advisers recommend otherwise. The IPER faculty advising team has primary responsibility for ensuring the adequacy of the course of study. The student meets with these advisers quarterly during the first year and annually thereafter.
2. To be admitted to candidacy for the Ph.D. degree, a student must have successfully completed at least 25 graded units (not including research credits) of graduate courses (200 level and above) maintaining a 'B' average. In addition, the student must pass an oral qualifying exam that demonstrates command of two areas of specialization as well as interdisciplinary breadth. The qualifying exam should be successfully completed by the end of the eighth quarter in the program.
3. By the end of the sixth quarter of study, students present a Ph.D. candidacy plan to their primary advisers, with a copy to the Executive Director. This plan should include the following items: (a) the names of 4-5 proposed oral qualifying exam committee members; (b) a list of courses or experiences used to fulfill the IPER breadth and depth requirements and certify completion of the IPER core curriculum; and (c) a proposed date for the oral qualifying exam. The oral qualifying exam consists of two parts: a presentation of a dissertation proposal, and a question and answer period during which the student should be prepared to address questions and issues about the proposal, and broader questions arising from IPER breadth and depth course work. The oral qualifying exam committee should include at least two members of the IPER affiliated faculty, and each of the student-designated depth areas should be represented by at least one faculty member with expertise in that particular area. A member-at-large is selected by the student. The oral qualifying exam should be successfully completed by the end of the eighth quarter. To complete the Ph.D., the student must pass a University oral examination in defense of the dissertation.
4. Teaching experience is an essential element of training in the Ph.D. Program. Each student is required to complete two quarters of teaching which can be fulfilled by serving as a teaching assistant for one of the IPER core courses and working as a TA for a course with a discussion section.

The interdisciplinary Ph.D. program is complementary to the disciplinary environmental science, engineering, and policy analysis taught in Stanford departments and schools. Students in IPER develop depth in multiple disciplinary fields and integrate the knowledge across those fields. The goal of the interdisciplinary Ph.D. program is for students to achieve an integrated understanding of environmental processes or problems, and the tools they need to address these challenge in the real world.

Additional information may be found in the *Graduate Student Handbook* at http://www.stanford.edu/dept/DoR/GSH/.

The following courses may be of interest to IPER students.

ECONOMICS AND POLICY ANALYSIS

ECON 106. World Food Economy
ECON 155. Environmental Economics and Policy
ECON 165. International Economics
ECON 243. Economics of the Environment
IPER 243. Energy and Environmental Policy Analysis
MS&E 248. Economics of Natural Resources
POLISCI 140. Political Economy of Development
PUBLPOL 103B. Ethics and Public Policy
PUBLPOL 104. Economic Policy Analysis

CULTURE, LAW, INSTITUTIONS, AND POLITICS

ANTHSCI 164. Ecological Anthropology
ANTHSCI 162. Indigenous Peoples and Environ. Problems
ANTHSCI 168C. Environmental Politics in Latin America
ANTHSCI 263. Human Behavioral Ecology
BIOSCI 247. Controlling Climate Change in the 21st Century
LAW 280. Toxic Harms
LAW 281. Natural Resources Law and Policy
LAW 282. Environmental Ethics
LAW 437. Water Law
LAW 592. International Conflict
LAW 594. International Law: The National-International Interface
LAW 603. Environmental Law: Pollution
LAW 604. Environmental Law and Policy Workshop
POLISCI 441. Politics of Development

NATURAL SCIENCES

BIOHOPK 263H. Oceanic Biology
BIOHOPK 264H. Marine Botany
BIOHOPK 273H. Marine Conservation Biology
BIOSCI 101. Ecology
BIOSCI 117. Biology and Global Change
BIOSCI 121. Biogeography
BIOSCI 136. Evolutionary Paleobiology
BIOSCI 144. Conservation Biology
BIOSCI 146. Population Studies
BIOSCI 216. Terrestrial Biogeochemistry
BIOSCI 245. Behavioral Ecology
CEE 274A,B. Environmental Microbiology I and II
CEE 164. Introduction to Physical Oceanography
EARTHSYS 189. Field Studies in Earth Systems
EARTHSYS 280. Fundamentals of Sustainable Agriculture
GES 166. Soil Chemistry
GES 170. Environmental Geochemistry
GES 205. Advanced Oceanography
GES 225. Isotopes in Geological and Environmental Research
GES 230/CEE 260A. Physical Hydrogeology
GES 231/CEE 260C. Contaminant Hydrogeology
GES 259. Marine Chemistry
GES 240. Geostatistics for Spatial Phenomena
GEOPHYS 130. Biological Oceanography
GEOPHYS 141/241. Remote Sensing of the Oceans
IPER 250. Ecological Principles for Environmental Problem Solving
PETENG 260. Groundwater Pollution and Oil Slicks: Environmental Problems in Petroleum Engineering

TECHNOLOGY AND ENGINEERING

CEE 171. Environmental Planning Methods
CEE 172. Air Quality Management
CEE 176A. Energy Efficient Buildings
CEE 176B. Electric Power: Renewables and Efficiency
CEE 262A. Hydrodynamics
CEE 263A. Air Pollution Modeling
CEE 265. Sustainable Water Resources Development
CEE 270. Movement and Fate of Organic Contaminants in Surface Waters and Groundwater
CEE 278A. Air Pollution Physics and Chemistry
EE 293A,B. Fundamentals of Energy Processes
MS&E 446. Policy and Economics Research Roundtable (PERR)
PETENG 101. Energy and the Environment

COURSES

Additional courses may be listed in the quarterly *Time Schedule*.

IPER 210. Communication and Leadership Skills—(Same as BIOSCI 388.) Focus is on delivering information to policy makers and the lay public. How to speak to the media, congress, and the general public; how to write op-eds and articles; how to package ideas including titles, abstracts, and CVs; how to survive peer review, the promotion process, and give a job talk; and how to be a responsible science advocate.
2 units (Root) not given 2005-06

IPER 220. Special Topics Seminar—See *Time Schedule* for information on courses offered each quarter. May be repeated for credit.
1-5 units, Aut, Win, Spr, Sum (Staff)

IPER 225. Intellectual Foundations of Interdisciplinary Research—Competing philosophical perspectives on the epistemological and ontological underpinnings of knowledge from positivism to postmodernism. Contrasting notions of theory from deductive explanations to inductive interpretations. Methodological options and types of data.
3-5 units, Win (Staff)

IPER 230. Environment and Resources Field Research—Contemporary environment and resource challenges at sites around the world. Courses are offered on a variable schedule depending on the interests of IPER students and faculty. See the *Time Schedule* for current offerings.
1-9 units, Aut, Win, Spr, Sum (Staff)

IPER 235. Global Environmental Ethics—Theories of environmental ethics and their evolution. Environmental treaties as a framework to analyze case studies of contemporary ethical issues raised by environmental problems that transcend national boundaries.
4-5 units, Spr (Hoagland)

IPER 243. Energy and Environmental Policy Analysis—(Same as MS&E 243.) 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: 241 or ECON 50, 51.
3 units, Spr (Goulder, Sweeney)

IPER 244. Fundamentals of Geographic Information Science (GIS)—(Enroll in GES 144.)
4 units, Spr (Seto)

IPER 250. Ecological Principles for Environmental Problem Solving—For students in Law, Business, or Medicine, or IPER students with limited biology background. Topics include field methods, climate, biogeography, biogeochemical cycles, physiology, population genetics, and environmental ethics.
3 units (Root) alternate years, given 2006-07

IPER 260. The Social Sciences and Environmental Problem Solving—For students with little background in the social sciences interested in incorporating them into their research. Focus is on the contribution that the social sciences of international relations, political science, anthropology, and sociology make to environmental problem solving. Case studies from international regime building, inter-agency politics, organizational behavior, and cultural dynamics.
2-3 units (Staff) not given 2005-06

IPER 265. Central America: Environment, Sustainable Development, and Security—(Same as ANTHSCI 165B/265B.) Interrelationships among environmental stress, poverty, and security in Central America, with focus on Costa Rica. The legacy of the Cold War in Central America as manifested in the Contra War and U.S. policy. Current development schemes and their impact on environment and security in the region. Dilemmas between population growth in the developing world and consumption patterns in the industrial world. Some years, the course includes an optional field trip to Costa Rica over Spring Break at extra expense; limited capacity. GER:DB-SocSci
3-5 units (Hoagland) not given 2005-06

IPER 270. Graduate Practicum in Environment and Resources—Opportunity for IPER students to pursue areas of specialization in an institutional setting such as a laboratory, clinic, research institute, governmental agency, non-governmental organization, or multilateral organization. Meets US CIS requirements for off-campus employment with endorsement from designated school official.
1-9 units, Aut, Win, Spr, Sum (Hoagland)

IPER 300. Earth Sciences Seminar—(Same as GES 300, GEOPHYS 300, EARTHSYS 300, PETENG 300.) Required for incoming graduate students except coterms. Research questions, tools, and approaches of faculty members from all departments in the School of Earth Sciences. Goals are: to inform new graduate students about the school's range of scientific interests and expertise; and introduce them to each other across departments and research groups. Two faculty members present work at each meeting. May be repeated for credit.
1 unit, Aut (Matson, Graham)

IPER 310. Environmental Forum Seminar—Required IPER core course. Participants attend the Institute's forum series and meet to discuss issues such as the conceptual framework of the topic, analytical approaches, validity of conclusions from an interdisciplinary perspective, and alternative approaches. May be repeated for credit.

1-2 units, Aut (Staff)

IPER 320. Case Studies in Environmental Problem Solving—Required IPER core course. The case study method and related qualitative research techniques. Possible cases include the Central American Free Trade Agreement, the American Prairie Restoration Project in Montana, NGO-sponsored renewable energy, and sustainable agriculture development projects in Kenya. Students conduct a group service learning project in the rehabilitation of the degraded estuarine wetlands of the Cargill salt ponds in San Francisco Bay.

3-5 units, Win (Hoagland)

IPER 330. Interdisciplinary Research Approaches and Analysis—Required IPER core course. Analytical tools, models, and approaches central to interdisciplinary research on the world's leading environmental issues. Topics include: observing systems and data sources; computation and modeling approaches to complex problems; translation and integration of alternative disciplinary approaches to research, analysis, and uncertainty; policy analysis; cost benefit analysis, risk benefit analysis, qualitative methods, and other decision analytic frameworks and valuation approaches; team building and leadership roles; review and proposal writing; speaking.

3 units, Spr (Matson, Daily)

IPER 398. Directed Individual Study in Environment and Resources—Under supervision of an IPER faculty member on a subject of mutual interest.

1-9 units, Aut, Win, Spr, Sum (Staff)

IPER 399. Directed Research in Environment and Resources—For advanced graduate students.

1-9 units, Aut, Win, Spr, Sum (Staff)

IPER 410. Ph.D. Qualifying Tutorial—For Ph.D. students only.

1 unit, Aut, Win, Spr, Sum (Staff)

IPER 460. Proposal Writing Seminar—Practical training in grant writing methods. Students draft research proposals relevant to individual interests with supervision from IPER faculty.

1-2 units, Aut, Win, Spr (Hoagland)

IPER 480. Dissertation Writing Seminar in Environment and Resources—Required of IPER Ph.D. candidates.

1-15 units, Aut, Win, Spr, Sum (Hoagland)