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 B.

Over the last 30 years, environmental and resource investigations have tended to focus 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; specific threats, such as toxic chemicals; or specific resources, such as forests or wetlands. Today we face challenges that are global in scale, issues such as climate change and biodiversity loss that pose fundamental threats to the health of the planet. It has become clear that effective solutions to these problems must be multifaceted, addressing the interactions among multiple threats and resources, and engaging diverse actors, from academia to national governments and international institutions, business, and civil society. It is equally clear the research and understanding necessary to devise such solutions must be not only multidisciplinary, but interdisciplinary, integrating the analytical tools of diverse fields to yield new insights and more promising responses.

Our research and teaching have responded to these new challenges in a number of ways. Stanford's considerable faculty strengths in disciplines ranging from ecology and engineering to law and economics are increasingly being directed toward interdisciplinary research and problem solving. Researchers here work across department and school boundaries with great frequency and little difficulty. Likewise, our teaching encompasses collaborative and synthetic courses that cross departmental boundaries. The Interdisciplinary Graduate Program in Environment and Resources (IPER) extends this effort with a focus on interdisciplinary graduate level education and research.

Interdisciplinary work requires that individuals and groups over time become familiar with the concepts, methods, data, and analyses of several disciplines in order to focus research questions more sharply on issues as they exist in the real world. It requires the integration of multidisciplinary knowledge in the formulation of research questions and hypotheses, and in the execution and analyses of results. Students of the IPER program learn this through sustained interactions with a cohort of students and a dedicated faculty who influence each other's ways of thinking and asking questions. Our graduate students receive a truly interdisciplinary education and participate in research opportunities in which knowledge and know-how from multiple disciplines are integrated in the formulation of research questions and hypotheses, and in research execution, analysis, and application of results.

FOUNDATION AND FLEXIBILITY

IPER students construct a truly integrative graduate curriculum through shared foundational study and flexibility in the specific research course. Students in the program are expected to make significant headway along each of three intellectual dimensions:

1. Recognition and evaluation of the linkages between physical and biological systems, and understanding of the potential environmental consequences associated with the dynamics or evolution of these joint systems.
2. Recognition and evaluation of the interplay between human activities and the Earth system, and understanding of how human influence on the environment (for example, 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. Development of 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 also flexible enough to enable students to focus on their areas of greatest interest. For example, a student with an especially strong interest in the relationship between the nitrogen cycle and climate might concentrate on biology, biogeochemistry, and climatology. A student aiming to understand the environmental impacts from agricultural production decisions, and how the environmental consequences of various practices feed back on agricultural productivity, profitability, and future land use decisions, might focus on the interplay between economics and ecology. A student especially interested in the design and evaluation of policies to curb emissions of greenhouse gases might learn about a range of scientific, technological, and economic issues, as well as gain skills in policy analysis, evaluation, and implementation.

RESEARCH HIGHLIGHTS

Research is the cornerstone of the Interdisciplinary Graduate Program in Environment and Resources. Faculty and current graduate students at Stanford are already engaged in interdisciplinary research projects that reach from the effects and constraints of agricultural intensification and urbanization in the Yaqui Valley of Sonora, Mexico, to spatial analysis of land use changes in Vietnam. Students in the IPER have the opportunity to work on existing projects and are also expected to develop their own research directions and topics during their course of study.

While IPER is only beginning, we envision that the type of research projects coming from students in the program will 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 specific research projects from the IPER:

1. Investigating the causes and consequences of coastal land use change in Sonora, Mexico, focusing on how the interaction of macro policies and local institutional and biophysical factors are shaping the patterns and scale of shrimp aquaculture development in the region.
2. Evaluating the 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, please visit the Stanford Environmental Science, Engineering, and Policy 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.

JOINT DEGREE MASTER OF SCIENCE

The Interdisciplinary Program in Environment and Resources offers a joint program of study leading to the Master of Science degree. It provides training in interdisciplinary environmental problem solving. Only students enrolled in another graduate program (Law, Business, Medicine) at the University will be eligible for the joint M.S. program. The 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 will apply no later than the first year of their primary graduate program. To be admitted, a student will need the approval of both the interdisciplinary graduate program and his or her principal school and/or department. Applicants to the M.S. program will be 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 will depend 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 joint 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. 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 areas of specialization (economics; policy, law, and culture; biological sciences; earth and ocean sciences; and technology/engineering) chosen to complement but not duplicate their primary research or professional degree program at Stanford. The faculty advisory team reviews and approves the adequacy of each student's course of study.

DOCTOR OF PHILOSOPHY

1. The student works with his/her faculty advisers to design a course of study that allows the student to develop and exhibit 1) depth in at least two areas of specialization, 2) adequate preparation in analytical methods and skills, and 3) interdisciplinary breadth provided by the Program's core courses. Areas of specialization include, but are not restricted to economics; anthropology, law and policy; biological sciences; earth and ocean sciences; and technology/engineering. 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. The IPER faculty advising team has primary responsibility for ensuring the adequacy of the course of study. The student meets with these advisers before the first quarter of study, again in the following spring and the spring quarter of the second year.
2. To be admitted to candidacy for the Ph.D. degree, a student must have successfully completed at least 25 units (not including research credits) of graduate courses (200 level and above) with no grade lower than a B. In addition, the student must pass an oral qualifying exam that demonstrates command of two areas of specialization as well as interdisciplinary breadth. At least two members of the examining committee must be members of the IPER advisory faculty. The qualifying exam should be successfully completed by the end of the 6th quarter in the program.
3. At the time of the qualifying exam, the student is expected to have developed a written dissertation proposal (suitable for submission to a funding organization) and selected a dissertation adviser and committee. The proposed research must be interdisciplinary in nature, utilizing interdisciplinary research approaches in its accomplishment. The dissertation adviser and three other faculty members will comprise the reading committee (at least one of these faculty members must be program advisory faculty). The student will consult at least annually with the committee before the completion of the dissertation. Upon completion, 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 or by special arrangement, designing and offering a new course.

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

Additional information can also be found in the *Graduate Student Handbook*.

The following courses may be of interest to IPER students.

ECONOMICS

ECON 106. World Food Economy
ECON 155. Environmental Economics and Policy
ECON 165. International Economics
ECON 243. Economics of the Environment
MS&E 248. Economics of Natural Resources
PUBLPOL 104. Economic Policy Analysis

CULTURE, LAW, AND POLICY

ANTHSCI 153. The Population Question
ANTHSCI 164. Ecological Anthropology
ANTHSCI 162. Indigenous Peoples and Environ. Problems
ANTHSCI 252. Political Ecology
HISTORY 281A. Environmental History of the Americas
LAW 280. Toxic Harms
LAW 281. Natural Resources Law and Policy
LAW 282. Environmental Ethics
LAW 437. Water Law and Policy
LAW 592. International Conflict
LAW 594. International Institutions
LAW 603. Environmental Law and Policy
LAW 604. Environmental Workshop
LAW 605. International Environmental Law and Policy
LAW 667. Marine Resources
POLISCI 216M. Environmental Politics of the Asian/Pacific Region

BIOLOGICAL SCIENCES

BIOSCI 101. Ecology

BIOSCI 117. Biology and Global Change
BIOSCI 121. Biogeography
BIOSCI 136. Evolutionary Paleobiology
BIOSCI 138. Ecology and Evolution of Plants
BIOSCI 144. Conservation Biology
BIOSCI 146. Colloquium on Population Studies
BIOSCI 216. Ecosystem Ecology
BIOSCI 245. Behavioral Ecology
CEE 274A,B. Environmental Microbiology I and II

EARTH AND OCEAN SCIENCES

BIOSCI 263H. Principles of Oceanic Biology
BIOSCI 264H. Marine Botany
BIOSCI 273H. Marine Conservation Biology
CEE 164. Introduction to Physical Oceanography
EARTHSYS 280. The Fundamentals of Sustainable Agriculture
EARTHSYS 189. Field Studies in Earth Systems
GEOPHYS 130. Biological Oceanography
GEOPHYS 135. Remote Sensing of the Oceans
GES 166. Soil Chemistry
GES 170. Environmental Geochemistry
GES 205. Advanced Oceanography
GES 225. Isotopes in Geo. and Enviro. Res.
GES 230/CEE 260A. Physical Hydrogeology
GES 231/CEE 260C. Contaminant Hydrogeology
GES 239. Advanced Geomorphology
GES 259. Marine Chemistry
GES 240. Geostatistics for Spatial Phenomena
GES 295. Integrating Remote Sensing and GIS
PETENG 260. Groundwater Pollution and Oil Spills

TECHNOLOGY/ENGINEERING

CEE 171. Environmental Planning Methods
CEE 172. Air Quality Management
CEE 176A. Energy Efficient Building Design
CEE 176B. Electric Power: Renewables and Efficiency
CEE 261. Watershed and Wetland Hydrology
CEE 262A. Environmental Fluid Mechanics
CEE 262C. Modeling Environmental Flows
CEE 263A. Air Pollution Modeling
CEE 265. Sustainable Water Resources Development
CEE 266. Environmental Policy, Design, and Implementation
CEE 270. Movement, Fate and Effects of Contaminants
CEE 278A. Air Pollution Physics and Chemistry
EE 293A,B. Fundamentals of Energy Processes
MS&E 446. Transportation, Energy, Environ. Resources Roundtable
PETENG 101. Energy and the Environment

COURSES

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

IPER 220. Special Topics Seminar—Topics of interest to IPER faculty and students are explored in a variety of course formats including intensive short courses of a few weeks and extended investigations of several months. See the *Time Schedule* for content information on courses offered each quarter.
1-5 units, any quarter (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, any quarter (Staff)

IPER 240. Principles in Economics for Environment and Resources—The fundamental principles of economics relevant to the study of environment and resources. Designed for non-Economics majors who want to incorporate economics into interdisciplinary policy analysis and research.
3 units, Spr (Staff)

IPER 250. Background in Ecological Principles for Environmental Problem Solving—For students in graduate programs in Law, Business, or Medicine, or IPER students with limited biology background. Basic ecological principles needed to address environment and resource issues. Topics include field methods, climate, biogeography, biogeochemical cycles, physiology, population genetics, and environmental ethics.
3 units, Win (Root)

IPER 260. The Social Sciences and Environmental Problem Solving—For students with little background in the social sciences who are interested in incorporating them into their interdisciplinary environment and resources 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, to inter-agency politics, organizational behavior, and cultural dynamics.
2-3 units, Spr (Hoagland)

IPER 265. Central America: Environment, Sustainable Development, and Security—(Same as ANTHSCI 165B.) 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 added expense; limited capacity.
3-5 units, Win (Hoagland)

IPER 270. Graduate Practicum in Environment and Resources—Opportunity for IPER graduate students to pursue areas of specialization in an institutional setting such as a laboratory, clinic, research institute, governmental agency, NGO, multilateral organization.
1-9 units, any quarter (Staff)

IPER 310. Environmental Forum Seminar—Required IPER core course; three-part sequence during an IPER graduate student's first year in the program. The seminar takes advantage of the multiple forum series presented throughout the year that address environmental issues. Students and faculty attend a forum and meet the following Monday morning to address issues such as the conceptual framework of the topic, the analytical approaches used, the validity of conclusions from an interdisciplinary perspective, and alternative approaches that would have enhanced the analysis presented.
1-2 units, Aut, Win, Spr (Matson, Goulder, Dunbar, Naylor, Schneider, Root)

IPER 320. Case Studies in Environmental Problem Solving—Required IPER core course. Interdisciplinary case studies. Each topic addresses the interacting proximal and distal causes of environmental problems and integrative approaches to solutions. Cases may include the Cal Fed Bay Delta Project or the Everglades Project with respect to water allocation and quality issues; the agro-metro-plex approach to evaluating and solving atmospheric problems; multiple environmental issues in the Searsville Dam/San Francisquito Creek Watershed; the Kyoto Protocol and plausible alternatives; integrated conservation and development projects such as the Masoala National Park Project in Madagascar. Multiple points of view, drawing on multiple sources of information and knowledge to evaluate the data and modeling needs, and analytical frameworks needed to understand causes, consequences, and solutions.
3 units, Win. not given 2002-03

IPER 330. Interdisciplinary Research Approaches and Analysis—Required IPER core course. The 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 and other decision analytic frameworks and valuation approaches; team building and leadership roles; review and proposal writing.

3 units, Aut (Staff) not given 2002-03

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

1-9 units, Any quarter (Staff)

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

1-9 units, Any quarter (Staff)

IPER 410. Ph.D. Qualifying Tutorial—Restricted to Ph.D. students as part of the IPER qualifying process.

1 unit, Any quarter (Staff)

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

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

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

1-15 units, any quarter (Staff)