EARTH, ENERGY, AND ENVIRONMENTAL SCIENCES GRADUATE PROGRAM (EEES)

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The goal of the Earth, Energy, and Environmental Sciences (EEES) is to complement the disciplinary Earth Science and Engineering programs offered within the departments of the School of Earth Sciences and to train graduate students to integrate knowledge from these disciplines through tools and methods needed to evaluate the linkages among physical, chemical, and biological systems of the Earth, and understand the dynamics or evolution of these integrated systems and the resources they provide.

Students in EEES must make significant headway in, and combine insights from, more than one scientific discipline. For example, a student whose goal is to understand the structure of the Earth's interior using computational methods might design a study plan that includes high-level mathematics, numerical modeling, and geophysical imaging techniques. A student interested in water management might integrate water flow analysis and modeling, geophysical imaging, geostatistics, and satellite remote sensing of changes in agricultural intensity and land use. A student interested in marine carbon cycling might use knowledge and tools from numerical modeling, marine biogeochemistry and geochemistry, oceanography, and satellite imaging. The key to the program is its academic flexibility and ability to exploit an increasingly interdisciplinary faculty, particularly in the School of Earth Sciences, but also in the greater Stanford community.

GRADUATE PROGRAMS

To ensure that students are appropriately placed in this program, a statement of purpose submitted with the application for admission must reflect the student's reasoning for pursuit of a crossdisciplinary program of study in contrast to a more traditional disciplinary one readily provided by a department in the School of Earth Sciences.

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

MASTER OF SCIENCE

The objective of the M.S. degree in Earth, Energy, and Environmental Sciences is to prepare the student either for a professional career or for doctoral studies.

Students in the M.S. degree program must fulfill the following requirements:

1. Complete a 45-unit program of study, of which a minimum of 30 units must be course work, with the remainder consisting of no more than 15 research units.
2. Course work units must be divided among two or more scientific and/or engineering disciplines and can include the three core courses required for the Ph.D. degree.
3. The program of study must be approved by the research adviser and the academic oversight committee.
4. All students are required to complete a M.S. thesis, approved by the student's thesis committee.

DOCTOR OF PHILOSOPHY

In addition to the University's basic requirements for the doctorate, the Interdepartmental Program in Earth, Energy, and Environmental Sciences has the following requirements:

1. Prior to the formation of a thesis committee, the student works with research advisers and the academic oversight committee to design a course of study with depth in at least two areas of specialization and preparation in analytical methods and skills. Ph.D. students must take the three core courses: EEES 300, Earth Sciences Seminar; EEES 301, Earth Dynamics; and EEES 302.,Challenges and Best Practices in Crossdisciplinary Research and Teaching. The research advisers and academic oversight committee have primary responsibility for the adequacy of the course of study.
2. Students must complete a minimum of 13 courses, including the three core courses and five courses from each of the two areas of specialization. At least half of the ten non-core classes must be at a 200 level or higher and all must be taken for a letter grade. Students obtaining their M.S. from within the program can apply all master's units toward Ph.D. requirements. Students with an M.S. degree or other specialized training from outside EEES may be able to waive some of the non-core course requirements, depending on the nature of the prior courses or training. The number and distribution of courses to be taken by these students is determined with input from the research advisers and academic oversight committee .
3. During Spring Quarter of each year, students must undergo an annual review by their thesis committee to allow the committee to monitor the progress of the student and make recommendations, where necessary.
4. Prior to taking the oral qualifying examination at or before the end of their 6th academic quarter, the student must have completed 24 units of letter-graded course work, developed a written crossdisciplinary dissertation proposal suitable for submission to a funding organization, and selected a thesis committee.
5. To be admitted to candidacy for the Ph.D. degree, the student must pass an oral qualifying examination. At least two of the minimum four-member examining committee must be faculty within the School of Earth Sciences. During the exam, students present and defend their proposed thesis research work; the exam generally takes the form of a 20-30 minute presentation by the student, followed by 1-2 hours of questioning.
6. The research advisers and two other faculty members comprise the dissertation reading committee. Upon completion of the thesis, the student must pass a University Oral Examination in defense of the dissertation.

In addition to the three core courses, students can select other courses from departments of the School of Earth Sciences and other University departments as appropriate. All courses must be approved by the student's thesis committee or by the academic oversight committee.

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

COURSES

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

EEES 257. Introduction to Computational Earth Sciences—Techniques for mapping numerically intensive algorithms to modern high performance computers such as the Center for Computational Earth and Environmental Science's (CEES) high productivity technical computing (HPTC). Earth science examples such as fluid flow, seismic and subsurface imaging, bio-oceanography, and crustal deformation illustrate real world applications of high performance computing. Topics include: concepts of parallel programming; efficient serial and parallel programs; converting Matlab to complied code; OpenMP; and MPI. Exercises using SMP and cluster computers.See http://pangea.stanford.edu/research/cees/. Recommended: familiarity with Matlab, C, or Fortran. May be repeated for credit.

2-4 units, Spr (Clapp, R; Harris, J)

EEES 300. Earth Sciences Seminar—(Same ss GES 300, GEOPHYS 300, EARTHSYS 300 IPER 300, PETENG 300.) Required EEES core course. Research questions, tool, and approaches of faculty members form 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 ot introduce them to each other across departments and research groups. Two faculty members present work at each meeting. Maybe repeated for credit.

1 unit, Aut (Matson, P; Graham, S)

EEES 301. Earth Dynamics—Required EEES core course. Features and dynamics characteristic of the atmosphere, ocean, and solid earth, and the physical, chemical, and biological connections that link them.

1 unit, Win (Staff)

EEES 302. Challenges and Practices in Crossdisciplinary Research and Teaching— Required EEES core course. Presentations by Earth Sciences faculty. Pedagogical tools to present interdisciplinary concepts to a non-specialist audience.

1 unit, Spr (Staff)

EEES 400. Research in Earth, Energy, and Environmental Sciences—May be repeated for credit.

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