

# Energy Science and Technology

The main goals of the Designated Emphasis in Energy Science and Technology (DEEST) are to enrich each student's technical education and to enhance and facilitate interactions between faculty and students in different programs by creating a flexible and integrated interdisciplinary research and teaching environments.

The graduate group has 11 affiliated PhD programs: Chemical Engineering; Chemistry; Nuclear Engineering; the Energy Resources Group; Materials Science and Engineering; Physics; Plant and Microbial Biology; Mechanical Engineering; Electrical Engineering and Computer Sciences (EECS); the ME-Fluid Mechanics and Ocean Engineering Group; and Applied Science and Technology.

Students are required to complete academic work in the DEEST in addition to or as part of the full requirements of the affiliated programs. Where appropriate, affiliated PhD programs may choose to recognize the DEEST as fulfilling the requirements of an outside field in their program.

To be admitted to the DE in Energy Science and Technology, an applicant must already be accepted into one of the affiliated PhD programs. Candidates must then submit a petition for admission to the DEEST Graduate Group Admissions Committee prior to taking the PhD qualifying examination in the affiliated program. A sponsoring faculty member in the student's affiliated program who is member of the DEEST Graduate Group must endorse the petition. As different affiliated programs have different examination requirements, the timeline for the application may vary.

To be considered for admission, applicants must submit:

1. The DEEST petition form (<http://www.me.berkeley.edu/graduate/degree-programs/special-programs-ebs-de-deest/designated-emphasis-energy-science-and>) and the Graduate Division "Change of Major or Degree Goal" (<http://registrar.berkeley.edu/sites/default/files/pdf/GRAD.DEG.MAJ.CHNG.pdf>) petition to the chair of the DEEST for approval. The "Change of Major or Degree Goal" must also be signed by the vice-chair of the graduate studies of the applicant.
2. The "Change of Major or Degree Goal" petition to the Degrees Unit, 318 Sproul Hall, to indicate admission to the DEEST. Upon receipt of the appropriately signed petition, the addition of the DEEST will be entered into the Graduate Division and Registrar's databases.

It is important to submit the "Graduate Petition for Change of Major Degree Goal" since the student must be admitted to the DEEST before the qualifying examination. In the early stages of the DE, admission after the qualifying examination might be considered by the DE admission committee in exceptional cases, where it can be certified that a member of the DEEST Graduate Group was on the student's qualifying exam committee, and that at least one of the student's qualifying topics had sufficient content in the field of energy science or energy technology and engineering to meet the requirements of the DE. Such an exception must be recommended to the Graduate Division for its approval.

The Admissions Committee of the Graduate Group for the DEEST decides on admission to the DEEST.

For further information regarding admission to graduate programs at UC Berkeley, please see the Graduate Division's Admissions website (<http://grad.berkeley.edu/admissions>).

For students who can enroll in the DE curriculum to satisfy an outside field requirement in their PhD program of study, the DE should have little impact on normative time, as it might require only one additional class, plus one seminar per semester. Only for students who decide to join the DEEST after finishing their regular PhD coursework this might require additional time, but this problem should diminish in the future, and then be of relevance only for a small number of students.

## Curriculum

The curriculum of the DE will consist of graded upper division and graduate courses with the following distribution:

- One course required in Group A: Energy Policy and Management
- Two required technical courses selected from two course groups, Group B: Energy Sciences, and Group C: Energy Technology.

The selection of courses will be maintained and regularly updated by the DE Graduate Group's Curriculum Committee to follow developments in the field, and the offering of new relevant courses.

An initial list is given below. In addition, students are required to attend a seminar series and discussion forum, as arranged by the curriculum committee, which is to serve as a focal point for communication and interaction between the participants. It is expected that students who elect the DEEST will do so in fields that broaden their subjects of study beyond that of their major. It is also expected that the major programs contain sufficient background to support the choice of courses for the DEEST. While the course selections do not have to focus on one technology or one science aspect, the choices in Groups B and C have been presented so as to allow a selection of coherent sets. Variations and exemptions may be allowed upon petition to the DEEST Graduate Group's Advising Committee.

### Required Group A: Energy Management and Policy

|   |                                  |   |
|---|----------------------------------|---|
| CIV ENG 107                                 | Climate Change Mitigation        | 3 |
| ENE,RES C100                                | Energy and Society               | 4 |
| ENE,RES C200                                | Energy and Society               | 4 |
| ENE,RES 280                                 | Energy Economics                 | 3 |
| Politics of Energy and Environmental Policy |                                  |   |
| MBA 212                                     | Energy and Environmental Markets | 3 |

### Group B: Energy Sciences

Chemistry: graduate course sequence of three 1 unit course modules may serve as satisfying one 3 unit course in Group B.

|             |   |     |
|-------------|---|-----|
| CHEM 143    | Nuclear Chemistry   | 2   |
| CHM ENG 176 | Principles of Electrochemical Processes   | 3   |
| CHM ENG 244 | Kinetics and Reaction Engineering   | 3   |
| CHM ENG 245 | Catalysis   | 3   |
| MEC ENG 259 | Microscale Thermophysics and Heat Transfer  | 3   |
| MEC ENG 253 | Thermal Radiation   | 3   |
| NUC ENG 180 | Introduction to Controlled Fusion   | 3   |
| NUC ENG 280 | Fusion Reactor Engineering  | 3   |
| NUC ENG 281 | Fully Ionized Plasmas   | 3   |
| PHYSICS 250 | Special Topics in Physics (this course may have different topics. Not all of these can be considered for the DEEST) | 2-4 |

**Group C: Energy Technology**

|                           |   |   |
|---------------------------|---|---|
| Electrical Power Systems: |   |   |
| ENE,RES 254               | Electric Power Systems  | 3 |
| Nuclear Power Systems:    |   |   |
| NUC ENG 124               | Radioactive Waste Management  | 3 |
| NUC ENG 161               | Nuclear Power Engineering   | 4 |
| NUC ENG 167               | Risk-Informed Design for Advanced Nuclear Systems   | 3 |
| NUC ENG 224               | Safety Assessment for Geological Disposal of Radioactive Wastes                                 | 3 |
| NUC ENG 225               | The Nuclear Fuel Cycle  | 3 |
| NUC ENG 265               | Design Analysis of Nuclear Reactors   | 3 |
| Renewable Resources:      |   |   |
| MEC ENG 241B              | Marine Hydrodynamics II   | 3 |
| Photovoltaics:            |   |   |
| MAT SCI C226              | Photovoltaic Materials; Modern Technologies in the Context of a Growing Renewable Energy Market | 3 |
| Materials Engineering:    |   |   |
| EL ENG 290Y               | Advanced Topics in Electrical Engineering: Organic Materials in Electronics                     | 3 |
| MAT SCI 213               | Environmental Effects on Materials Properties and Behavior                                      | 3 |
| NUC ENG 120               | Nuclear Materials   | 4 |
| NUC ENG 220               | Irradiation Effects in Nuclear Materials  | 3 |
| NUC ENG 221               | Corrosion in Nuclear Power Systems  | 3 |
| Thermal Engineering:      |   |   |
| MEC ENG 140               | Combustion Processes  | 3 |
| MEC ENG 252               | Heat Convection   | 3 |
| MEC ENG 253               | Thermal Radiation   | 3 |
| MEC ENG 254               | Thermodynamics I  | 3 |
| MEC ENG 255               | Advanced Combustion Processes   | 3 |
| MEC ENG 256               | Combustion  | 3 |
| MEC ENG 257               | Advanced Combustion   | 3 |
| MEC ENG 258               | Heat Transfer with Phase Change   | 3 |

**Seminars**

Energy Science and Technology Seminars: [1 unit S/U] see announcements. The student must maintain a list of DEEST seminars attended, and present a list of at least 10 seminars to the qualifying exam committee. Questions on these seminars may be part of the PhD qualifying exam.

**Qualifying Examination**

The qualifying examination shall include examination of knowledge within the DEEST. The qualifying examination committee shall include at least one member of the DEEST Graduate Group. If a faculty member of the student's major, the DE representative can serve either as the chair or as an inside member of the committee. If the DEEST representative is from an affiliated program, it is permissible for him or her to serve as either an additional inside or outside member. Satisfactory performance on the qualifying examination for the PhD will be judged according to the established standards in the student's major program.

**Dissertation**

The dissertation topic shall incorporate study within the DEEST. The dissertation committee shall include at least one faculty member of the DE to ensure that the dissertation contributes in significant manner to the interdisciplinary field of Energy Science and Technology.