DOCTORAL STUDIES IN

ENERGY, ENVIRONMENTAL AND CHEMICAL ENGINEERING

(www.eec.wustl.edu)

WASHINGTON UNIVERSITY IN ST. LOUIS

GRADUATE STUDENT HANDBOOK
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Graduate Handbook last updated August 2009
A key objective of the doctoral program is to promote cutting edge multidisciplinary research and education in the thematic areas of Energy, Environmental and Chemical Engineering (EECE). The doctoral student works in conjunction with his or her advisor in designing their program of study and research.

Students are selected for admission to the Program by a competitive process, and they typically start in the Fall Semester. The student is normally supported in the first year by the School through allocations made to the Department and in following years by the faculty advisor through research grants or other external fellowships. Every student will be expected to serve as a teaching assistant (TA) in the second or third year of residency in the Department while they are working with their mentor on research.

Temporary advisors will be assigned when the graduate students are admitted. On arriving at the University, the student will be advised by the temporary advisor on all procedural issues. The student will choose a permanent advisor in May of the first year of residency in the program.

The following is a brief summary of the requirements for doctoral students:

1) Base competency in core subject areas demonstrated by passing the Qualifying Examination in first year of residency in the Program
2) Research rotation in first year of study prior to choosing a permanent advisor
3) Demonstrated teaching experience as per Graduate School Teaching Requirement
4) Minimum of 36 credits for coursework, and minimum of 30 credits for doctoral research; total of 72 credits to earn the Ph.D. degree
5) Defend a proposal within 18 months of passing the Qualifying Examination
6) Defend Ph.D. dissertation by making an open oral Seminar presentation, followed by questions from the dissertation committee members.

The purposes of this handbook are to provide guidance to Ph.D. students in EECE and to inform students of department-specific policies. Additional comprehensive information on graduate studies is available from the School of Engineering and from the Graduate School of Arts and Sciences (http://artsci.wustl.edu/GSAS/). The Graduate Handbook is particularly comprehensive (http://artsci.wustl.edu/GSAS/Policies/GradGuide%20WEB%202006.pdf).

1. REGISTRATION

Registration takes place each semester on dates announced by the University. Detailed instructions for registration plus necessary materials are mailed directly to all graduate students enrolled during the previous semester.

All graduate students in the department must register each semester until all degree requirements are completed. The maximum time period for completing all Ph.D. degree requirements is 7 years. There are three categories of registration:
Active: Normally students register in this category for a minimum of nine credits each semester until they have earned the total number of credit hours required for their degree. Near the end of the student’s program or after 72 credits are on the student’s record, they can register for less than 9 credits but must enroll in EECE 884.

Inactive: Students who have not completed their course requirements but who, because of personal reasons, must suspend their studies temporarily, may register as inactive students with the approval of their adviser and the Department Chair. The Henry Edwin Sever Graduate School of Engineering and Applied Science sets the registration fee for inactive status.

Special: Students who have earned the required number of credit hours and who have only to complete the writing of a dissertation may register as special students (register for EECE 884, as per details above). This status is not appropriate for students who are still actively engaged in the performance of research.

Students who fail to register in one of the previously mentioned categories will automatically have their graduate standing revoked. Students whose graduate standing has been revoked may apply to the director of the Henry Edwin Sever Graduate School of Engineering and Applied Science for reinstatement. There is an application fee for reinstatement (currently it is $100). Students seeking reinstatement may be required to take a special reinstatement examination and to repeat previous work that fails to meet contemporary standards. Candidates for the Ph.D. degree who apply for reinstatement may be required to repeat the Qualifying Examination.

2. FIRST YEAR ADVISING

2.1 Academic Advisor

Each entering graduate student will be assigned a temporary academic advisor by the Department Chair. This advisor will be a full-time faculty member in the Department of Energy, Environmental and Chemical Engineering and will be responsible for acquainting the student with degree requirements, initial choice of classes as per guidelines, including the required laboratory rotations and seminar.

2.2 Research Rotation EECE 508 Research Rotation (Fall and Spring, 1st Year)

All first year students will do a research rotation by working in two laboratories as per availabilities developed based on faculty interests. After meeting with three or more professors to discuss research opportunities, students will submit three choices for lab rotations. Based on these choices, the faculty in coordination with the Graduate Program Coordinator will make the two assignments for the student rotations. The first year doctoral student will work for 12 or more weeks in each laboratory. One rotation will be done in the Fall Semester and one in the Spring Semester. The student will sign up for the 0 credit course – EECE 508 (S/F option), but students are expected to work at least 6 hours per week, with details established in discussion with the mentor. Students will also be responsible for submitting a brief report based on the work conducted (and required for the Qualifying Examination, see Section 3).

i. Rotation Preference Form

Based on meetings with professors and the availability of projects, the students will fill out the Rotation Preference Form by September 15. As part of completing the form, the students are required to meet with three or more potential faculty mentors and to record those meetings on
the Rotation Preference Form. The students will identify at least three faculty laboratories as their choices for their rotation.

ii. Rotation Selection

The faculty will review the rotation preference sheets and assign each student to two rotation mentors. Under exceptional circumstances, students will be allowed to update their rotation assignments (after the first rotation). Any such changes must be approved by the Graduate Program Coordinator and the Department Chair and the faculty duly informed.

iii. Rotation requirements

Each student will complete the two rotations before taking the Qualifying Examination in May of their first year in residency. At the conclusion of each rotation, the student will submit a 10-page report for that rotation to the student’s rotation mentor and to the Administrative Assistant for the EECE Graduate Program. The two 10-page reports will be compiled into a report (discussing both rotation experiences) that will be evaluated by a committee of faculty as part of the Qualifying Examination.

3. QUALIFYING EXAMINATION

The Qualifying Examination is to be taken in May of the first year of study in the program. It will be administered by a faculty committee consisting of four or more professors from different specializations appointed by the Department Chair. The entire examination will be finished in one week, and the student will be informed of the results.

The examination will consist of:

a) Written Test (4 hours) – based on integrated contents of the core classes. The objective is to test broader understanding of the subject matter (in contrast to exams in a specific subject).

b) Research Rotation Report – The report will be prepared based on work done in the research rotation in the two laboratories. The report is completed in increments of two 10-page reports submitted at the conclusion of each rotation period.

c) Oral Examination (not to exceed 1.5 hours) – judged by the faculty qualifying examination committee. This is an open test to judge whether the student is capable of pursuing a Ph.D. degree. Other faculty members are encouraged to attend and participate in the oral examination. The final decisions will be made in a departmental faculty meeting by reviewing and evaluating all the scores, overall performance in courses and research rotations.

The Qualifying Examination score will be based on a maximum of 40 points with the point breakdown as follows:

- Written Test – 15 points
- Research Rotation Report – 10 points
- Oral Examination – 15 points

The student can receive a Pass, Conditional Pass or Fail grade for the examination. A Pass score will be designated as a total of more than 30 points and a Fail score as one less than 25 points. Scores between 25 and 30 points will be designated by the faculty to be either a Conditional Pass or a Fail. If a student receives a Fail grade, the student has the option of taking additional classes and obtaining a M.S. degree. Students who receive a Fail grade may not be financially
supported any longer by the Department. If a Conditional Pass is received, specific conditions will be laid out which have to be fulfilled within one year. Failing to satisfy all conditions will result in a conversion to a Fail grade.

4. SELECTION OF PERMANENT ADVISOR

After completing the second rotation and before the first Friday in May, the students will submit their top four choices for an advisor on the Permanent Advisor Choice form to the Department Administrative Assistant for the graduate program. At the same time, each faculty member will notify the Graduate Program Coordinator of (a) the number of students that they wish to advise and can support beginning in September and (b) their ranked preferences of students to advise. The lists from the students and from the faculty will be sealed until after the Qualifying Exam. After the Qualifying Exam, the faculty will make the permanent advisor assignments. Students will begin conducting research with their permanent advisor in June.

5. REQUIREMENTS FOR Ph.D. DEGREE

a. Academic Requirements

Candidates for this degree must complete a total of 72 credits beyond the bachelor’s degree. Of these, a minimum of 36 must be graduate coursework and a minimum of 30 must be doctoral thesis research units. To be admitted to candidacy, the student must have completed at least 18 credits at Washington University, have an overall GPA greater than 3.0, and pass the Qualifying Examination as described in Section 3. The student must also have completed the research rotations and have selected a permanent advisor.

Transfer Credits: at most 9 graduate credits in a masters program from another university may be counted as transfer credits toward the required 36 units of coursework.

Maximum Research Units Per Semester: at most 9 units of research units may be taken in a semester.

Seminar Credits: the 1-unit EECE seminar course may be taken for graduate coursework credit in up to six semester for a total of 6 units.

Independent Study Credits: at most 3 units of coursework may be taken as graduate independent study. An independent study must be entirely separate from work done as part of the graduate thesis research. The student should prepare a proposed plan of study to be completed, and this plan must be described on the Independent Study Petition form approved by the independent study instructor, student’s advisor, Graduate Program Coordinator, and Department Chair for the independent study credits to count toward the 36 required units of coursework.

400-level Courses: Courses must be 500-level graduate courses except for up to three 400-level courses provided that they are approved by the Graduate Program Coordinator and Department Chair.

b. Thesis Proposal

Following successful completion of the Qualifying Examination, students will select a research area and a permanent mentor/advisor (see Section 4). The student and advisor will decide upon a suitable problem whereupon the student will prepare a comprehensive written research proposal that includes a thorough survey of the field, a discussion of those areas needing further research, and a tentative but clear definition of the proposed research. Results of preliminary studies or feasibility studies should be included. This proposal will be submitted to the Thesis
Committee at least one week prior to a Thesis Proposal Examination consisting of an oral presentation and questions before the committee. The committee normally consists of six tenured or tenure-track faculty members (including the advisor); four faculty members should be from the student’s major department and two from other departments or schools of the University. The committee is appointed by the Dean of the Graduate School upon the request of the Department Chair or Graduate Program Coordinator. Any exceptions to the normal composition of the committee should be discussed with the Graduate Program Coordinator and be approved by the Dean of the Graduate School. The thesis proposal should be successfully presented within 18 months of passing the Qualifying Examination and at least 12 months prior to graduation.

The student must meet with the thesis committee (either as a group or individually) annually to update them on research progress.

A student who has passed the Thesis Proposal Examination, completed 30 units of required coursework toward the Ph.D. degree, and published or submitted at least one peer-reviewed manuscript from the thesis research is eligible to receive an M.S. degree. The publication and submission of the manuscript must be with the approval of the research advisor. Students must submit their request to receive the M.S. degree at least one year before the Thesis Defense.

c. Teaching Assistant Requirement

All students must serve as a teaching assistant or assist in some teaching activity in the Department for at least two semesters prior to graduation; in some cases a student may be required to serve as a teaching assistant in more than two semesters. This will normally be done after the first year and after having passed the Qualifying Examination. In serving as a teaching assistant, students should meet the Graduate School-Wide Teaching Requirement for Ph.D. Candidates; details of fulfilling teaching requirements are described at http://artsci.wustl.edu/GSAS/Policies/TeachingRequirementPhD.htm. Students should be aware that this requirement involves activities beyond just offering office hours and grading assignments. During the semester, the student will perform teaching assistant duties in addition to the normal coursework and research duties that are expected by the research advisor.

d. Thesis Defense

Upon completion of the thesis, the candidate must present the thesis in a public forum and successfully defend the thesis before their Thesis Committee. Students should submit their completed thesis to the Committee at least 2 weeks prior to the defense. The student should also have submitted at least one paper to a peer reviewed journal prior to defending his or her thesis. Normally students are expected to have at least one paper accepted in a peer reviewed journal, and at least another paper submitted prior to graduation. Presentation at national conferences is also encouraged.

6. FINANCIAL AID

All full-time doctoral students in good standing will receive financial aid – in the first year as a departmental fellowship, and in subsequent years through a research assistantship from the advisor or through independent fellowships. Students are expected to discuss their financial aid needs before finalizing their choice of an advisor. Academic achievements and satisfactory
performance in research and other assignments while at Washington University are the primary factors governing continuation of financial aid.

Students who are placed on academic suspension will automatically have their financial assistance canceled, effective with the date of suspension.

Research assistants are paid a regular monthly stipend. During the academic year a research assistant is considered to be employed half-time on a research project and, as such, is normally not permitted to register for more than 9 hours of graduate credit per semester after the first year. A minimum of 20 hours of work per week is required on the research project. However, graduate assistants whose thesis research coincides or overlaps with their project assignment are expected to devote more than this minimum effort to research, and, in fact, the student’s diligence and devotion will be important factors in renewal of the assistantships. It is important to note that it is the prerogative of the research advisor to terminate a research assistantship at any time for unsatisfactory performance.

Research assistantships are continued during the summer and renewable for the next year at the discretion of the research advisor. Summer appointments are at the same rate as during the academic year, but full-time effort (minimum of 40 hours per week) is expected.

6.1 Tax Liability

The taxability of the various types of awards described above is determined by current policy of the U.S. Internal Revenue Service (IRS). It is prudent to assume that all stipends are fully taxable and that tax will be withheld. Questions concerning any individual’s tax liability must be referred to the IRS.

6.2 Outside Employment

Holders of fellowships, traineeships and assistantships are required to devote full time effort to graduate studies. They are not permitted to engage in any outside employment without special permission of the advisor and Department Chair.

6.3 Time Off

Graduate students on financial support are expected to commit themselves fully to their studies and research. Intersession periods listed in the University Academic Calendar denote times when classes are not in session, and graduate students are expected to devote themselves full-time to their research during these periods.

Students on full support are permitted to take off a maximum of two weeks during the calendar year for holidays, interview trips, etc. Additional time off can be arranged in discussion with the research advisor, but may result in a reduction of the student’s stipend. During the first year in the program when students do not have a permanent advisor, they should consult their first-year advisors to schedule any time off. Absences of research assistants must be scheduled so as not to impede the progress of an ongoing research project and should be approved by the research advisor.
7. OTHER POLICIES

7.1 Seminars

Each year the department sponsors or participates in a series of seminars by visiting lecturers and Washington University faculty and students. All full-time graduate students are required to enroll in EECE 509- Graduate Seminar, which is a S/F course carrying 1 unit of coursework credit. Full time graduate students may receive up to 6 units of coursework for EECE 509. A passing grade (S) is required for each semester for all full-time students and is earned by regular attendance at these events.

7.2 Secretarial Service

Department secretaries and staff will help students with payroll, purchases, keys and allocation of space issues. They do not generally provide clerical services to graduate students except in connection with scheduled courses and sponsored research projects.

7.3 Copying Service

Graduate students may not charge copying work to the department or a research project without prior authorization. Personal copies can be charged to a student’s personal account. The cost of copying and binding dissertations beyond the three copies required by the department is considered a personal obligation.

7.4 Annual Reviews

All graduate students should meet with their advisors on a routine basis. Every summer, the student will undergo a formal review of his or her progress by the Advisor. A standard form (Exhibit G in Appendix) will be used. The faculty member is responsible to complete the review; and it is the student’s responsibility to remind the Advisor to ensure that these reviews are completely annually by end of August every year.

8. COURSE SELECTION

Students formulate their course program in consultation with their academic advisor. While there are no specific course requirements for the doctoral degree, the student is expected to be proficient in the following Core Classes. A list of graduate courses offered by the Department faculty is also listed. Doctoral students are strongly urged to take at least 3 graduate level classes (400-level or higher) outside the department. These courses can be selected based on discussion with their advisor and research interest areas.

A) Core Classes

Courses are offered to doctoral students in three core areas. The courses corresponding to these areas are:

a) EECE 501 Transport Phenomena in EECE
b) ESE 501 and 502 Mathematics of Modern Engineering I and II*
c) EECE 503 Kinetics and Reaction Engineering Principles
*Students who have extensive mathematical preparation may choose to take EECE 502 (Mathematical Principles in Engineering) in place of or in addition to ESE 501 and 502.

These courses will provide the base knowledge that is expected of all doctoral students in the department. These classes will provide the fundamentals and provide the foundation in the topical areas that are essential for successful study and conduct of research in energy, environmental and chemical engineering. A student can opt to take more advanced classes after discussion with the faculty teaching the classes. However, the student is responsible for passing the qualifying examination which will be based on integrated content of the three core subject areas.

First-year students will also register for EECE 508 Research Rotation (0 credits, S/F grade, first year in Program). During every semester of residency, students should register for EECE 509 - Seminar in EECE (0 credits, S/F grade).

Students can avail of course sequences in areas of specialization in the department. Students are encouraged to review the same on the Department website, discuss with their advisors and are encouraged to avail themselves of these opportunities.

**Suggested Course Selections for First Year Doctoral Students**

**Fall Semester (10 credits)**

1) EECE 501 Transport Phenomena in EECE
2) ESE 501 Mathematics of Modern Engineering I or EECE 502 Mathematical Principles in Engineering
3) Elective Class (Select one from Menu and discussions with temporary advisor)
4) EECE 508 Research Rotation (0 credits)
5) EECE 509 Seminar in EECE (1 credit, Pass / Fail)

**Spring Semester (10 credits)**

1) EECE 503 Kinetics and Reaction Engineering Principles
2) ESE 502 (if ESE 501 was taken in the Fall), Mathematics of Modern Engineering II
3) 1 or more Elective Class (select from menu based on interests and discussions with advisor)
4) EECE 508 Research Rotation (0 credits)
5) EECE 509 Seminar in EECE (1 credit, Pass / Fail)

**Graduate Level Elective Classes (please review list of exact offerings each year – current listings of courses are maintained on the EECE website)**

**Aerosol Science and Engineering**

1) EECE 518 Aerosol Science and Engineering (Fall )
2) EECE 510 Dynamics of Air Pollutants (alt Spring)
3) EECE 548 Combustion and the Environment (Fall)
4) EECE 563 Measurement Techniques for Particle Characterization (alt Spring, even years)
5) EECE 564 Topics in Nanotechnology (alt Spring, odd years)
6) EECE 592 Advanced Topics in Aerosol Science and Engr. (alt Spring, even years)

**Engineered Aquatic Processes**

1) EECE 443 Environmental Chemistry (Fall)
2) EECE 534 Environmental Nanochemistry (Spring even numbered years)
3) EECE 543 Aquatic Chemistry (Spring odd numbered years beginning 2011)
4) EECE 591 Computational Chemistry of Molecular and Nanoscale Systems (Spring)

**EECE Courses Complementing Engineered Aquatic Processes**

1) EECE 5XX Metabolic Engineering (Spring beginning 2010)
2) EECE 553 Bioprocess Engineering I (Fall)
3) EECE 537 Environmental Risk Assessment (Spring)

**Courses in Other Departments that Contribute to Engineered Aquatic Processes**

1) EnSt 461 Environmental Law and Policy (Spring)
2) EPSc 444 Environmental Geochemistry (Fall)
3) EPSc 511 Minerals in Aqueous Environments (Fall odd numbered years)
4) EPSc 430 Environmental Mineralogy (Spring odd numbered years)
5) Chem 465 Solid-state and Materials Chemistry (Spring odd numbered years)

**Multiscale Modeling and Molecular Transformation Engineering (not complete list)**

1) ChE 516 Turbulent Transport Processes

**Metabolic Engineering and Systems Biology (not complete list)**

1) ChE/EECE 453/553 – Bioprocess Engineering I: Fundamentals and Applications

**Other EECE Graduate Classes**


**Other Graduate Classes from Chemistry, Physics, Biology, and other Departments approved by your Advisor**
APPENDIX (LIST OF FORMS)

List of Forms to be Completed by Students during Period of Study

<table>
<thead>
<tr>
<th>Form</th>
<th>Date Due</th>
<th>Receive From and Submit to</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRMS Personal Information</td>
<td>Upon arrival</td>
<td>Theresa Kenyon</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cupples II 205</td>
</tr>
<tr>
<td>Research Rotation Form</td>
<td>September 15</td>
<td>Rose Baxter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cupples II 207</td>
</tr>
<tr>
<td>Permanent Advisor Choice</td>
<td>First Monday in May</td>
<td>Rose Baxter</td>
</tr>
<tr>
<td>Thesis Information Form</td>
<td>Three weeks before</td>
<td>Rose Baxter</td>
</tr>
<tr>
<td>(used to start proposal process)</td>
<td>Thesis Proposal Examination</td>
<td></td>
</tr>
<tr>
<td>Teaching Requirement Fulfillment</td>
<td>Before thesis defense</td>
<td>Rose Baxter</td>
</tr>
<tr>
<td>Notice of Title, Scope, and Procedure (Thesis)</td>
<td>Six months before degree conferral</td>
<td>Rose Baxter</td>
</tr>
<tr>
<td>Exit Document</td>
<td>Last day at WU</td>
<td>Rose Baxter</td>
</tr>
<tr>
<td>Post-graduation Job Survey</td>
<td>Last day at WU</td>
<td>Rose Baxter</td>
</tr>
</tbody>
</table>

List of Forms Completed by Department Faculty or Staff

<table>
<thead>
<tr>
<th>Form</th>
<th>Date Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D. Qualifying Examination Result</td>
<td>May of first year</td>
</tr>
<tr>
<td>Thesis Proposal Result</td>
<td>Upon Completion of Exam</td>
</tr>
<tr>
<td>Annual Student Review</td>
<td>By end of August (every year)</td>
</tr>
<tr>
<td>(section for student response submitted to advisor)</td>
<td></td>
</tr>
<tr>
<td>Final Program Form</td>
<td>Three weeks before Thesis Defense</td>
</tr>
<tr>
<td>(student will receive form for confirmation)</td>
<td></td>
</tr>
</tbody>
</table>