

THE PENNSYLVANIA STATE UNIVERSITY
College of Engineering
Department of Chemical Engineering

INFORMATION FOR GRADUATE STUDENTS

These notes describe opportunities and responsibilities related to graduate study in the Department of Chemical Engineering. Additional regulations are to be found in the Graduate Bulletin, and the Thesis Guide. These publications are available at the Office of the Graduate School, Kern Building.

All students are expected to assume full responsibility for knowing the requirements and procedures given in these publications. New students should become familiar with this material without delay. Students should consult with the secretary in charge of graduate student records (Sue Ellen Bainbridge) for any questions related to this handbook of program requirements. Any questions regarding the actual policies should be addressed to the Graduate Program Coordinator (Dr. Ali Borhan) or the Department Head (Dr. Andrew Zydney).

The requirements described in this Handbook have been established to insure that all students achieve a minimum level of competency required for a graduate degree in Chemical Engineering while at the same time providing sufficient flexibility to allow students to pursue their individual professional development. Special opportunities have also been provided to recognize outstanding performance in research and teaching. Occasionally unusual circumstances will develop that were not anticipated and may thus not be effectively handled by the official program requirements. If such conditions arise, students should contact the Graduate Program Coordinator and / or the Department to discuss the particular situation and to explore potential options / solutions.

www.che.psu.edu/grad/handbook/

Updated Summer 2013

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INFORMATION ON REGISTRATION AND TUITION

REGISTRATION:

Approximately 2-3 months before the beginning of a semester, the University publishes the Semester Schedule of Classes. It is available on-line at <http://soc.our.psu.edu/soc/>. It will provide all registration instructions and a worksheet to help with the registration process. Students are encouraged to advance register to avoid any late fees. This process will generate a semester tuition bill (see below). All courses must be approved by the student's thesis advisor (or by the Graduate Program Coordinator during the first semester).

LATE REGISTRATION:

All graduate students who register late will be responsible for payment of all late fees incurred.

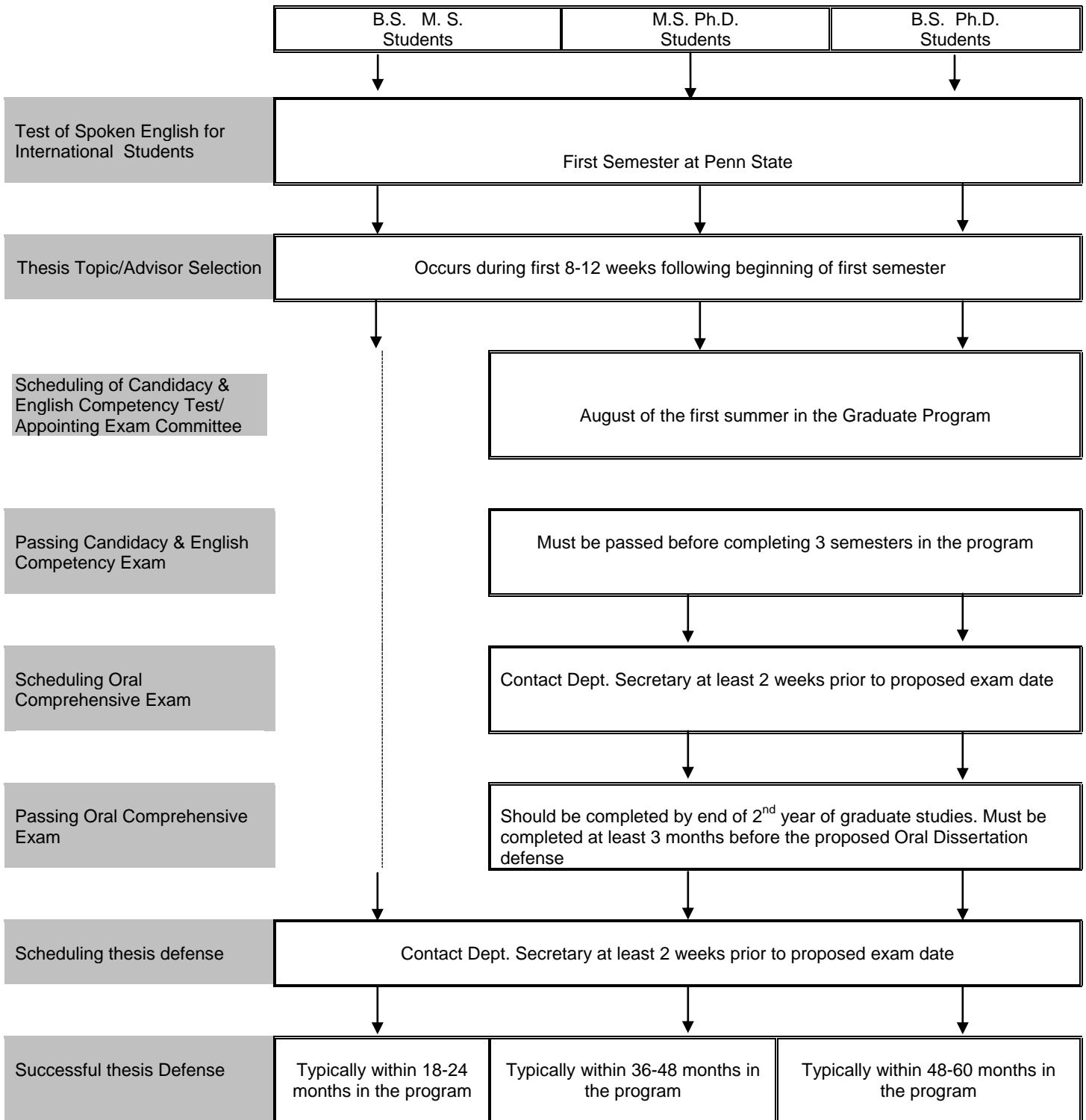
TUITION BILL: "Who must file?"

Graduate Assistants or Fellowship/Traineeship students must return the bill **EVEN IF YOU OWE NO MONEY**. Line 6(A) is an example of the deduction for a Graduate Assistantship. This can be filed on-line through e-Lion or the bill must be returned to the Bursar's Office to complete your registration. If it is not returned and processed by the Bursar's Office your name will be removed from the class roster, and the class space will be made available to other students.

DEPARTMENTAL OBLIGATION

As a Graduate Assistant, your first commitment is to the Chemical Engineering Department. If you are going to be employed by any other department, project, or program you must inform your advisor and Laurinda Benner (Administrative Manager in Chemical Engineering) **before** you are appointed. Failure to comply with this procedure could result in the termination of your Graduate Assistantship.

CALENDAR FOR STUDENT ACTION STUDENT ACTION CHECK LIST



MASTERS DEGREE ONLY

- G **Thesis Topic/Advisor Selection** 6-10 Weeks following start of program.
- G **Appointment of M.S. Committee**
Consult with advisor to identify appropriate committee members and submit appropriate form to the Department Secretary.
- G **Scheduling of M.S. Thesis Defense** **Required of all M.S. Students**
 - G Notify Dept. Secretary at least 3 weeks prior to proposed exam date.
- G **Notify committee at least 3 weeks prior to proposed test date.**
 - G Submit M.S. Thesis to committee two weeks prior to proposed exam date.
 - G Must have a GPA of at least 3.00 in course work to schedule exam.
- G **No more than 6 credits of thesis research**
(600) may be assigned a quality letter grade.
Any credits over this maximum must be changed to an "R" grade before a student will be permitted to graduate.

**STUDENT ACTION CHECK LIST
(M.S. to Ph.D.) and (B.S. to Ph.D.)**

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- G Thesis Topic/Advisor Selection** 8-13 Weeks following start of the Program
- Test of American English Oral Communicative Proficiency Oral Proficiency Test for International Students**
(Required of all International Students)
Must be taken in the first Semester at Penn State.
- G** Student must schedule by calling the Department of Linguistics and Applied Language Studies.
- | Time | Date | Place |
|------|------|-------|
|------|------|-------|
- G Scheduling of Candidacy Examination/** On or before the third Friday of October in the student's second fall semester in the program.
- Note: The Candidacy Exam serves as the English Competency Test in Chemical Engineering.
- G** Student must meet the Ph.D. eligibility requirement with a GPA of 3.33 in designated courses.
- G** Student must be registered for the semester the Candidacy Exam & English Competency Exam is taken.
- G** Notify Dept. Secretary (Cathy Krause) by last Friday of September in the student's second fall semester in the program.
- G** Notify Candidacy Examination Chairperson and Committee at least two weeks prior to test date.
- G** Submit thesis proposal to Candidacy Exam Chairperson and committee and a copy to Dept. Secretary, on or before the last Friday of September in the student's second fall semester in the program.
- G** Appointment of Ph.D. Committee
- G** Consult with advisor to identify appropriate committee members, See Dept. Secretary for Committee Appointment Forms.



Schedule Final Oral Dissertation Defense

- G** Student must be registered for the semester in which the Final Doctoral Defense is scheduled.
- G** Notify Dept. Secretary (Cathy Krause) at least 3 weeks prior to proposed exam date.
- G** Notify doctoral committee at least 3 weeks prior to test date.
- G** Submit thesis to doctoral committee, two weeks prior to proposed exam date.
- G** Must have a GPA of at least 3.00 in course work to schedule exam.

**STUDENT ACTION CHECK LIST
(M.S. to Ph.D.) and (B.S. to Ph.D.)
Page 3 of 3**

**G Additional Requirements for scheduling Final
Oral Dissertation Defense**

- G** Residency requirement: Between admission to the Ph.D. Program and completion of the Pd Program. You must spend at least 2 semesters (summer not included) as a full-time student.
- G** Have 3 months elapsed between the Comprehensive and the final oral?
- G** Continuous registration requirement: Have you been registered continuously each semester beginning with the semester following the passing of the comprehensive.
- G** The final oral examination must be held within six years of the date the comprehensive examination was passed. If more than six years have passed, a second Comprehensive examination \ must be given before scheduling the final oral examination
- G** Time limitation. All requirements including submission of the thesis must be completed within eight years of the candidacy date.
- G** No missing or deferred grades can appear on a student's transcript when the final oral dissertation defense is scheduled.
- G** No more than 12 credits of thesis research (600/610) may be assigned a quality letter grade. Any credits over this maximum must be changed to 'R' before a student will be permitted to graduate.

03/09/2013

Leaving the Chemical Engineering Department at Penn State

Name: _____

Date/Semester of Departure: _____

The following items must be completed before your departure from Penn State. As you complete each item, please have the individual listed place their initials in the left hand column indicating that you have completed each task

Once all the items are completed, please return this form to: Laurinda Benner

Initials	Task to be completed	Person in Charge	Room
_____	Return your keys	Roger Dunlap	127A Fenske
_____	Return your Purchasing Card	MJ Smith	133 Fenske
_____	Leave a forwarding address/phone #	Steven Smith	133 Fenske
_____	Return your parking permit	Laurinda Benner	133-B Fenske
_____	Accompany the Safety Officer on a walk-through of your lab for proper disposal of remaining chemicals and wastes associated with research	Roger Dunlap	127A Fenske

INTRODUCTION

Chemical Engineering graduate studies at Penn State are based on a very flexible program designed to meet the divergent needs of students involved in a variety of research projects in the department. The requirements are kept to a minimum and the students are given a wide choice in developing their own programs of study. To facilitate this process, you have been provided with this brief handbook containing a description of all the existing departmental requirements. Additional regulations to meet the requirements of Penn State's Graduate School are described in the Graduate Bulletin and the Thesis Guide.

Advising for all entering students is initially provided by the Chair of the Graduate Program Committee (currently Dr. Ali Borhan). All students entering the graduate program will meet with the Chair of the Graduate Program Committee to decide on their courses for the first semester. Students entering the department with Master's Degrees obtained at other institutions will also have their courses evaluated as to their equivalence to Penn State courses. Once the thesis topics are chosen by the students, all advising will be done by the thesis advisors.

In designing their programs of study, students should pay particular attention to the general requirements of teaching, participation in the departmental seminars, graduate student colloquium, and English language tests for international students. Also, students should plan ahead their Oral Defense of Master's Thesis, the Candidacy Examination (which also satisfies the University's requirement for the English Competency Test), and the Comprehensive Examination for the Doctoral Degree and the Oral Doctoral Dissertation Defense, all of which will have to be officially scheduled by the department.

The set of policies described in this book are those currently in force. They are subject to changes as the chemical engineering discipline and hence our graduate program continues to evolve. The student has to make sure that he/she satisfies all the requirements that are in force at the time of his/her admission to the graduate program at Penn State. Students may consult with the secretary in charge of graduate student records, for any questions related to this handbook of program requirements.

Occasionally unusual circumstances will develop that were not anticipated and may thus not be effectively handled by the written program requirements. If such conditions arise, students should contact the Graduate Program Coordinator and / or the Department to discuss the particular situation and to explore potential options / solutions.

APPOINTMENTS

TYPES OF APPOINTMENTS

Graduate students may receive appointments as Graduate Assistants, Teaching Assistants or Fellows. The normal appointment offered to new graduate students in Chemical Engineering is the half-time Graduate Assistantship. The Graduate Assistantship requires the student to carry out research which culminates in a thesis/dissertation satisfying the requirements for a graduate degree. Teaching Assistantships are offered to continuing students whenever they are assigned teaching responsibilities. All Ph.D. students are required to demonstrate some teaching experience as a part of their degree requirements; this requirement is currently satisfied by serving as a Teaching Assistant for at least 2 semesters. Usually, no student has the Teaching Assistantship for the entire duration of his/her graduate studies. M.S. students are not required to serve as Teaching Assistantships. Fellowships are offered to continuing as well as incoming graduate students on a merit basis. The evaluation of the credential of the graduate students and the decisions on the Fellowships are made by the Graduate School. The department nominates suitable candidates for the Fellowship competition to the Graduate School.

Graduate Assistantships

Appointments are based on "superior ability and promise". Reappointment to an assistantship is based on availability of positions and the quality of the student's work.

Quarter-Time - The student normally schedules 9-14 credits per semester, receives a stipend plus a grant-in-aid of resident education tuition, and performs tasks that, on the average, occupy approximately ten hours per week.

Half-Time - The student normally schedules 9-12 credits per semester, receives a stipend plus a grant-in-aid of resident education tuition, and performs tasks that, on the average, occupy approximately twenty hours per week.

Three-Quarter-Time - The student normally schedules 6-8 credits per semester, receives a stipend plus a grant-in-aid of resident education tuition, and performs tasks that, on the average, occupy approximately thirty hours per week.

Graduate School Fellowship - Awarded by the Graduate School to a limited number of scholastically outstanding students. Fellows receive a stipend plus payment of tuition. Fellows are required to enroll as full-time students.

CREDIT LOADS AND HOURS OF SERVICE

Credit loads allowed and hours of service required under various appointments as established by the Graduate School are tabulated below.

Appointment	Credit Load Allowed		Service Hours/Week
	Summer	Fall/Spring	
None (Part-Time Student)		1-8	0
None (Full-Time Student)	5	9-15	0
Three-Quarter-Time Graduate Assistantship	3-5	6-8	
Quarter-Time Graduate Assistantship	5-7	9-14	10
Half-Time Graduate Assistantship	4-6	9-12	20
Fellowship (Traineeship, etc.)		9-12	0

It should be noted that while the academic semester lasts 15 weeks, service under a graduate assistantship is required for 18 weeks or an equivalent number of hours. For example, a half-time graduate assistant is required to give 360 hours of service in one semester. For the graduate student on a teaching appointment, this work will relate to the instructional activities of the department. Those not involved in teaching duties are expected to spend at least an equivalent amount of time on their research.

Half-time assistants may register for up to 22 credits over the Fall and Spring semesters, three-quarter time assistants for 16.

¹A graduate assistant or fellow who is required to register for a certain minimum number of credits is not permitted to count audited course credits toward the minimum credits needed. The special language courses are exceptions. The student may register for credit or audit beyond the required minimum but may not exceed the normal maximum without special permission."

¹Graduate Degree Programs Bulletin, Penn State University 1998-2011.

[ALLOWED VACATION TIME

Graduate Assistants who are appointed for 18 weeks of work for each semester, and an additional 12 weeks during the summer are allowed a total of four weeks of vacation during the calendar year.

SCHEDULE OF STIPEND PAYMENTS

Assistantship stipends are paid monthly. For the Fall Semester, graduate assistants will be paid $\frac{1}{5}$ of the semester stipend at the end of August, September, October, November, and December. For the Spring semester, graduate assistants will receive $\frac{1}{5}$ of the semester stipend at the end of January, February, March, April and May. For the Summer Semester, graduate assistants will be paid $\frac{1}{2}$ of the semester stipend at the end of June and July.

New graduate students will not receive a stipend at the end of August, but will receive $\frac{2}{5}$ of the stipend at the end of September. New students should meet with Laurinda Benner as soon as they arrive on campus to complete all paperwork associated with payments. Students will need to bring proof of citizenship (social security card, birth certificate, or passport) in order to be officially entered into the University system.

Fellows are also paid once a month, on the last day.

If a payday falls on a Saturday, Sunday, or a holiday, paychecks are issued on the preceding full working day. Paychecks are obtained at the Office of the Bursar, Shields Building or may be direct deposited to the student's account in a bank.

RESIDENCE TIME LIMITS ON STIPENDS

Chemical Engineering Department has established upper limits for the time duration over which financial support will be awarded to graduate students. B.S. chemical engineers entering the graduate program are expected to attain the M.S. degree in two years of graduate studies and the Ph.D. degree after three additional years. The department will terminate the support of the graduate student after the prescribed number of years in the program. For graduate students on externally supported projects, funding can be extended beyond the general guidelines by the discretion of the advisor. No extensions will be granted for Graduate Assistants working on projects which are not funded by external grants.

FINANCIAL AID FOR SELF-SUPPORTING GRADUATE STUDENTS

All self-supporting² graduate students desiring financial aid from the department may request such consideration upon completing a minimum of 12 credits of technical courses with a minimum grade point average of 3.0 of which six credits must be at the 500 level. The earliest time a self-supporting student could obtain departmental support would be at the end of the second semester after starting graduate work at Penn State. In all cases, any financial support given self-supporting students will be contingent upon departmental resources, and will be awarded on a competitive basis among all applicants, including any students applying for admission to the Chemical Engineering department at the time of consideration. In the event that financial aid is not granted to a self-supporting student, he/she may request review of his/her case tri-annually, at the end of each semester or summer session. In the latter case, the student's research performance as well as course grades will be considered. The student's research performance will be evaluated from a written analysis by the student's research advisor.

Financial aid arrangements for students entering graduate studies with a previous degree in an area other than Chemical Engineering (Chemistry, for example) are usually made on an individual basis. The Chair of the Graduate Program Committee may be contacted for this purpose.

If departmental resources permit, the applications of non-departmentally supported students for supplemental financial aid will be considered if such students meet the above criteria (minimum G.P.A. of 3.0 in non-research courses). These applications will be considered on the basis of demonstrated need³ if the stipend being received is less than that obtained with the normal department mode of support. The awarding of this kind of support will be subject to the procedure outlined above for self-supporting students.

No graduate assistant may accept other employment during the time the assistantship is held without the concurrence of both the student's advisor and the Department Head.

²The term "self-supporting students" refers only to those students whose support comes from private individuals such as themselves, families, relatives, or friends. It does not include students who are supported by organizations such as companies, other universities, governments, or by private scholarships or fellowships. These latter students will be included in the broader category of non- Departmentally supported students.

³In consultation with the Office of International Students in the case of foreign students.

GENERAL REQUIREMENTS

TEACHING REQUIREMENT FOR Ph.D. DEGREES

A teaching experience is an integral part of a graduate education. Therefore, the department requires all graduate Ph.D. students to serve as Teaching Assistants before they can receive their graduate degrees. One semester as a TA in classroom and/or laboratory will satisfy this academic requirement. (Work as a Graduate Grader is not considered as satisfying the TA requirement). Additional semesters of TA duty can occur upon mutual agreement of the graduate student, the student's advisor, and the department head. Students serving as TA's to meet their academic requirement will receive the normal stipend given to all the students. Students who are volunteering as TA's, beyond the requirements, will be given stipends at a higher grade. Although not required, M.S. students may also serve as Teaching Assistants.

The Chemical Engineering Department is fully committed to recognizing outstanding performance in all of our graduate students. The Department provides special Fellowship (cash) awards to recognize graduate students whose work as a Teaching Assistant has been particularly outstanding. Decisions on the TA Awards will be made by the Department Head in consultation with the faculty.

ENGINEERING 588 - Seminar/Engineering TA's

All Teaching Assistants in Chemical Engineering whose duties include direct classroom instruction can satisfy the College requirements for TA's by formally registering for the 1 credit course Engineering 588. This course is highly recommended for TA's who will have significant responsibilities for classroom (lecture) instruction. The course is not required for the Ph.D. degree. The registration and course participation is done concurrently with the performance of TA duties. Engineering 588 is a semester long course that meets once weekly. Various aspects of teaching experience are examined in this course via formal lectures, student presentations and class discussions.

TA's whose duties do not include direct classroom instruction but who grade and hold office hours must attend the Grading Seminar for College of Engineering Graders. This is a one day seminar that covers a variety of topics such as: establishing grading criteria, evaluating the fairness of tests, professional conduct during office hours and handling student complaints etc.

Pre-registration is required for the Grading Seminar. Please check with the department secretary for more information.

TEACHING FELLOWS PROGRAM

The Teaching Fellows Program provides an enhanced teaching experience for graduate students who may be considering an academic career, with the goal of encouraging students to pursue academia while at the same time assisting them in developing their teaching skills and teaching portfolio.

Teaching Fellows will co-teach a Chemical Engineering course with a faculty mentor, becoming involved in all aspects of the course (lecturing, developing new course materials, preparing problem sets and exam questions, grading, etc). The faculty mentor will provide the support and critical feedback needed for the development of effective teaching skills. The Department will typically have one Teaching Fellow each semester, with a focus on the core undergraduate courses.

Application Process:

If you are interested in being a Teaching Fellow, you should submit the following material at least 3 months prior to the start of the semester in which you would like to teach:

* A short write-up explaining your teaching interests / experience and how being a Teaching Fellow would fit into your current career plans.

* A list of the course (or courses) that you would be interested in co-teaching. Course information is available on the web at: http://soc.our.psu.edu/soc/fall/up/a-c/ch_e.html

* A short letter (e-mail is fine) of support from the faculty you have previously worked with as a Teaching Assistant.

* A short letter / e-mail of support from your thesis advisor

You should discuss plans for being a Teaching Fellow with your Advisor, and you should also to talk with the faculty who are teaching the courses you would be interested in co-teaching to get a better idea of their expectations. Priority will be given to graduate students who have already completed their TA requirement (being a TA for 2 semesters), although we will also consider applications from students who have only been a TA for a single semester (in which case the Teaching Fellow position can serve to satisfy your second TA position). You should contact the Department Head if you have any questions about the Teaching Fellows program.

TEST OF SPOKEN ENGLISH FOR INTERNATIONAL STUDENTS

All international students who have not completed an academic program in a U.S. university are required to take the American English Oral Proficiency Test administered by the Linguistics and Applied Languages Studies Department at Penn State. The test is designed to evaluate graduate students before they could be utilized by the department as Teaching Assistants and Instructors. The results from this test are used to recommend remedial steps, if any, to be taken by the graduate student. The Center's evaluation is done in terms of the following proficiency codes:

NR = No Restrictions. This person should be allowed to teach with no restrictions based on ability to communicate in English (**PSU American English Oral Communicative Proficiency Test Score of = 250-300 or Official TSE Score of 55-60**).

WR = Take ESL 118G. This person *should not* be allowed to teach before completing and receiving a grade of "A" in ESL 118G. "American Oral English for ITA's III." (**PSU American English Oral Communicative Proficiency Test Score of = 230-249 or Official TSE Score of 45-50**).

TC = Take ESL 117G. This person *should not* be allowed to teach before completing and receiving a grade of "A" in both ESL117G - "American Oral English for ITA'S II." And ESL 118G – "American Oral English for ITA'S III." ." (**PSU American English Oral Communicative Proficiency Test Score of = 200-229 or Official TSE Score of 35-40**).

SL = Speaking/Listening. This person should enroll in ESL 115G- "American Oral English for ITA'S I and receive a grade of "A" before taking ESL 117G and ESL 118G. ." (**PSU American English Oral Communicative Proficiency Test Score below = 200 or Official TSE Score of 20-30**).

All international students will be notified of the test dates, and each student must take the test at the first available opportunity after he or she arrives at Penn State. Doctoral students who score below 250 are required to take all of the prescribed courses up to and including SPCOM 118G. Master's of Science students are required to take one of the prescribed courses. More information concerning the TSE can be obtained from the Programming English as a Second Language, 305Sparks Building, 865-7365. This test must be completed before a student can receive any advanced degree from Penn State. Students that have taken the TSE before arriving at Penn State should see the Graduate Secretary for assistance in interpreting their scores.

CHEMICAL ENGINEERING COLLOQUIUM (CH E 590, Fall Semester)

Each Fall Semester, short presentations by faculty on their current research projects will be followed by a series of presentations on orientation topics such as computer facilities, library information services, documenting research, laboratory safety, and responsible conduct of research. Students will select their thesis research topics after completion of the faculty presentations, typically about 8 to 13 weeks following the start of the semester. All new graduate students are required to attend this one credit course. The grading system to be used will be an R grade.

CHEMICAL ENGINEERING COLLOQUIUM - (CH E 590, Spring Semester)

This one credit course offered each Spring Semester gives graduate students the opportunity to develop their skills at giving oral research presentations and evaluating such presentations. All graduate students are required to take this course once during their tenure, and give one presentation on a topic of their choice. Ph.D. students are required to present a talk at a technical society meeting, research seminar, or other professional forum in addition to the presentation they give in this class. Whether or not the student gives a presentation of their own, he or she must attend all the lectures and evaluate the lectures by the other graduate students. The evaluation of a student's performance in the course will be based on the presentation of the individual student and his or her participation in the evaluation of other student's presentations. The grading system to be used will be an R grade.

DEPARTMENT SEMINARS

The department schedules a regular weekly seminar for all the graduate students and the faculty. Faculty members from various universities and scientists from government and industry are invited as the seminar speakers. Seminars are a key part of graduate education and all graduate students enrolled in our department are required to regularly attend the lectures and discussions. All students should register for the Department Seminar course (currently CHE 597B, 1 credit) every semester up until completion of the Comprehensive Exam.

LABORATORY SAFETY

Graduate students must follow safe laboratory practices. The department maintains an active Laboratory Safety Committee composed of faculty, staff and students who carry out periodic laboratory inspections. Students are expected to be responsive to the safety improvements suggested by the committee, and to serve on the committee when asked. From time to time, the department will schedule safety seminars or training sessions that all students are expected to attend. All graduate students must receive EHS safety training from the University, and a copy of the EHS certificate should be kept on file in each laboratory where the student works. Questions about safety issues should be addressed to the Department's Safety Officer (Roger Dunlap). Additional information can be obtained from the University's Environmental Health and Safety website <http://www.ehs.psu.edu/>.

THESIS INFORMATION

SELECTION OF A THESIS RESEARCH TOPIC

The department wishes its graduate students to have as much free choice as possible in selecting a thesis topic, within the confines of the department's financial resources and faculty interest.

At the beginning of the Fall Semester, new students entering the graduate program will hear a presentation of possible thesis topics from all faculty members having open research positions. These presentations will be made during the Colloquium class. During the 2 to 6 week period in which these presentations are made, new students will have the opportunity to speak to all faculty members offering thesis research topics on a person-to-person basis. The purpose of these meetings is to allow a more in-depth investigation of the thesis topics available. It is expected that each student will speak to all the faculty members having thesis topics that are of interest to the student. The meetings also allow the faculty to evaluate the students as potential research assistants in their laboratory.

By the sixth class day following the last presentation (before 5:00 p.m.), the student should place his/her name under the chosen topics on the blackboard set up in the Receiving Room. At least three topics must be chosen and the order of preference should be indicated by numbers 1, 2, and 3 for first, second, and third choices. During this six-day period, students are free to change their choices up to the final deadline.

Matching thesis research topics to students' choices will be determined by the entire faculty. Every effort will be made to assign students their first or second choices. However, students must remember that individual faculty can only accommodate a limited number of new students and that the Department has made a commitment to all of the faculty to provide them with sufficient students to fill available funded projects. A student who is dissatisfied with the topic assigned to him/her may appeal the decision to the faculty.

There will be no seminar presentation of thesis topics by the faculty for new graduate students entering during the Spring Semester or Summer. Instead, the students will be provided with a list of thesis topics from which they are to choose and they must meet with the faculty members concerned on an individual basis. The listing will be available from the Chair of the Graduate Program Committee who will also advise the student of other details of thesis topic selection procedure in his/her particular case.

THESIS REGISTRATION AND GRADING POLICY

Graduate students normally register for thesis research using the course number Ch E 600. Those who have passed the Ph.D. Comprehensive Exam register under Ch E 601 (for 0 credits). The thesis work is graded according to the policy adopted by the Graduate Council. The normal passing grade assigned is R. Letter grades are not to be given for Ch E 600, except F for a failing performance. At the completion of a degree program a specified maximum number of research credits may be changed from R to a letter grade. This change is not required for graduation purposes but merely permitted if a student and his/her thesis advisor choose to do so.

The maximum number of credits for which a grade change is allowed is 6 for master's students and 12 for doctoral students. Since grade changes are usually permitted for only the last semester, the students are advised to register for 6 or less credits of research in their last semester for which the letter grade can be assigned.

TIME-TABLE FOR WRITING THE THESIS

The mechanism of producing a finished thesis, from the first written rough draft to the final typing, is often more time consuming than the student realizes. In estimating the time of completion, allowances should be made for each step in the process. The typical times required for a student in residence are:

2-3 months	-	rough draft writing
2-3 weeks	-	advisor reading
2-4 weeks	-	correcting and preparing for committee
<u>1 month</u>	-	final editing and typing after defense
4-5 months		AVERAGE TOTAL TIME

The University's requirements and guidelines for preparing the written thesis, including answers to questions regarding formatting of the final document, are available on-line at:

<http://www.gradsch.psu.edu/current/thesis.html>

LEAVING BEFORE COMPLETION OF A THESIS

Some students may be tempted to leave the department and accept employment before their theses are completely written, typed and printed. If such is the case, the following departmental regulations should be considered:

- (1) A graduate student who has completed all of his/her requirements except thesis submission and defense must register for one credit each semester (or its equivalent) for the second and all succeeding semesters following departure from The Pennsylvania State University Campus. Graduate students will be financially responsible for paying the cost of tuition each semester.
- (2) A graduate student who leaves the campus before his/her thesis is approved by his/her advisor will be financially responsible for the typing and reproduction of the thesis in accordance with the departmental standards.

THESIS PRODUCTION IN THE DEPARTMENT

As soon as you have passed your defense and your thesis is ready for reproduction, contact Lisa Haines in Room 133 Fenske Laboratory for the Request for Thesis Form and further instructions. A copy of your thesis must be provided in any of the following formats: hard-copy, CD or Zip Disk. While each student is responsible for having his/her own thesis typed, the department will assist with thesis reproduction. The department will furnish the required number of copies of the final draft including multiple copies which are to be furnished to a sponsor. Binding will be the responsibility of the department, except of the author's personal copies. The student must assume responsibility for getting the thesis to the Graduate School and providing the department with contact information for concerns regarding the thesis. Specific arrangements for reproducing your thesis should be made through your thesis advisor.

If your thesis is to be printed through department facilities, the student should inform the advisor and all others concerned as early as possible in what semester or summer session he/she expects to graduate, and as closely as possible, when the thesis will be ready for printing. In many cases, departmental printing schedules are tight and the student should allow ample time for the thesis to be printed. Theses are generally printed on a "first come" basis, but in all cases, department printing will take precedence over thesis printing.

Students are responsible for their own proofreading required in connection with the thesis.

Students are responsible for the payment of binding and other Graduate School fees related to the thesis and graduation.

Ph.D. theses must be accompanied by a vita sheet. Both M.S. and Ph.D. theses require an abstract.

GRADUATION TIME TABLE

The graduating student should be aware of specific deadlines relating to certain obligations which must be met during their last semester or summer session before graduation. These include:

- Last date to deliver a thesis to Doctoral Committee or M.S. Thesis Committee
- Last date for a Final Oral Doctoral Examination
- Last date to pay thesis fee
- Last date to activate intent to graduate
- Last date to deliver thesis to Graduate School
- Last date to resubmit a corrected final copy of a thesis
- Last date to submit a request to graduate in absentia

Specific dates for these deadlines in any particular semester or summer session will be distributed by the department Secretary or they can be found in the current edition of the Graduate Bulletin or on-line at:

<http://www.gradsch.psu.edu/calendar/gradcal.html>

GRADUATE COURSE OFFERINGS

- Ch E 501 (BIOE 501), Bioengineering Transport Phenomena (3)**
Application of the equations of mass, energy, and momentum conservation to physiological phenomena and to the design of artificial organs.
- Note: Ch E 501 can be taken in place of Ch E 546 to satisfy the Department's requirement for an advanced transport course.
- Ch E 503 Fluid Mechanics of Bioengineering Systems (3)**
Cardiovascular system and blood flow, non-Newtonian fluid description, vessel flows, unsteady flows and wave motion, windkessel theory, transmission line theory.
- Ch E 524 Chemical Engineering Applications of Thermodynamics (3) - Required**
Thermodynamics of pure fluids and fluid mixtures with emphasis on applications to phase equilibria calculations of importance in Chemical Engineering.
- Ch E 528 Colloidal Forces and Thermodynamics (3)**
Unified treatment of formation, growth and stability of colloids based on principles of intermolecular and colloidal forces and thermodynamics. Prerequisite: CHEM 45 1, Ch E 320 or an equivalent background in chemical thermodynamics.
- Ch E 535 Chemical Reaction Engineering (3) -Required**
Optimal design of batch and continuous chemical reactors and reactor batteries; effect of mixing on reactor operation.
- Ch E 536 Heterogeneous Catalysis (3),** Thermodynamics and kinetics of adsorption and reactions on solid surfaces, heat and mass transfer effects, theory and correlations in catalysis, Prerequisites: CHEM 450, 452.
- Ch E 544 General Transport Phenomena (3) - Required**
Formulation and solution of transport problems involving momentum, heat, and mass transfer, with chemical engineering applications. Prerequisites: CH E 330, CH E 350, and CH E 410.
- Ch E 545 Transport Phenomena I (3)**
Momentum transport, laminar and turbulent flow, boundary layer analysis, non-Newtonian flow, mechanical energy balance, chemical engineering applications.

- Ch E 546** **Transport Phenomena II (3) - Required**
Heat and mass transfer, steady and unsteady state, coupling, molecular diffusion, moving boundaries, transfer coefficients, chemical engineering applications.
- Ch E 576** **(CE 576), Environmental Transport Processes (3)**
Fundamentals of chemical transport in engineered environments, such as biofilm reactors, and natural systems including aquifers and rivers. Prerequisite: C E 475
- Ch E 596** **Individual Studies (1-9)**
- Ch E 597** **Special Topics (1-9)**
Some recent course offerings include:
- Advanced Polymer Processing**
Application of principles of heat, mass, and momentum transfer to analysis of polymer processing.
- Polymer Solution Thermodynamics**
Fundamental and applied aspects of modeling solution properties of polymers.
- Bioprocess Engineering**
Principles of engineering applied to biochemical production, with emphasis on biochemical separations, microbial growth kinetics, and enzyme catalysis.
- Numerical Methods in Chemical Engineering**
Application of numerical analysis and computational methods to the solution of algebraic and differential equations of relevance to chemical engineering.
- Math**
Advanced analytical methods involving vectors and tensors with applications to transport processes.
- Non-Linear Optimization: Fundamental and Applications**
Fundamentals of optimization and applications in Chemical Engineering.
- Environmental Transport Processes** (co-listed as C E 576 taught by Prof. Logan)
Fundamentals of mass transport of chemicals between air, water, soil and biota. Note: This course does not satisfy the Department's core transport requirement.
- Surfactant Self-Assembly**
The course discusses quantitative, predictive theories for diverse self-assembly phenomena such as micellization, solubilization, microemulsification, and surfactant-polymer interactions developed on the basis of molecular thermodynamic methods.

MASTER OF SCIENCE IN CHEMICAL ENGINEERING

STUDENTS WITH A B.S. IN CHEMICAL ENGINEERING

1. Minimum number of total credits – 30.
2. Minimum number of course credits in Chemical Engineering and in related fields of science and engineering (400 and 500 series) - 18. (excluding Ch E 590)
 - a) At least 12 of these 18 credits must be Chemical Engineering 500 level courses. These must include Ch E 524 (3), Ch E 535 (3), and Ch E 544 (3).
 - b) Any course presently required of P.S.U. Chemical Engineering undergraduates, or courses equivalent to these courses, is excluded from these 18 credits.
 - c) Approved 400 level Chemical Engineering courses are listed on the check sheet.
3. Graduate Student Colloquium - M.S. graduate students must register for Ch E 590 one Fall Semester and one Spring Semester during their tenure.
4. Participation in Chemical Engineering Departmental Seminar (no credit) is required each semester the student is in residence.
5. Completion of all 400, 500, and 600 level credits with a grade point average of 3.00.
6. Completion of a written thesis and its oral defense.

MASTER OF SCIENCE IN CHEMICAL ENGINEERING

Check sheet for students with a B.S. in Ch E

Minimum Total Course Credits = 18

Minimum Ch E 500 Series Credits = 12

ChE Courses (400 Level)		
Ch E 415	3	
Ch E 416	3	
Ch E 431	3	
Ch E 441	3	
Ch E 446	3	
Ch E 448	3	
Ch E 453	3	
Ch E 455	3	

Colloquium (2) (required)		
Ch E 590 (Fall)	1	
Ch E 590	1	

Non-Ch E Courses (400/500 Level)		

Core Courses Required		
Ch E 524	3	
Ch E 535	3	
Ch E 544	3	

Ch E Courses (500 series)		
Ch E 501	3	
Ch E 503	3	
Ch E 507	3	
Ch E 509	3	
Ch E 516	3	
Ch E 528	3	
Ch E 536	3	
Ch E 545	3	
Ch E 546	3	
Ch E 548	3	
Ch E 597-		
Ch E 597		

Ch E Research (600 Level) <u>Minimum 6 Credits</u>		
Ch E 600		
Ch E 600		
Ch E 600		
Ch E 600		
Ch E 600		
Ch E 600		
Ch E 600		
Ch E 600		

Test of Spoken English:
Thesis Defense Date:

M.S. Thesis Title: _____

M.S. Thesis Committee Members: _____ (Chair)

MASTER OF SCIENCE IN CHEMICAL ENGINEERING

STUDENTS WITH A B.S. IN A NON-CHEMICAL ENGINEERING DISCIPLINE

1. Minimum number of total credits – 30.
2. Minimum number of course credits in Chemical Engineering and in related fields of science and engineering (400 and 500 series) - 21. (excluding Ch E 590).
 - a) At least 12 of these 21 credits must be Chemical Engineering 500 level courses. These must include Ch E 524 (3), Ch E 535 (3), and Ch E 544 (3).
 - b) Any course presently required of P.S.U. Chemical Engineering undergraduates, or courses equivalent to these courses, is excluded from these 21 credits although it may be counted in the total credit requirement.
 - c) Approved 400 level Chemical Engineering courses are listed on the check sheet.
3. Graduate Student Colloquium - M.S. graduate students must register for Ch E 590 one Fall Semester and one Spring Semester during their tenure. (see page 10 for description of Ch E 590).
4. Chemical Engineering 600 level - minimum 6 credits.
5. Participation in Chemical Engineering Departmental Seminar (no credit) is required each semester the student is in residence.
6. Completion of all 400, 500, and 600 level credits with a grade point average of 3.00.
7. Completion of a written thesis and its oral defense.
8. Competency in the following areas must be shown by either taking courses or examinations:
 - a) Momentum, heat and mass transfer (equivalent to Ch E 330, 350, and 410).
 - b) Thermodynamics (equivalent to Ch E 220 and 320).
 - c) Kinetics and Reactor Design (equivalent to Ch E 430).

MASTER OF SCIENCE IN CHEMICAL ENGINEERING

Check sheet for students with a Non-Ch E Degree

Minimum Total Course Credits = 21
Minimum Ch E 500 Series Credits = 12

ChE Courses (400 Level)		
Ch E 415	3	
Ch E 416	3	
Ch E 431	3	
Ch E 441	3	
Ch E 446	3	
Ch E 448	3	
Ch E 453	3	
Ch E 455	3	

Colloquium (2) (required)		
Ch E 590 (Fall)	1	
Ch E 590 (Spring)	1	

Non-Ch E Courses (400/500 Level)		

Core Courses Required		
Ch E 524	3	
Ch E 535	3	
Ch E 544	3	

Ch E Courses (500 series)		
Ch E 501	3	
Ch E 503	3	
Ch E 507	3	
Ch E 509	3	
Ch E 516	3	
Ch E 528	3	
Ch E 536	3	
Ch E 545	3	
Ch E 546	3	
Ch E 548	3	
Ch E 597- Math		
Ch E 597 -		

Ch E Research (600 Level) Minimum 6 Credits		
Ch E 600		
Ch E 600		
Ch E 600		
Ch E 600		
Ch E 600		
Ch E 600		
Ch E 600		
Ch E 600		

Test of Spoken English:
Thesis Defense Date:

M.S. Thesis Title: _____

M.S. Thesis Committee Members: _____ Chair

APPOINTMENT OF M.S. THESIS COMMITTEE

All students must have at least a co-advisor who is a member of the Chemical Engineering Faculty. After a student selects his/her thesis topic and research advisor, the thesis advisor will appoint a committee consisting of himself/herself and two (or more if desired) other graduate faculty members as a thesis review committee. In all cases, a majority of the thesis committee shall be members of the faculty of the Department of Chemical Engineering.

The responsibility of this committee includes periodic review of the progress of the research at the call of the advisor or the student. When the student is ready to write the first draft of the thesis, he/she may schedule a committee meeting to present his/her results for discussion and criticism. As soon as the student completes the draft, a copy will be given to each of the committee members for at least one week's study.

At the appropriate time the student should have the following form completed and submitted to the Head of the Department.

To: Head of the Department of Chemical Engineering

The following faculty members have agreed to serve on the M.S. Thesis Committee for _____ . This committee, in accordance with Departmental rules, includes at least three members of the graduate faculty.

1. _____ CHAIR
2. _____
3. _____
4. _____ (Optional)

Approved: _____
Committee Chair

Date

M.S. PRELIMINARY EXAM

Graduate students progressing towards a Master's degree in Chemical Engineering are required to take the Master's Preliminary Examination prior to the student's second fall semester in the graduate program. The M.S. Preliminary Examination will be scheduled in August at about the same time as the Ph.D. Candidacy Exams. The format of both the required written document and the oral presentation is identical to the Ph.D. Candidacy Exam, and students should consult the section on Ph.D. Candidacy Exam within this graduate handbook for further information on the content of the evaluation. The make-up of the evaluation committee will be determined by the Graduate Program Coordinator. The student's faculty advisor will attend the Preliminary Examination. However, the advisor is not a member of the committee and should not be involved in questioning the student.

The goal of the M.S. Preliminary Examination is to assess the student's progress towards completion of the degree and to provide feedback to the student on his/her progress and opportunities for development. The evaluation committee will provide a recommendation to the student's faculty advisor(s) regarding whether the student should be allowed to continue towards the Master's degree and whether it is appropriate for the student to consider petitioning to allow their Master's Thesis Defense to count as the Ph.D. Candidacy Exam in Chemical Engineering. The committee can also provide advice on whether the student's progress is sufficient for him/her to continue to receive financial support for their research activities, although the final decision on whether to financially support the student is at the discretion of the faculty advisor.

M.S. THESIS DEFENSE

The student is responsible for scheduling the thesis defense by notifying the department secretary. The student will then schedule a thesis defense which is to be conducted under the following guidelines:

1. The formal presentation of the thesis is to be public, and the public will be given ample opportunity to ask questions. The questioning by the thesis committee is usually done in public although this can be handled in private at the discretion of the thesis committee. The final deliberations of the committee will be done in private.
2. The student will begin the defense with a presentation of the highlights of the work which should not exceed 30 minutes.
3. The general audience will then be allowed to ask questions.
4. The committee will follow this with questions prepared on the basis of their study of the thesis.
5. A time period of two hours must be provided for the defense.
6. The committee will then meet in executive session to decide how to implement improvements in the final draft, if needed, and to determine if the defense met Departmental requirements or needs to be repeated.
7. Upon successful completion of the defense, the student will make necessary corrections to the draft, obtain the committee's approval, and have the final copy typed.
8. The student will then submit the thesis to the Graduate School after obtaining the signatures of the advisor and the Department Head.

Note: Forms for committee use when voting on the thesis defense and approving thesis draft are provided in this section of the publication.

(To be completed by the student and returned to the Departmental Office in 158A Fenske)

SCHEDULING M.S. THESIS DEFENSE IN CHEMICAL ENGINEERING

Name:

Thesis

Title:

Time:

Date:

Place:

Committee Members

CHAIRPERSON:

CONTINUOUS REGISTRATION REQUIREMENT

Ch E 600/610 - If the student does not need to maintain full-time student status, he/she should register for the appropriate number of thesis credits which accurately reflects the amount of research being done on the thesis (number of credits to be determined in consultation with student's advisor).

If a student defends the semester he/she leaves campus, the student does not have to register for that semester.

PROGRESSING FROM THE M.S. TO THE PH.D. PROGRAM

Eligibility for Admission into the Ph.D. Program:

Students desiring admission into the Ph.D. program must obtain a course grade point average of 3.33 or above, based on the credits earned in the Ph.D. core courses: CH E 524, CH E 535, and CH E 544.

Students who receive their M.S. degrees from other institutions will be evaluated by the Graduate Admissions Committee, for their eligibility to be admitted into our doctoral program.

To be admitted as a candidate for the Ph.D. degree by the Graduate School, the student must pass the Ph.D. Candidacy Exam. The minimum 3.33 grade point requirement must be achieved before scheduling the Candidacy Exam.

PH.D. CANDIDACY EXAMINATION

Objectives and scope

The objectives of the Candidacy Exam are to assess whether a student has the necessary background and skills to successfully pursue a Ph.D. in chemical engineering, and to provide an opportunity for the student to obtain guidance and feedback from multiple faculty on their short-term research objectives and direction. The exam is composed of an oral component to take place at the end of the first year and a written component due two weeks prior to the oral exam.

The Candidacy Exam should be treated as a white paper for the Ph.D. thesis research. The exam will be centered on the development of the student's initial research efforts, and the deliverables of the exam must contain the following:

1. Brief introduction of the broad motivation and objectives of the research task described during the exam, including a short summary of critical literature relevant to the field
2. Description of the approach taken and relevant technique(s)
3. Summary of recent research efforts by the student
4. Description of the research plan and direction for the next 6 months to a year

Presentation of preliminary results on your project is desirable but not required in the Ph. D. Candidacy Exam. Examples of research efforts include, but are not limited to, experiments, technique development, data interpretation, and mastery of a research-related technique.

Criteria for a successful exam and possible outcomes

Students will be assessed through a written report, oral presentation (15-20 min), and responses to questions after the oral presentation (20-30 min). Altogether, the oral exam will last no more than 50 min. The written report is to be a maximum of 5 pages double spaced, including everything. The font and margins of the document must follow the guidelines for theses and dissertations at Penn State. The written report should include a brief introduction, the rationale for the research, the hypothesis to be tested, the general approach to be used, and any specific aims. In developing the document, the student may confer with his or her advisor regarding the availability of background materials, and the formulation of the research objectives. The writing and editing of the written report should, however, be the exclusive work of the student. The written report will be used by the Department to satisfy the University's requirement for the English Competency Exam.

In order to successfully pass the Candidacy Exam a student must:

1. Demonstrate mastery of chemical engineering fundamentals
2. Demonstrate an understanding of the scientific method (observation, hypothesis generation, hypothesis testing, analysis)
3. Effectively present and communicate technical ideas and concepts related to the student's research
4. Demonstrate effective verbal and written communication skills in English

The examination committee is at liberty to inquire into any aspect of the student's preparation and progress. Failure of the student to demonstrate one or more of the criteria listed above will result in failure of the Exam. Unless otherwise specified by the exam committee, students who do not pass the Candidacy Exam will be required to first complete a Masters thesis before they can petition to take the Candidacy Exam a second time. At the discretion of the exam committee, a maximum of one retake may be allowed for any student. If a retake of the Exam is recommended by the exam committee, the retake

must take place before the end of the fall semester with the same committee, and scheduling will be the responsibility of the student.

Candidacy Exam Committee:

The Candidacy Exam committee will consist of all faculty members in the Department of Chemical Engineering who are present during the Exam. The student's advisor may attend the exam but must not participate in the discussions and deliberations involving the student except to provide specific information regarding research performance.

Scheduling of Candidacy Exam

The Ph.D. Candidacy Exam will be scheduled in August (for students starting the program the previous Fall semester). The timing for the Candidacy Exam for students who start the Ph.D. program in January will be determined on an individual basis. The exact dates for the exam will depend on the availability of the faculty, and may vary from year to year. All students entering the graduate program in the fall must take the Ph.D. Candidacy Exam the first time this exam is scheduled after they enter the Graduate Program. The written part of the exam must be submitted to the Graduate Program Assistant at least two weeks prior to the oral exam.

In order to take the Candidacy Exam, students must first obtain a minimum GPA of 3.33 in Ch E 524, Ch E 535, and Ch E 544, and complete each of these courses with a grade of B or better. This requirement is designed to insure that all Ph.D. students have sufficient understanding of the core Chemical Engineering fundamentals to pursue advanced study and professional career opportunities. Students who do not meet this prerequisite will be required to first complete a Masters thesis before they can petition for an exemption from the GPA requirement. The decision to allow the student to continue towards the Masters degree will be made by the student's thesis advisor. Upon completion of the Masters degree, the student must submit a written petition (including a letter from the thesis advisor) to the Department, requesting an exemption from the GPA requirement. Petitions will be considered by the entire faculty and will only be granted if the student has demonstrated truly exceptional research performance, leading to publication of key research results. If the petition is approved, the student will be allowed to take the Candidacy Exam the next time it is scheduled.

Criterion of Research Performance:

Research performance will be used as an additional criterion in making the pass/fail decisions on the Candidacy Exam. Doctoral thesis advisors will be asked to present the Candidacy Exam committee with a written evaluation of the research performance of the student. If the student completes a M.S. thesis with a different advisor, she/he will also be asked to present the committee with an evaluation of the student's M.S. thesis research performance.

Walter L. Robb Fellowship for Outstanding Performance on Candidacy Exam:

The Chemical Engineering Department is fully committed to recognizing outstanding performance in all of our graduate students. The Walter L. Robb Fellowship provides a cash award to selected graduate students based on outstanding performance on the Candidacy Exam and in the students' required coursework. Decisions on the Robb Fellowships will be made by the Department Head in consultation with the faculty.

**DEPARTMENT OF CHEMICAL ENGINEERING
PENN STATE UNIVERSITY**

CANDIDACY EXAMINATION SCHEDULING

NAME: _____

PSU ID NUMBER: _____

ADVISOR: _____

DATE OF CANDIDACY EXAMINATION: _____

TIME: _____
—

PLACE: _____

COMMITTEE MEMBERS: (Chair by rotation): _____

Ch E Faculty: _____

Ch E Faculty: _____

(From Related area: _____
Please list Department)

Please remember - You must notify the secretary and the Chair of the Candidacy Exam Committee at least two weeks before the proposed date of the exam. The department appoints the Chair for the Candidacy Exam Committee each semester.

Committee Members - Note that your thesis advisor is not a member of the committee.

Room Scheduling - Sign up room 101 or 133A Fenske Lab. If the conference room is not available, please notify the secretary for room scheduling.

PH.D. DEGREE REQUIREMENTS

Course Requirements

1. The M.S. Degree is not a prerequisite for the Ph.D.
2. A minimum number of 24 credits in the 500-level (excluding 590 and department seminar) courses in Chemical Engineering and in related fields of science and engineering, including 3 Chemical Engineering core courses and at least 6 additional credits of 500-series Chemical Engineering courses. With the approval of the student's thesis adviser, 3 credits of either ChE 596 or a 400-level course in related fields of science and engineering may be counted towards this requirement. All courses outside Chemical Engineering must be approved by the student's advisor. Each of the courses counting towards the required 24 credits must be passed with a grade of B- or better.
3. Core courses that must be taken are: Ch E 524 (3), Ch E 535 (3), and Ch E 544 (3). Note: Ch E 524, Ch E 535, and Ch E 544 must be taken prior to scheduling the Ph.D. Candidacy Exam. Students must have a minimum GPA of 3.33 in these courses and a grade of B or higher in each of these core courses to be eligible to take the candidacy exam. Students who do not meet this requirement are required to take the MS Preliminary Exam, and are able to petition the faculty for entrance into the Ph.D. program as described elsewhere. Exceptions to the requirement for these courses to precede candidacy exam will be considered, especially for students from non-Chemical Engineering undergraduate programs.
4. Graduate Student Colloquium - Ph.D. students are required to register for Ch E 590 in their first Fall Semester. Students must register for CHE 590 during one spring semester, and are encouraged to do so in their second Spring Semester. In addition, students are required to present at the Department Research Symposium, typically during their 4th year.
5. Students must register for research every semester, following their first, until the completion of degree requirements. Ch E 600 (610) is used until completion of the Comprehensive Exam. Ch E 601 (611) is used after the Comprehensive Exam has been completed. Students should register for a total of 9 credits during every semester following their first semester, using CHE 600 or CHE 601 to raise the total to 9. Students should register for the course with their research advisor as the instructor.
6. Participation in Chemical Engineering Departmental Seminar (no credit) is required each semester a student is in residence. Students should register for the seminar course (typically with a CHE 597 designation) every semester until they pass the comprehensive exam.
7. No courses outside of the Chemical Engineering Department are required by the department; however, the doctoral Committee may specify up to 9 credits of non-Chemical Engineering courses.
8. Students transferring to Penn State with a MS degree from another institution may transfer up to 12 credits of course work if so evaluated by the Graduate Program Coordinator with consultation from the Graduate Admissions Committee. These students must complete at least 12 credits of 500 level courses at Penn State (excluding the seminar and ChE 590 requirement) of which at least 6 credits must be in the Ch E 500 series. In addition, they must satisfy the course requirements described under (3), either by transfer of courses or by taking the Penn State courses.
9. Completion of all 400, 500, and 600 level credits with a grade point average of 3.00.

10. Completion of a minimum of 1 Teaching Assistantship.

DOCTOR OF PHILOSOPHY IN CHEMICAL ENGINEERING
Minimum Total Course Credits = 24

Non-Ch E Courses (500 Level)		

Core Courses (Required)		
Ch E 524	3	
Ch E 535	3	
Ch E 544	3	
Ch E 546 or Ch E 501	3	

Ch E Research (600 Level) <u>Minimum 6 Credits</u>		
Ch E 600		
Ch E 600		
Ch E 600		
Ch E 600		
Ch E 600		
Ch E 600		
Ch E 600		
Ch E 600		
Ch E 600		

Ch E Courses (500 series)		
Ch E 501	3	
Ch E 503	3	
Ch E 507	3	
Ch E 509	3	
Ch E 516	3	
Ch E 528	3	
Ch E 536	3	
Ch E 545	3	
Ch E 548	3	
Ch E 550	3	
Ch E 597	3	

Colloquium (Required)		
Ch E 590 (Fall)	1	
Ch E 590 (Spring)	1	
Presentation	1	

Test of Spoken English:
Thesis Defense Date:
ENGR 588
CANDIDACY EXAM RESULTS:
English Competency Exam:

Other Courses		

Minimum ChE Course Credits = 12

Ph.D. Thesis Title: _____

Ph. D. Committee Members: _____

ENGLISH COMPETENCY REQUIREMENT FOR PH.D. STUDENTS

The Department of Chemical Engineering has introduced an English Proficiency requirement which integrates the goal of attainment of English proficiency with simultaneous enhancement of chemical engineering research capabilities. The student can thus look at the English Competency requirement not as a barrier to or as a distraction from doctoral research, but as a beneficial component of doctoral studies. The department's policy requires demonstration of high level of competence in the use of English language, including reading, writing and speaking. The main elements of the policy are detailed below.

(1) Testing International Students on Entry into Graduate Program

All international students who have not completed an academic program in a U.S. university are required to take American English Oral Communicative Proficiency Test administered by the Center for English as a Second Language at Penn State. (This is the current departmental policy and will continue to remain in effect). The results from the American English Oral Communicative Proficiency Test will be used to recommend measures for improving English competency of the international students as they commence their graduate studies at Penn State.

All international students will take the test soon after they arrive on campus. Typically, the American English Oral Communicative Proficiency test is offered during the Orientation week or the first week of the semester. If the performance level of the student is below the highest proficiency code (= 250-300), then the student will be advised to take one of the following courses during the first semester: ESL 115G, ESL 117G, or ESL 118G.

(2) All Ph.D. students, domestic and international, will undergo an assessment of English competency during their first year. The assessment will include the student's ability to read and comprehend to participate in scientific and technical discussions. The assessment will be conducted during the Ph.D. Candidacy Examination by a committee of 4 graduate faculty members. The English Competency Testing will consist of three parts.

(a) Writing

The student will prepare a detailed research proposal on the topic chosen for his/her doctoral dissertation. The written proposal should include, as appropriate, the following:

- (i) Brief introduction.
- (ii) Rationale for the research. What problems motivate this research?
- (iii) Hypothesis to be tested
- (iv) General approach to be used,
- (v) Tentative time table for completion of research.

The written thesis proposal should typically be about 5 typewritten pages. The written document will be judged for its organization, the logical arguments in support of the student's hypotheses, the inclusion of relevant details, style in the use of language, grammar, punctuation and spelling. The written document must be the individual work of the student and no editing of the written proposal by the student's thesis advisor is to be done.

(b) Formal Presentation

The student will make a formal presentation of the thesis proposal before a faculty committee, after a period of at least two weeks following the submission of the written thesis proposal. Typically, the formal presentation will be of about 20 minutes duration. The presentation will be judge for its clarity, adaptation to the audience, organization, appropriate use of visual aids and effectiveness of delivery. The quality of the formal presentation should be comparable to papers presented at the technical sessions of the professional society meeting.

(c) Oral Discussion

The main purpose of the Oral Examination part of the English Competency Test is to evaluate the oral skills of the student to participate in scientific and technical discussions with other technical professionals, who may not necessarily be specialists. The Oral Examination will follow the formal presentation of the research proposal by the student. The examination committee will conduct a discussion with the student on all aspects of the research proposal and also on the scientific and technical issues surrounding the research area.

At the end of the Candidacy Exam, each member of the committee will present an assessment of student's English competency in the three categories: writing, formal presentation and oral discussion. These assessments will be used to certify the attainment of English competency for students judged to be competent and to recommend measures for improving their English competency for students judged to be deficient.

(3) Improving English Competency of Students with Deficiencies

If the expected level of competence is not demonstrated, the student will be required to enroll in course(s) offered at the university to improve English competency. The committee will recommend the suitable course(s) for each student from among the following:

(i) Oral Language Skills

ESL 114G, American Oral English for Academic Purposes
ESL 115G, American Oral English for ITAs I

(ii) Presentational Skills

CAS 100A, Effective Speech
CAS 211, Informative Speech

(iii) Writing Skills

ESL 116G, Composition for Academic Disciplines
ENGL 202C, Effective Writing: Technical Writing
ENGL 198G, Writing in the Disciplines

(4) Attainment of English Competency

If the student completes and passes the recommended course(s) with a B grade or better, then the student will be certified as having attained English competency. If the student fails to achieve a for better, then the student will have to retake the course (or another comparable course). Students judged as not making sufficient progress towards achieving competency in English will have their funding terminated.

(5) Further Opportunities for Enhancement of English Competency

The department has two other formal requirements designed to enhance the English competency of all doctoral students. These requirements relate to chemical engineering colloquium and the doctoral Comprehensive Exam.

(a) Colloquium

All doctoral students are required to register for 2 credits (one credit each semester for two semesters) of CH E 590 Chemical Engineering Colloquium. The students scheduling CH E 590 are required to give a formal oral presentation on a topic of their choice. The formal presentation should be comparable to that given in technical and professional society meetings. The students will have to also participate in the question and answer session following the presentation.

(b) Ph.D. Comprehensive Exam

This exam will be scheduled only after the department certifies that the student has attained competency in English, The format of the Comprehensive Exam gives students additional opportunities to enhance their reading, writing, formal presentation and oral discussion skills

APPOINTMENT OF DOCTORAL COMMITTEE

- A. After the student passes the Ph.D. Candidacy Exam and before he/she takes the Comprehensive Exam, members of his/her Doctoral Committee must be appointed. The Doctoral Committee is to consist of at least 3 Faculty members in the major field and at least 1 Faculty member in a related field (outside the major). The committee Chair will ordinarily be the candidate's research advisor.

The outside member shall have no conflicts of interest with members of the department such as a budgetary connection to the department, or serving as a co-principal investigator with any other members of the committee. The Primary responsibilities of this outside member are (1) to maintain the academic standards of the Graduate School and (2) to assure that all procedures are carried out fairly.

- B. The committee should meet with the student at least once a year to review the progress of the research at the call of the advisor or the student. When the student is ready to write the first draft of the dissertation, he/she may schedule a committee meeting to present his/her results for discussion and criticism.
- C. The student's doctoral committee has the responsibility to guide the course of study undertaken by the student.
- D. If a student is pursuing an official minor (e.g., Chemistry, Materials Science and Engineering, Biochemistry and Molecular Biology, etc) then at least one member of the Doctoral Committee must be a member of that Department.

For a copy of the “Appointment of Doctoral Committee Form”, please see Cathy Krause in room 158 Fenske Laboratory.

COMPREHENSIVE EXAMINATION

A Comprehensive Examination is required of all doctoral candidates by the Graduate School. As partial fulfillment of the requirements for the Comprehensive Examination, the candidate must submit a dissertation proposal. The finished report must be presented in writing to the Doctoral Committee and defended orally after it has been accepted. The Comprehensive Examination should be completed within 2.5 years after joining the Ph.D. program.

The dissertation proposal should be of the same nature and quality as would normally be submitted to a funding agency such as the National Science Foundation - i.e., it should define a significant problem, review the current literature and provide a critical review of the state-of-the-art, propose methods of investigation, and contribute some significant new information, data, or preliminary results which could be submitted to research sponsors or for publication in a journal. It is recommended that the dissertation proposal be prepared by adhering to the guidelines provided for research proposals submitted to the National Science Foundation.

The size of the main body of the proposal is limited to the equivalent of 15 single-spaced pages or 25 double-spaced pages, using a font size not smaller than 11 pt and margins not smaller than 1". These are upper limits, and do not preclude shorter documents that convey the needed material. The pdf file for the written document must be submitted to Breanne Robinson in the department office at least two weeks before the scheduled exam date. The written document will be checked for format and length requirements, and then distributed to the Doctoral Committee for review. **Please note that written reports that do not meet the format and length requirements will be returned to the student. In such cases, the exam will need to be rescheduled.**

The candidate will be responsible for arranging a time for an oral defense of the dissertation proposal. The oral defense will consist of a 30-minute presentation by the candidate on the highlights of the work, followed by questions from the Doctoral Committee. The oral defense of the proposal is intended to help the candidate develop better technical communication skills as well as demonstrate his/her knowledge of the area. This Oral Examination constitutes the official Graduate School Comprehensive Examination, and must be officially scheduled through the Graduate School at least three weeks prior to the date of the Exam. Students should note that in order to schedule the Ph.D. Comprehensive Exam, they must have successfully completed the English Competency requirements. Students must schedule and complete their Comprehensive Examination before the end of their fifth semester in the graduate program. It is expected that all of the course requirements for the Ph.D. degree will be completed by the end of the semester in which the student completes the Comprehensive Exam.

The Chemical Engineering Department is fully committed to recognizing outstanding performance in all of our graduate students. Special Fellowship funds have been set aside to provide cash awards to selected graduate students based on outstanding performance on the Comprehensive Exam. Decisions on the Robb Fellowships will be made by the Department Head in consultation with the faculty

For a copy of the "Schedule the Comprehensive Examination Form", please see Breanne Robinson in room 158 Fenske Laboratory.

EXTERNAL INTERNSHIP

Although the department does not have a formal internship program, many students find it useful to work in industry or a government agency during their doctoral program. Such an external internship is encouraged if it enhances a student's doctoral research, provides a basis of the Comprehensive Examination, or enriches the student's graduate education in some other specific manner. Although formal approval for an external internship is not required, it should be planned with the full knowledge and cooperation of the student's advisor.

DISSERTATION DEFENSE

The student will schedule a dissertation defense at least three weeks prior to the proposed exam date. After the student completes the final draft of the dissertation, it will be given to each of the committee members for at least one week's study. The dissertation defense is to be conducted under the following guidelines:

1. All parts of the defense are to be public, except the final deliberations of the committee.
2. The student will begin the defense with a presentation of the highlights of the work which should typically not exceed 30 minutes.
3. The general audience will then be allowed to ask questions.
4. The committee will follow this with questions prepared on the basis of their study of the dissertation. This questioning will serve as the Final Oral Examination required by the Graduate School.
5. A time period of two hours must be provided for the defense. The committee will then meet in executive session.
6. If the dissertation is deemed satisfactory by at least two-thirds of the Committee who are members of the Chemical Engineering Faculty, the student will pass the examination and the Committee will decide how to implement improvements in the final draft, if needed.
7. If the dissertation is not deemed satisfactory, it is the responsibility of the Committee to determine whether another examination may be taken by the student.

Upon successful completion of the defense, the student will make necessary corrections to the draft, obtain his committee's (majority) approval, and have the final copy typed.

The student will submit the dissertation to the Graduate School after obtaining the signatures of approval of the advisor and the Department Head.

Note: Forms for committee use when voting on dissertation defense draft are provided at the end of this publication.

DEPARTMENT OF CHEMICAL ENGINEERING

(To be completed by the student and returned to the Departmental Office in Room 158A Fenske)

SCHEDULING FINAL ORAL DISSERTATION DEFENSE

Name: _____

PSU ID No: _____

TITLE: _____

Time: _____

Date: _____

Place: _____

Committee Members

CHAIRPERSON: _____

Ch E Faculty: _____

Ch E Faculty: _____

(From Related area _____
please list Department)

SCHEDULING OF THE FINAL ORAL EXAM

The Ph.D. Oral Comprehensive Examination should be scheduled at least **three months** before the Final Oral Dissertation Defense. Both examinations are scheduled officially by the Graduate School. To allow sufficient time for the Graduate School, the students should contact the Graduate Program Secretary in Chemical Engineering at least **two weeks prior** to the desired date of the examination.

CONTINUOUS REGISTRATION REQUIREMENT

Ch E 600/610 - If the student does not need to maintain full-time student status, he/she should register for the appropriate number of thesis credits which accurately reflects the amount of research being done on the thesis (number of credits to be determined in consultation with students advisor).

Ch E 601/611 - This special registration should be used by Ph.D. students starting with the semester after the Comprehensive Examination is passed. If a student must maintain full-time status for an assistantship, fellowship, bank loan deferment, etc., 601 would be an appropriate registration. 601 students must be devoting their efforts entirely to thesis research/writing (i.e. no courses). Tuition and fees for students registering for CHE 601/611 are significantly reduced compared to that for CHE 600/610; thus, all eligible students should register for CHE 601/611.

If a student is in the continuous registration stage of his/her program, registration must be maintained each semester (including summer sessions if student is using University facilities, faculty time, etc.) up to and including the semester the Final Oral Examination is passed. If the student is not on campus during the summer and is not using University facilities or faculty, registration in the summer is not required (except as noted below).

Note: Registration is required the semester the Final Oral Examination is held -- even if it is held during a summer session. Students should register for ChE 601 (for 0 credits) if they are defending their thesis during the summer. This requirement also applies to the Comprehensive Examination -- students should register for ChE 600 under these conditions

CHECK LIST OF GRADUATE SCHOOL REQUIREMENTS FOR PH.D. CANDIDATES

The following is a summary of Graduate School requirements that Ph.D. students must meet before the Office of Graduate Programs may approve their graduation. For more detailed information on these and other requirements, please refer to the Graduate Degree Programs Bulletin.

- G Residency requirement. After passing the doctoral Candidacy Examination, students must be registered full time for two semesters in a twelve-month period. This may include the semester of Candidacy Examination if it is taken during spring or fall.

- G A candidate for the Ph.D. must have satisfied the departmental English Competency Test before taking the Comprehensive Examination.

- G Three or more months must have elapsed between the passing of the Comprehensive Examination and scheduling of the Final Oral Examination.

- G The Final Oral Examination must be held within six years of the date the Comprehensive Examination was passed. If more than six years have passed, a second Comprehensive Examination must be given before scheduling the Final Oral Examination.

- G Continuous registration requirement. Students must be registered continuously each semester (excluding summers, but see below*) beginning with the semester following the passing of the Comprehensive Examination and continuing each semester until the Final Oral Examination is passed.

- G Time limitations. All requirements including submission of the thesis must be completed within eight years of the Candidacy date.

*Students **MUST** be registered the semester of the Candidacy Examination, the Oral Comprehensive Examination, and the Final Oral Examination -- even if taken during summer session. Students should register for Ch E 600 or ChE 601 as appropriate.

No missing or deferred grades can appear on a student's transcript when the Oral Comprehensive Examination of the Final Oral Examination is scheduled.

Students must have at least a 3.0 grade point average to schedule and Oral Comprehensive Examination or Final Oral Examination and to graduate.

No more than 12 credits of thesis research (600/610) may be assigned a quality letter grade. Any credits over this maximum must be changed to "R" before a student will be permitted to graduate.

THESE ARE GRADUATE SCHOOL REQUIREMENTS **ONLY** AND DO NOT INCLUDE SPECIFIC PROGRAM/DEPARTMENT REQUIREMENTS.

STUDENT ORGANIZATIONS

Chemical Engineering Graduate Student Council

The Chemical Engineering Graduate Student Council (GSC) represents Ch E graduate students in department-oriented matters. Examples of activities in which the GSC has previously been involved in are the annual spring and fall picnics, the Colloquium series, safety inspections, and graduate course evaluations. The most important function of the Committee is to serve as a channel which graduate students can use to direct complaints, problems, or suggestions that they might have to faculty, staff, or anyone else associated with the Chemical Engineering department.

The Committee consists of about ten members who are elected to the various positions listed below. These elections take place at the beginning of each academic year. Members meet once or twice a month to discuss various topics and concerns brought forth by the graduate students. It is important that the Committee is able to fill all of the positions available, for then it is able to run efficiently and effectively addresses the concerns of the graduate students. All students are encouraged to serve as a member of the GSC at some point of their graduate academic career.

Positions available in the Chemical Engineering
Graduate Student Council
GSC Chairperson
Faculty Representative
Social Committee (2)
AIChE Representative
Graduate Student Recruiting Committee

MINOR IN CHEMICAL ENGINEERING

A minor in Chemical Engineering is available to both MS and PhD candidates who are enrolled in related fields of study.

REQUIREMENT FOR THE M.S. MINOR

1. Nine (9) credits of course work bearing a Ch E designation as follows:
 - a. 3 credits in a 500-level thermodynamics course (e.g., 524- Chemical Engineering, Application of Thermodynamics, 528-Colloidal Forces and Thermodynamics. 597-Polymer Thermodynamics).
 - b. 3 credits in a 500-level reaction engineering course (e.g., 535-Chemical Reaction Engineering, 536-Heterogeneous Catalysis)
 - c. 3 credits in a 500-level transport course (e.g., 501 -Bioengineering Transport Phenomena, 503-Fluid Mechanics of Bioengineering Systems, 544-General Transport Phenomena, 545-Transport Phenomena I, 546-Transport Phenomena II.

Independent study courses (Ch E 496 and Ch E 596) and laboratory courses are not allowed in any of these three categories.

All of these 9 credits must be passed with a grade of B or better.

2. The Chair of the Graduate Program will have the responsibility of approving the specific courses that the student selects to fulfill the requirements of the minor.

REQUIREMENTS FOR THE PH.D. MINOR

1. Fifteen (15) credits of course work bearing a Ch E designation as follows:
 - a. 3 credits in 500-level thermodynamics course
524-Chemical Engineering, Application of Thermodynamics
528 Colloidal Forces and Thermodynamics
 - b. 3 credits in 500-level reaction engineering course
535-Chemical Reaction Engineering
536-Heterogeneous Catalysis
 - c. 3 credits in 500-level transport course
(e.g., 501 Bioengineering Transport Phenomena
503-Fluid Mechanics of Bioengineering Systems
544-General Transport Phenomena
545-Transport Phenomena I
546-Transport Phenomena II
597-Interfacial and Membrane Transport in Biological Systems.
 - d. 6 credits of additional 400-level or 500-level courses. Independent study courses (Ch E 496 and Ch E 596) and laboratory courses are not allowed.

All of these 15 credits must be passed with a grade of B or better.

2. A member of the Graduate Faculty of the Department of Chemical Engineering is required to be a member of the student's doctoral committee. This faculty member will have the responsibility of approving the specific courses that the student selects to fulfill the requirements of the minor.

OTHER INFORMATION SOURCES

The following is a list of booklets available to graduate students.

Thesis Guidelines:

Guidelines for the Preparation of Master's and Doctoral Theses can be found at the following web address:

<http://www.gradsch.psu.edu/current/thesis/guide.html>

The Thesis Office guidelines can be found at the following web address:

<http://www.gradsch.psu.edu/current/thesis.html>

Thesis Office
115 Kern Building

Health Insurance:

Student Insurance Office (SIO)
320 Grange Building
865-7467

<http://www.sa.psu.edu/uhs/basics/insurance.cfm>

Tax Information:

GSA TAX Guide
Available for pick up at:
118B Kern Building
865-4211

General information on campus, student organizations etc.

A GUIDE TO GRADUATE LIFE
Available for pick up at:
111B Kern Building
865-4211

Financial Aid Information:

Student Aid Office
314 Shields Building
865-6301

<http://www.psu.edu/studentaid/>

Environmental Health and Safety:

<http://www.ehs.psu.edu/>