

John R. and Jeannette Dachille McWhirter Graduate Program

HANDBOOK FOR GRADUATE STUDENTS

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 course 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, this handbook describes opportunities and responsibilities related to graduate study in the John R. and Jeannette Dachille McWhirter Graduate Program of the Department of Chemical Engineering. Additional regulations are to be found in the [Graduate Bulletin](#).

Advising for all entering students is initially provided by the McWhirter Graduate Program Coordinator (currently, **Dr. Seong Kim**). Students entering the department with a MS degree obtained at other institutions may request their courses to be 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 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 in a timely manner the Qualifying Examination (which also satisfies the University's requirement for the English Competency Test), the Comprehensive Examination for the Doctoral Degree and the Oral Doctoral Dissertation Defense, all of which must be officially scheduled by the department.

The set of policies described in this book are those currently in force. These are established to ensure that all students achieve the satisfactory 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. They are subject to changes as the chemical engineering discipline and hence our graduate program continues to evolve. The student must make sure that he/she satisfies all the requirements that are in force at the time of his/her admission to the McWhirter Graduate Program at Penn State. Students may consult with the staff person in charge of departmental graduate records (**Cathy Krause**) 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 Head (**Dr. Phillip Savage**) to discuss the situation and to explore potential options / solutions.

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Information on Registration and Tuition

REGISTRATION:

The University publishes the Semester Schedule of Classes. It is available on-line at [LionPath](#). Students are responsible for their registration through [LionPath](#) every semester. This process will generate a semester tuition bill (see below). All courses must be approved by the student's thesis advisor (or by the McWhirter Graduate Program Coordinator during the first semester).

The minimum credits required to maintain the full-time student status are 9 for Fall and Spring; in the semester taking less than 9 credits of courses, the PhD student should add ChE 600 to make the total credit to 9 until he/she passes the comprehensive exam (typically the second-year summer). The PhD student also is required to register for 1 credit for the summer semester in which the comprehensive exam is taken. After passing the comprehensive exam, the PhD student should register for ChE 601 with zero credit until he/she finishes the final oral defense. In the semester of taking the oral defense, the student should register for 1 credit again.

LATE REGISTRATION:

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

TUITION BILL: "Who must file?"

A semester tuition bill will be generated automatically when students register via [LionPath](#). Other fees (except the ones included in the tuition bill) are students' responsibility.

DEPARTMENTAL OBLIGATION

As a Graduate Assistant, student's first commitment is to do research in the McWhirter Graduate Program in Chemical Engineering. If they are going to be employed by any other department, project, or program, students must inform his/her advisor and the Administrative Manager in Chemical Engineering (**Laurinda Benner**) before they are appointed. Failure to comply with this procedure could result in the termination of the Graduate Assistantship. Information pertaining to other employment is addressed on the terms of offer.

For international students, there are additional regulations set by the [Directorate of International Student and Scholar Advising \(DISSA\)](#); working without proper permission is a violation of status and a deportable offense.

Quick Summary for Non-Thesis MS Students

- 1) Complete 30 credits of graduate work, including:
 - a) 9 credits of core graduate Chemical Engineering foundational courses, specifically
 - CHE 524 Chemical Engineering Application of Thermodynamics (3 credits)
 - CHE 535 Chemical Reaction Engineering (3 credits)
 - CHE 544 General Transport Phenomena (3 credits)
 - b) 6 additional credits of CHE coursework at the 500-level (typically 2 elective courses, each 3 credits). In semesters in which offerings of CHE 5XX electives are not sufficient, a list of 500-level graduate courses from outside CHE that may satisfy this requirement will be distributed.
 - c) 6 additional credits of other elective courses. 3 credits may be at the 400-level, though the 4xx credits cannot be from a core course required of CHE undergraduate majors in the department.
 - d) 2 credits of graduate colloquium (ChE 590). In the Fall Colloquium (1 credit), faculty present their research and the advisor selection process is conducted; also, "[Scholarship and Research Integrity](#)" (SARI) requirements are completed in the Fall. The Spring Colloquium (1 credit) will focus on research and presentation skills.
 - e) 7 credits of research, registered as CHE 596. The research credits are typically divided to 1 credit in Fall, 1 credit in Spring, and 5 credits in Summer.
 - f) Attendance to the Chemical Engineering Departmental Seminar (no credit) is required each semester the student is in residence. Students are required to miss no more than 2 seminars per semester in both the spring and the fall, unless additional absences are approved by the seminar instructor.
- 2) Attain a grade of C or higher in all courses that count towards the MS degree. A grade point average (GPA) of 3.00 or higher is required for graduation.
- 3) Present a final research poster in the last month of the one full academic year.
- 4) Complete a final research paper (typically, about 10-15 single-spaced pages, with a separate cover page).

Quick Summary for Ph.D. Students

- **Thesis Topic/Advisor Selection** within 6-10 weeks following the start of the Graduate Program. This will be done through the ChE 590 Colloquium in the Fall semester of the first year.
- **American English Oral Communicative Proficiency Test (AEOCPT)** – This test is required for all international students and will be scheduled by the department before the start of Fall semester of the first year. Students will be electronically notified of the date, time, and place of examination.
- **Course Requirements**
 - Total 24 course credits are required. Among these, 9 credits are core chemical engineering courses (ChE 524, 535, and 544) from which students must get a GPA of 3.33 or higher to qualify for the qualifying exam. At least, 15 credits should be in the 500-level courses in Chemical Engineering. Advanced 400-level undergraduate courses may be used to meet the course requirement if a written consent from the research advisor is provided.
 - A maximum of 12 credits of high-quality graduate work earned from another graduate program may be accepted in partial fulfillment of course requirements for the Ph.D. degree in the McWhirter Graduate Program. This transfer process requires submission of full course materials from such courses taken in the previous institution (including the contact information of the course instructor) and the submitted materials will be evaluated by the pertinent course instructor or the McWhirter Graduate Program Coordinator. The final recommendation for the acceptance of the submitted credits will be made based on this evaluation.
- **Departmental Seminar (ChE 597) & Colloquium (ChE590)**
 - Attending the Chemical Engineering Departmental Seminar is required every semester until they pass the Comprehensive Exam (typically, 1 credit)
 - In the Fall Colloquium (1 credit), faculty present their research and the advisor selection process is conducted; also, "[Scholarship and Research Integrity](#)" (SARI) requirements are completed in the Fall. The Spring Colloquium (1 credit) will focus on research and presentation skills.
- **Qualifying Exam** is usually scheduled early in August before the start of the fall semester of the second year. Students must meet the Ph.D. eligibility requirement with a GPA of 3.33 in core courses before the exam can be taken. Note that the Qualifying Exam also serves as the English Competency Test which is required by the Graduate School.
- **Appointment of Ph.D. Committee:** Consult with the research advisor to identify appropriate committee members and see Cathy Krause for Committee Appointment Forms.
- **Oral Comprehensive Examination**
 - Should be scheduled as soon as possible and no later than the end of the 2nd year of graduate program. Students must be registered for the summer semester in which the Comprehensive Exam is taken through the [Summer Tuition Assistance Program \(STAP\)](#).
 - Notify Cathy Krause **at least 3 weeks prior** to the proposed exam date. Two weeks prior to proposed exam date, submit Comprehensive Exam research proposal to the doctoral committee and a copy to Cathy Krause. Notify Cathy Krause upon successful completion of Comprehensive Examination.

- Students must have a cumulative GPA of at least 3.00 to be allowed to schedule the exam. No missing or deferred grades can appear on the student's transcript when the oral comprehensive is scheduled.
- **Final Oral Dissertation Defense**
 - Students must be registered for the semester in which the Final Doctoral Defense is scheduled. If the final defense is scheduled in the Summer, registration should be done through the [STAP](#).
 - Notify Cathy Krause **at least 3 weeks prior** to the proposed exam date.
 - Submit the thesis draft to the doctoral committee, two weeks prior to the proposed exam date.
 - Students must have a cumulative GPA of at least 3.00 to be allowed to schedule the exam. No missing or deferred grades can appear on a student's transcript when the final oral dissertation defense is scheduled. 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.
 - All requirements including submission of the thesis must be completed within **eight years** of the candidacy date.
- **Dissertation Acceptance**
 - Completion of the requirements of a Ph.D. degree program entails the acceptance of the dissertation meeting (i) the research quality standards, as indicated by the signatures of at least two-thirds of the doctoral committee, as well as the head of the graduate program, on the doctoral signature page, and (ii) the editorial standards of the Graduate School, so that it constitutes a suitable archival document for inclusion in the University Libraries.
- **Before Departure from the University**
 - Upon the completion of all requirements and earning the degree, the department needs to submit the [Initiate A Separation](#) form to the Human Resources. To initiate this process, students must see Cathy Krause.

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 Grade 16**. The Graduate Assistantship requires the student to carry out research which culminates in a thesis/dissertation satisfying the requirements for a graduate degree. Fellowships are offered to incoming and continuing students on a merit basis. The evaluation of the credential of the graduate students and the decision on fellowships are made by the Graduate School. The department nominates suitable candidates for the Fellowship competition to the Graduate School.

GRADUATE ASSISTANTSHIP

- Appointments are based on "superior ability and promise". Reappointment to an assistantship is based on the quality of the student's work.
- 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.
- 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.
- Students supported by external organizations (such as companies, other universities, foreign governments) or by scholarships or fellowships (including from both internal organizations affiliated to Penn State such as College of Engineering or Graduate School and external sources such as federal agencies or private foundations) are categorized as non-departmentally supported students. These students **may not** receive stipends concurrently from two sources (for example, non-departmental and departmental funds). A one-time top-up award may be arranged for such students (especially, students with scholarships or fellowships) in recognition of their accomplishment, which can be used to support scholarly activities that are not covered by the non-departmental scholarships or fellowships. If the financial support from the non-departmental resources is less than the half-time Graduate Assistantship Grade 16, then the department will try to subsidize the deficit with the available resources. When the non-departmental support expires, the students will be eligible for the financial support from the department (usually, through the grant of the research advisor of the student). Note that all additional financial aid or offer beyond the half-time Graduate Assistantship Grade 16 is subject to the availability of such funds in the department.
- The audited course credits cannot be counted toward the minimum credits needed for the graduate assistantship. 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 from the McWhirter Graduate Program Coordinator while being supported by the graduate assistantship.
- 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.

RESIDENCE TIME LIMITS

Completion of the Ph.D. degree requires demonstrated mastery of a body of knowledge, a set of skills, and evidence of embodying essential professional attributes. Only the most rudimentary of these can be

learned or demonstrated through coursework or remote study. The [Graduate School policy](#) requires that over a twelve-month period the Ph.D. student must spend at least two consecutive semesters, exclusive of summer sessions, as a registered full-time student engaged in academic work at the Penn State campus. Full time University employees enrolled in a Ph.D. program must be registered for 6 credits or more in each semester in which residency is declared and must be certified as full-time employees by their unit leader. Subject 601 and 611 cannot be used to meet this requirement. The exception of this requirement should be discussed with the McWhirter Graduate Program Coordinator.

B.S. chemical engineers entering the graduate program are expected, on average, to attain the Ph.D. degree in 5 years from their admission to the program. Outstanding students often complete their studies in less than 5 years. For graduate students on externally supported projects, funding can be extended beyond the general guidelines at the discretion of the faculty advisor. The Graduate School policy is that a doctoral student is required to complete the program, including acceptance of the doctoral dissertation, **within 8 years after the date of successful completion of the qualifying exam.**

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 (including Thanksgiving, Christmas, and New Year holidays) during the calendar year.

UNSATISFACTORY SCHOLARSHIP

A graduate student who fails to maintain satisfactory scholarship or to make acceptable progress in a degree program may be dropped from the University. One or more failing grades or a cumulative GPA below 3.00 for any semester and the negligence of required research activities may be considered as evidence of failure to maintain satisfactory scholarship. Action may be initiated by the department or committee in charge of the graduate major or by the chair of the student's doctoral committee (typically, research advisor). The procedures to be followed in such action are found in [Appendix III](#) in the Graduate Bulletin.

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. At least 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 if the student is interested in additional teaching experience or if a TA appointment is needed to provide financial support. Students serving as TAs to meet their degree requirement will receive the normal stipend given to all the students. Although not required, M.S. students may also serve as Teaching Assistants.

ENGINEERING 888 - Seminar/Engineering TAs

All Teaching Assistants in Chemical Engineering whose duties include direct interactions with undergraduate students must satisfy the College requirements for TAs by formally registering for the 1 credit course Engineering 888. This course is required for TAs who will have significant responsibilities for classroom interactions with undergraduate students. *The registration and course participation are the best if that is done concurrently with the performance of TA duties.* ENGR 888 examines teaching methods and theories, and focuses on practical information that students can effectively use in their position. The course will be taught in a blended format, with most of the course content and assignments administered online. Students will meet in-person for three sessions during the semester.

Teaching Fellow 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.

Application Process:

The student interested in being a Teaching Fellow should submit to the Department Head the following material at least 3 months prior to the start of the semester in which he/she would like to teach:

- A short write-up explaining the teaching interest / experience and how being a Teaching Fellow would fit into his/her current career plans.
- A list of the course (or courses) interested in co-teaching.
- A short letter / e-mail of support from the faculty the student has previously worked with as a TA.
- A short letter / e-mail of support from the thesis advisor

The student should discuss plans for being a Teaching Fellow with his/her advisor as well as talk with the faculty who are teaching the courses of interest to get a better idea of their expectations. Priority will be given to graduate students who have already completed the minimum TA requirement.

CHEMICAL ENGINEERING COLLOQUIUM (CH E 590, Fall Semester)

Each Fall Semester, short presentations by faculty on their current research projects will be given to all new graduate students, which 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 from the start of the semester. Also, the [Scholarship and Research Integrity \(SARI\)](#) requirements are completed in this class. 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. Ph.D. students typically take this course during the Spring semester of their second year. 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/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 seminar series each semester 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 597 - CHE Seminar, 1 credit) every semester up until completion of their Comprehensive Exam. Note that this credit does not count toward the 24 credit requirements.

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. *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.* The safety training for all new graduate students will be done during the orientation (typically held the week before the Fall semester begins). 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](#).

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 available thesis topics from all faculty members that offer open research positions. These presentations will be made during the ChE 590 Colloquium class. During the 4-8 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 an in-depth investigation of the thesis topics available. It is expected that each student will speak to as all faculty members having thesis topics that are of his/her interest (minimum, three). The meetings also allow the faculty to evaluate the students as potential research assistants in their laboratory.

At the completion of the presentations of all projects offered to the new incoming students, everyone must choose at least three topics and the order of preference should be indicated by numbers 1, 2, and 3 for first, second, and third choices with a brief description about the project and their interests and qualifications. This information will be submitted to the McWhirter Graduate Program Coordinator.

Matching thesis research topics to students' choices will be determined in consultation with the students and faculty members involved. Every effort will be made to assign students their first or second choices. However, students must note that individual faculty can only accommodate a limited number of new students and that the Department has made a commitment to 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 McWhirter Graduate Program Coordinator.

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 available thesis topics and they must meet with the faculty members concerned on an individual basis. The listing will be available from the McWhirter Graduate Program Coordinator.

IF UNASSIGNED AT THE END OF THE FIRST SEMESTER

In rare occasions, students may not find a project that they can work on. In that case, the department may provide financial aid for the Spring semester based on half-time TA assignment or other types of service to the department. During that period, students must proactively search for a project that they can work on. During the Summer semester, students may not receive financial aid from the department without doing research. If the student is still unassigned to a research project at the beginning of the second Fall semester, he/she may receive financial aid from the department again through a half-time TA assignment. If that student fails to find a research project again by the end of the Fall semester of his/her second year, then he/she will not be eligible for further financial aid from the department and will be dismissed from the McWhirter Graduate Program for not making timely progress toward the Ph.D. degree.

CHANGING THE RESEARCH GROUP IN THE MIDDLE OF GRADUATE STUDY

Except non-departmentally supported students, most Ph.D. students are financially supported by research grants secured by the faculty. Since the research grant has a fixed duration, changing the assigned student in the middle of the project may have negative impacts on the student, that specific project and by large the university. Thus, once assigned, the Ph.D. student is expected to take ownership of the project and make the best effort to complete the project before he/she moves to another project. However, a rare situation may arise where a Ph.D. student wishes to change the research group due to irreconcilable personality conflicts with the faculty advisor or differences in opinion about the overall research direction. In such cases, the student should initiate consultation with the McWhirter Graduate Program Coordinator. It is inappropriate for the student to speak to other faculty members about the situation or his/her intention prior to this consultation.

The first recommendation in such situations will be the direct conversation among the student and the faculty advisor to explore possible options for addressing the student's concerns and reconciliation. If the student and advisor are in mutual agreement that a change of research group is appropriate, the McWhirter Graduate Program Coordinator, upon the approval of the Department Head, will inform the faculty of the student's interest in changing thesis advisor.

If the student and advisor are unable to reach an agreement, the student should meet with the McWhirter Graduate Program Coordinator and the Department Head. Then, a plan will be developed to bring the ongoing research efforts to a reasonable state of completion. After the plan is implemented, the student's interest in pursuing a new thesis advisor will be announced to the faculty.

In all the above cases, it is the student's responsibility to meet with interested faculty members to try to identify a new project / advisor. If the student is unable to find a faculty member who is willing to serve as a new thesis advisor, then the student will need to consider other options, e.g., pursuing a graduate degree in another program.

THESIS REGISTRATION AND GRADING POLICY

Graduate students normally register for thesis research using the course number ChE 600. Those who have passed the Ph.D. Comprehensive Exam register under ChE 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.

LEAVING BEFORE COMPLETION OF A THESIS

Some students may consider leaving the department to accept employment before their theses are completed and accepted by the Graduate School. A graduate student who has completed all his/her requirements except thesis submission and defense must register for one credit of ChE 610 or 611 each semester (or its equivalent) for the semester and all succeeding semesters following departure from the university campus. Graduate students will be financially responsible for paying the cost of tuition each semester.

CHANGING FROM PHD TO MS

Graduate students who are originally admitted to the Ph.D. program may wish to change their trajectory towards a MS degree. If this decision is made before the completion of the first year, they may have an option of pursuing the Non-Thesis MS program (which requires meeting a different set of requirements). If the student passes the Ph.D. Qualifying Exam and wishes or needs to leave before the completion of the Ph.D. degree and meets the [requirements for the MS degree](#) set by the Graduate School, then the decision to grant a MS degree will be made in mutual agreement between the student and the faculty advisor. In this case, the student is required to complete a MS thesis based on the research that has been done by that time.

IMPORTANT TIME LINE

The graduating student should be aware of specific deadlines relating to all obligations which must be met during their last semester or summer session before graduation. The updated information is available at [The Thesis, Dissertation, Performance and Oral Presentation Deadlines Calendar](#) available at the Graduate School website.

GRADUATE COURSE OFFERINGS

Core Courses (Required):

- Ch E 524** **Chemical Engineering Applications of Thermodynamics (3).** Thermodynamics of pure fluids and fluid mixtures with emphasis on applications to phase equilibria calculations of importance in Chemical Engineering.
- Ch E 535** **Chemical Reaction Engineering (3).** Optimal design of batch and continuous chemical reactors and reactor batteries; effect of mixing on reactor operation.
- Ch E 544** **General Transport Phenomena (3).** Formulation and solution of transport problems involving momentum, heat, and mass transfer, with chemical engineering applications.

Note: Completing the core courses with a grade of B or higher is required. Students getting a grade lower than the minimum acceptance level in any of the core courses must retake that specific course.

Elective Courses:

- Ch E 510** **Characterization of Material Interfaces (3).** This course reviews undergraduate-level chemistry, physical chemistry and physics relevant to surface and interface characterizations and studies how these basic principles are applied to state-of-the-art materials characterization techniques.
- 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 451, ChE 320 or an equivalent background in chemical thermodynamics.
- 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 546** **Transport Phenomena II (3).** Heat and mass transfer, steady and unsteady state, coupling, molecular diffusion, moving boundaries, transfer coefficients, chemical engineering applications.
- Ch E 576** **Environmental Transport Processes (3).** Fundamentals of chemical transport in engineered environments, such as biofilm reactors, and natural systems including aquifers and rivers (co-listed as C E 576). Prerequisite: C E 475
- Ch E 597** **Special Topics:** Some recent course offerings include:
Bioprocess Engineering (3). Principles of engineering applied to biochemical production, with emphasis on biochemical separations, microbial growth kinetics, and enzyme catalysis.

Numerical Methods in Chemical Engineering (3). Application of numerical analysis and computational methods to the solution of algebraic and differential equations of relevance to chemical engineering.

Non-Linear Optimization: Fundamental and Applications (3). Fundamentals of optimization and applications in Chemical Engineering.

Surfactant Self-Assembly (3). The course discusses quantitative, predictive theories for diverse self-assembly phenomena such as micellization, solubilization, micro-emulsification, and surfactant-polymer interactions developed on the basis of molecular thermodynamic methods.

Modern Control Approaches (3). Introduction to state-space methods for the analysis of dynamic systems and the design of observers to monitor the process and controllers to regulate the process to a desired trajectory.

Electroactive and Conductive Polymers (3).

CONTINUOUS REGISTRATION REQUIREMENT

ChE 600/610 - If the student needs to maintain full-time student status before the Comprehensive Examination, 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).

ChE 601/611 - This special registration should be used by Ph.D. students starting with the semester after the Comprehensive Examination is passed. 601 would be the 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 the program, registration must be maintained each semester up to and including the semester the Final Oral Examination is scheduled. 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: Students should register for ChE 601 (for 0 credits) through the [STAP](#) if they are defending their thesis during the summer. This requirement also applies to the Comprehensive Examination.

Note: If a student defends the Final Oral Examination, the student does not have to register after that semester.

ADVANCING FROM NON-THESIS M.S. TO PH.D. PROGRAM

- Students in the Non-Thesis MS program desiring admission into the Ph.D. program must obtain a course GPA 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 also should take the M.S. Preliminary Exam in the same week that Ph.D. students are taking their Qualifying Exam (early August) and pass with the satisfactory evaluation from the committee assigned by the Graduate Program Coordinator. The exam format is identical to the Ph.D. Qualifying Exam, and students should consult the section on Ph.D. Qualifying Exam within this graduate handbook for further information on the content and the evaluation.
- The evaluation committee will provide a recommendation regarding whether the student should be allowed to continue towards the Ph.D. degree.
- Once admitted to the Ph.D. program, students will get course credits up to 12 credits (three core courses plus one ChE 500-level elective course taken at Penn State) toward the course requirement for the Ph.D. degree and have the freedom to choose a new research topic among the projects available for the new Ph.D. students through the ChE 590 class in the Fall semester.

PH.D. DEGREE REQUIREMENTS

1. 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 9 credits of Chemical Engineering core courses and at least 6 credits of 500-level Chemical Engineering elective courses. With the written 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. Up to 9 credits from 500-level courses outside Chemical Engineering can be counted toward the required 24 credits. Each of the courses counting towards the required 24 credits must be passed with a grade of B- or better.
2. 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. Qualifying 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 submit petition for entrance into the Ph.D. Qualifying as described elsewhere. Exceptions to the requirement for these courses to precede the qualifying exam will be considered on an individual basis, especially for students from non-Chemical Engineering undergraduate programs.
3. 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 as early as possible. In addition, students are required to make an oral presentation at the Department Research Symposium, typically during their 4th year (usually scheduled in the Fall semester).
4. Students must register with proper course or research credits 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.

5. Participation in Chemical Engineering Departmental Seminar is required each semester a student is in residence. Students should register for the seminar course (typically, 1 credit of CHE 597) every semester until they pass the Comprehensive Exam.
6. Students admitted to the McWhirter Graduate Program with a MS degree from another institution may request the use of up to 12 credits of graduate course work from the previous institution toward the 24 credits of course requirement. The process requires submission of full course materials from such courses taken in the previous institution (including the contact information of the course instructor) and the submitted materials will be evaluated by the pertinent course instructor or the McWhirter Graduate Program Coordinator. The final recommendation for the transfer credit will be made based on this evaluation. 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.
7. Completion of all 500 and 600 level credits (including 400-level credits with thesis advisor's approval) with a grade point average of 3.00.
8. Completion of a minimum of one Teaching Assistantship.
9. Completion of the [SARI](#) requirement.

American English Oral Communicative Proficiency Test 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 Communicative Proficiency Test (AEOCPT) administered by the Linguistics and Applied Languages Studies Department at Penn State. The test date will be scheduled by the department (before the Fall semester of the first academic year) and announced to the students who need to take this test. The results from this test are used to recommend remedial steps, if necessary, to be taken by the graduate student.

The Center's evaluation is done in terms of the following proficiency codes:

NR = No Restrictions (PSU AEOCPT Score of = 250-300): This person will be allowed to teach with no restrictions based on ability to communicate in English.

WR (PSU AEOCPT Score of = 230-249): This person *will not* be allowed to do TA before completing and receiving a grade of "A" in ESL 118G.

TC (AEOCPT Score of = 200-229): This person *will not* be allowed to do TA before completing and receiving a grade of "A" in both ESL117G and ESL 118G.

SL (AEOCPT Score below = 200): This person should enroll in ESL 115G and receive a grade of "A", and then complete both ESL 117G and ESL 118G.

Students that have taken the Test of Spoken English (TSE) before arriving at Penn State should see Cathy Krause for assistance in interpreting their scores. Information concerning the TSE can be obtained from the Programming English as a Second Language, 305 Sparks Building, 865-7365.

PH.D. QUALIFYING EXAMINATION

The objectives of the Qualifying 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 Qualifying 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
Note: *Presentation of preliminary results on your project is desirable but not required in the Ph.D. Qualifying Exam.* Examples of research efforts include, but are not limited to, experiments, computations, technique development, data interpretation, and mastery of a research-related technique.
4. Description of the research plan and direction for the next 6 months to a year

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 50-55 min. *The written report is to be a maximum of 5 single-spaced pages, including everything except references. The margin of the page must be 1", and the font size must be 11 pt if Calibri or Arial fonts are used / 12 pt if Time New Roman is used.* 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. However, **the writing and editing of the written report should be the exclusive work of the student** because it will be used by the Department to satisfy the University's requirement for the English Competency Exam.

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

1. Demonstrate mastery of chemical engineering fundamentals
2. Demonstrate 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 entitled 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. 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. Unless otherwise specified by the exam committee, students who do not pass the Qualifying Exam will be required to first complete a M.S. thesis before they can petition to move onto the regular track of the Ph.D. program.

Qualifying Exam Committee:

The Qualifying Exam committee for each student will consist of 3 graduate faculty members assigned by the McWhirter Graduate Program Coordinator. 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 Qualifying Exam

In order to take the Qualifying Exam, students must first obtain a minimum GPA of 3.33 in ChE 524, ChE 535, and ChE 544, and complete each of these courses with a grade of B or better. This requirement is designed to ensure that all Ph.D. students have sufficient understanding of the core Chemical Engineering fundamentals to pursue advanced study and professional career opportunities.

For the students to meet this GPA requirement from the first Fall semester, the Ph.D. Qualifying Exam will be scheduled in early August in the following year. The timing for the Qualifying 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. Qualifying Exam the first time this exam is scheduled after they enter the Graduate Program. The written part of the exam must be submitted to Cathy Krause at least two weeks prior to the oral exam.

Students who do not meet this prerequisite (a GPA of 3.33 and higher from the three core courses) will be required to take the M.S. Preliminary Exam (scheduled in the same week of the Ph.D. Qualifying Exam)** and complete a MS thesis before they can petition for an exemption from the GPA requirement. The decision to allow the student to continue towards the MS degree will be made by the student's thesis advisor. Upon completion of the MS degree, the student can submit a written petition (including a letter from the thesis advisor), requesting to continue working toward the PhD study. Petitions will be discussed among the entire faculty and will be granted only if the student has demonstrated truly exceptional research performance, leading to publication of key research results. If the petition is approved, it is equivalent to meet the Ph.D. Qualifying Exam and the student will be allowed to continue the Ph.D. study.

** For the student in the M.S. track who *performs exceptionally outstanding at the M.S. Preliminary Exam*, the exam committee and the faculty advisor can suggest waiving the 3.33 GPA prerequisite and moving the student back to the normal track of the PhD program. Then, the suggested waiver will be discussed at the faculty meeting and granted upon approval of the majority of faculty attending that meeting.

Criterion of Research Performance:

Research performance from the thesis advisor will be used as an additional criterion in making the pass/fail decisions on the Qualifying Exam. The thesis advisors will be asked to present the Qualifying 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.

English Competency Evaluation through Ph.D. Qualifying Exam

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. Qualifying Examination by a committee of 3 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 document will be judged for its organization, the logical arguments in support of the student's hypotheses, the inclusion of relevant details, and 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 judged 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 professional society meetings (such as AIChE Annual 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 Qualifying 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.

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 may recommend the suitable course(s), workshops, or consultation sessions. Examples include:

- (i) Oral Language Skills: ESL 114G (American Oral English for Academic Purposes), ESL 115G (American Oral English for ITAs I)
- (iii) Writing Skills: ESL 116G (Composition for Academic Disciplines), ENGL 202C (Effective Writing: Technical Writing), ENGL 198G (Writing in the Disciplines)
- (iv) Communication skills: Individual consultations or workshops offered by [English for Professional Purposes Intercultural Center \(EPPIC\)](#)

If the student completes and passes the recommended steps with satisfactory grades or evaluations, then the student will be certified as having attained English competency. Students judged as not making sufficient progress towards achieving competency in English will have their funding terminated.

Further Opportunities for Enhancement of English Competency

The department has two additional requirements designed to enhance the English competency of all doctoral students – Colloquium (ChE 590 in the Spring semester, 1 credit) and Department Research Symposium (typically in the Fall semester of student's 4th year).

Graduate Minors

A [Graduate Minor](#) may be taken in one of the approved graduate degree programs offered at Penn State. A doctoral minor consists of no fewer than 15 graduate credits of integrated or articulated work in one field related to, but different from, that of the major with a preponderance of courses at the 500 level; however, at a minimum, 6 credits must be at the 500 level.

A student seeking a minor must have the approval of the student's major program of study, the minor program, and the Graduate School. *Official requests to add a minor to a doctoral candidate's academic record must be submitted to Graduate Enrollment Services prior to establishing the doctoral committee and prior to scheduling the comprehensive examination.*

APPOINTMENT OF DOCTORAL COMMITTEE

- A. After the student passes the Ph.D. Qualifying Exam and before he/she takes the Comprehensive Exam, members of his/her Doctoral Committee must be appointed. The doctoral committee is nominated to the Graduate School by the McWhirter Graduate Program Coordinator, based upon input from the student and the student's adviser.
- B. The Doctoral Committee is to consist of at least 3 Graduate Faculty members in the major field (Chemical Engineering) and at least 1 Faculty member outside the major field (called "Outside Unit Member"). The Committee Chair will ordinarily be the candidate's research advisor.

The primary duties of the Chair are to: (1) maintain the academic standards of the doctoral program, Graduate Council, and the Graduate School and assure that all procedures are carried out fairly, (2) ensure that the comprehensive examination and final oral examination are conducted in a timely fashion, and (3) ensure that requirements set forth by the committee are implemented in the final version of the dissertation.

The Outside Side 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.

- C. 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.
- D. The student's doctoral committee has the responsibility to guide the course of study undertaken by the student.
- E. If a student is pursuing a [Graduate Minor](#), then at least one member of the Doctoral Committee must be a member of that Department.
- F. A person who has particular expertise in the candidate's research area but is not a member of the Graduate Faculty (either affiliated with Penn State or not) may be added as a "Special Member," upon recommendation by the thesis advisor and the McWhirter Graduate Program Coordinator and approval of the director of Graduate Enrollment Services.
- G. Graduate Faculty officially appointed by the Graduate School to a doctoral committee who then leave Penn State may maintain that committee appointment for up to one year if the student's graduate program and the dean of the Graduate School, through the Office of Graduate Enrollment Services, approve the request for this exception. A retired or emeritus faculty member may serve as a doctoral committee chair if, and only if, he/she was officially appointed and began chairing the committee prior to retirement and has the continuing approval of the program head and the dean of the Graduate School, through the Office of Graduate Enrollment Services. Requests must be sent by the program head to the director of Graduate Enrollment Services.
- H. The membership of doctoral committees will be reviewed periodically by the McWhirter Graduate Coordinator to ensure that all members continue to qualify for service on the committee in their designated roles. If changes are warranted, they must be made as soon as possible to prevent future problems that may delay academic progress for the student.

COMPREHENSIVE EXAMINATION

A Comprehensive Examination is required for 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 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 15 single-spaced pages with 1" margins and using a font size of 11 pt if Calibri or Arial fonts are used / 12 pt if Time New Roman is used. 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 electronically to Cathy Krause 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 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. It is expected that all 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.

Note: When a period of more than 6 years has elapsed after passing the Comprehensive Examination, the student is required to pass a second Comprehensive Examination before the Final Oral Examination will be scheduled. This should be at least 3 months before the Final Oral Dissertation Defense.

AWARDS

The McWhirter Graduate Program is fully committed to recognizing outstanding performance of our graduate students. The Department provides special awards to recognize graduate student(s) whose performance has been particularly outstanding every year. The award categories are as follows:

Walter L. Robb Fellowship for Outstanding Performance on Qualifying Exam

Excellence in Teaching

Annual Competition for Best Paper

Best Presentation Award at the Chemical Engineering Research Symposium

The Robb Fellowships will be made by the Department Head in consultation with the faculty and the McWhirter Graduate Program Coordinator. Decisions on the best TA, paper, and presentation awards will be made by the McWhirter Graduate Program Committee.

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 a formal approval for an external internship is not required for US graduate students, it should be planned with the full knowledge and cooperation of the student's advisor.

For international students, it should be noted that employment for F-1 and J-1 students is limited and working without permission is a violation of status and a deportable offense. F-1 and J-1 students may not work off-campus (such as [Curricular Practical Training \(CPT\)](#)) without prior consultation with their advisor and the [Directorate of International Student and Scholar Advising \(DISSA\)](#). If the external internship enriches the student's graduate education in their specific research topic and is central to their research towards the PhD degree, the student should seek permission from the DISSA; working without approval from the DISSA is [a deportable offense](#). Also, it should be noted that F-1 students will be responsible for course registration of the semester working under CPT (601 for Fall/Spring and 610 for summer) as well as tuition payment (except for the summer).

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 should be given to each of the committee members for at least two weeks before the date of the scheduled examination. The dissertation should be complete and in its final draft, with correct and polished content and style, appropriate notes, bibliography, tables, etc., at the time it is distributed to the committee members. If a committee member finds that the final draft is not correct and polished with respect to content and style, it is his/her responsibility to notify the committee chair/dissertation adviser at least one week in advance of the final oral examination date. The committee member should indicate his/her concerns regarding the draft and may recommend consideration of postponement of the examination to the committee chair/dissertation adviser. The chair/adviser, in consultation with committee members, is responsible for notifying the student and assessing whether the student can make the necessary revisions to the final draft before the examination date. If it is determined that revisions cannot be made in time, the final oral examination must be postponed. Note that

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. At least 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.

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 and submit the required Doctoral Signatory Page. The dissertation is usually expected to be submitted in the same semester as the oral defense.

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 [University Bulletin](#). These are the Graduate School Requirements and do not include the specific department requirements:

- Residency requirement. After passing the doctoral Qualifying Examination, students must be registered full time for two semesters in a twelve-month period. This may include the semester of Qualifying Examination if it is taken during spring or fall.
- A candidate for the Ph.D. must have satisfied the departmental English Competency Test before taking the Comprehensive Examination.
- Three or more months must have elapsed between the passing of the Comprehensive Examination and scheduling of the Final Oral Examination.
- 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.
- Continuous registration requirement. Students must be registered continuously each semester (excluding summers without taking the Oral Comprehensive Examination and the Final Oral Examination) beginning with the semester following the passing of the Comprehensive Examination and continuing each semester until the Final Oral Examination is passed.
- Time limitations. All requirements including submission of the thesis must be completed within eight years of the Qualifying date.
- 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.

Thesis and Dissertation Information

The Graduate School, the University Libraries, and the graduate faculty of Penn State have established format standards that a thesis or dissertation must meet before receiving final approval as fulfillment of a graduate requirement. Every thesis and dissertation must be reviewed by the Office of Theses and Dissertations for format only and are not edited for spelling, grammar, or punctuation. Master's papers are not reviewed by the Office of Theses and Dissertations.

When a thesis or dissertation is submitted to the Office of Theses and Dissertations, it must meet the formatting and [deadline](#) requirements set forth in the [Thesis and Dissertation Guide](#). Additional information can be found at [the Office of Thesis and Dissertations website](#).

Thesis Production in the Department

An electronic copy of your thesis must be submitted to the Graduate School in a pdf format. The department will print and bound one copy for the student and one copy of the advisor(s); to arrange the printing of the thesis, the pdf file of the thesis should be sent to **Lisa Haines**. Purchase of additional copies can be requested at the submission of the pdf copy. Students are responsible for their own proofreading required in connection with the thesis.

NON-THESIS MS DEGREE IN CHEMICAL ENGINEERING

The non-thesis MS track integrates fundamental Chemical Engineering concepts with a culminating chemical engineering research project. This program will provide a framework for life-long learning and problem solving via the application of advanced chemical engineering topics.

The non-thesis MS track consists of 30 credits, including 21 credits of coursework, 2 credits of colloquium, and 7 credits of research that culminates in a research project showcase (poster presentation) and paper. This program will allow students to complete a MS degree typically in 12 months, beginning in the fall and including spring and summer semesters.

A typical program of study for non-thesis MS students:

Fall Semester (14 credits)

CHE 524, Chemical Engineering Application of Thermodynamics (3)
CHE 535, Chemical Reaction Engineering (3)
CHE 544, General Transport Phenomena (3)
CHE 5XX, Graduate Elective (3)
CHE 590, Colloquium (1)
CHE 596, Independent Study (1) [supervised by the MS program coordinator]

Spring Semester (15 credits)

CHE 5XX, Graduate Elective (3)
ENGR/SCI Elective (3)
ENGR/SCI Elective (3)
CHE 590, Research Skills Development Colloquium (1)
CHE 596, Independent Study (5) [supervised by the student's research advisor]

Summer Semester (1 credit)

CHE 596, Independent Study (1) [supervised by the student's research advisor]

Though students are registered for only 1 credit of CHE 596 during the summer, they are expected to devote their full effort towards their research.

Elective Courses

The non-thesis MS degree requires 2 CHE 5XX electives and 2 ENGR/SCI electives. Students typically have room in their schedule for one elective course in the Fall. Here are some electives you might consider. Note the list of ENGR/SCI electives is not exhaustive, as any 5XX in an engineering or science discipline would be acceptable, and you are allowed to substitute one 4xx for one of the ENGR/SCI courses.

CHE 5XX elective courses [check the LIONPATH for course offering in each semester]

CHE 501, Bioengineering Transport Phenomena

CHE 510, Surface Characterization of Materials
CHE 536, Heterogeneous Catalysis
CHE 576, Environmental Transport Processes
CHE 597, Cellular Biophysics
CHE 597, SynBio: Engineering Genetic Systems

ENGR/SCI electives that may be of interest

MATSE 501, Thermodynamics of Materials
MATSE 514, Characterization of Materials
MATSE 542, Polymeric Materials: The Solid State
MATSE 575, Functional Polymeric Materials
BIOE 512, Cell and Molecular Bioengineering
ME 550, Foundations of Engineering Systems Analysis
CHEM 525, Analytical Separations
CHEM 526, Spectroscopic Analysis
CHEM 545, Statistical Thermodynamics

Advisor and Research Project Selection

During the Fall semester, MS students will be distributed a list of available research projects and advisors. Advisors will present at the CHE 590 Colloquium course, describing research in their group and the available projects. Students will then schedule individual meetings with faculty they are interesting in working with. By a prescribed date, typically in early to mid-October, students will provide a ranking of their project preferences to the MS program coordinator. The faculty will meet to match students with advisors, considering preferences of the students as a priority but also considering faculty opinions on the suitability of a match to the group and the balance of students across advisors. Students will be informed of their project assignment within a few weeks of submitting their choices.

Completion of research requirements of non-thesis MS program

To complete the research requirements of the non-thesis MS program, students must:

- A) Receive a grade of C or higher in 7 credits of CHE 596, Independent Study
- B) Present a poster on their research to the faculty at the end of the summer of their first year in the program
- C) Submit and have approved their final research paper.

Poster Presentation

A poster session will be scheduled for early August, held over lunch with each student presenting their research to a small group of faculty, mainly composed of the MS Program Coordinator and other MS research advisors. Faculty will ask questions of the students and provide feedback on questions that might be answered when preparing their written document.

TENTATIVE DATE: The first Friday of August

Final Research Paper Requirements

The final research paper must represent an **academic contribution** to the field of Chemical Engineering. It should follow an academic style in its sub-discipline of CHE, typically including an *Introduction* providing the research motivation, background, and objectives/hypothesis;

Methods section describing the approach towards reaching the research goals;
Results and analysis with *Discussion* in context of the field and the goals of the research;
Conclusions: a final set of outcomes of the work.

Figures, tables, and schematics should be used to aid in explaining and reporting the work completed. References to the published literature should be used to aid in providing background on the area and methods used, and to put the work completed in the context of the field. Bibliography format should follow Penn State thesis guidelines.

The document must represent original work prepared by the student.

A typical length of the document would be 10 pages, single spaced, though length may vary.

The document must be approved by both the research advisor and the MS program coordinator. A signature sheet template must be obtained from Cathy Krause and should be signed by the research advisor and the MS Program Coordinator.

TENTATIVE DUE DATE FOR FINAL SIGNATURES: The second Wednesday of August

Non-thesis MS students, graduation timing

The typical period of student for a non-thesis MS student is expected to be 12 calendar months, beginning with the fall semester and ending with the completion of the research paper at the end of the following summer. Students who postpone any of the 21 credits of coursework, or need to repeat a class due to a dropping or a failing grade, may do so in Fall of their second year. Students needing more time to complete their research may also extend into the Fall of their second year. During fall of the second year, students may pay tuition per credit for any credits needed to graduate from the program. International student's visas may be extended without requiring full time (9 credit) enrollment during the final semester of graduation.

Applying to the PhD program in Chemical Engineering at Penn State

The non-thesis MS program is not intended to serve as a step towards PhD studies in the department, and it is not expected that a majority of students will continue to PhD. Students are welcome to apply during the normal winter application period. Applications received at this time will be compared with external applications, and mainly judged on the student's undergraduate record. Non-thesis MS students may submit applications to the PhD program over the summer as well. For interested students, an oral exam following the same format as the department's PhD candidacy exam (5 page paper, 20 minute oral presentation, 30 minutes of questioning) will be scheduled to aid in the admission decision.

Transfer to the thesis MS program.

Our department does not admit students to a thesis MS program, and does not generally have an intent to have students in this program. Requests to transfer to this program following completion of 12 months of MS study may be considered, with the requirement that any student in the thesis MS program be financially supported (tuition plus stipend) by their research advisor.

STUDENT ORGANIZATIONS

The **Chemical Engineering Graduate Student Association (GSA)** represents Ch E graduate students in department-oriented matters. Examples of activities in which the GSA 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 GSA at some point of their graduate academic career.

The current president of GSA is **Daniel Cetnar** (dpc5107@psu.edu). Students who want to get involved in GSA activities are encouraged to contact the GSA president.

APPENDIX

The links available in this page provide details on graduate student's responsibilities and useful guidance or information about various situations not covered in this handbook.

[Code of Conduct](#) The Pennsylvania State University recognizes the basic rights and responsibilities of the members of the University and accepts its obligation to preserve and protect those rights and responsibilities.

[Procedures for Resolution of Problems](#) These procedures pertain to a range of concerns and disagreements involving graduate students and other members of the University community.

[Procedures for Termination of the Degree Program of a Graduate Student for Unsatisfactory Scholarship](#) Every graduate student is expected to exhibit and promote the highest ethical, moral, and professional standards as scholars, and as future faculty, professionals, and leaders in their respective fields. Meeting this expectation is a component of satisfactory scholarship for graduate students, in addition to meeting academic standards. A violation of ethical, moral, and/or professional standards is regarded as a serious offense may result in academic sanctions including suspension or dismissal by the graduate program and/or by the Graduate School. Where the basis for unsatisfactory scholarship is behavior that is believed to fall within the Code of Conduct, it should first be referred to the Office of Student Conduct for adjudication.

[Procedures for Termination of Assistantships due to Inadequate Performance](#) The purpose of this policy is to provide guidance to units in dealing with inadequate performance by graduate assistants. This policy applies only to inadequate performance by a graduate assistant in his or her duties and responsibilities during the term of appointment. It does not apply to (i) a decision by the unit not to renew an assistantship appointment, (ii) matters involving the academic performance of the graduate assistant, and (iii) the automatic termination of an assistantship appointment when the graduate assistant is no longer a student.

[Guidelines for Graduate Assistant Paid Leave](#) Circumstances occasionally occur that prevent graduate assistants (including graduate teaching assistants, TAs, and graduate research assistants, RAs) from performing the duties of their appointment. Consistent with Penn State's continuous effort to support the personal and professional development of all members of our community, these guidelines seek to reduce the professional and personal stresses that can develop when graduate assistants encounter extenuating circumstances that warrant a temporary absence from their assistantship duties, while continuing their stipend and benefits.

[Letter of Certification](#) Candidates for graduation during a particular semester may request an official letter that verifies their status with respect to meeting degree requirements and their expected graduation date. Potential employers, licensure boards, embassies and other agencies may require this type of verification, including petitions for H-1B visas.

[Recommended Practices in Graduate Education](#) This document suggests examples of recommended practices in each of three core areas for all of the key participants in graduate student education.

Tax Information: GSA TAX Guide available for pick up at 118B Kern Building. For international students, the [DISSA office](#) can provide further information.