A Guide to Graduate Studies in Chemical Engineering

School of Chemical Engineering
Purdue University

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1. Introduction

This document summarizes the policies, procedures, and requirements for graduate studies in the School of Chemical Engineering. In particular, it emphasizes policies, procedures, and requirements that are left by the Graduate School to the discretion of the School.

The majority of students enrolling in graduate studies in the School do so to pursue the Doctor of Philosophy (PhD) degree. The School also offers Master's (MS) degrees with thesis [MS(thesis)] and nono-thesis [MS(non-thesis)] options. After enrollment, a student must accomplish a number of tasks to obtain a degree. These include passing the PhD qualifying procedure, which occurs a little over a year after a student joins the School and is required before a student is admitted into the PhD program, and the preliminary examination, which occurs about two and a half years after enrollment and is required before a student is admitted into PhD candidacy. Along the way, the student must pick a thesis or research advisor, form a thesis advisory committee, take courses and do well in them, file plans of study, do research, give seminars and other oral presentations, prepare reports, publish papers, and serve as a teaching assistant (TA), among other things. Some of the key events in a student's graduate career are summarized in Appendix 1. This document discusses all of these events in detail and also provides information on vacation policies, safety, and any other issue that may arise while the student works toward the successful completion of his/her thesis dissertation and degree requirements.

2. Degree programs

The school offers Doctor of Philosophy (PhD), Masters degree with a research thesis (MS(thesis)) and a coursework based Masters degree (MS(non-thesis).

2.1. Typical PhD degree program

The PhD program is designed to prepare each student to take an active part in the development and growth of the field of chemical engineering at all levels in industry and various research organizations, e.g. national laboratories, or in research and teaching in a university. To qualify for the PhD program, a student must demonstrate competence in graduate course work and demonstrate the capability to do independent research. This process is called the PhD Qualifying Procedure and is described in detail in section 3. Most students who qualify are eligible to proceed directly to the PhD program without writing an MS thesis. Beginning with the third semester, each student, as part of the degree requirement, occasionally assists in the instructional activities of the department. The current periodicity is one semester every other year. Advanced students may have the opportunity to participate directly in the planning and presentation of undergraduate courses that are related to their thesis work.

As described in greater detail in sections 6 and 8, each student selects a major professor and an advisory committee to assist him/her in planning a program of course work and thesis research. Thirty hours of graduate course work (including those for the MS) are required for the PhD degree . The thesis research should be original work that contributes significantly to new knowledge. Major research work is preceded by a preliminary examination, discussed in section 4, at which the student presents to the advisory committee a plan for research and demonstrates proficiency in the theory and experimental methods needed for its completion. Once a student passes this hurdle, he/she is said to have been admitted into candidacy. The final PhD examination is the defense of the written thesis. The appendix gives rubrics for the oral qualifier, preliminary exam and final exam the student's committee will use to judge the performance of the student and to give feedback.

2.1.1. Residence time

Students entering the PhD program with an undergraduate degree in chemical engineering can expect to take approximately four calendar years to complete the degree requirements. Those who arrive with an MS in chemical engineering may be able to go through the program in three years. If a student obtains an MS on the way to the PhD, his/her tenure may be about four and a half years. However, if the student joins the program with a BS in another discipline, obtaining the PhD may take up to five years.

The aforementioned durations indicate the desirable timings. The actual timings may be somewhat longer or shorter depending on the nature of the research attempted and the student's academic progress. Financial support by the School is guaranteed only for the indicated periods of time. Moreover, if the student's tenure runs over a year longer than these times, the financial support may be reviewed by the Head and the Director of Graduate Studies (DGS) of the School. Upon this review and after consultation with the advisor, the support may be reduced or withdrawn.

2.1.2. Credit and course requirements

A PhD degree in chemical engineering requires a minimum of ten (10) three-credit-hour courses for a total of thirty (30) credit hours. Four of these courses must be core courses in chemical engineering (see below) and the remaining six are electives. The electives are typically a mixture of courses from chemical engineering and other disciplines that are chosen by the student after consultation with the advisor and sometimes the advisory committee. Most elective should be at 500 or 600 level. A maximum of 6 credit hours of electives from 300 and 400 level courses with approval of the advisory committee.

The four core courses are:
ChE 610 (Advanced Chemical Engineering Thermodynamics, hereafter called Thermo)
ChE 620 (Advanced Transport Phenomena I, hereafter called Transport 1)
ChE 630 (Applied Mathematics for Chemical Engineers, hereafter called Math)
ChE 660 (Chemical Reaction Engineering, hereafter called Reaction Engineering)

ChE 610, 620, and 630 are offered every fall semester and 660 is offered every spring semester.

Students are required to take four courses during their first semester. The typical student who comes to Purdue with a BS in chemical engineering takes ChE 610, 620, and 630 and a three-credit-hour elective in the first semester. Exceptions result because some students may have an unusually good or inadequate preparation in some or all of the areas covered by the core courses. The exceptions are handled on a case-by-case basis by the student and the Director of Graduate Studies (DGS). In addition, each student signs up for six credit hours of research (ChE 698), graduate seminar (ChE 690) which is required but carries no credit, and Safety in the Chemistry Laboratory (CHM 605) which is also a zero-credit required course. With the exception of summer sessions and possibly the semester in which he/she may be graduating, each student registers for 18 credit hours each fall and spring semester.

For students who join the program with a BS degree in chemical engineering, the core course sequence must be completed within the first two semesters of residence. For others, this requirement must be met in three semesters. Thus, the typical student usually takes ChE 660 during the second semester. By this time, all students have been matched with thesis advisors. A student may also take one or more electives during the second semester. In addition, the student would sign up for sufficient number of credit hours of research to bring his/her total credits to 18 and the zero-credit graduate seminar (ChE 690).

Once the student is admitted into the PhD program, i.e. once he/she passes the qualifying procedure, he/she must sign up for ChE 699, which is the equivalent of the MS-course ChE 698 for PhD students. Some students elect to satisfy their course requirements by doing the remaining course work during either the first semester of their second year or their second year. Others opt to spread

out the remaining course work over their tenure in graduate school. The first option allows the student to focus virtually exclusively on research beyond the third or the fourth semester. The second option allows for the fact that some specialized graduate level courses inside and outside the School may only be offered every two or three years.

Summers are excellent times for students to concentrate on research without interruptions. PhD students are expected to devote all their time to research during summers. They receive 9 credits for research during the summer sessions.

2.2. Typical MS degree program with research thesis (MS(thesis))

The MS program is designed to prepare each student to make an effective contribution to engineering research, development, production, design or management. In addition to leading to the MS degree, this program provides a basis for continued study leading to the PhD degree. The program consists of a set of graduate courses, independent research, and defense of a thesis based on this research. Similar to PhD students, beginning with the third semester, each MS student, as part of the degree requirement, occasionally assists in the instructional activities of the department. The current periodicity is one semester every other year. Given the residence time of MS students (see below), the typical student will TA once during his/tenure in the School unless he/she advances into the PhD program.

As described in greater detail in sections 6 and 8, each student selects a major professor and an advisory committee to assist him/her in planning a program of course work and thesis research. Fifteen hours of graduate course work are required for the MS degree. The thesis research should be original work that contributes to new knowledge but will be of limited scope compared to PhD thesis research. The student will defend her/his thesis at an final defense. A rubric for the oral defense that the thesis committee will use to evaluate the written thesis and oral defense is attached in the appendix.

2.2.1 Residence time

Students entering the MS program with an undergraduate degree in chemical engineering can expect to take approximately two calendar years to complete the degree requirements. However, if the student joins the program with a BS in another discipline, obtaining the MS may take about two and a half to three years. The actual timings may be somewhat longer or shorter depending on the nature of the research attempted and the student's academic progress. If the student's tenure runs over six months longer than the times indicated in the first paragraph, the financial support may be reviewed by the Head and the Director of Graduate Studies (DGS) of the School. Upon this review and after consultation with the advisor, the support may be reduced or withdrawn. Infrequently, a PhD student may change his/her mind and decide to leave the university with an MS degree. In such situations, a time table for completing the MS thesis will be set by the advisor alone or the advisor in consultation with the Head and DGS.

2.2.2. Credit and course requirements

An MS(thesis) degree in chemical engineering requires a minimum of five (5) three-credit-hour courses for a total of fifteen (15) credit hours. Four of these courses must be core courses in chemical engineering and are identical to the core courses listed previously in the description of the PhD program. The elective may be a course from chemical engineering or another discipline, and is chosen by the student after consultation with the advisor and sometimes the advisory committee. Course credits obtained while the student is working toward the MS can be used toward the PhD degree.

The MS(thesis) students take the same courses, including research, seminar, and safety course, taken by the PhD students during their first semester. They then take one more three-credit-hour class, plus research and seminar, during their second semester to meet the course requirement. With the exception of summer sessions and possibly the semester in which they may be graduating, MS students sign up for 18 credit hours each fall and spring semester.

2.2. Typical coursework MS degree program (MS(non-thesis)).

An MS(non-thesis) degree in chemical engineering requires a minimum of ten (10) three-credit-hour courses for a total of thirty (30) credit hours. Four of these courses must be core courses in chemical engineering (see below) and the remaining six are electives. The electives are typically a mixture of courses from chemical engineering and other disciplines that are chosen by the student after consultation with the advisor and sometimes the advisory committee. The MS (non-thesis) degree does not require a dissertation. However, students may take a research project as one of their elective courses. A maximum of 6 credit hours of electives from 300 and 400 level courses with approval of the advisory committee.

The four core courses are:
ChE 610 (Advanced Chemical Engineering Thermodynamics, hereafter called Thermo)
ChE 620 (Advanced Transport Phenomena I, hereafter called Transport 1)
ChE 630 (Applied Mathematics for Chemical Engineers, hereafter called Math)
ChE 660 (Chemical Reaction Engineering, hereafter called Reaction Engineering)

ChE 610, 620, and 630 are offered every fall semester and 660 is offered every spring semester.

3. PhD qualifying procedure

The PhD qualifying procedure consists of two parts:

- Performance in the coursework, particularly the four core courses, the purpose of which is to ensure the student is capable of doing work at the graduate level;
- Performance in an ***oral presentation*** and a ***written report on research***, the purpose of which is to ensure that the student is able to do independent creative work.

3.1. Coursework performance

Students need to perform at a satisfactory level in coursework during their first year, particularly in the core courses outlined in section 2.1.2. Students should maintain an overall GPA of 3.0 or higher and receive no more than one C in a core course. A student who receives multiple Cs and/or a grade lower than a C in any course may be placed on probation or asked to leave the program. If a student receives three Cs in core courses, the student will be required to terminate with an MS(non-thesis) degree.

3.2. Oral/written research exam

Any student who enters the graduate program in the Fall (Spring) semester has to submit a written research report and give an oral research presentation to a committee consisting of three faculty members and chaired by his/her thesis advisor and at least one other Chemical Engineering faculty member. The deadline for submission of the written report is September 15 (February 15). The report is limited to no more than 15 pages but may also contain appendices. Before the end of October (March) the same year, the student must defend his/her written report and undergo an oral oral examination on his/her thesis research and subjects of relevance to his/her research specialty.

A typical written report will have the following structure:

Summary
Introduction and Research Objectives
Background Literature and Theory
Research Plan

- Methods and materials
- Preliminary results
- Plan for next 12 months

Appendices

The report structure may vary somewhat with the research field and with the progress at the time of the oral examination. Students should agree to a structure for the report with their advisor and discuss content of the report at least a month before it is submitted.

The oral examination lasts between 1.5 and 2 hours. It begins with a formal presentation from the student to the committee and is followed by questions and additional discussion. Students should plan their presentation to be approximately 30 minutes. This presentation should include a brief overview of important concepts in the research area relevant to the thesis topic, a statement of draft research objectives, a summary of research progress so far (training, methods and materials,

preliminary results and analysis) and a research plan for the next 12 months. The committee uses a rubric (see appendix) to examine the student and to provide formal feedback.

Based on performance in the oral/written research exam and considering the student's performance in coursework (including core courses) to this point, the committee will recommend to the Graduate Committee one of three options:

1. The student be admitted to the PhD program;
2. The student complete an MS (thesis) degree and a decision on admission to the PhD be decided based on the defense of the MS (thesis);
3. The student should terminate with an MS (thesis) or MS (non-thesis) degree.

3.3. Admission to the PhD program

Once the oral/written research examination is completed, the Graduate Committee will meet to decide the results of the PhD qualifying procedure based on:

1. Coursework performance particularly in core courses
2. Recommendations from the student's advisory committee following the oral examination.

All students who (1) have a GPA of 3.0 or higher, (2) have no more than one grade of C in core courses, and (3) are recommended for admission to the PhD program by their committee, will automatically be admitted to the PhD program.

Students who do not meet all three of the above measures will be considered on a case by case basis by the Graduate Committee, with one of three possible outcomes:

1. The student will be admitted to the PhD program;
2. The student will be asked to complete an MS (thesis) degree and a decision on admission to the PhD be decided based on the defense of the MS (thesis);
3. The student will be asked to terminate with an MS (thesis) or MS (non-thesis) degree.

Students who receive three Cs in core courses will be asked to terminate with an MS (thesis) or MS (non-thesis) degree.

Students will receive formal notification of the Graduate Committee decision by the end of November (Fall students) or April (Spring students).

Where a student is required to terminate with an MS degree, financial support (stipend and tuition fees) during completion of the MS degree is at the discretion of the advisor and the Head of School.

4. The PhD preliminary examination

PhD candidates in the School of Chemical Engineering are required to schedule and conduct their *oral preliminary examination* before the beginning of their sixth semester of graduate study. If candidates do not pass this examination, they are required to retake and successfully pass the examination by the end of the sixth semester. If this requirement is not met, the students' financial support may be terminated starting the beginning of the seventh semester. The University requires that the preliminary examination be completed at least two full semesters prior to scheduling the final Ph.D. examination eg. students completing a preliminary examination in Spring may defend in Spring of the following year. More typically in chemical engineering, students passing their preliminary examination in semester 5 or 6 aim to defend and graduate in the summer after semester 8 of their degree.

The student will need to arrange with his/her Advisory Committee for a suitable time and file a request to conduct a Preliminary Examination with the Graduate Administrator at least two and one-half weeks ahead of time, giving the time, place, and names of the committee members. A written preliminary report should be submitted to the committee at least one week prior to the oral examination.

The examination is intended to demonstrate to the committee that the student is adequately prepared for PhD research, including a good grasp of the previous work and how it relates to his/her research, a set of objectives for the work which are realistic, and a collection of methods which are capable of attaining the objectives. In most cases, the student will have performed enough work (experimental and/or theoretical) to demonstrate that the methods produce results, but since the committee's objective is to consult with the student on the directions and methods of the PhD work, most of the thesis work will occur after the examination.

A typical written preliminary report will have the following structure:

Summary
Introduction and Research Objectives
Literature Review
Research Plan

- Theory
- Methods and materials
- Results to date
- Research plan and schedule to complete the PhD.

Appendices

It is important that the introduction and critical literature review support the originality and significance of the stated research objectives. The report structure may vary a little with the research field and with the progress at the time of the preliminary examination. Typically, the report (not including appendices) will not exceed 30 pages. Students should agree a structure for the report with their advisor and discuss content of the report at least a month before it is submitted.

The oral examination lasts between 1.5 and 2 hours. It begins with a formal presentation from the student to the committee and is followed by questions and additional discussion. Students should plan their presentation to be approximately 45 minutes. The presentation should give a *brief* review of the literature, but focus mainly stating and defending the research objectives, describing the

research methods, presenting and critiquing results to this point and explaining the research plan for the PhD.

The committee uses a rubric (see appendix) to examine the student and to provide formal feedback. The committee should provide constructive feedback and suggestions on the originality and significance of the proposed research, the suitability of the proposed methods and the likelihood of the plan being achieved in reasonable time.

In some cases, the committee may ask the student should alter his/her directions, or read or collect more information in a new direction or rewrite section of the written report before approving the student's candidature. The committee may also wish to meet with the student again at a later time to discuss the student's response to their concerns. If the student has met the deadline with the first meeting and passes the examination at the second or later meeting (but no later than by the end of the sixth semester), the student will have achieved the preliminary examination objective. He/she will then be admitted to PhD candidacy and may also be eligible for an increase in stipend.

5. Grades

Only grades of A (4.0), B (3.0), or C (2.0) are acceptable for courses on a plan of study. The C grade is viewed as marginal performance in courses at the graduate level. If a student's graduate index falls below 3.0, he/she will be assigned a probationary status and must attain a semester index of 3.0 or better for each subsequent semester that the student is on probation. If the student does not subsequently maintain a 3.0 semester average, he/she will not be allowed to continue in the graduate program in Chemical Engineering. If the student's graduate index rises above 3.0, his/her probationary status will be removed.

If a student receives two grades of U (unsatisfactory) in research (ChE 698 or 699), he/she will not be allowed to continue in the graduate program in Chemical Engineering.

If a student feels that the grade in a course or in research has been unfairly assigned, he/she can appeal that grade using the University appeal procedure as detailed in Part 5, Section III-E of the University Regulations Handbook. The appeals procedure consists of the following sequence of events:

1. The student should attempt to resolve the dispute with the appropriate faculty member.
2. If step 1 is not satisfactory, the student may appeal to the Head of the School of Chemical Engineering and/or the DGS. The Head and/or the DGS may choose to personally resolve the dispute or he/she (they) may appoint a special committee to act in his/her (their) behalf (behalves) to resolve the dispute.
3. If step 2 does not resolve the dispute, the student may appeal to the School of Engineering Grade Appeals Committee.

The sequence of appeal steps described above must be taken in the order given.

6. Committee Structure

All graduate students have an Advisory, or Thesis, Committee that will provide advice on academic, professional, and research matters. The Advisory Committee will sit for all oral/written Preliminary, Final, and any other formal examination that is required. The student and his/her major professor(s) will decide whom they would like to have on the student's committee, based in part on potential

contributions to the student's research. It is the responsibility of the student to ask each person to serve on his/her committee. Committee members may wish to discuss a student's plan of study at that time since the plan of study is the official form that they sign. Usually the persons initially selected for the Advisory Committee will be retained on all subsequent committees, but the membership can be changed with the approval of the major professor.

7. Plans of Study

The Plan of Study is chosen by the student and his/her Advisory Committee and then approved by the DGS of the School of Chemical Engineering and the Dean of the Graduate School. The Plan of Study indicates the courses the student plans on taking and lists his/her Advisory Committee. The student should consult with his/her major professor on the choice of courses and Advisory Committee, then approach the chosen members of the Committee to get their agreement to serve and show them the proposed plan of study for their comments. The Plans of Study are completed and filed electronically. All the approvals, i.e. the signatures, are handled via a secure web site. The Graduate Administrator should be consulted for the mechanics of the process.

The MS plan of study must be filed before the end of the first semester after the student has been assigned a major professor. MS plans of study must include the four Chemical Engineering core courses 610, 620, 630, and 660. If a student thinks that he/she has already covered the material taught in any of these courses, he/she should talk to the instructor of the course to obtain a waiver and submit this waiver to the Graduate Office at the time the plan of study is being filed.

The course requirement for the MS degree is 15 graduate level credit hours, usually five courses. Four of these will be the core courses. The remaining course can be drawn from disciplines outside of chemical engineering or may be in chemical engineering. This course may be chosen to be of help in the student's research or to broaden his/her professional background.

The PhD plan of study must be filed before registering for PhD research and should be filed as soon as possible after the student has successfully completed the PhD qualifying procedure. The total number of graduate credit hours is 30 minimum, usually 10 courses, including those on the MS plan of study. Students arriving at Purdue with an MS degree in Chemical Engineering may be able to apply some of their MS coursework to their PhD plan of study. Students should check with the Graduate Administrator for the proper procedure.

Any course changes or committee changes to the plan of study may be requested on the Request for Change to the Plan of Study. Once again, students should check with the Graduate Administrator for the proper procedure.

8. Advisor Selection

Selecting an advisor is one of the most important events in a graduate student's career. Most undergraduate experiences do not expose starting graduate students to many of the exciting areas in which chemical engineering faculty do research. Thus, the School has developed a carefully thought out program to match students with advisors.

During the week before the start of the first fall semester, several events occur to provide exposure of faculty research areas to the new students. The process begins whereby each faculty member gives a 30-minute research presentation to all of the first year graduate students. During these presentations,

faculty members advertise research projects which they would like to staff with new graduate students. New students learn more about research areas of each faculty member during the GSO symposium which also takes place this week. Subsequently, each student is required over the next few weeks to arrange individual meetings with faculty members whose research programs they are interested in. Several such meetings may take place between each student and various faculty members over this period. At the end of a time period which is designated by the Head of the School and which may vary slightly from year to year, each student is asked to turn in to the Head a rank-ordered list of preferences of at least six projects/advisors. Based on these requests and after consultation with the faculty, the Head then matches each student with a faculty member who will serve as the student's advisor during the student's graduate student career. In most cases, each student is assigned his/her first choice. However, in some instances, several students select the same project and thus a first choice cannot be assigned to all of them. Typically, this process will be complete by early November.

9. Teaching Fellow Duties

Serving as teaching fellow is a required part of the academic program for a graduate degree in chemical engineering. Teaching assistantship duties may involve grading of homework assignments and exams in both graduate and undergraduate lecture courses, running help sessions in such courses, and coming into close contact with undergraduates in laboratory courses.

As this service is an academic requirement of the degree, students will register for the course CHE69700 *Teaching Experience* during the semesters in which they teach and the course will be recorded on their academic transcript. The course consists of a one hour weekly workshop on a developing teaching skills and putting these skills into practice through your TA duties. A course outline is attached in the appendix.

It is expected that TF duties should require 10-12 hours per week on average over the semester.

International students are required to demonstrate proficiency in English before they are permitted to serve as TFs. International students must arrange through the Graduate Office to take a university-administered test designed to measure this proficiency.

Teaching assistant duties typically begin in the third semester. The current periodicity for TF duties is one semester every other year.

Advanced students may have the opportunity to participate directly in the planning and presentation of undergraduate courses that are related to their thesis work. In addition, those considering the possibility of an academic career may request the opportunity to serve as a classroom instructor during the later phases of PhD study. In this case, they should contact the DGS. The DGS will work with the Head of School and faculty member in charge of teaching assignments to consider the request and make a decision.

10. Weekly School Seminars (CHE69000)

The School of Chemical Engineering provides students with the opportunity to hear about research currently being conducted or that has been conducted off campus by inviting a variety of speakers who will share their work on Tuesdays and Thursdays throughout the semester. Occasionally, there

may also be additional departmental seminars such as the Kelly Lectures that take place on days other than Tuesdays or Thursdays. The student's presence is required at these seminars and attendance is recorded. Two unexcused absences (plus one unexcused absence for prospective faculty seminars) are allowed per semester. Any excused absences (i.e. attendance at a professional meeting, a class conflict, etc.) must be approved by the Graduate Administrator prior to the absence.

11. Safety

Safety is of paramount importance and safe conduct is essential to operation of modern laboratory facilities in industry, academia, and government. Knowledge of proper procedures is of particular importance in the research and instructional laboratories in the School. However, unsafe conditions may result even outside the laboratory. Thus, graduate students, along with all other members of the School of Chemical Engineering, must actively participate in various departmental safety programs to make the environment safe for everyone. All students should familiarize themselves with the departmental Safety Manual and follow the guides/directives therein.

To sensitize students to the importance of safety in the work environment, exposure to safety related issues begins at the start of a graduate student's career. All students must enroll in CHM 605 (Safety in the Chemistry Laboratory) in the first semester, and attend the introductory lecture, the lecture on fire extinguishers and gas masks, the field trip on operating fire extinguishers, and at least six of the remaining eight lectures. Failure to satisfactorily complete this course when scheduled can result in an interruption of the student's research. A student will not be allowed into the various research laboratories until he/she has successfully completed CHM 60500.

12. Ethics and Responsible Conduct of Research (RCR)

It is imperative that students and faculty are honest in their discovery and learning endeavors and adhere to the highest ethical standards. Therefore, the Graduate School has developed the Purdue University Responsible Conduct of Research (RCR) program. The purpose of this program is to ingrain, promote and sustain an environment of integrity among all stakeholders, i.e. graduate students, staff and faculty, at Purdue University. A multi-pronged approach is available to promote Responsible Conduct of Research:

a. Attending workshops,

b. Online training/tutorial modules, and

c. Meeting Departmental or College expectations in Responsible Conduct of Research

In the School of Chemical Engineering, the student's introduction to RCR occurs during the first day of Orientation. Thereafter, the student's involvement with RCR develops by attending workshops and/or completing self-study online tutorials. Additional training in this area is provided by the student's thesis advisor during individual or group meetings.

13. Vacations

The student should familiarize himself/herself with the vacation policies for graduate students that are posted on the Graduate School web site. Students are allowed 22 vacation days during each twelve-month period in addition to several university holidays. Students are to consult with their

advisors regarding specific days that they wish to take as vacation days so that research can progress in a planned and coordinated manner. An official vacation form must be signed by the advisor and submitted to the business office prior to leaving on vacation.

Appendix A: Typical sequence of events and timetables for a PhD student

Semester 1

Take 4 three-credit courses
Select research/thesis advisor
Form MS thesis committee and file MS plan of study

Semester 2

Take 2-4 courses

Summer Semester 1

Full time on research

Semester 3

Turn in written research report (by September 15) and take oral research exam (by October 30) as part of PhD qualifying procedure
Serve as a Teaching Fellow
Form PhD thesis committee and file PhD plan of study

Semester 4

Take one or two elective course and continue research

Summer Semester 2

Full time on research

Semester 5

Complete preliminary exam
Continue research and any remaining elective courses

Semester 6

Serve as a Teaching Fellow
Continue research and any remaining elective courses

Summer Semester 3

Full time on research
Present seminar during GSO symposium in August

Semester 7

Research

Semester 8

Research, start writing PhD thesis

Summer Semester 4

Defend PhD thesis

Appendix B: Rubrics for oral and preliminary exams and thesis defense.

EVALUATION RUBRIC: ORAL QUALIFIER EXAMINATION
(Draft, CHE Graduate Committee, September 09)

Candidate Name: _____Date: _____

Title of Dissertation: _____

Evaluation/Guidance	**Needs Significant Improvement**	**Needs Improvement**	**Acceptable**	**Very Good**	**Excellent**
1. **Problem Definition:** Has a reasonable understanding of the significance of research area and makes a good first attempt to define a relevant research topic					
2. **Literature and Previous Work:** Demonstrates sound background knowledge of key concepts in the research area, and some knowledge of prior work on the specific research problem					
3. **Impact of Proposed Research:** Demonstrates the potential value of solution to the research problem in advancing knowledge within the area of study					
4. **Solution Plan:** Shows a good understanding of how to use methods/tools effectively and has a plan for the next 12 months leading into the preliminary examination					
5. **Expected Results:** Provides a sound plan for analyzing and interpreting research results/data					
6. **Quality of Written and Oral Communication:** Communicates research proposal clearly and professionally in both (a) **written** and (b) **oral** form **(a)**					
(b)					
7. **Critical Thinking:** Demonstrates capability for independent research in the area of study, preparedness in core disciplines relevant to research, and ability to complete the proposed research					
8. **Broader Impact:** Demonstrates awareness of broader implications of the proposed research. Broader implications may include social, economic, technical, ethical, business, etc. aspects.					

Overall Assessment: The assessment of the overall performance of the candidate based on the evidence provided in items 1 – 8 above.

CRITERIA	**PERFORMANCE RATINGS**				
	Does NOT PASS oral qualifier. Terminate with MS.	**Do MS(thesis) before decision on PhD**	**Passes Oral Qualifier Exam**		
OVERALL, my rating of the PERFORMANCE	**Needs Significant Improvement**	**Needs Improvement**	**Acceptable**	**Very Good**	**Excellent**

Name of the Examining Committee Member: _____
Signature of the Examining Committee Member: _____

EVALUATION RUBRIC: PRELIMINARY EXAM - PROPOSAL PRESENTATION
(Draft, CHE Graduate Committee, Sept.09)

Candidate Name: _____Date:_____

Title of Dissertation:_____

Evaluation/Guidance	**Needs Significant Improvement**	**Needs Improvement**	**Acceptable**	**Very Good**	**Excellent**
1. **Problem Definition:** States the research problem clearly, providing motivation for undertaking the research					
2. **Literature and Previous Work:** Demonstrates sound knowledge of literature in the area, and of prior work on the specific research problem					
3. **Impact of Proposed Research:** Demonstrates the potential value of solution to the research problem in advancing knowledge within the area of study					
4. **Solution Plan:** Provides a sound plan for applying state-of-the-field research methods/tools to solving the defined problem and shows a good understanding of how to use methods/tools effectively					
5. **Expected Results:** Provides a sound plan for analyzing and interpreting research results/data					
6. **Quality of Written and Oral Communication:** Communicates research proposal clearly and professionally in both (a) **written** and (b) **oral** form **(a)**					
(b)					
7. **Critical Thinking:** Demonstrates capability for independent research in the area of study, preparedness in core disciplines relevant to research, and ability to complete the proposed research					
8. **Broader Impact:** Demonstrates awareness of broader implications of the proposed research. Broader implications may include social, economic, technical, ethical, business, etc. aspects.					

Overall Assessment: The assessment of the overall performance of the candidate based on the evidence provided in items 1 – 8 above.

CRITERIA	**PERFORMANCE RATINGS**				
	Does NOT PASS PRELIMINARY Exam	**Passes PRELIMINARY Exam**			
OVERALL, my rating of the PERFORMANCE	**Needs Significant Improvement**	**Needs Improvement**	**Acceptable**	**Very Good**	**Excellent**

Name of the Examining Committee Member: _____
Signature of the Examining Committee Member: _____

EVALUATION RUBRIC: DISSERTATION (Ph.D.) DEFENSE EXAM
(Draft, CHE Graduate Committee, Sept.09)

Candidate Name:_____ Date: _____
Title of Dissertation:_____

Evaluation/Guidance	**Poor**	**Marginally Acceptable**	**Acceptable**	**Very Good**	**Excellent**
1. **Problem Definition:** Stated the research problem clearly, providing motivation for undertaking the research					
2. **Literature and Previous Work:** Demonstrated sound knowledge of literature in the area, and of prior work on the specific research problem					
3. **Impact of Proposed Research:** Demonstrated the potential value of solution to the research problem in advancing knowledge within the area of study					
4. **Solution Approach:** Has applied sound state-of-the-field research methods/tools to solve the defined problem and has described the methods/tools effectively					
5. **Results:** Analyzed and interpreted research results/data effectively					
6. **Quality of Written and Oral Communication:** Communicates research proposal clearly and professionally in both (a) **written** and (b) **oral** form **(a)**					
(b)					
7. **Critical Thinking:** Has demonstrated capability for independent research in the area of study, significant expertise in the area, and ability to make original contributions to the field					
8. **Broader Impact:** Demonstrates awareness of broader implications of the concluded research. Broader implications may include social, economic, technical, ethical, business, etc. aspects.					
9. **Publications:** Journal or conference publications have resulted (or anticipated) from this research					

Overall Assessment: The assessment of the overall performance of the candidate based on the evidence provided in items 1 – 8 above.

CRITERIA	**PERFORMANCE RATINGS**				
	Does NOT PASS DISSERTATION DEFENSE Exam	**Passes DISSERTATION Defense Exam**			
OVERALL, My Rating of the Dissertation:	**Poor**	**Marginally Acceptable**	**Acceptable**	**Very Good**	**Excellent**

Name of the Examining Committee Member: _____

Signature of the Examining Committee Member: _____

EVALUATION RUBRIC: THESIS (MS.) DEFENSE EXAM
(Draft, CHE Graduate Committee, Sept.09)

Candidate Name:_____ Date:_____

Title of Dissertation:_____
_____

Evaluation/Guidance	**Poor**	**Marginally Acceptable**	**Acceptable**	**Very Good**	**Excellent**
1. **Problem Definition:** Stated the research problem clearly, providing motivation for undertaking the research					
2. **Literature and Previous Work:** Demonstrated sound knowledge of literature in the area, and of prior work on the specific research problem					
3. **Impact of Proposed Research:** Demonstrated the potential value of solution to the research problem in advancing knowledge within the area of study					
4. **Solution Approach:** Has applied sound state-of-the-field research methods/tools to solve the defined problem and has described the methods/tools effectively					
5. **Results:** Analyzed and interpreted research results/data effectively					
6. **Quality of Written and Oral Communication:** Communicates research proposal clearly and professionally in both (a) **written** and (b) **oral** form **(a)**					
(b)					
7. **Critical Thinking:** Has demonstrated capability for independent research in the area of study, significant expertise in the area, and ability to make original contributions to the field					
8. **Broader Impact:** Demonstrates awareness of broader implications of the concluded research. Broader implications may include social, economic, technical, ethical, business, etc. aspects.					
9. **Publications:** Journal or conference publications have resulted (or anticipated) from this research					

Overall Assessment: The assessment of the overall performance of the candidate based on the evidence provided in items 1 – 8 above.

CRITERIA	**PERFORMANCE RATINGS**				
	Does NOT PASS THESIS DEFENSE Exam	**Passes Thesis Defense Exam**			
OVERALL, My Rating of the Thesis:	**Poor**	**Marginally Acceptable**	**Acceptable**	**Very Good**	**Excellent**

Name of the Examining Committee Member: _____
Signature of the Examining Committee Member: _____

Appendix C: Course outline for CHE69700 *Experience in Teaching*

CHE69700 *Chemical Engineering Experience in Teaching*
Spring 2011

Instructors: Jim Litster

Textbook: https://engineering.purdue.edu/ChE/AboutUs/Publications/TeachingEng/index.html

Handbook description:
The course consists of one hour per week seminar/workshop on teaching topics, plus teaching practice as a TA in the same semester. The course covers a brief introduction to teaching pedagogy, practical advice on running recitations, encouraging active learning, providing effective and efficient feedback, reflection and evaluation of performance.

Course Objectives:

- Provide an introduction to a basic pedagogical basis for teaching for the graduate students;
- Provide practical tips for TAs in running recitations, giving quality feedback during grading, etc.
- Help students reflect on, and improve, their teaching skills
- Prepare and inspire students for future careers in academia

Grading:
Grading will be "satisfactory" or "unsatisfactory". For students taking the course for the first time, satisfactory performance will involve:

- Active involvement in Monday Workshops
- Keeping a TA time log and reflective journal

For students taking the course for the second time, satisfactory performance will involve:

- Active involvement in five specified Monday workshops
- Keeping a TA time log and reflective journal
- Doing and documenting some independent learning to improve your teaching eg. attending Center for Instructional Excellence workshops, attending ENE seminars, attending education sessions at the AIChE meeting, reading papers in *ASEE Journal, Chemical Engineering Education,* etc.
- Writing a one or two page reflection on something you have experimented within in your teaching: What was it? What was the pedagogical reason for trying it? Where did you get the idea? How did you institute it? Was it successful (and how did you know)? What did you learn from the experience?

Draft Class Schedule

Jan 10* Introduction. Reason for the course. Student introductions.

Jan 17 MARTIN LUTHER KING HOLIDAY

Jan 24* Feedback from the coal face

Jan 31 How Students Learn (http://www.ncsu.edu/effective_teaching click link to Learning Styles)

Feb 07 Structuring recitations and other face to face meetings to maximize active learning (*Teaching Engr*, 114-128)

Feb 14 Active listening skills applied to working as a TA (*Teaching Engr*, 189-211)

Feb 21* Peer mentoring session

Feb 28 Roles and dynamics in student project teams

Mar 07 Mentoring and assessing student teams

Mar 14 SPRING BREAK

Mar 21 Grading (scoring) homework and tests (*Teaching Engr*, 220-223, 224-229)

Mar 28 Introduction to designing courses (*Teaching Engr*, chapters 4 and 14)

April 04 Academic careers and educational research (Prof Wankat)

April 11 Student reflections on TA experience (1st time TAs)

April 18* Student reflections on TA experience (2nd time TAs)

April 25* Course wrap up