

Department of Chemical Engineering

Worcester Polytechnic Institute

Graduate Student Handbook

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## **1. Introduction and Administration**

This document outlines the administrative procedures and educational requirements for graduate study in Chemical Engineering at Worcester Polytechnic Institute. The WPI Graduate Catalog outlines all requirements for graduate degrees, which are not all described here. Please refer to the WPI Graduate Catalog for WPI-wide requirements.

### **1.1. Graduate Programs.**

The Chemical Engineering Department offers graduate programs leading to the Doctor of Philosophy (Ph.D.) and the Master of Science (Professional Engineering Option, Thesis Option, Course-Based Option, and B.S.-M.S. Option).

### **1.2. Departmental Administration of the Graduate Programs.**

#### **1.2.1. Graduate Program Director.**

The Graduate Program Director administers the graduate program, working with the Chemical Engineering Department Head, graduate students, faculty, and staff. The Graduate Program Director also functions as the Chair of the Graduate Program Committee.

#### **1.2.2. Graduate Program Committee.**

The Graduate Program Committee consists of the Graduate Program Director, the Department Head, and other faculty appointed by the Department Head. These faculty track student progress, vote on student petitions, and recommend program changes to the Department Head and Chemical Engineering Faculty.

#### **1.2.3. Professional Engineering Master's Program Director.**

The Professional Engineering Master's Program Director administers the Master of Science in Chemical Engineering: Professional Option program.

#### **1.2.4. Graduate Advisor.**

Each graduate student enrolled in a Graduate Program shall have a Graduate Advisor. For graduate students in the M.S. Course-Based Option and B.S.-M.S. Option programs, the Graduate Advisor is the Graduate Program Director. For graduate students in the M.S. Professional Option program, the Graduate Advisor is the Professional Engineering Master's Program Director. For graduate students in the Doctor of Philosophy and M.S. Thesis Option, the Graduate Advisor is the Principal Investigator directing the student's thesis or dissertation research.

#### **1.2.5. Thesis or Dissertation Committees.**

Committees are convened for each graduate student enrolled in the M.S. Thesis Option and the Doctor of Philosophy. The function of the Thesis or Dissertation Committee is to evaluate and track progress towards completion of program objectives, primarily the research components. Thus, Committees shall meet regularly, as specified in this document.

### **1.2.6. Graduate Administrative Assistant.**

The Graduate Administrative Assistant is a WPI staff member with assigned responsibilities to the Graduate Program, as determined by the Department Head. The Graduate Administrative Assistant is responsible for tracking student progress through the Chemical Engineering Department Graduate Program. This includes receiving Annual Progress Reports from faculty, receiving Committee Reports from students, and keeping a sample record of the Proposal.

### **1.2.7. Chemical Engineering Graduate Organization (CEGO).**

CEGO is a student-led organization of Chemical Engineering graduate students that performs a variety of functions in service to the Department graduate student population.

## **1.3. Current Positions Held by WPI Faculty and Staff**

Department Head	Prof. S. Roberts	scroberts@wpi.edu
Graduate Program Director	Prof. E. Young	emyoung@wpi.edu
Graduate Program Committee	Prof. A. Deskins Prof. N. Kazantzis Prof. E. Stewart Prof. M. Timko	nadeskins@wpi.edu nikolas@wpi.edu ejstewart@wpi.edu mttimko@wpi.edu
Professional Engineering Master's Program Director	Prof. W. Zurawsky	wpzurawsky@wpi.edu
Graduate Administrative Assistant		

## **2. Objectives and Standards for All Students in the Graduate Program**

### **2.1. Objectives.**

These apply to all Chemical Engineering graduate students. The objectives are:

#### **2.1.1. Core Discipline Knowledge.**

Students must have command of the Chemical Engineering discipline. Achievement is assessed through core courses.

#### **2.1.2. Broad Discipline Knowledge.**

Students must have command of areas beyond the core Chemical Engineering discipline. Achievement is assessed through elective courses within and outside of the Chemical Engineering Department.

#### **2.1.3. Professionalism.**

Students must develop professional identities and networks, career goals, communication skills, and awareness of engineering ethics, wellness, and diversity, equity, and inclusion in professional environments. Achievement is assessed through a seminar course.

#### **2.1.4. Research Breadth.**

Students must be aware of the broader Chemical Engineering research community. Achievement is assessed through attending visiting lectures/seminars.

#### **2.1.5. Safety.**

All graduate students are required to adhere to and stay current with all safety trainings as determined by WPI Environmental Health & Safety (EHS) for the laboratory area(s) they work in. Achievement is assessed through staying current in all necessary safety trainings.

### **2.2. Academic Standards.**

These apply to all Chemical Engineering graduate students. The standards are:

**2.2.1.** A grade of C or better must be attained in a course submitted for graduate credit.

**2.2.2.** If, after a student has taken four or more courses acceptable for graduate study, the Cumulative Quality Point Average (CQPA) for all such courses falls below **3.0** (A=4.0), the student will be ineligible for further study at WPI unless the Graduate Program Committee recommends continuation for the next semester.

**2.2.3.** Additional WPI standards can be found in the WPI Graduate Catalog.

### **2.3. Department Seminar.**

Seminar is a professional development course. Seminar is designated CHE 501 (fall) and CHE 502 (spring) and meets every other week throughout the fall and spring semester. All full-time M.S. students must complete one year of seminar (one fall semester and one spring semester).

Part-time M.S. students must either complete one year of seminar in-person or develop an individual plan for achieving equivalent professional development training that is approved and assessed by the seminar instructor. Ph.D. students must complete eight semesters of seminar. This is to fulfill the professionalism objective (Section 2.1.3).

**2.4. Department Colloquium.**

All graduate students must enroll in CHE 503 Colloquium while in residence at WPI. This is to fulfill the research breadth objective (Section 2.1.4).

**2.5. Courses Acceptable for Graduate Credit**

**2.5.1.** All courses at the 500 level or above, taken undergraduate student status, are automatically acceptable for graduate credit by the Chemical Engineering Department in accordance with the rules for each graduate degree.

**2.5.2.** If a graduate student wishes to take an undergraduate course for graduate credit, they should petition the department Graduate Program Committee before taking the course, to verify that the course will be acceptable. Note that it is not enough for the department offering the course to count it for graduate credit.

**2.5.3.** If a graduate student wishes to count a graduate course taken under undergraduate status, they should file a petition to the Graduate Program Committee. In this case, the petition may be submitted after the course is taken. This most often occurs for students enrolled in the B.S.-M.S. Option (Section 6), and the procedures are more fully described in Section 6.3 for those students.

### **3. Master of Science in Chemical Engineering: Course-Based Option**

#### **3.1. Program Objective.**

The objective of the M.S. Course-Based Option program is to provide an opportunity for students wishing to pursue advanced training in Chemical Engineering. It is designed to provide a broad base in advanced course work in Chemical Engineering. This option has no specific objectives beyond those outlined in Section 2.1. While most students will select this option upon applying to the program, the M.S. Option can be changed at any time by changing your Program of Study in Workday.

#### **3.2. Graduate Advisor.**

The Graduate Advisor for students in the M.S. Course-Based Option program is the Graduate Program Director.

#### **3.3. Course Requirements for the M.S. Course-Based Option.**

**3.3.1.** Not less than 30 credit hours must be taken in graduate level courses, in advanced undergraduate level courses, or independent study, which are approved by the Graduate Advisor and the Graduate Program Committee.

**3.3.2.** A minimum of 24 credit hours must be in graduate level courses.

**3.3.3.** A minimum of 21 course credit hours must be in Chemical Engineering.

**3.3.4.** A minimum of 9 credit hours must be from the following core courses:

CHE 504	Mathematical Analysis in Chemical Engineering
CHE 509	Reactor Design and Kinetics
CHE 561	Thermodynamics
CHE 571	Transport Phenomena

#### **4. Master of Science in Chemical Engineering: Professional Engineering Option**

##### **4.1. Program Specific Objectives.**

The Professional Engineering M.S. program is an opportunity for students seeking an industrial career. While most students will select this option upon applying to the program, the M.S. Option can be changed at any time by changing your Program of Study in Workday. In addition to Section 2.1, objectives are:

##### **4.1.1. Project Experience.**

Students must have a project experience. Achievement is assessed by completing a Graduate Qualifying Project (GQP).

##### **4.1.2. Concentrated Discipline Knowledge.**

Students must concentrate in a subject of interest. Achievement is assessed through completion of the concentration specific elective courses.

##### **4.2. Graduate Advisor.**

The Graduate Advisor for students in the Professional Engineering M.S. program is the Professional Engineering Master's Program Director.

##### **4.3. GQP Advisor.**

The GQP is approved and supervised by a GQP Advisor, who is a Chemical Engineering Department Faculty or Affiliate.

##### **4.4. Course Requirements for the M.S. Professional Engineering Option.**

**4.4.1.** Not less than 30 credit hours must be taken in graduate level courses, in advanced undergraduate level courses, or independent study, which are approved by the Graduate Advisor (the Professional Engineering Master's Program Director), and the Graduate Program Committee. A summary of course requirements are given in Table 1 (Section 3.6).

**4.4.2.** A minimum of 9 credit hours must be from the following core courses:

CHE 504	Mathematical Analysis in Chemical Engineering
CHE 509	Reactor Design and Kinetics
CHE 561	Thermodynamics
CHE 571	Transport Phenomena

**4.4.3.** A minimum of 6 credits of Chemical Engineering electives must be taken. These may be at the graduate or advanced undergraduate level. Any questions as to which courses count should be directed to the Graduate Advisor.

**4.4.4.** Students pursuing the Bioengineering concentration must take CHE 521: Biochemical Engineering, while students in the Advanced Process Engineering concentration must take CHE 565: Advanced Process Engineering. Both courses will be offered annually.

**4.4.5.** A minimum of 6 credits of concentration electives must be taken. Table 2 (Section 3.7) lists approved courses for these electives. Students can choose additional courses to fulfill their concentration requirement as new courses become available, as long as they receive approval, in advance, from the Graduate Committee.

**4.5. Graduate Qualifying Project**

A minimum of 6 credits in **CHE 590: Graduate Qualifying Project (GQP)** must be taken. The GQP provides a capstone experience in applying chemical engineering skills to real-world problems. GQPs are in cooperation with an industrial, technological, or national laboratory partner and with the approval and supervision of a GQP Advisor (Section 3.3).

**4.6. Table 1: Course Credit Distributions**

<b>Bioengineering Concentration</b>	Credits
<b>Core:</b>	
3 Core Courses in CHE	9
2 Chemical Engineering Electives <sup>1</sup>	6
<b>Concentration:</b>	
CHE 521: Biochemical Engineering	3
2 Concentration Courses	6
CHE 590: GQP	6
<b>Total</b>	<b>30</b>

<b>Advanced Process Engineering Concentration</b>	Credits
<b>Core:</b>	
3 Core Courses in CHE	9
2 Chemical Engineering Electives <sup>1</sup>	6
<b>Concentration:</b>	
CHE 565: Advanced Process Engineering	3
2 Concentration Courses	6
CHE 590: GQP	6
<b>Total</b>	<b>30</b>

<sup>1</sup>Students may choose to take one of these courses in the topic of innovation to gain additional experience in business and for preparation for the GQP, including ETR 500. Entrepreneurship and Innovation. Students should get approval from the Faculty Director for course substitution.

#### 4.7. Table 2: Possible Concentration Courses

<b>Bioengineering</b>	
BCB 501. Bioinformatics	BME 523. Biomedical Instrumentation
BCB 502. Biovisualization	BME/ME 550. Tissue Engineering
BCB 503. Biological and Biomedical Database Mining	CH 538. Medicinal Chemistry
BCB 504. Statistical Methods in Genetics and Bioinformatics	CH 540. Regulation of Gene Expression
BB 505. Fermentation Biology	MTE 555/ME 4860. Food Engineering
BB 509. Scale Up of Bioprocessing	BB 565. Virology
BB 560. Methods of Protein Purification and Downstream Processing	BB 575. Advanced Genetics and Cellular Biology
BB 562. Cell Cycle Regulation	BME 552 / ME 552. Tissue Mechanics
	CE 562. Biosystems in Environmental Engineering

  

<b>Advanced Process Engineering</b>	
CHE 504. Mathematical Analysis in Chemical Engineering <sup>2</sup>	MTE 555/ME 4860. Food Engineering
CHE 509. Reactor Design and Kinetics <sup>2</sup>	MTE 558. Plastics
CHE 573. Separation Processes	MTE 5844. Corrosion and Corrosion Control
CHE 531. Fuel Cell Technology	ME 516. Heat Transfer
DS 501. Introduction to Data Science	ME/AE 5220. Control of Linear Dynamical Systems
FP 521. Fire Dynamics I	ME/AE 5221. Control of Nonlinear Dynamical Systems
FP 553. Fire Protection Systems	SD 550. System Dynamics Foundation: Managing Complexity
FP 554. Advanced Fire Suppression	SD 553. Model Analysis and Evaluation Techniques
FP 555. Detection, Alarm and Smoke Control	SYS 501. Concepts of Systems Engineering
FP 573. Industrial Fire Protection	SYS 502. Business Practices
FP 575. Explosion Protection	SYS 510. Systems Architecture and Design
MFE 510/ME 542. Control and Monitoring of Manufacturing Processes	SYS 512. Requirements Engineering
MFE 520/MTE 520/ME 543. Design and Analysis of Manufacturing Processes	SYS 520. System Optimization
MFE/MTE/ME 5420. Fundamentals of Axiomatic Design of Manufacturing Processes	SYS 521. Model-Based Systems Engineering
	SYS 540. Introduction to Systems Thinking

<sup>2</sup>Can be used to satisfy concentration requirements if not taken as part of the core.

## **5. Master of Science in Chemical Engineering: Thesis Option**

### **5.1. Program Specific Objectives.**

Graduates of the program should be equally capable of performing research and development in a laboratory or joining a Ph.D. program. While most will select this option when applying, the M.S. Option can be changed at any time by changing your Program of Study in Workday. In addition to Section 2.1, the objectives are:

#### **5.1.1. Thesis Experience.**

Students must have specialized expertise in research. Achievement is assessed through completion of CHE 599: M.S. Thesis and Thesis Defense.

### **5.2. Graduate Advisor.**

The Graduate Advisor for students in the M.S. Thesis Option program is a Chemical Engineering Faculty or Affiliate who is the Principal Investigator directing the thesis research.

### **5.3. Thesis Committee.**

The composition of a Thesis Committee must be at least three individuals, and two must be WPI Faculty members. It must consist of the Graduate Advisor, one other WPI Chemical Engineering Faculty or Affiliate, and one other member. This other member may be WPI faculty or external. WPI faculty is inclusive of teaching tenure-track and research professors. External committee members will usually be faculty at other institutions. In the rare case they are not, to qualify as an external committee member, the person must hold a Ph.D. or equivalent degree in a related field and be active in research, technology development, analysis, or similar in a related field.

### **5.4. Course Requirements for the M.S. Thesis Option.**

**5.4.1.** A minimum of 18 credit hours must be in graduate level courses.

**5.4.2.** A minimum of 15 credit hours must be in Chemical Engineering.

**5.4.3.** A minimum of 12 credit hours of thesis research must be completed.

**5.4.4.** A minimum of 9 credit hours must be from the following core courses:

CHE 504	Mathematical Analysis in Chemical Engineering
CHE 509	Reactor Design and Kinetics
CHE 561	Thermodynamics
CHE 571	Transport Phenomena

### **5.5. Thesis Defense.**

The Thesis Defense consists of a written Thesis (4.6) and a public Oral Defense (4.7). This is the final approval given by the Thesis Committee.

- 5.5.1. Timing.** After completion of all other requirements, typically by the end of their fourth semester at WPI, students submit a written Thesis and present an Oral Defense.
- 5.5.2. Passing.** The Thesis Committee will evaluate the Thesis and the Oral Defense. If, in the evaluation of the Thesis Defense, it becomes apparent that there are serious omissions or errors in concept, fact, or technique, then additional research may be required and the thesis must be revised and submitted to the Thesis Committee for reexamination at a later date.
- 5.6. Thesis.** The student must be the primary author of the written Thesis, although they are encouraged to discuss it with their Graduate Advisor and members of their Thesis Committee. Students can also utilize the WPI Writing Center for feedback on their written materials. Copies of the Thesis are to be distributed to the Thesis Committee prior to the Oral Defense.
- 5.7. Oral Defense.** A date for the Oral Defense shall be set with the Thesis Committee and sent to the Graduate Administrative Assistant for a public announcement. It is the responsibility of the student to set this date. After the Oral Defense, the Thesis Committee will hold a private discussion to determine the outcome of the Oral Defense.

## **6. Master of Science in Chemical Engineering: B.S.-M.S. Option**

### **6.1. Program Objective.**

The objective of the B.S.-M.S. Option program is to provide an opportunity for outstanding WPI undergraduates to complete an M.S. degree in addition to their B.S. degree. This typically results in the completion of both degrees faster than pursuing each consecutively. To do this, B.S.-M.S. students are encouraged to include graduate level courses in their undergraduate program. This option has no specific objectives beyond those outlined in Section 2.1.

### **6.2. Graduate Advisor.**

The Graduate Advisor for students in the B.S.-M.S. Option program is the Graduate Program Director.

### **6.3. Requirements for the B.S.-M.S. Option.**

**6.3.1.** All requirements of the appropriate M.S. degree that the student is pursuing (Professional Engineering, Thesis, or Course-Based Option). This must be declared upon entering the program. The M.S. Option can be changed at any time by changing your Program of Study in Workday.

**6.3.2. Credit Minimum.** For B.S.-M.S. students, the minimum credit from graduate courses in Section 3.3.2. is reduced from 24 to 22 to enable double counting of up to four undergraduate courses.

**6.3.3. Double Counting.** B.S.-M.S. students may double count up to 12 credits from undergraduate or graduate courses. A maximum of four undergraduate courses may be double counted. A 3 credit undergraduate course counts as 2 graduate credits, thus, a maximum of 8 graduate credits may come from undergraduate courses.

**6.3.4. Double Counting Undergraduate Courses.** The undergraduate courses allowed to double-count are listed in Section 6.3.5. Students may also petition the graduate committee for other 4000-level courses to double-count. A minimum grade of “B” is required for the course to be counted. In order for a course to be double-counted, students must also complete an extra assignment for each course demonstrating graduate-level competence. This extra assignment may be for instance a project or a literature review. The instructor for each course should instruct the student what this assignment would be after being notified that the student is double counting the course towards the BS-MS degree. Students must be accepted into the B.S.-M.S. program before courses are allowed to double-count.

**6.3.5. Automatically Allowed Undergraduate Courses**

(Maximum of four are allowed to Double-Count)

CHE 3501 Applied Mathematics in Chemical Engineering

CHE 4405 Chemical Process Dynamics and Control Laboratory

MQP Major Qualifying Project (1/3 unit maximum)

An Independent Study in Chemical Engineering at the 4000 level (1/3 unit maximum)

Only One of the Following May Count:

CHE 4401 Unit Operations of Chemical Engineering I

CHE 4402 Unit Operations of Chemical Engineering II

Only One of the Following May Count:

CHE 4404 Chemical Plant Design Project

CHE 4410 Chemical Process Safety Design

**6.3.6. Graduate Level Courses Taken While an Undergraduate.** Graduate courses taken while an undergraduate that do not double-count towards the B.S. will count towards the M.S. degree requirements. For example, if a student takes several graduate courses while an undergraduate at WPI, only two may count towards the Chemical Engineering B.S. degree requirements. The other courses will count towards the M.S. degree only.

## **7. Doctor of Philosophy in Chemical Engineering**

### **7.1. Program Specific Objectives.**

The Ph.D. program is designed to train students to be independent investigators capable of leading a research program. In addition to Section 2.1, the objectives are:

#### **7.1.1. Advanced Core Discipline Knowledge.**

Students must have command of the Chemical Engineering discipline. Achievement is assessed through the core courses and the Written Qualifying Examination.

#### **7.1.2. Advanced Research Expertise.**

Students must have expert knowledge in their research area. Achievement is assessed through the Proposition and Dissertation.

#### **7.1.3. Responsible Conduct of Research.**

Students must be trained in the responsible conduct of research. Achievement is assessed through the completion of ID 500 Responsible Conduct of Research.

#### **7.1.4. Original Contribution.**

Students must be able to advance Chemical Engineering scholarship. Achievement is assessed through the submission of an authored manuscript to a refereed journal, a technical presentation at an external conference, and the Dissertation Defense.

#### **7.1.5. Education Experience.**

Students must be able to facilitate learning. Achievement is assessed through completion of a teaching experience. This includes, but is not limited to, serving as a Teaching Assistant or advising undergraduate researchers. Please consult with the Graduate Program Committee about your teaching experience if you have questions about fulfilling this requirement.

### **7.2. Graduate Advisor.**

The Graduate Advisor for students in the Ph.D. program is a Chemical Engineering Faculty or Affiliate who is the Principal Investigator directing the dissertation research. The Graduate Advisor tracks doctoral student progress through the Annual Progress Report, which is filed with the Graduate Administrative Assistant and regularly reviewed by the Department Head, the Graduate Program Director, and the Graduate Program Committee.

### **7.3. Dissertation Committee.**

The composition of a Dissertation Committee must be at least four individuals, and three must be WPI Faculty members. It must consist of the Graduate Advisor (a Chemical Engineering Faculty or Affiliate), at least two other WPI Chemical Engineering Faculty or Affiliates, and at least one external faculty. The external faculty must hold a non-Chemical Engineering appointment at WPI or another institution. In rare cases, additional committee members may be included beyond these four. To qualify as an additional committee member, the person must hold a Ph.D. or equivalent degree and be active in research, technology development, analysis, or similar in a related field. The Dissertation Committee tracks doctoral student

progress through the Committee Report, which is filed with the Graduate Administrative Assistant and regularly reviewed by the Department Head, the Graduate Program Director, and the Graduate Program Committee.

#### **7.4. Course Requirements for the Ph.D.**

**7.4.1.** A total of 90 credit hours after the B.S., including at least 30 in research. Research credits should be CHE 598: Directed Research prior to earning candidacy. Ph.D. Candidates should enroll in CHE 698: Pre-Dissertation Research (See Section 7.7 for Candidacy).

**7.4.2.** A minimum of 9 credit hours of graduate elective courses approved by the Graduate Advisor and the Graduate Program Committee.

**7.4.3.** All of the following core courses (12 credit hours):

CHE 504	Mathematical Analysis in Chemical Engineering
CHE 509	Reactor Design and Kinetics
CHE 561	Thermodynamics
CHE 571	Transport Phenomena

#### **7.5. Ph.D.60 Track: Requirement Modifications for Students with Prior Graduate Degrees.**

There are two Ph.D. tracks at WPI: Ph.D.90 and Ph.D.60. Ph.D.60 students require 60 credits to graduate, while Ph.D.90 (the standard track) require 90 credits to graduate. The Chemical Engineering Ph.D.60 track is available to students who hold a Chemical Engineering M.S. (Sections 7.5.1 and 7.5.2). Students with other degrees or additional graduate credit should refer to Section 7.5.3. Students should check with the Graduate Program Committee to confirm which track they are on.

**7.5.1.** A student holding a Chemical Engineering M.S. from WPI (any option) may count 30 course credits towards the Ph.D. course requirements, meaning that 60 credits will be required to complete the Ph.D. Students may need to complete an additional 3 credit hours of core courses (Section 7.4.3.), to ensure they have taken 12 credit hours in core courses.

**7.5.2.** A student holding a Chemical Engineering M.S. from another institution may count 30 course credits towards the Ph.D. course requirements, meaning that 60 credits will be required to complete the Ph.D. A minimum of 6 graduate course credit hours must be earned at WPI.

**7.5.3.** For a student with previous graduate credit (such as from a M.S. or Ph.D. degree in a field other than Chemical Engineering), appropriate courses can be transferred toward the Ph.D. course credit requirements subject to approval of the Graduate Program Committee. Such a student will need to complete 90 total credits. Note that a maximum of one third of the required credits can be transferred from outside of WPI to fulfill the Ph.D. requirements (30 for Ph.D.90 and 20 for Ph.D.60). The Graduate

Program Committee usually asks for a transcript and a signed course equivalency list from the WPI Department which most closely matches the field of the transfer course(s).

- 7.5.4.** Ph.D.60 students defending less than four years after entering the program can apply to the Graduate Committee to waive up to two semesters of seminar (CHE 501/502: Seminar).

**7.6. Dissertation Committee Meetings.**

Students must form a Dissertation Committee (Section 7.3) and hold meetings yearly starting in the second year. The process for Dissertation Committee Meetings that are neither the Research Proposition nor the Defense is described below.

- 7.6.1. Timing.** Starting in the second year, all students must meet with their Dissertation Committee on a yearly basis to show sufficient progress. Dissertation Committee Meetings can occur any time before the end of the designated year. It is the responsibility of the student to arrange the Dissertation Committee Meetings at these times. Missing a Dissertation Committee Meeting will count as an automatic failure unless the Graduate Program Committee has approved a petition, in advance, excusing the student from holding a Dissertation Committee Meeting.

- 7.6.2. Passing.** At the meeting, the student will give an Oral Presentation only. The Dissertation Committee must then fill out a Committee Meeting Report and provide feedback and direction to the student. A copy of the Committee Meeting Report will be given to the student, the Graduate Program Committee, and the Graduate Administrative Assistant for tracking. Students who fail to pass a Dissertation Committee Meeting will be given a second opportunity within three months to address the concerns of the Dissertation Committee. Students who fail a Dissertation Committee Meeting a second time will not be in good standing, will be ineligible for a Chemical Engineering Ph.D., and will be ineligible for departmental funding such as a Teaching Assistantship.

- 7.6.3.** In the third year, the Research Proposition (Section 7.9) counts as the Dissertation Committee Meeting.

- 7.6.4.** In the final year, the Dissertation Defense (Section 7.13) counts as the Dissertation Committee Meeting.

**7.7. Qualifying for Candidacy.**

Doctoral Candidacy is earned by a student after passing the Qualifying Examination (Section 7.8) and passing the Research Proposition (Section 7.9). Students seeking degrees at a particular commencement must officially apply for candidacy with the Registrar prior to the deadline date listed in the Graduate Catalog. Forms for the Application for Degree may be obtained from the Graduate Administrative Assistant.

**7.8. Qualifying Examination.**

Students wishing to pursue the Ph.D. degree are required to pass the Qualifying Exam. The

Qualifying Exam consists of three elements. The first element is performance in graduate coursework. The second element is an oral presentation. The third element is Graduate Advisor recommendation. All three elements will be evaluated by the Exam Review Committee.

**7.8.1. Timing.** The Qualifying Exam takes place in May. Doctoral students must complete the exam the first May they are matriculated at WPI. Students joining in January and students without a Chemical Engineering background may petition the Graduate Program Committee to take this the second May they are matriculated at WPI. It is the responsibility of the student to complete it at these times. Missing these times will count as an automatic failure unless the Graduate Program Committee has approved a petition, at least one month in advance, excusing the student.

**7.8.2. Passing.** Students are required to submit an initial Plan of Study to complete Ph.D. requirements and give an oral presentation not to exceed 30 minutes. In the oral presentation, students will describe their Plan of Study, their research topic, any preliminary data acquired to date, and how the research topic relates to core Chemical Engineering concepts. Students pass the Qualifying Exam by majority vote of the Chemical Engineering faculty, based on recommendations from the Graduate Advisor and the Exam Review Committee. The Graduate Program Administrative Assistant will inform students of the result. Students who do not pass the first time will be given an Action Plan and a timeline not to exceed 1 year to satisfactorily complete the process and present a second time. Students who do not pass the second time do not satisfactorily complete the qualifying Exam and are not allowed to continue in the Chemical Engineering Ph.D. program.

## **7.9. Research Proposition.**

Students wishing to pursue the Ph.D. degree are required to complete a Research Proposition consisting of a written Research Proposal and an Oral Presentation. Both parts of the Research Proposition are intended to assess the suitability, degree of originality, methodological scope, and intellectual merit of the student's proposed doctoral dissertation topic.

**7.9.1. Timing.** Students will start working on their dissertation topic soon after they are assigned a Graduate Advisor. By the end of their fifth semester at WPI, students will prepare and submit a written Research Proposal (Section 7.9.3) followed by an Oral Presentation (Section 7.9.4). Missing this deadline will count as an automatic failure to make satisfactory academic progress unless the Graduate Program Committee has approved a petition, in advance, excusing the student from completing the Research Proposition at that time.

**7.9.2. Passing.** The Dissertation Committee will evaluate the Research Proposal and the Oral Presentation. The Dissertation Committee must fill out a Committee Meeting Report and provide feedback and direction to the student. A copy of the Committee Meeting Report will be given to the student, the Graduate Program Committee, and the Graduate Administrative Assistant for tracking. In the event of a "Conditional Pass" the Dissertation Committee may require revisions and amendments of the

Research Proposal. Students who fail to pass the Research Proposition will be given a second opportunity within three months to address concerns of the Dissertation Committee. Students may not submit a third Research Proposition.

**7.9.3. Research Proposal.** The Research Proposal provides students the opportunity to reflect on and structure a plan of future research activities that aim at advancing the state of knowledge in an original and thoughtful manner. Its scope is to assess the students' ability to meet the standards of scholarship expected in doctoral studies by demonstrating a comprehensive understanding and critical assessment of the evolution of ideas and scientific discourse pertinent to their dissertation topic, the novelty of the objectives of the proposed research work and its expected significance, as well as the suitability of the methodological framework employed, its range of validity, and possible limitations. Each student must be the primary author of the Research Proposal, although they are encouraged to discuss it with their Graduate Advisor and members of their Dissertation Committee. Students can also utilize the WPI Writing Center for feedback on their written proposal. Copies of the Research Proposal are to be distributed to the Dissertation Committee at least 7 days prior to the Oral Presentation.

The following structure is recommended for the Written Research Proposal:

1. No more than 15 total pages, inclusive of figures but excluding references.
2. Introduction: A clear statement of the problem, the key motivating factors for its study, and an assessment of its importance.
3. Background: A critical literature review thematically relevant relating to the problem of interest and the current state of knowledge in the specific field.
4. Description of Proposed Research: An organized description of the approach and outcomes for the work accomplished to date and the proposed work.
  - a. A thoughtfully structured and coherent narrative encompassing key objectives and research questions, methodological scope and framework, conceptual, analytical, computational tools employed and experimental design options/methods considered, data evaluation, analysis and interpretation.
  - b. An organized description of any preliminary research work accomplished to date.
  - c. A tentative timetable for a successful completion of the proposed research activities.
5. References: A comprehensive list of works cited.

**7.9.4. Oral Presentation.** The purpose of the Oral Presentation exam is to allow students to defend the proposed research activities plan as well as demonstrate general competency and contextual understanding in their respective areas of study. A date for the Oral Presentation shall be set with the Dissertation Committee. It is the responsibility of the student to set this date. The duration of the Oral Presentation should not exceed 45 minutes, with an additional 45 minutes for a discussion and Q&A session. After the Oral Presentation, the Dissertation Committee members will hold a private discussion concerning student progress and fill out a Committee Meeting Report containing their overall assessment, specific remarks, suggestions, and recommendations.

**7.10. Manuscript Submission.**

Prior to the Dissertation Defense, a student must have submitted an authored manuscript to a refereed journal. This is to fulfill the Original Contribution objective.

**7.11. External Presentation.**

Prior to the Dissertation Defense, a student must have presented a poster or talk at an external conference. This is to fulfill the Original Contribution objective.

**7.12. Education Experience.**

Prior to the Dissertation Defense, a student must have participated in an activity that facilitates learning of another individual. Activities that automatically fulfill this requirement are working as a Teaching Assistant, mentoring an MQP, or mentoring an Independent Study. Other activities, like obtaining a teaching certificate or leading a significant outreach event, need to be approved by the Graduate Program Director.

**7.13. Dissertation Defense.**

The Dissertation Defense consists of CHE 699: Ph.D. Dissertation (taken the final semester at WPI), a written Dissertation (7.13.3) and a public Oral Defense (7.13.4). This is the final approval given by the Dissertation Committee.

**7.13.1. Timing.** After completion of all other requirements, typically by the end of their tenth semester at WPI, students submit a written Dissertation and present an Oral Defense.

**7.13.2. Passing.** The Dissertation Committee will evaluate the Dissertation and the Oral Defense. The Dissertation Committee will fill out a Committee Meeting Report. A copy of the Committee Meeting Report will be given to the student, the Graduate Program Committee, and the Graduate Administrative Assistant for tracking. If, in the evaluation of the Dissertation Defense, it becomes apparent that there are serious omissions or errors in concept, fact, or technique, then additional research may be required and the dissertation must be revised and submitted to the Dissertation Committee for reexamination at a later time.

**7.13.3. Dissertation.** The student must be the primary author of the Dissertation, although they are encouraged to discuss it with their Graduate Advisor and members of their Dissertation Committee. Copies of the Dissertation are to be distributed to the

Dissertation Committee prior to the Oral Defense.

**7.13.4. Oral Defense.** A date for the Oral Defense shall be set with their Dissertation Committee and sent to the Graduate Administrative Assistant for a public announcement. It is the responsibility of the student to set this date. After the Oral Defense, the Dissertation Committee will hold a private discussion and fill out a Committee Meeting Report.

**7.14. Departure Prior to Dissertation Completion.**

Occasionally graduate students have left the department prior to completion of all their degree requirements. In such instances, a Ph.D. Dissertation cannot be submitted for a degree beyond three years after the student is no longer actively pursuing the research. Exceptions may be only granted upon petition to the Graduate Program Committee, which a) demonstrates extenuating circumstances and b) proves that the research is still of value to the profession.

## **8. Rules Governing the Assignment of a Graduate Advisor**

### **8.1. Rules for Ph.D. Students**

The Chemical Engineering Department has two processes for assigning Ph.D. students a Graduate Advisor based on the time of admission to the program.

**8.1.1. Ph.D. Students Admitted to the Department through Spring Graduate Recruitment.** Most students receive an offer of admission to the Department during the spring semester. Assignment of Graduate Advisors takes into account student preferences, faculty preferences, and the availability of funding to support graduate students. After collecting student and faculty preferences and assessing the available funding, the Graduate Program Committee meets to match incoming Ph.D. students with Graduate Advisors. Final assignment of a Graduate Advisor is reached by mutual agreement between the student and faculty, with final approval by the Graduate Program Committee and Department Head.

**8.1.2. Ph.D. Students Admitted Directly to a Graduate Advisor's Research Group.** Because WPI has a rolling admission process, the Graduate Committee may directly admit students to Research Assistantships or Teaching Assistantships that are available in specific research groups. In this case, the Graduate Advisor will be assigned at the time of admission, with final approval by the Graduate Program Committee and Department Head. This process typically occurs for students admitted off cycle from the spring graduate recruitment.

### **8.2. Rules for M.S. Thesis Option Students**

New or currently unassigned M.S. Thesis Option students are required to follow the procedure described below in choosing a Graduate Advisor. In addition to satisfying equitable student distribution, this procedure is designed to allow students to introduce themselves and become familiar with Chemical Engineering Faculty and their research interests.

**8.2.1.** A list of Chemical Engineering Faculty with M.S. thesis projects available in their labs will be distributed to students at the beginning of the Fall semester.

**8.2.2.** Each student should make appointments with all faculty who have M.S. thesis projects available in their labs to learn about the available projects.

**8.2.3.** After meeting with Faculty, students must submit their rank of the available research projects to the Graduate Program Committee. Students must rank projects in the research groups of at least three different faculty.

**8.2.4.** By the end of the first semester in the program, the Graduate Program Committee and Department Head will approve Graduate Advisor assignments. Notification of assignments will be completed by the end of the first semester in the program.

## **9. Rules Governing Funded Graduate Students**

### **9.1. Support.**

It is the goal of the Department and its Faculty to provide financial support for full-time doctoral students for the duration of their degree program. A Ph.D. student will work as a Research Assistant (RA) or Teaching Assistant (TA), which typically provide a stipend and tuition coverage. Priority for TA funding is given to Ph.D. students. M.S. students do not typically have TA positions available to support their studies, but may work as a Peer Learning Assistant (PLA), which provides an hourly wage. Continuation of support for all funded students depends upon the satisfactory performance of their assigned duties as well as their academic work. Failure to satisfactorily complete assigned duties may result in loss of funding.

#### **9.1.1. Support for Students Pursuing the M.S. Degree Options**

**9.1.1.1.** M.S. students do not typically have TA positions available to support their studies. In instances where students have received Department or Institute support in the form of a TA or fellowship, such students are required to complete the M.S. Thesis Option (Section 4).

**9.1.1.2.** A student working as a PLA may pursue any of the M.S. degree options (Sections 3, 4, 5, or 6).

**9.1.1.3.** Students who have received support from external funding agencies (government, industrial, etc.) are required to complete the M.S. Thesis Option (Section 4), unless the Graduate Advisor for the project notifies the Graduate Committee otherwise.

#### **9.1.2. Support for Students Pursuing the Ph.D. Degree**

**9.1.2.1.** The Department makes a commitment that each Ph.D. student making satisfactory progress will be fully funded for a minimum of five years. Funding beyond the 5<sup>th</sup> year is at the discretion of the Graduate Advisor and the Graduate Committee. Satisfactory progress means completing requirements in Section 2 and Section 7. This includes maintaining a minimum 3.0 GPA, passing ChE 501/502/503, maintaining up-to-date laboratory safety training, having appropriate yearly committee meetings, filing an annual progress report, and making appropriate advances in research as approved by the student's Dissertation Committee.

### **9.2. Staff Designation.**

All funded students (TA, RA, fellowship, M.S., Ph.D., *etc.*) are regarded as WPI employees and are expected to be present during undergraduate school vacations and term breaks. Absences must be approved by the Graduate Program Director for TAs, and the Graduate Advisor for RAs. Note that TAs are required to report one week prior to the start of a new term and at least one week prior to the start of a new academic year.

### **9.3. Teaching Assistants (TA)**

- 9.3.1.** TAs will be assigned to specific undergraduate courses on a term-by-term basis. The TA should contact the professor in charge of their assigned course regarding expectations and duties as soon as they receive their assignment.
- 9.3.2.** TA duties will include: assisting the Faculty in laboratory courses, grading laboratory reports, homework assignments, and exams, holding office hours, and supporting the course as needed. Occasionally, TAs may be asked to conduct a lecture or conference in the absence of the Faculty member in charge. It is a department practice that TAs will not give lectures on a regular basis.
- 9.3.3.** It is the responsibility of the TA to be familiar with the course material and with the operation of the course. This will, at a minimum, require close communication with the professor in charge, and may require that the TA attend some or all of the lectures/conferences. It is the responsibility of the Faculty to inform the TA of their specific duties in a timely fashion so that they may be adequately prepared.
- 9.3.4.** A Teaching Assistant load should be 1/2 a normal academic load. This is usually 20 hours per week. Some courses will require significant preparation when school is not in session. TAs are required to report one week prior to the start of a new term and at least one week prior to the start of a new academic year.

### **9.4. Research Assistants (RA)**

- 9.4.1.** RAs will be responsible for conducting research related to the project to which they are assigned. The specifics of these duties will be communicated to the student by the student's Graduate Advisor.

## Appendix 1: Committee Meeting Report

**Student:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Research Advisor:** \_\_\_\_\_

**Committee Members:** \_\_\_\_\_,

\_\_\_\_\_, \_\_\_\_\_,

**Pick one:**     Research Proposition  
                   Yearly Committee Meeting  
                   Dissertation Defense

The student (circle one):      Successfully,              Conditionally,              Unsuccessfully  
completed the activity noted above.

**Committee Signatures:** \_\_\_\_\_,

\_\_\_\_\_, \_\_\_\_\_,

**Comments:** (committee summary & suggestions, student's progress, modifications to Plan of Study, etc.)

## Appendix 2: Annual Progress Report for Ph.D. Students

### WPI Department of Chemical Engineering

Academic Year Report Period: \_\_\_\_\_

This report provides a way for you and your Graduate Advisor(s) to formally review your progress toward completing your degree and dissertation research. You are encouraged to work closely with your Advisor(s) when preparing this report since it is primarily for mentoring purposes. The report will be reviewed by the Graduate Program Committee and filed by the Graduate Administrative Assistant, because satisfactory progress in the Ph.D. program is required for continued financial support.

The table below provides the typical timeline for milestones associated with satisfactory progress through the Ph.D. program for students entering with an undergraduate degree in chemical engineering. Students coming from other backgrounds may be delayed in reaching some of the milestones and should meet with the Graduate Program Director to develop an appropriate plan by the end of Year 1. Please note that the table below is not meant to be comprehensive and students should refer to the Graduate Handbook for a full list of requirements.

<b>Time</b>	<b>Milestones</b>	<b>Other Suggested Milestones</b>
During Year 1	<ul style="list-style-type: none"> <li>• Complete core ChE courses (504, 509, 561, 571)</li> <li>• Pass Written Qualifying Exam (typically Jan. of first yr)</li> </ul>	<ul style="list-style-type: none"> <li>• Submit a fellowship application.</li> </ul>
During Year 2	<ul style="list-style-type: none"> <li>• Perform research*</li> <li>• Form dissertation committee</li> <li>• Hold first dissertation committee meeting</li> <li>• Complete and file Ph.D. Committee Meeting Report</li> </ul>	<ul style="list-style-type: none"> <li>• Present poster within WPI (i.e. GRIE)</li> <li>• Develop research work plan that will likely lead to a manuscript submission within the next year</li> </ul>
During Year 3	<ul style="list-style-type: none"> <li>• Perform research*</li> <li>• Complete and pass Research Proposition (~ 2.5 yr)</li> <li>• Complete and file Ph.D. Committee Meeting Report</li> </ul>	<ul style="list-style-type: none"> <li>• Present talk within WPI (i.e. 3MT)</li> </ul>
During Year 4	<ul style="list-style-type: none"> <li>• Perform research*</li> <li>• Hold dissertation committee meeting</li> <li>• Complete and file Ph.D. Committee Meeting Report</li> </ul>	<ul style="list-style-type: none"> <li>• Deliver a talk at a national or international meeting (i.e. AIChE, ACS, MRS, etc.)</li> </ul>
Year 5+	<ul style="list-style-type: none"> <li>• Write and defend dissertation (ChE 699)</li> <li>• Complete and file Ph.D. Committee Meeting Report for each year prior to defending dissertation</li> </ul>	<ul style="list-style-type: none"> <li>• Secure post-Ph.D. employment in parallel with writing dissertation</li> </ul>
Anytime prior to defense	<ul style="list-style-type: none"> <li>• Satisfy all course requirements (90 credit hours after BS, with 30 in research)</li> <li>• Submit manuscript based on dissertation research for publication in a peer-reviewed journal</li> <li>• Obtain teaching experience (i.e. TA course, mentor undergraduate researchers, complete teaching certificate)</li> </ul>	<ul style="list-style-type: none"> <li>• Write and submit additional manuscripts for publication</li> <li>• Apply for conference travel grants</li> <li>• Participate in Office of Graduate Studies programs aligned with career goals (i.e. IDP Program, Graduate Fellowship Workshops, Postdoc Search Boot Camp, Start-up Boot Camp, Pedagogy Boot Camp, etc.)</li> </ul>
All Years	<ul style="list-style-type: none"> <li>• Maintain GPA &gt; 3.0/4.0</li> <li>• Participate in Seminar - ChE 501 and ChE 502</li> <li>• Attend Colloquium and register for ChE 503</li> <li>• Maintain up-to-date EHS laboratory safety training</li> <li>• Complete Annual Ph.D. Progress Report</li> </ul>	

\*Research is CHE 598 before the Qualifier and Proposition are passed, and CHE 698 afterwards.

**Student-completed section**

Student Name \_\_\_\_\_

Advisor(s) \_\_\_\_\_

Term Entered Ph.D. Program (e.g., F10) \_\_\_\_\_

1. Indicate the term in which you completed (or plan to complete) each of the following Ph.D. degree requirements.

<b>Term</b>	<b>Required Degree Milestone</b>
	Pass Written Qualifying Exam
	Pass Research Proposition
	Complete all coursework (90 credit hours after BS, with 30 in research)
	Make presentation at external meeting (e.g., AIChE, ACS, MRS, etc.)
	Submit publication to peer-reviewed journal
	Obtain Teaching Experience
	Defend dissertation

2. Document the dates of your committee meetings in the table below. As a reminder, it is required for you to file the Ph.D. Committee Meeting Report with the ChE Departmental Office upon completion of your annual committee meeting.

<b>Year</b>	<b>Meeting Date</b>	<b>Committee Members Present</b>
2		
3		
4		
5		

3. On which date(s) did you meet with your dissertation committee during the reporting period? If you did not have any meetings with your committee, give a brief explanation.



e. Professional Development Activities (workshops attended, internships, courses taken, committee memberships, leadership roles):

f. Outreach Activities (K-12, public):

g. Other:

7. What are your current post-Ph.D. career goals?

8. Do you anticipate any problems or barriers (e.g., TA duties every term, limited access to essential equipment) that will delay you from successfully defending your dissertation within five (5) years of enrolling in the Ph.D. program? If so, please explain.

9. Do you believe you are making satisfactory progress toward the Ph.D. degree?

**Advisor-completed section**

1. Please provide three examples of where the student performed at their best in the last year related to the student's progress and accomplishments.
  
  
  
  
  
  
  
  
  
  
2. Please provide a few comments about areas in which student improvement would lead to better productivity and/or higher quality dissertation research as well as recommendations for how the student can improve in these areas.
  
  
  
  
  
  
  
  
  
  
3. Give your best estimate of the anticipated date for the dissertation defense (term and year).
  
  
  
  
  
  
  
  
  
  
4. Is this student making satisfactory progress toward the Ph.D. degree? If no, please explain.

By signing below, we indicate that we have discussed the contents of this report.

Student Signature \_\_\_\_\_ Date \_\_\_\_\_

Advisor Signature \_\_\_\_\_ Date \_\_\_\_\_

Co-Advisor Signature \_\_\_\_\_ Date \_\_\_\_\_