

# **The William G. Lowrie Department of Chemical and Biomolecular Engineering Graduate Guide**

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**2018 Edition**

**William G. Lowrie Department of  
Chemical and Biomolecular Engineering**

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## **Table of Contents**

|  |    |
|--|----|
| <b>Introduction</b> .....  | 3  |
| <b>Graduate Studies Committee</b> .....  | 4  |
| <b>Department Mission Statement</b> .....  | 4  |
| <b>Graduate Degree Programs</b> .....  | 4  |
| <b>Doctor of Philosophy Degree Program</b> .....                                     | 5  |
| <b>Thesis Master’s of Science Degree Program</b> .....                               | 12 |
| <b>Non-Thesis Master’s of Science Degree Program</b> .....                           | 15 |
| <b>Combined BS/MS in Chemical and Biomolecular Engineering</b> .....                 | 16 |
| <b>Continuation to PhD Program After MS degree</b> .....                             | 17 |
| <b>Seminar Course</b> .....  | 17 |
| <b>Advisor Selection</b> .....   | 18 |
| <b>Course Registration</b> .....   | 18 |
| <b>Policy for Graduate Students with Non-ChE Degrees</b> .....                       | 22 |
| <b>Policy on Graduate Student Service in Support of Undergraduate Programs</b> ..... | 22 |
| <b>Professional Ethics and Code of Student Conduct</b> .....                         | 24 |
| <b>General Concerns and Grievance Procedures</b> .....                               | 26 |

## **Introduction**

This handbook contains policies, rules, procedures and general information that affect both graduate students and graduate faculty in the Department of Chemical and Biomolecular Engineering (CBE). The material presented here has been discussed, and approved by a vote of the graduate faculty in CBE. This guide, prepared by the Graduate Studies Committee (GSC) and Graduate Program Coordinator, is intended to specify Departmental policies. CBE students are advised to become thoroughly familiar with, and abide by, the appropriate sections of the GSH and this departmental guide. The *Graduate School Handbook* (GSH) should be consulted for details regarding university rules and regulation. The *Graduate School Handbook* can be located in its entirety on the Graduate School website: <http://www.gradsch.ohio-state.edu/handbook>.

There are many other instructive publications which contain information directly relevant to graduate education. For example, refer to the *Guidelines for Preparing and Submitting Theses, Dissertations and D.M.A. Documents* (issued by The Graduate School) for specific instructions to prepare for the Master's Degree thesis and the Ph.D-degree dissertation. These documents are required reading for every graduate student who intends to submit a thesis or dissertation to the Graduate School. The CBE Department will make every effort necessary to provide both the physical resources and intellectual environment for successful completion of your graduate program. Graduate students are expected to exhibit motivation, integrity, and the professional ambition in order to fully utilize the resources available for this achievement. We hope that each student will experience professional growth and personal enjoyment during their graduate program at OSU.

The Department offers the M.S. degree and the Ph.D. degree in Chemical Engineering. Graduate research may be conducted in any of the research areas associated with the graduate faculty. For a current list, refer to the department's website. Research also may be conducted in other areas if approved in advance by the GSC.

## **Graduate Studies Committee**

The Graduate Studies Committee (GSC) in CBE is composed of Graduate Faculty members in the Department. The GSH defines the Graduate Faculty and describes the responsibilities of the Graduate Studies Committee. The Graduate Studies Committee Chair is appointed by the Department Chair.

## **Department Mission Statement**

- To create knowledge in the field of Chemical and Biomolecular Engineering through cutting-edge research, including interdisciplinary research, and pass this new knowledge on to our students, our profession, and society in general.
- To educate undergraduate and graduate students in Chemical and Biomolecular Engineering and foster cross-fertilization of allied fields.
- To serve the public, academic, industrial and governmental communities through consultation, collaborative efforts, entrepreneurial activity and dissemination of research results.
- To create a learning environment that fosters diversity in scholarship, approach to teaching, and in student, faculty, and staff composition.
- To instill in our students an appreciation of, and the necessity for, lifelong learning and to provide them the skills to prosper in a global economy.

## **Graduate Degree Programs**

The Department of Chemical and Biomolecular Engineering in the College of Engineering offers a broad program of graduate study, leading to the MS-degree and to the Ph.D. degree. The Master of Science (MS) is an intermediary degree which can lead to the Doctoral (Ph.D.) degree.

The MS program provides students with added depth in the technical aspects of the field and breadth through technical electives. The MS degree requires 30 hours of coursework and includes a project conducted under supervision of a faculty member on a topic of interest to the student.

The Doctoral or Ph.D.-degree is a recognized terminal degree in the practical and creative areas in chemical engineering. The Ph.D. candidate is one who understands and demonstrates what it means to be a working researcher. Each degree program consists of core of courses, related theoretical and applied courses, and a dissertation project specific to the research area. It requires a minimum of 80 graduate credit hours beyond the baccalaureate degree.

The Ohio State University Department of Chemical and Biomolecular Engineering is an accredited member of the AIChE – American Institute of Chemical Engineers ([www.aiche.org](http://www.aiche.org)) and the ACS – American Chemical Society ([www.acs.org](http://www.acs.org)).

## **Doctor of Philosophy Degree Program**

### **Ph.D.-Degree Requirements**

Procedures and requirements for the Ph.D.-degree are detailed in the GSH. The Department requires a qualifying examination. No foreign language is required.

A minimum of 80 graduate credit hours are required beyond the Bachelor's degree of which 27 hours are for courses, not including CBE 8999. Course credit hours should normally be divided among (1) Chemical and Biomolecular Engineering, (2) basic sciences, and (3) area of specialization. Students shall develop their course of study in consultation with their respective advisors and the other members of each student's Graduate Advisory Committee. The course work shall provide a concentration in a specific area, yet allow reasonable breadth of subject matter, being designed to foster both productive scholarship and knowledge of chemical engineering in relation to allied fields

### **Course Requirements**

The minimum course requirements beyond the Bachelor's degree are classified into three areas:

#### **Core Courses**

The total core course requirements are 15 credit hours. These courses and the material prerequisite to them must be mastered by all Ph.D.-degree students. A student may be excused from any of the following required courses if an equivalent course was taken for the MS-degree at another university. In order to be excused from one of the core courses, the student must submit a detailed description of the course, including the syllabus, details of where and when it was taken, and a copy of the transcript showing a grade for this course, to the Graduate Studies Committee. The Committee will review these materials and then decide whether or not to allow the student to substitute the transfer course in place of the related OSU course.

|           |     |                                |
|-----------|-----|--------------------------------|
| CBE 8801  | (3) | Analysis of CBE Problems       |
| CBE 8808  | (3) | Advanced Thermodynamics I      |
| CBE 8812  | (3) | Advanced Kinetics I            |
| CBE 8815  | (3) | Advanced Transport             |
| CBE 8781  | (2) | Research Communications in CBE |
| Chem 6781 | (1) | Laboratory Safety              |

#### **Advanced Coursework**

The minimum requirement is 12 credit hours. Graduate level courses in chemical and biomolecular engineering or other scientific, mathematics, or engineering disciplines are to be selected to fit the candidate's goals, with the consent of the advisor.

### **Research Requirements**

At least 53 credit hours of research (CBE 8999) are required. It is recommended that each student selects a research topic by the end of the first semester of work in the Ph.D. program. A satisfactory dissertation, as judged by the advisor and the Reading Committee under the Graduate School Rules, must be submitted as one of the requirements for the Ph.D. degree.

### **Transferring Master's Degree Credits**

If a student has a Master's Degree in Chemical Engineering from another university, they may transfer it as 30 semester hours of credit. This will change the requirements for the following: Advanced coursework from 12 to 6 credits and Research Requirements from 53 credits to 29 credits. Please see the Ph.D.-Degree Study Plan with an MS Degree in the appendix. You should transfer your MS Degree during your first academic year.

### **Language Requirements**

All students must be proficient in written and oral English. Non-native English speaking students must pass the equivalent of EDU T&L 5901 or 5902 within one calendar year after beginning graduate school. EDU T&L 5040, 5045, 5050 and/or 5055 (spoken English courses) must also be passed. These requirements must be fulfilled, including passing the Oral Proficiency Assessment (OPA), prior to undertaking the Instructional Associate Requirement.

### **Academic Standards**

The Department follows the academic standards of the Graduate School specified in the GSH. If, in the opinion of his/her advisor, a CBE graduate student is not making reasonable progress toward the degree, the GSC shall review the student's academic and research performance. If the GSC concurs, the Chair may then recommend to the Dean of the Graduate School that the student be denied further registration in CBE.

### **Course Credit, Marks, and Point-Hour Ratio**

The Department follows the policies and criteria of course credit, marks, and point-hour ration defined in the GSH.

## **Ph.D.-Degree QUALIFYING EXAMINATION**

### **Purpose and Format**

It is essential that Ph.D.-degree bound graduate students have a sound background in chemical engineering and the creativity and judgment necessary to conduct independent research. The purpose of the Qualifying Examination is to assess these qualities with an emphasis on evaluation of the student's potential to conduct original research. To serve this purpose, the Exam will have two parts that are administered sequentially after the students have completed five core courses (CBE 8801, CBE 8808, CBE 8812, CBE 8815, and CBE 8781) with a minimum average GPA of 3.2 in these five core courses. If a student has a Core GPA between 3.0 and 3.19, the student must petition, with approval of their advisor, to be able to take the Qualifying Examination. If a student has a Core GPA below 3.0, they will not be allowed to proceed in the Ph.D. program.

The first part of the exam will test the student's ability to comprehend and critique modern chemical engineering research literature. This examination should be taken immediately after the student has completed the six core courses. Part I will usually be administered immediately after the final week of Spring semester for students started in Autumn semester. Part II of the exam will test the student's ability to initiate original research and formulate a plan to conduct the research. This examination should be taken within one or two semesters after the student has passed the first part of the exam, or when the student's advisor feels it is appropriate. Students with an average core course GPA of 3.45 or higher may be waived from the first part of the qualifying exam. The student's advisor must submit a letter requesting the waiver to the GSC, who will make the final decision. If this request is approved, these students may proceed directly to the second part of the exam. Since the core course GPA is calculated based only on grades received in OSU courses, students who wish to be considered for a waiver of the first part of the exam must take at least three of the five core courses at OSU. Transfer students who take fewer than three core courses at OSU will be required to take the first part of the exam. Details about each part of the examination are explained as follows:

### **Part I: Literature-Critiquing Exam**

This exam will be based upon the student's ability to critically evaluate a recently published research article in chemical engineering journals. Specifically, the student will be asked to:

- a) Identify the problems addressed in the paper
- b) Formulate a critical appraisal of the author's contributions to the problems and the significance of the work
- c) Critically evaluate the technical soundness of the approach used and results obtained in the work
- d) Propose in concrete terms research work that might be done to extend and (if necessary) improve upon the study discussed in the article.

The student taking the exam will be given three research articles to consider. The student will have one week to choose one of those three articles to evaluate, and another week to submit a written report addressing the four points listed above. Within 6 working days after the submission of the report, the student will give an oral presentation to a three-member faculty panel. The oral presentation will be approximately 1 hour in length; the student will first give a 20-minute presentation, followed by a 40-minute question and answer session. The panel members for this examination will be selected by the Graduate Studies Committee. The student's advisor will not be a member of the panel. A majority vote from the faculty panel is required for the student to pass this exam. If the student fails the exam, he/she must take the exam again within one semester before he/she can take the Research Proposition Exam.

### **Part II: Research Proposition Exam**

This exam will test the student's ability to initiate original research and formulate a plan to conduct the research. Immediately after having been waived from or having passed Part I, the student should consult with his/her advisor on the research topic and prepare a proposal outlining a research plan that may be conducted as a part of his/her dissertation research. The

proposal should be prepared following the format and guidelines provided by the student's advisor. Usually the proposal should contain statements about the research problems and approaches to be used, literature review, project goal and specific objectives, experimental methods, and expected results and significance of the work. It is highly advisable to follow the NSF proposal guidelines in preparing the proposal. The proposal should be submitted to a three-member committee with the student's advisor as the chair of the committee. The student should then orally defend the proposal within two weeks of proposal submission. The oral defense should include a 30-minute presentation followed with questions and answers, for a total of 1.5 hours. A majority vote from the committee is required for the student to pass this examination. If the student fails the exam the first time, he/she may take the exam again after one semester. If he/she should fail the exam twice, he/she will not be allowed to continue in the Ph.D. program.

### **Additional Requirements**

The advisor and Graduate Studies Committee may determine that additional requirements are appropriate for an individual student's academic program. The nature of such requirements may be to satisfy unusual deficiencies or to recommend special professional enrichment opportunities. Such requirements will have been established within six months after the student passed the Qualifying Exam.

### **Ph.D.-Degree CANDIDACY EXAMINATION**

When a student has passed the Qualifying Examination and met all of the course requirements, he or she becomes eligible to take the Ph.D. Candidacy Examination in Chemical and Biomolecular Engineering. The Graduate School Handbook outlines the requirements for the Candidacy Examination. Refer to the GSH for policies about the timing and purpose of the Candidacy Examination. It is a single examination consisting of two portions, written and oral, administered under the auspices of the Graduate Studies Committee in conjunction with the student's Advisory Committee and the Graduate School. The Candidacy Examination is a test of the student's knowledge of chemical engineering and allied areas of study, of the capacity to undertake independent research, and of the ability to think and express the ideas clearly. It should be open-ended in nature.

The Advisory and Candidacy Examination Committee is chaired by the student's advisor and is responsible for administering the written and oral examinations and for evaluating the examination in accordance with the rules of the Graduate Studies Committee and the Graduate School. The advisory committee consists of four authorized Graduate Faculty members including the student's advisor. The Candidacy Examination will cover the broad aspects of the student's area of specialization, but should not be limited to the dissertation subject. If the student has demonstrated a weakness in a major area of his or her course work, then the appropriate faculty member(s) will serve on the Advisory Committee. Each member of the Advisory Committee will prepare one or more questions for the student, for the written examination, which he or she will grade. The time period in which the written portion is administered to the candidate will not exceed seven calendar days. Each student must be



responsible to learn the deadlines, options, required forms, and take the full responsibility of executing them in a timely manner.

### **Candidacy Examination Timing**

1. The written proposal must be presented to the committee no less than three weeks before the oral exam is scheduled.
2. The written questions will be submitted to the Graduate Program Coordinator no less than two weeks before the oral exam is scheduled, who will collect them and pass them all to the student at least two weeks before the oral exam.
3. In the event that the Graduate Program Coordinator is unavailable; the exam questions will be collected by the Chair of the Graduate Studies Committee; currently professor Shang-Tian Yang.
4. Answers to the written questions are due back to the committee one week from the time that they are provided to the student, or at least one week before the oral exam is scheduled, whichever is earlier.

Before the student can take the Candidacy Examination, the **Notification of Doctoral Candidacy Examination form** must be submitted on GRADFORMS.OSU.EDU. This form, including the names of the Doctoral Committee members, date, time and location of the Candidacy Examination, needs to be submitted in time to allow all the required approvals to be posted and the form is received by the Graduate School by the mandatory two-week notification deadline.

**Format for the oral presentation.** The oral portion of the Candidacy Examination is conducted according to the rules of the Graduate School. The Policy and Standards Committee Research and Graduate Council interpret this rule to mean that the presentation should not be a formal presentation of a prepared talk. To satisfy the oral part of the examination, the candidate must demonstrate a broad knowledge of the field. The oral portion of the Candidacy Examination lasts approximately two hours. Oral presentation of any proposal or other prepared materials must be made prior to or after the oral examination. Questioning of the student should occupy the entire period of the examination.

At the conclusion of the oral portion, the committee determines pass or fail of the entire Candidacy Examination, based on both the written and oral performance. Attendance at the oral portion of the exam is limited to the student and the members of the Examination Committee. Successful completion of the Candidacy Examination requires *a unanimously affirmative decision* of the Committee. After satisfactory completion of the Candidacy Exam the student may be admitted to the candidacy for the doctoral degree which signifies that the student is judged to be properly prepared to undertake work on the dissertation.

**Continuous Enrollment.** This policy is effective for all students who were admitted to the Graduate School Autumn Quarter 2008 and after.

All students who successfully complete the doctoral candidacy examination will be required to be enrolled in every semester of their candidacy (summer session excluded) until graduation. Students must be enrolled for at least 3 credits per semester. While the Graduate School and the individual graduate programs will monitor the enrollment of all post-candidacy students, it ultimately will be the responsibility of each student to ensure that they are meeting the enrollment provisions of this policy.

**Non-enrollment.** Post-candidacy students who do not enroll in a required semester will be withdrawn from active candidacy status. A student whose candidacy status has been withdrawn will not be allowed to continue on in the doctoral program until reinstated. A hold will be placed on the student's university record preventing any further registration or access to university resources. A student wishing to be reinstated to the doctoral program and active candidacy status will need to petition the Graduate Studies Committee in their program. If approved, the Graduate Studies Chair of the program will send a formal request to the Graduate School to allow the student to resume studies and register. Non-enrollment does not interrupt a student's five year candidacy period.

Upon approval of a post-candidacy reinstatement, the student will be retroactively enrolled in every semester of missed enrollment for three credits of 8999 research hours under their advisor. The student will be responsible for paying the past tuition charges as well as the current university per semester late registration penalty. All past due charges will need to be paid before the Graduate School will approve the student for any future enrollment.

**Leave of Absence.** Post-candidacy students who cannot continue in their doctoral program due to extenuating circumstances can request a Leave of Absence from their doctoral studies on a semester basis for up to a maximum overall leave period of one year. While there are many situations upon which a leave can be requested, such as the birth or adoption of a child or a serious medical condition, a leave will not be granted with the sole reason of financial hardship. The initial request for a leave should be submitted by the student to the Graduate Studies Committee in the student's home program. If the leave is approved at the program level, the Graduate Studies Chair will formally request the leave in writing to the Dean of the Graduate School. A request for a leave needs to be submitted before the actual leave period begins. Verification of circumstances should be included as part of the leave request. If a leave is granted, the student's candidacy period will be paused until the student returns to continuous enrollment status.

**Condition of Reinstatement.** Any student who was admitted to the Graduate School before Autumn Quarter 2008 is not bound by the continuous enrollment policy. However, a student who is not enrolled for at least two years will need to be reinstated to their graduate program to resume doctoral studies. As a condition of reinstatement a student will be required to follow the continuous enrollment guidelines as a post-candidacy student regardless of when they were admitted to the Graduate School.

**Time Limit.** If a student fails to submit the final copy of the dissertation or D.M.A. document to the Graduate School within five years of being admitted to candidacy, his or her candidacy is cancelled. In such a case, with the approval of the advisor and the Graduate Studies Committee, the student may take a supplemental candidacy examination. If the student passes this supplemental candidacy examination, the student is readmitted to candidacy and must then complete a dissertation or D.M.A. document within two years.

**Supplemental Candidacy Examination.** The nature of the supplemental candidacy examination and the membership of the candidacy examination committee are determined by the student's advisor within the rules of the Graduate Studies Committee. The examination committee is comprised of the advisor and at least three other authorized Graduate Faculty members. The supplemental candidacy examination must include a written and an oral portion that last approximately two hours. A Graduate Faculty Representative is appointed if a prior unsatisfactory examination result is on record. All other rules pertaining to candidacy examinations must be followed.

### **Application to Graduate**

One semester prior to your planned graduation, notify the Graduate Program Coordinator. For example, if you plan to graduate Spring semester, the Graduate Program Coordinator should be notified before the end of Autumn semester. This will provide sufficient time for the Graduate Studies Committee to review your academic record, and to formally ensure that you have met the department's graduation requirements. In addition, the Department requires that graduating students return all keys, that laboratory equipment and desks be left clean and in order.

An Application to Graduate form must be submitted through the Graduate School's form web site at: [gradforms.osu.edu](http://gradforms.osu.edu). Note: the completed and approved online form must be submitted to the Graduate School by the end of the third Friday of the semester in which you wish to graduate.

### **Dissertation Draft Approval**

The **Doctoral Draft Approval/Notification** form on **GRADFORMS.OSU.EDU** needs to be submitted by the student and approved by all members of the committee and the Graduate Studies Committee Chair in time for the Graduate School to receive the approved form two weeks before the date of the Final Oral Examination.

1. The typed dissertation draft must be checked by the Graduate School before that office will approve the Final Oral Examination.
2. A complete, typed dissertation draft must be submitted to the Dissertation Committee for approval.

## **Ph.D.-Degree FINAL ORAL EXAMINATION**

The student initiates the scheduling of the examination by completing the **Notification of Final Oral Examination form** on **GRADFORMS.OSU.EDU**. The Final Oral Exam Committee, with the advisor as the Chair, also includes the Dissertation Committee and the Graduate School Faculty Representative (GFR).

The final oral examination consists of two parts: **1)** a 45-60 minute (no longer than 60 minutes) oral presentation by the student, followed by **2)** a question-and-answer session, lasting at least 1 hour (per Graduate School Rules). Departmental Policy permits University faculty and graduate students to attend the oral presentation part of the Ph.D.-degree Final Oral Examination. One week prior to the Final Oral Exam, the student must give the Graduate Program Coordinator their thesis abstract, date, time and location of their exam. At least one day prior to the examination, all attendees must notify the Chair of the Examination Committee of their intent to attend. The candidate shall be excused when Committee members discuss and vote on the approval decision. The student is considered to have completed the final oral examination successfully only when the decision of the final oral examination committee is unanimously affirmative.

## **Thesis Master's of Science Degree Program**

### **Program of Study**

Candidates for the Master's of Science (MS) Degree in Chemical and Biomolecular Engineering will develop, with the advice and approval of their advisor, a program of study which satisfies the student's goals, subject to the requirements of the Graduate Studies Committee and the Graduate School. The minimum requirement for the MS degree is 30 credit hours beyond the Bachelor's of Science (BS) degree.

### **Course Requirements**

The minimum course requirements beyond the Bachelor's degree are classified into the following areas:

#### **Core Courses**

The total core course requirements are 15 credit hours. These courses and the material prerequisite to them must be mastered by all Thesis MS students. A student may be excused from any of the following required courses if an equivalent course was taken at another university. In order to be excused from one of the core courses, the student must submit a detailed description of the course, including the syllabus, details of where and when it was taken, and a copy of the transcript showing a grade for this course, to the Graduate Studies Committee. The Committee will review these materials and then decide whether or not to allow the student to substitute the transfer course in place of the related OSU course.

|          |     |                           |
|----------|-----|---------------------------|
| CBE 8808 | (3) | Advanced Thermodynamics I |
| CBE 8812 | (3) | Advanced Kinetics I       |

|           |     |                                |
|-----------|-----|--------------------------------|
| CBE 8815  | (3) | Advanced Transport             |
| CBE 8781  | (2) | Research Communications in CBE |
| Chem 6781 | (1) | Laboratory Safety              |

Math requirement – 3 credits please choose one from the list:

CBE 5779 – Experimental Design

CBE 8801 – Analysis of CBE Problems

Math 4568 – Linear Algebra for Engineering Graduate Students

Statistics – Graduate level courses of 5000 level or higher

### **Advanced Coursework**

The minimum requirement is 6 credit hours. Graduate level courses in chemical and biomolecular engineering or other scientific, mathematics, or engineering disciplines are to be selected to fit the candidate's goals with the consent of the advisor.

### **Research Requirements**

At least 6 credit hours of research (CBE 6999) are required. It is recommended that each student select a research topic by the end of the first semester of work in the M.S. program. A satisfactory thesis, as judged by the advisor and committee under the Graduate School rules, must be submitted as one of the requirements for the M.S. degree.

### **Language Requirements**

All students must be proficient in written and oral English. Non-native English speaking students must pass the equivalent of EDU T&L 5901 or 5902 within one calendar year after beginning graduate school. EDU T&L 5040, 5045, 5050 and/or 5055 (spoken English courses) must also be passed.

### **Additional Requirements**

There is a six-year time limit for application of credit earned in course work or research toward fulfilling MS-degree requirements.

A maximum of six (6) semester-credit hours may be accepted for candidates transferring into the MS program. Transferred courses must have the written approval of the student's advisor and the Department Graduate Studies Committee.

In order to maximize each student's potential for graduate coursework success; he or she may be required to complete selected undergraduate coursework. A student who has not earned an ABET-accredited Bachelor's (BS) degree in Chemical Engineering should expect this requirement. Based on each applicant's credentials, the Graduate Studies Committee makes these assessments and establishes remedial course requirements.

### **Application to Graduate**

One semester prior to your planned graduation, notify the Graduate Program Coordinator. For example, if you plan to graduate Spring semester, the Graduate Program Coordinator should be

notified before the end of Autumn semester. This will provide sufficient time for the Graduate Studies Committee to review your academic record, to formally ensure that you have met the department's graduation requirements. In addition, the Department requires that graduating students return all keys, that laboratory equipment and desks be left clean and in order.

An Application to Graduate form must be submitted through the Graduate School's form web site at: [GRADFORMS.OSU.EDU](http://GRADFORMS.OSU.EDU). Note: the completed and approved online form must be submitted to the Graduate School by the end of the third Friday of the semester in which you wish to graduate.

### **Master's Degree EXAMINATION**

A final oral defense of the Master's Degree Thesis is required for all candidates. Each student's academic advisor selects one (other) faculty member to serve on the Examination Committee. Each Committee member shall be given a copy of the thesis no later than one week prior to the defense date. An oral Master's Examination is held after the submission and preliminary approval of the thesis. Upon completion of the oral defense portion of the examination, the Committee will determine whether or not the work is satisfactory. The Committee's decision on the Master's examination is recorded on The Graduate School's Master's Examination Report form. This form is created after the student submits an Application to Graduate and can be accessed by the advisor and OSU committee members at [GRADFORMS.OSU.EDU](http://GRADFORMS.OSU.EDU).

Department policy permits other faculty and graduate students to attend the oral examination if the following provisions are met:

- At the time that the examination is scheduled, the Graduate Program Coordinator or designee notifies the faculty and graduate students of the examination. It is the student's responsibility to request this service.
- Those faculty and graduate students who wish to attend the oral examination shall notify the student's advisor at least 24 hours before the exam.
- The level of participation of non-committee members shall be strictly in keeping with Graduate School rules and within the discretion of the student's advisor.

### **Master's-Degree THESIS**

The written content and format of the thesis shall conform to The OSU *Graduate School Handbook*. First, the thesis must have the advisor's approval. The Examination Committee grants final thesis approval on The Graduate School's Thesis Approval Report Form. This form can be accessed by the advisor and OSU committee members at [GRADFORMS.OSU.EDU](http://GRADFORMS.OSU.EDU).

Soon after advisors' assignments, Master's-degree students should discuss research opportunities with the advisor and, shortly thereafter, prepare a written research proposal for the thesis. The purposes of early research topic definition are: **1)** to provide focus to the student's program, **2)** to allow the advisor and the Department Chair to plan and manage resources, and **3)** to permit the student advisor time to acquire appropriate instrumentation.

Classroom learning and research discover should proceed concurrently throughout the entire program.

## **Non-Thesis Master's of Science Degree Program**

### **Course Requirements**

The total number of course credit hours is the same as for the thesis option; however, to increase flexibility there are fewer core courses and more elective hours.

### **Core Courses**

The total core course requirements are 12 credit hours. These courses and the material prerequisite to them must be mastered by all Non-Thesis MS students. A student may be excused from any of the following required courses if an equivalent course was taken at another university. In order to be excused from one of the core courses, the student must submit a detailed description of the course, including the syllabus, details of where and when it was taken, and a copy of the transcript showing a grade for this course, to the Graduate Studies Committee. The Committee will review these materials and then decide whether or not to allow the student to substitute the transfer course in place of the related OSU course.

|          |     |                           |
|----------|-----|---------------------------|
| CBE 8808 | (3) | Advanced Thermodynamics I |
| CBE 8812 | (3) | Advanced Kinetics I       |
| CBE 8815 | (3) | Advanced Transport        |

Math requirement – 3 credits please choose one from the list:

CBE 5779 – Experimental Design

CBE 8801 – Analysis of CBE Problems

Math 4568 – Linear Algebra for Engineering Graduate Students

Statistics – Graduate level courses of 5000 level or higher

### **Chemical and Biomolecular Engineering Electives**

Nine credit hours of CBE elective courses are required.

### **Additional Electives**

The minimum requirement is 6 credit hours. Graduate level courses in chemical and biomolecular engineering or other scientific, mathematics, or engineering disciplines are to be selected to fit the candidate's goals with the consent of the advisor.

### **Independent Study**

A short term (1 semester) project may be conducted under supervision of a faculty advisor on a topic of interest to the student. The project may be conducted at the student's work location. The project may be an in-depth study and analysis of technical literature on the topic of interest, or an original project involving experimental, computational, and/or theoretical work. The project is graded pass/fail.

### **Master's Examination**

The Master's Examination is taken after submitting the Application to Graduate form during the semester in which the student plans to graduate. A student must be registered for at least 3 graduate credit hours during the semester this examination is taken. The student must successfully complete two activities that comprise the Master's examination: **1)** preparation of a written report summarizing their independent study project; **2)** oral presentation and defense of their project. The oral exam may also test the student's knowledge of engineering fundamentals. The exam committee is composed of at least two faculty members, including the project advisor. The Committee's decision on the Master's examination is recorded on The Graduate School's Master's Examination Report form. This form is created after the student submits an Application to Graduate and can be accessed by the advisor and OSU committee members at GRADFORMS.OSU.EDU.

### **Time Limitations**

There is no time limit, although students are encouraged to complete the program within 5 years of admission.

### **Transfer Credit**

A maximum of 6 credit hours may be accepted for coursework taken at another institution. Transfer courses are evaluated on a case-by-case basis by the department.

## **Combined BS/MS in Chemical and Biomolecular Engineering**

### **Criteria**

To be admitted to the combined BS/MS program, the applicant must submit documentation that demonstrates satisfactory fulfillment of the following admission criteria:

- Current registration in the Department
- Rank of senior (rank 4)
- A minimum of 3.5 cumulative point hour ratio in all previous undergraduate work

### **General Description**

The purpose of this program is to give outstanding undergraduate students an opportunity to obtain both BS and MS degrees in chemical engineering with relatively little additional time required beyond the BS degree. Students eligible for this program should have substantial room in their senior year schedule projection in order to incorporate the required coursework. Students can complete the thesis or non-thesis MS option. If a student is interested in the thesis option, they should attempt to complete some undergraduate research to get a feel for their interest in graduate work.



### **General and Specific Educational Goals**

The program does not change any existing goals of the BS or MS degree in chemical engineering. This is done by streamlining those requirements that substantially overlap, namely, the technical elective program of the BS degree and the “Advanced Course” requirements for the MS degree. Up to 12 credit hours of BS-degree technical elective courses may receive credit towards the MS-degree.

### **Status in Graduate Program**

Upon enrollment in the combined program and following receipt of the baccalaureate degree, the student must meet the requirements of the MS program as specified by the Graduate School and the CBE Department.

### **Curriculum for Combined BS/MS in Chemical and Biomolecular Engineering**

These course requirements match those for the MS degree in CBE. Please see the Non-Thesis Master’s or Thesis Master’s section.

### **Continuation to PhD Program After MS degree**

Students who receive their MS degree from the department in Chemical and Biomolecular Engineering can be considered for the PhD-degree program. The student should notify the Graduate Program Coordinator during the regular admission cycle for the semester which they would like to be considered. Please check the Graduate Prospective Student website for application deadlines - <https://cbe.osu.edu/how-apply>. A new online application is not needed. A statement of support from the research advisor is also required. The application will be reviewed with new applications. Students who complete the MS program in our department are not guaranteed admission to the Ph.D. program.

### **Seminar Course**

**CBE 8895:** As part of the department’s on-going effort to improve its visibility and reputation in the Chemical Engineering community, several distinguished guests are invited each year to present seminars on timely topics. This is an opportunity for the Department to present its best image to those people who help determine academic reputation and ranking. Furthermore, these seminars are an opportunity to learn about new and different areas of research outside of one’s own research group. Under the course number CBE 8895, these seminars are offered during Autumn and Spring semester only. Each semester it is offered, all Ph.D. students are required to enroll in this 1-credit course. This course is optional for MS students and does not count towards advanced course requirements. Based strictly on attendance at the weekly seminars, it will be graded S/U. More than two (2) unexcused absences in any semester may result in an unsatisfactory grade. This course counts toward the research requirement for Ph.D. students.

## **Advisor Selection**

The Graduate Studies Committee Chair initially advises incoming students. During Autumn semester, faculty members make presentations about their respective research projects for incoming students. Students then take the initiative to arrange private meetings with individual faculty members to discuss potential research topics. Unless an advisor has already been assigned, each student then chooses at least three potential advisors. Students may also indicate a preference. Advisor Selection is normally completed by the end of Autumn semester for incoming Autumn semester students whose degree(s) is chemical engineering and by special arrangement for those students who matriculate other semesters, or with another degree(s). The Graduate Studies committee makes final advising assignment decisions based on student preference, faculty workloads, available financial support, and other pertinent concerns.

Effective communication between students and faculty members is an important aspect of the learning process. Each advisor approves respective research problems and defines the quantity and/or type of results which will be expected of his or her advisee. The nature of or interaction between each student and his or her advisor varies, from almost daily contact to periodic meetings on a weekly basis, or, in some cases, less frequently. To ensure that degree requirements will be met in a timely manner, each semester the advisor must approve each advisee's course registration. Meet with your advisor on a regular basis to discuss and evaluate course work, to review work evaluations by other instructors, and to confirm your future course registration.

### **See your Advisor to:**

- Talk about any concern you have, your successes, your research project
- Receive help to determine your course schedule
- Have projects approved

## **Course Registration**

### **Course Load**

The minimum registration requirements per semester, including the seminar (if applicable) and research credits (CBE 6999/8999) are as follows:

- Eight credit hours = full-time for all students (US citizens, permanent residents, International students, or students holding a 50% Graduate Associate position).
  - Note: Four credit hours = full-time for students who hold a 50% Graduate Associate position during the Summer Term. Two credit hours = full-time for students who hold a 25% Graduate Associate position during the Summer Term.

- 12 credit hours = full-time for all Fellowship students (university fellows, other fellows and GS Match appointments) and eligible for a fee authorization from the Graduate School.
- Three credit hours = minimum number of hours required in the semester of graduation.
  - Note: Students on GA or Fellowship appointments must still register for the minimum number of hours required to maintain their appointment (see above).
- Three credit hours = full-time for all PhD students admitted to candidacy (i.e. passed the Candidacy Exam).

### **Course Credit**

Courses numbered 6000-8000 carry graduate credit only and are restricted to graduate students.

**OSU Late Registration Fees.** In order to avoid late registration fees, you be registered full-time at least 1 week prior to the start of the semester. Visit the University Registrar's website: <http://registrar.osu.edu/> to learn of all important registration dates and deadlines.

**Advice to Students.** In order to be admitted to the courses you want, register as early as possible. If a course is closed, add yourself to the wait-list.

**How the Wait-list Works.** Students can be placed on a wait-list during registration if they are unable to schedule a course due to time conflicts or because the course is closed (full). When sections of the desired course open, students on the wait-list are automatically added on a "first-on, first-off" basis – the earlier you register, the higher you will be on the wait-list. The wait-list is only active during the first week of the semester; if you are on a wait-list but are not added to a course by the end of the first week, then the only way for you to get into that course is to add it manually. If it is still closed at the time that you are added, you will also need written approval/permission (Course Enrollment Permission form) from the instructor to add the course.

If you are on the wait-list for a course, you are responsible for checking your status regularly. You should do this at least once a week before the semester starts, and every day during the first week of classes. You should attend class during the first week if you are high on the wait-list, since you have a good chance of being added. Students not processed from the wait-list will receive scheduling priority for the course if the student requests it the next quarter it is offered.

### **Course Registration Procedures**

Use the Buckeye Link: <http://buckeyelink.osu.edu/> for links to deadline dates and academic calendars. For course registration, refer on-line for classes and call numbers. The Department will not assume late registration fee assessments

- After your advisor approves the course or class schedule, follow the course registration guidelines. Register on-line at <http://buckeyelink.osu.edu/>. Be prompt to register, otherwise, a penalty will be charged for late registration. *Even if you expect your*

*schedule to change, register on time in order to have access to the web site when classes begin. Online class registration extends only through the first Friday of each semester.*

### **Schedule Changes – after the 1st week of classes**

- Please refer to the Graduate School's web site and/or the *Graduate School Handbook* for additional deadlines.

### **Satisfactory Academic Standing**

The Ohio State University Graduate School policy requires graduate students to maintain an average of B (3.00 grade point average or GPA) or higher in all graduate credit courses, and must maintain reasonable progress toward the degree requirements. In addition to the Graduate Schools rules, if a PhD student does not meet the Qualifying Examination Requirement the student is not considered in good academic standing with the Department of Chemical and Biomolecular Engineering. For the Departmental policy about the PhD-degree Qualifying Examination requirement, refer to that section in this *Graduate Handbook*.

### **Go to the Graduate School office to:**

Refer to the Graduate School website as a rich source of information:

<http://www.gradsch.ohio-state.edu/> or telephone 614-292-6031.

- Register for any University course not accepted by the on Buckeyelink (must have written permission of instructor)
- Officially add and drop any course (refer to the Registrar's website for deadlines and important dates)
- Petition to change, waive or substitute college or University requirements (first and only with departmental permission)
- Ph.D. Dissertation or D.M.A. Document
- Guidelines including deadline dates for all graduation requirements.

### **Go to the Registrar to:**

Refer to the Buckeye Link's website (<http://buckeyelink.osu.edu/>) for course/class registration guidelines and other valuable information.

- Obtain access to official University grade records (e.g. academic transcripts)
- Formalize a legal name change
- Inform them of an address change. It is important to keep your local address and telephone number records current, even if they are only short-term. If you change your mailing address, please update it as soon as possible on the Buckeyelink.
- Obtain academic calendars and deadline dates.

### **Petitions and Other Special Requests**

Situations may arise which may require a waiver or a modification to a program plan. To petition the Graduate School, refer to policies and procedures which are explained in *The Ohio State University Graduate School Handbook*. Direct departmental petitions to the Graduate

Studies Committee (GSC) Chair. The GSC generally requires written approval from the student's advisor in conjunction with petitions. A written explanation by the student should also support petitions.

### **Graduate Research Associate Appointments**

Refer to the Graduate School Handbook. Graduate Research Associate (GRA) appointments are generally for 50% time, requiring up to 20 hours of work per week. In special cases other percentage appointments are made.

GRA appointees will be assigned to a specific research project and the duties of each appointment will be determined by the academic and/or research supervisor(s). The research work may or may not involve the student's thesis or dissertation research, though it generally does. It will normally include literature review and analysis, planning of experimental procedures, construction of equipment, data collection and analysis, report writing, and oral presentations supported by electronic or other media.

### **Graduate Teaching Associate Appointments**

Refer to the Graduate School Handbook. Graduate Teaching Associate (GTA) appointments are generally for 50% time, requiring up to 20 hours of work per week. In special cases other percentage appointments are made.

GTA assignments are based upon need in department courses and are based on annual budget allotment. In general, GTA positions are reserved for Chemical Engineering PhD students.

### **Fellowships**

University, government, industrial and/or endowed fellowships may be available for student support. Stipends vary depending on the availability of funds. To hold a Fellowship, a student must be in good standing.

### **Grievance Procedures (Graduate Associate)**

Any Graduate Associate grievance will first be brought to the attention of the professor in charge and, if necessary, to the Department Chair, either directly or through the members of the Graduate Studies Committee (GSC). If, after discussing the matter with all persons concerned, including the Department Chair, no satisfactory resolution has been attained, the individual concerned will then submit a written statement of his or her grievance to the GSC. The GSC will then take action on the grievance. If not resolved at this point, the grievance will be submitted to the Graduate School Grievance Committee for resolution (GSH).

### **Benefits Information**

The Department endeavors to provide the necessary office space, supplies and equipment, as well as such support services as might be required to carry out the assigned duties. In addition, all students are eligible for a Buck I.D. identification card which can be used for library, bookstore, and parking privileges, as determined by University policy. Fees for such privileges are the responsibility of the student.

## **Policy for Graduate Students with Non-ChE Degrees**

### **Course Requirements**

Students with a degree in science or engineering, not chemical engineering, may be successful in The Ohio State University Department of Chemical and Biomolecular Engineering (CBE) graduate program. These students can make up the subject matter or prerequisite course deficiency in the fundamental chemical engineering subject areas. In order for these students to do well in all the graduate core courses, a student entering the CBE graduate program without a ChE degree must take the following undergraduate courses or have equivalent coursework in these subject areas:

- Thermodynamics: CBE 3508
- Transport Phenomena (Momentum and Mass Transfers): CBE 2420 and 3521
- Chemical Reaction Kinetics: CBE 610 or 3610
- Engineering Mathematics (Ordinary and Partial Differential Equations): Math 2177

In consultation with the student's advisor, the Graduate Studies Committee will recommend and approve any prerequisite or subject matter deficiency. These additional undergraduate courses will not be counted toward student's graduate course requirements.

In general, any additional required undergraduate coursework may postpone the student's enrollment in some graduate core courses. Consequently, the student may not complete all graduate core courses within the first year. Based on when courses are offered, any student affected by such a decision, should be able to complete all graduate core courses within 1.5 calendar years.

The advisor may require that additional undergraduate core coursework be taken. Such additional coursework requirements will be imposed at the sole discretion of the faculty research advisor. These additional courses may count as graduate technical electives if they are offered for graduate credit and are numbered 5000 or above. In addition, the course cannot be taught by a graduate student.

## **Policy on Graduate Student Service in Support of Undergraduate Programs**

### **Philosophy and Benefits to Graduate Students**

A core graduate program educational objective in the William G. Lowrie Department of Chemical and Biomolecular Engineering is intellectual leadership. Intellectual leadership involves more than the generation of knowledge through research, but also its transfer through effective communication. We expect our students to be able to teach what they have learned, and to be able to critically judge the technical communications and ideas of others.

In addition to making an invaluable contribution to the undergraduate teaching mission of the CBE program, graduate students will benefit from this policy in several ways:

- Critically evaluating technical work prepared by someone else, explaining difficult concepts, and teaching fundamental ideas are essential skills for Ph.D. engineers. We believe these skills can be most effectively developed by “hands-on” practice: having graduate students work directly in the role of teachers with undergraduate students. Unlike many other departments at OSU, all courses in CBE are taught by faculty, and so graduate students generally have few opportunities to teach except through their experience as instructional assistants.
- Teaching experience of some sort is essential for a graduate student seeking academic positions after completion of the Ph.D. The teaching statement of new faculty candidates is an important component of their application.
- Serving as instructional assistants also benefits our graduate students by providing them opportunities to practice and improve communication skills. Most students have limited prior experience in communicating the detailed, technical, and complicated ideas and concepts that lie at the heart of science and engineering.

### **Implementation in CBE**

- After their first year, graduate students will complete the UCAT Teaching Orientation to be held in August. This orientation is usually offered a week or two before the start of Autumn semester classes. Topics covered include: OSU policies and procedures, academic integrity, working with students with disabilities, FERPA, teaching methods, learning styles, grading, and assessment. Students will be IA-eligible upon completion of this orientation.
- Graduate students in their second year or later will be assigned to serve as an IA in a specific course. During this semester, IAs will enroll in 8799, a 2-credit hour course. This course is graded S/U. Note that IAs are not appointed as Graduate Teaching Assistants (GTA) nor paid additional compensation.
- Each Ph.D. student is required to serve as an IA two times during their time in the graduate program; they will therefore earn a total of 6 credits for 8799.
- The average workload must not exceed 9 hr/week.

This policy applies to all CBE graduate students who have not served as an instructional assistant prior to Autumn 2010. No additional assignment will be required for students who have already completed this requirement by satisfying the previous policy. Students who have completed only one assignment under the previous policy will be required to serve as an IA once more.

**Language Requirement.** As soon as possible after matriculation, international students are required to be certified in the Oral Proficiency Assessment (OPA) before assuming teaching experience duties. To take the OPA test, call the English as a Second Language (ESL) Program for an appointment. Depending upon the test result, a prospective IA will be certified to teach

or placed in a Spoken English class. Since classes fill rapidly, it is recommended that you take the test as soon as possible.

English as a Second Language  
060 Arps Hall  
Columbus, OH 43210  
Phone: 292-6360

For more information on the OPA test, consult the English as a Second Language Program or visit the website at: [esl.ehe.osu.edu](http://esl.ehe.osu.edu).

### **Professional Ethics and Code of Student Conduct**

Ethical conduct in research and coursework is an absolute requirement of all students at The Ohio State University. Personal integrity is the foundation of individual and collective scholarly achievement. Department of Chemical and Biomolecular Engineering graduate students shall take personal responsibility to be aware and adhere to the laws, rules and regulations of the United States, the State of Ohio, and the University. Conduct and ethics in research and coursework studies are special concerns for graduate students. Students are expected to be thoroughly familiar with and adhere to the *Code of Student Conduct*. The *Code of Student Conduct* can be found in its entirety at [http://studentlife.osu.edu/resource\\_csc.asp](http://studentlife.osu.edu/resource_csc.asp).

Academic misconduct fatally undermines the University's mission and the Department of Chemical and Biomolecular Engineering's goals which are stated in this document. According to Section 3335-23-04 (A) of the *Code of Student Conduct*, academic misconduct includes any activity that tends to compromise the academic integrity of the university, or subvert the educational process. Examples of academic misconduct include, but are not limited to:

1. Violation of course rules as contained in respective course syllabi or other information provided to the student; violation of program regulations as established by departmental committees and made available to students;
2. Knowingly providing or receiving information during examinations such as course examinations and candidacy examinations; or the possession and/or use of unauthorized materials during those examinations;
3. Knowingly providing or using assistance in the laboratory, on field work, or on a course assignment unless such assistance has specifically been authorized;
4. Submitting plagiarized work for an academic requirement. Plagiarism is the representation of another's work or ideas as one's own; it includes the unacknowledged word-for-word use and/or paraphrasing of another person's work, and/or the inappropriate unacknowledged use of another person's ideas;



5. Submitting substantially the same work to satisfy requirements for one course that has been submitted in satisfaction of requirements for another course, without permission of the instructor of the course for which the work is being submitted;
6. Falsification, fabrication, or dishonesty in reporting laboratory and/or research results;
7. Serving as, or enlisting the assistance of a substitute for a student in the taking of examinations;
8. Alteration of grades or marks by the student in an effort to change the earned grade or credit;
9. Alteration of academically-related university forms or records, or unauthorized use of those forms; and
10. Engaging in activities that unfairly place other students at a disadvantage, such as taking, hiding or altering resource material, or manipulating a grading system.

*The Code of Student Conduct will be enforced by the Department of Chemical and Biomolecular Engineering. All members of the Department who observe violations should immediately contact an appropriate authority. Offenders of the Code of Student Conduct will be subjected to the Judicial Procedures outlined in sections 3335-23-05 through 3335-23-16 of the Code of Student Conduct. Academic misconduct violations will be provided to the Committee on Academic Misconduct. The Committee, comprised of faculty, undergraduate students, and graduate students is responsible for investigating the alleged infractions, conducting a hearing, and deciding the appropriate penalties. The penalties can include the following: formal reprimands; conduct probation; disciplinary probation; suspension; and dismissal from the University.*

Graduate students enrolled in the Department of Chemical and Biomolecular Engineering shall act in such a manner as to uphold and enhance the honor, integrity, and dignity of the engineering profession. Chemical and Biomolecular Engineering students are obligated to follow and abide by the ASAE *Code of Ethics of Engineers*. Each student should support the professional and technical societies of his or her discipline(s). Students shall be completely truthful in all professional report and statements. Students shall include all relevant and pertinent information in such reports and statements. Students shall admit and accept their own errors when proven wrong and refrain from distorting or altering the facts to justify their decisions. Students shall give proper credit for work to those to whom credit is due. Students shall endeavor to extend the public knowledge of engineering, and shall not participate in the dissemination of untrue, unfair, or exaggerated statements regarding their work.

## **General Concerns and Grievance Procedures**

In general, after thorough consideration by the Chemical Engineering Graduate Council (CEGC), graduate student concerns should be brought to the attention of the GSC. If necessary, a GSC sub-committee will be appointed by the GSC Chair to address special student concerns. If possible, individual student grievances should be resolved informally through discussion with the student's adviser, the GSC Chair, and/or the Department Chair. If resolution is not provided by recourse to these persons, grievance procedures which have been established by the Graduate School should be followed (Graduate School handbook Appendix D).