The Chemical & Biomolecular Engineering Graduate Program

Department of Chemical and Biomolecular Engineering
University of Delaware Newark, DE 19716

Effective **August 2025**

Graduate Program Contacts

Department Chair: Millicent Sullivan
Responsible for overall department leadership.

Associate Chair: April Kloxin
Responsible for faculty teaching assignments and graduate curriculum.

Graduate Program Director: Mark Blenner
Responsible for most graduate student matters, including qualifying exams, 2nd and 4th year talks, graduate student awards, and graduate curriculum. Leads the graduate education committee.

Graduate Program Coordinator: Cinda Younce
Does all of the work behind the scenes to make sure graduate students are on contract, are registered correctly, etc.

Graduate Admission Chairs: Catherine Fromen & Dongxia Liu
Responsible for leading efforts to recruit graduate students and admissions on behalf of the department. Facilitates graduate recruitment efforts, including in person and virtual visits,

Graduate Education Committee Members: Mark Blenner (Chair), Catherine Fromen, Dongxia Liu, April Kloxin, Arthi Jayaraman. Responsible for reviewing additions or deletions of courses and changes in graduate course descriptions appearing in any University Catalog prior to submittal to the College, reviews all changes in the graduate curriculum involving the number, composition or prerequisites of required courses, or any changes that alter the total hours for graduation. The committee recommends approval or rejection of each of the changes to the graduate curriculum prior to submittal to the College. Contacts departmental faculty to determine course transfer and/or allowable substitutions for program requirements including courses appropriate for the technical elective requirement.

Other Resources

Office of Graduate and Postdoctoral Affairs in the College of Engineering
Associate Dean, Danw Elliot
Senior Assistant Dean, Jacqueline Washington

Graduate College
Dean & Vice Provost, Louis Rossi
Senior Assistant Dean, Professional Development, Suprawee Tepsuporn
Senior Assistant Dean, LaRuth McAfee

International Student & Scholars Office
Associate Director, Janica Cimo
Assistant Director, Rachel Selway

Center for Counseling & Student Development
Staff Psychologist, Wallesca Castro Rodriguez Subasic (Dr. Wally)

Introduction to the Ph.D. Program

For an engineer, the Ph.D. represents the final phase of formal academic training, in preparation for a variety of careers in industry, government, and academia. The Ph.D. program aims to equip students to conduct research; enable them to develop the maturity of judgment necessary for critical, creative, and independent thinking; and prepare them to contribute to scientific and engineering knowledge in a

particular area of scholarship. The degree of versatility necessary to succeed in research and, in general, to be a productive member of the profession, requires a breadth of knowledge of chemical engineering fundamentals and their proper application.

The requirements specified below represent the minimum that the department expects every student to meet. They are designed to be sufficiently flexible to accommodate differences in interests, aptitude, and expected career paths among students. Students are encouraged to take the initiative in seeking opportunities for formal and informal intellectual exploration beyond the guidelines imposed by the degree requirements. Keep in mind that these guidelines will change with time, and that the faculty will continue to refine and improve the Ph.D. program in consultation with the graduate students and Graduate College.

Ph.D. Program Educational Objectives (approved in Spring 2023)

1. Identify important scientific questions and technological goals in chemical and biomolecular engineering and develop research approaches to address them.
2. Conduct research, critically analyze and evaluate research findings in chemical and biomolecular engineering, and demonstrate the willingness and discipline to learn new knowledge and develop skills required to solve new problems.
3. Communicate orally and in writing effectively with a diverse range of audiences.
4. Work independently and with others, lead multidisciplinary teams, and mentor younger peers.
5. Understand the impact of chemical and biomolecular research in modern society, considering the public's welfare and cultural, social, environmental, and economic factors.

Course Requirements for the Ph.D.

The aim of the course requirements is to establish a foundation of technical knowledge in chemical engineering. This foundation should foster a fundamental understanding of basic principles in general, while also providing depth in certain specific areas. An overall GPA of at least 3.00 **must be maintained in graduate courses**.

1. **Chemical and biomolecular engineering core courses**
   12 credits to be taken during the first year prior to the qualifying exams, earning at least a B- in each of these courses

   - CHEG802 Introduction to Data and Systems Analysis (2 credits; Fall 1) **or**
   - CHEG811 Chemical Interfaces and Surfaces (2 credits; Fall 2)
   - CHEG807 Modeling, Analysis, and Acquisition of Data (2 credits; Fall 2)
   - CHEG810 Molecular Thermodynamics (2 credits; Fall 2)
   - CHEG820 Kinetic Processes (2 credits Full Fall)
   - CHEG821 Diffusive Transport Processes (2 credits; Full Fall)
   - CHEG803 Advanced Scientific Communication (2 credits; Full Spring)

2. **Chemical and biomolecular engineering seminar**
   1 credit to be taken during the first year prior to the qualifying exams; 1 credit to be taken after passing the qualifying exam typically in the Spring of the second year.

- CHEG 800 Chemical and Biomolecular Engineering Seminar (1 credit x2; Full Fall, Full Spring)

3. Chemical and biomolecular engineering modules

Any combination of two 2-credit modules of advanced chemical engineering coursework not otherwise counted toward the student's core course requirements. They may, but do not have to, form a concentration as listed below. These credits must be taken during the first year Spring prior to the qualifying exams.

Biomolecular Concentration
CHEG 840 Rate Processes & Dynamics for Microbial Systems (2 credits)
CHEG 843 Rate Processes & Dynamics for Mammalian Cellular Systems (2 credits)

Catalysis and Energy Concentration
CHEG 850 Electrochemical Processes (2 credits)
CHEG 851 Applied Thermodynamics (2 credits)

Data and Systems Concentration
CHEG 860 Process Systems Engineering: Mathematical Modeling and Optimization Principles (2 credits)
CHEG 861 Data Science for Chemical and Biomolecular Engineering (2 credits)

Soft Matter Concentration
CHEG 830 Continuum Transport in Materials (2 credits)
CHEG 832 Soft Materials, Colloids, and Polymers (2 credits)

After enrollment, students may opt to declare a *concentration* or they may opt to obtain the degree without a concentration. A concentration may be declared at any time prior to graduation. To declare a concentration, students must complete a change of major form through the Graduate College:

https://www.udel.edu/content/dam/udelImages/grad-college/graduate-college-pdfs/Change-of-Major-Concentration-Degree.pdf.

4. Chemical and biomolecular engineering technical electives

At least seven credits of chemical engineering electives are required. At least three of these credits must be at the 800-level; the remainder may be at the 600- or 800-level, with the possibility of substituting suitable courses from outside chemical engineering. The chemical engineering technical electives may be started during the fall semester of the first year and are usually completed during the second year. A list of already approved electives is available on the CBE website, and there is a form to request additional graduate electives be added to the list.

5. Doctoral dissertation

Nine credits to be taken *after* all other course work, except CHEG 801, is completed and *after* being admitted to candidacy.

- CHEG 969 Doctoral Dissertation

After completing these credits, students should move into sustaining support mode.

Note, that if for any reasons you need additional credits to retain full time status, prior to completing CHEG969, you should register for CHEG964 Pre-Candidacy Study.

The curriculum is reviewed each year and updated often. A typical schedule of courses for the first year:

FALL I
CHEG 802 Introduction to Data and Systems Analysis (2 credits)

FALL II
CHEG 807 Modeling, Analysis, and Acquisition of Data (2 credits)
CHEG 810 Molecular Thermodynamics (2 credits)

FALL (REGULAR)
CHEG 820 Kinetic Processes (2 credits)
CHEG 821 Diffusive Transport Processes (2 credits)
CHEG 800 Chemical and Biomolecular Engineering Seminar (1 credit)
CHEG 6xx/8xx Technical Elective (3 credit)

SPRING I
CHEG 8XX Chemical and Biomolecular Engineering Module (2 credits)

SPRING II
CHEG 8XX Chemical and Biomolecular Engineering Module (2 credits)

SPRING (REGULAR)
CHEG 803 Advanced Scientific Communication (2 credits)
CHEG 6xx/8xx Technical Elective (3 credit)

Note this schedule still requires CHEG801 (aka the second CHEG800), and at least another credit of electives (a 2-credit module or a 3-credit elective). Other sample schedules for graduate coursework are provided in **Appendix A**.

The Graduate College requires all Ph.D. students to maintain an overall 3.00 GPA. A student who receives a C+ or lower letter grade in any core graduate course (Section 1 above) must retake the course. Students who receive one or more B- grades in any core graduate course may choose not to retake the course as long as the student meets the overall 3.00 GPA requirement in the graduate classes.

Ph.D. Qualifying Procedures

The department admits students into its graduate program with the expectation that they will be successful in the qualifying procedures and matriculate into the Ph.D. program. Consequently, the qualifying procedures are an evaluation intended to be a constructive learning and training experience, and not a barrier to the student's overall educational and professional goals.

The Ph.D. qualifying procedures are a series of requirements necessary for a Ph.D. student to enter into doctoral candidacy. They provide the faculty an opportunity to evaluate each student's analytical skills, ability to think critically, and ability to generate original ideas. In addition, qualifying procedures provide students a chance to practice their communication skills and faculty an opportunity to evaluate those skills. In essence, this is a demonstration that the student is prepared to successfully complete a Ph.D.

The qualifying exam is intended to evaluate each student's abilities in several areas: creative thinking, progress in understanding and formulating a research project, mastery of the relevant underlying

chemical engineering fundamentals, and effective communication of ideas in both oral and written forms. The qualifying exam includes both a written and oral exam typically given toward the end of the student's first year, after completion of the core courses, unless other legitimate activities, such as formal graduate training programs, or extenuating circumstances compel a postponement. This schedule ensures that all students have the necessary chemical engineering background to take the exams and allows students the time to become involved in their research in an efficient and meaningful manner. To avoid unnecessary delays in formal admission to the Ph.D. program, students are typically given a single opportunity to take and pass the qualifying exam. The faculty feel strongly that we have more than enough information to make an appropriate decision about Ph.D. candidacy after students have spent a full year in the department.

Before the oral examination, students are required to prepare a **written document**, to be made available to the faculty in electronic form (as a PDF file) at least 2 weeks before the oral exam, and are due to the graduate program coorindator 2-3 weeks before the exam. The written document should contain the following four elements:

1. A title page stating the title of your thesis, your full name, and your thesis advisor's name. This title page should not have any other text besides these three items.
2. The main document, including all tables and figures, should not exceed 10 pages on standard paper.
3. Any (appropriate) number of pages (beyond the 10-page limit of the main document) listing relevant references in a bibliography using the format listed in the NSF grants preparation guide website. "*Each reference must include the names of all authors (in the same sequence in which they appear in the publication), the article and journal title, book title, volume number, page numbers, and year of publication*."
4. One page of an appendix (not counted as part of the main document's 10-page limit), which outlines goals, plans, and a timeline for the proposed thesis research, with particular emphasis on the goals for the coming year.

You are expected to adhere strictly to the following format in all four elements listed above:

- Times New Roman with font size 11, OR Arial with font size of 10, OR Computer Modern with font size 11 (if you use LaTeX) for all text in the 10-page report and appendix, including figure captions, tables and references/bibliography.
- No more than six lines of text within a vertical space of one inch in the 10-page report and appendix, including figure captions, tables and references/bibliography.
- Margins, in all directions of the page, must be at least one inch. Do not include any text (e.g., references, footnotes, etc.) or figures within these 1-inch margins. Only page numbers can appear within the margin region.

Failure to comply with these formatting guidelines may result in a failure of the qualifying exam and the need to undertake a Master's defense before continuation in the PhD program.

The second part of the qualifying exam is an oral exam. The specific guidelines for the oral exam vary from year to year as the technology of the oral presentation advances, and as needed to improve the examination process. The current procedures are as follows:

Each **oral exam** lasts 60 minutes. The first 12-15 minutes are reserved for oral presentation with the remaining time reserved for faculty questions. Presentation files (Powerpoint or PDF) are used. Each student's exam is administered by a group including the thesis advisor(s) and at least three faculty that are not the students' advisor. The student will choose two members of the student's thesis committee to serve on the "qualifying exam committee". It is the student's responsibility to establish the thesis committee prior to scheduling the exam, in consultation with the research advisor.

The oral exam is typically scheduled by the Department's faculty Graduate Program Director in consultation with the faculty, with a common timeframe for all students set by the department each year, typically two weeks before the start of Fall classes. For CBI students, and for students with special circumstances, the oral exam occurs in January, typically two weeks prior to the start of the Spring semester.

Both the oral and the written presentations should provide succinct and clear descriptions of the concepts underlying the proposed thesis research, the goals of the project, and the methods to be used in achieving those goals. While they may be incomplete, results obtained to date provide a useful focus for the exam. Questions asked by the faculty may address specific details or the broader context of the project presented, the proposed approaches, and associated chemical engineering principles. Clear communication in both the oral and written presentations and in interpreting and answering questions is essential to pass the exam. A rubric used for committee assessment of the qualifying exam is provided in **Appendix B**.

In each student's preparation for the exam, the advisor is likely to be the principal source of information and guidance. However, since it is expected that both the written and the oral presentations represent the student's own work, **advisors do not work with the students on the structure or content of either the written document or the presentation, e.g., by reading drafts of the written document or the slides, or being present during practice talks at any time.**

In reaching a decision on admission to Ph.D. candidacy, the student's performance in the required first-year courses is also considered in addition to the written and oral exam. These courses provide the best assessment of each student's analytical skills. In recognition of the important role that coursework plays in providing a good assessment of the analytical capabilities essential for successful completion of the Ph.D., in a situation in which a student does not meet the minimum grade requirements (i.e., receiving B- or lower grade in one or more core graduate courses), the department will consult with the thesis advisor(s) on a case-by-case basis to determine the student's eligibility to take the qualifier exam before retaking any courses.

The faculty will also consider other information in addition to performance in the formal qualifying procedures in assessing the student's suitability for admission to Ph.D. candidacy. Course instructors and, most importantly, each student's advisor, because they have more opportunities for closer interactions, are expected to have informed perspectives on each student's comprehensive performance in the program.

The faculty, as a group, will make their decisions on admission into Ph.D. candidacy within a week after all the oral presentations have been completed. The decisions will be conveyed to the students in writing by the Department Chair. All of the components of the exam are equally important. A strong showing in only one area will probably not be sufficient to ensure admission into Ph.D. candidacy, but neither will a weak showing in any single area lead to automatic failure.

Students should expect to receive assessment forms for the written and oral exam. The faculty member in charge of each student's thesis committee will provide a written summary of the committee's feedback to the student within one week after candidacy decisions are completed. This summary will include strengths and weaknesses identified by the committee in the student's written report and oral exam, as well as recommendations regarding the student's goals and timeline for the coming year's research efforts.

Research & Research Milestones

A graduate education focuses on the development of the skills necessary to conduct and present independent research. The Ph.D. thesis should demonstrate that the student has (1) acquired the skills necessary to conduct high-quality research, including the ability to think creatively and critically, and (2) completed a coherent piece of independent research that makes a meaningful contribution to engineering scholarship. The length of the actual thesis, the number of associated publications, and the time required, will necessarily vary, depending on the abilities and effort of the student, the details of the project, and the philosophy of the thesis advisor.

The department does not prescribe, *a priori*, how long any given student will remain in residence. However, the Ph.D. program is a transition period, one that provides students with an opportunity to expand their intellectual horizons, to learn how to conduct research, and to be creative. The transitional nature means that students should progress as rapidly as possible toward completion of all of the objectives and requirements of the Ph.D. degree. The following sections describe the policies and guidelines that have been established to assist the student in the selection, conduct, and completion of the doctoral thesis.

Thesis Topic & Advisor Matching

The Department does not allow students to choose thesis topics or advisors prior to arriving at Delaware. Since research is such a critical component of the graduate program, students need time to gather information about advisor mentoring styles, and available projects, to clarify their own personal research interests, and to think carefully about their own long-term objectives. To start this process, a set of written descriptions of available projects (prepared by the faculty offering them) is provided to the students at the beginning of the fall semester. Over the course of the first few weeks, each faculty member accepting students presents their projects in a 30-minute talk. Graduate students are expected to attend all thesis topic presentations, even if they think have no interest in that particular research area. These presentations are an ideal way to meet the faculty and to become exposed to the full range of chemical engineering research activities in the department and broader profession. Students should talk individually to faculty members and their graduate students to gain a more thorough understanding of possible research topics and research group dynamics. Several meetings may be required to fulfill this objective, and students are even encouraged to work with the faculty to develop project ideas that match their personal research interests. It is a good idea for students to also attend group meetings to get a better feel for lab culture.

In mid October of the first year, students are required to provide a list of their advisor preferences and a paragraph describing their reasoning to the faculty Graduate Program Coordinator. This date can vary by a few weeks from year to year depending on funding or project availability as dictated by funding agencies.

The advisor–thesis project preference list must include at least three unique proposed advisors.

Advisor matching is a highly complex process that factors several individual and organizational objectives. While other factors may influence the matching process, our philosophy is that priority is given to student preference. In most cases students are matched with one of their top choices.

The matching process is facilitated by the Graduate Program Director. S/he collects student and faculty preferences and develops the optimal matching between student and advisor using these principles articulated above. The Graduate Program Director creates the preliminary advisor assignments in coordination with the Department Chair. When the department contemplates matching a student to an

advisor who was not their top three choices, the Graduate Program Director will discuss this potential with the student. The advisor assignments are shared with the faculty at large for comment, and the Department Chair has final say on the proposed assignments.

Thesis committee

Research projects are carried out independently, but not in isolation. Graduate students are encouraged to involve many faculty, both inside and outside the department. Since some students often feel uncomfortable asking other faculty members questions about research, a formal structure for this interaction is provided in the form of a thesis committee.

The thesis committee consists of at least two other CBE faculty members chosen by the student in consultation with the thesis advisor; other PhD holders (e.g., those working in industry or national laboratories) may also be included, as deemed appropriate. The committee for the final thesis defense must include one outside faculty member. This external member of the committee does not need to be identified prior to qualifying exam, but they must be included in subsequent committee meetings and decisions once a student has been admitted to Ph.D. candidacy. Additional committee members may be added at any time before the thesis defense. However, removal of a committee member requires that the committee member in question give written approval to the department's faculty Graduate Program Coordinator, or else requires special approval from the Department Chair if the faculty member in question is unable or unwilling to fulfill his or her role as a committee member within a reasonable time frame.

The thesis committee members make a commitment to provide input and feedback throughout the course of the thesis research. This includes feedback on your departmental research presentations and during committee meetings. Students are strongly encouraged to provide the committee with written progress reports and copies of manuscripts and publications.

Several departmental requirements for formal interactions with the thesis committee are described here. These interactions are intended to encourage flexibility and to ensure that substance, rather than form, prevails. However, the requirement of a minimal set of interactions is intended to help facilitate measurable progress toward degree completion at a reasonable pace, without stifling creativity and inhibiting the thesis direction from evolving freely. **Each student is required to meet with his or her thesis committee around the end the second year, prior to the start of the third year.** This is separate from the second year research talk presented to the department as a whole. The purpose of the meeting is for the student to present results and update the committee on progress made and any changes in direction since the qualifying exam. It is also intended to ensure that sufficient progress is being made to justify department funding commitments. Another committee meeting is required around the end of the fourth year, provided that the student has not already graduated. **A formal committee meeting is not required in the third year, but students must provide the committee members with a brief written summary as an update between the 2nd-year and 4th-year meetings.** The exact format is flexible. Students are encouraged to seek additional informal or formal feedback proactively from individual committee members as needed.

Department Research Symposia

Effective presentation skills are necessary for the practice of good research. Participation in the departmental research symposia provides the student an opportunity to develop these skills. Each student is expected to present two symposia talks during his or her graduate studies: one during the 2nd year and another during the 4th year. These talks are given as part of a day-long Departmental Research Review

that provides students, faculty, and postdocs an opportunity to learn about different research areas, discuss alternative approaches to research, and provide comments and feedback to colleagues.

The content of the talks will vary with the state of the projects, but a typical content will include background, experimental approach, results, and future plans. Typically, the second year talk is essentially a preliminary report and a research proposal; the fourth year talk is more polished, featuring a more coherent presentation of project results. The student can improve his or her skills by soliciting feedback from faculty members and other students; at a minimum each thesis committee member should be consulted. Students are encouraged to make use of video equipment, which is available for recording and reviewing presentations.

Final thesis defense

The final oral defense is a presentation of a summary of the completed research to the department, the defense committee, and the public research community. The defense committee may be the same as the thesis committee discussed above, with the addition of one member from outside the department. The student must provide a copy of the thesis to each member of the defense committee at least 2 weeks before the defense. At this time, the departmental Graduate Services Coordinator should also be informed of the date and venue of the defense, and an announcement, including an abstract, should be distributed to the department.

The period leading up to the final defense should involve close interaction of the student, the advisor, and the thesis committee. Since a good research project is often open-ended, questions such as which specific goals are to be pursued and which are to be set aside as secondary require substantial discussion. To allow all possible points of view to be brought to bear on these issues, continuous involvement of the thesis committee is recommended to obtain the best advice possible. Such involvement of several faculty also ensures good communication of progress and expectations, and that impartial reviews of any divergent views occur promptly. At a minimum, each student must hold a thesis committee meeting no less than six months prior to the intended defense date. This meeting may preempt the 4th-year committee meeting requirement described above.

An overview of course and non-course requirements and timeline to progress toward a Ph.D. degree is provided in **Appendix C**.

Funding

Funding will be provided on a continuing basis provided the student maintains satisfactory progress toward completion of the degree. During the first year, the main criterion is that a 3.00 GPA must be maintained in the course work. After the first year, progress will primarily be in research, where a clear quantitative measure of performance is infeasible.

In general, the thesis advisor is responsible for progress reviews after the first year, but in cases where there is disagreement between advisor and student, the thesis committee will provide an independent evaluation to determine if there is satisfactory progress. In the event that progress is deemed unsatisfactory, the student will be provided at least three months notice that funding is in danger of being discontinued, and, wherever possible, will be given sufficient opportunity to rectify the situation. Although the likelihood of this happening during the early stages of the research is slim, students should be aware that all thesis projects must eventually end, and thus the likelihood of funding being discontinued increases with increasing residence time in the program. Funding is not guaranteed beyond

four years.

The majority of students in the department are supported on research contracts, grants, and other funds obtained by their faculty advisors. Students on projects without external funding will be provided support (as long as their progress is satisfactory) using either departmental funds or by appointment as a teaching assistant. No student will be supported by departmental funds for more than five semesters; funds beyond such a commitment must be provided by the thesis advisor or by appointment as a teaching assistant.

External Fellowships

Ph.D. students who independently receive external fellowships that provide funding toward their stipend will have their standard graduate stipend supplemented by an amount equal to half the external fellowship amount or 1/3 of the regular Ph.D. graduate student stipend applicable at the time, whichever is smaller. Internal fellowships are considered to be those managed by the university (e.g. Delaware Space Grant Consortium), training grants, and graduate college fellowships.

Teaching Assistants

The ability to communicate ideas, concepts, and factual information in any environment is an essential skill for all PhD graduates, even those who have no interest in an academic position. Consequently, all PhD students are required to fulfill a teaching requirement, which consists of serving as a TA for two lecture-style courses or for one Junior or one Senior laboratory course. Students who serve as a TA for a lab will be considered full-time TAs for that semester, while students who serve as a TA for a lecture will be considered half-time TAs. All TAs are expected to continue to be actively involved in their research while serving as a TA. Although the exact timing of TA appointments is flexible, it is highly desirable that students complete all TA responsibilities relatively quickly (by the end of the 3rd year if possible) to allow them to focus entirely on their research as they near the end of their graduate studies.

In order to be an effective TA, it is essential that students have adequate command of the English language. Graduate students considered deficient in language ability will be required to correct this deficiency, for example, by taking an appropriate course through the University's English Language Institute. Language deficiencies can also be identified during the Oral Qualifying Examination. Final decisions on how to resolve these deficiencies are made by the Graduate Program Coordinator in consultation with the student's thesis advisors and the Department Chair.

Teaching Assistant positions are assigned by the faculty Graduate Program Coordinator in November (for the upcoming spring semester) and in May (for the following fall). Students are encouraged to submit their preferences for specific TA positions early to facilitate the process. Although every effort is made to satisfy these requests, this may not always be possible. **The educational needs of the Department may require the Graduate Program Coordinator to ask students to fill specific TA positions.**

Every spring, the Department recognizes the contributions of our most outstanding TAs with the Robert L. Pigford Awards for Outstanding Teaching Assistants. These awards, which include modest financial gifts, are used to acknowledge exceptional TAs for their efforts toward advancing the Department’s educational mission.

Teaching Fellowships

The Department has established the Teaching Fellowship program for graduate students with particular interest in academic careers. Each Teaching Fellow co-teaches a Chemical Engineering course with a faculty mentor. The Fellow is involved in all aspects of the course (lecturing, preparation of new material,

grading, assessment, etc.) Graduate students interested in the Teaching Fellow program should meet with the Graduate Program Coordinator to discuss the various course options. Teaching Fellows are chosen by a committee based on their performance in previous TA positions, recommendation from their thesis advisor(s), and comments from the prospective faculty mentor. Students are strongly encouraged to complete their TA requirements prior to applying for a Teaching Fellowship. The committee may award a particularly outstanding Teaching Fellow candidate the Shirley and Fraser Russell Teaching Fellowship.

Requirements for the MChE Degrees

Students who obtain a MChE instead of a PhD or who do not matriculate into the PhD program have two options for graduate education leading to a Masters in Chemical Engineering (MChE) Degree.

The thesis option requires 6 credit hours of thesis work (CHEG869 Master's Dissertation) and 24 credit hours of course work; it is designed for full-time graduate students in residence. The course option requires 30 credits of course work and is designed for engineers who are studying part-time. The faculty member supervising the thesis research will act as an advisor for students in the thesis option. The Department's Graduate Program Director will act as an advisor to all students in the course work option.

Both options require 10 credits (five courses) of core courses in chemical engineering fundamentals: Modeling, Analysis, and Acquisition of Data (CHEG 807, 2 credits); Molecular Thermodynamics (CHEG 810, 2 credits); Kinetic Processes (CHEG 820, 2 credits); Diffusive Transport Processes (CHEG 821, 2 credits) and either Introduction to Data and Systems Analysis (CHEG 802, 2 credits) or Chemical Interfaces and Surfaces (CHEG 811, 2 credits). Students must also take 2 credits of Advanced Scientific Communication (CHEG 803), and take 4 credits (two modules) of Advanced chemical and biomolecular engineering modules. Students must take an additional 14 credits of chemical engineering elective courses (or at least 8 credits of chemical engineering electives and 6 credits of CHEG869).

Modules can be combined to form a concentration.

Biomolecular Concentration
CHEG 840 Rate Processes & Dynamics for Microbial Systems (2 credits)
CHEG 843 Rate Processes & Dynamics for Mammalian Cellular Systems (2 credits)

Catalysis and Energy Concentration
CHEG 850 Electrochemical Processes (2 credits)
CHEG 851 Applied Thermodynamics (2 credits)

Data and Systems Concentration
CHEG 860 Process Systems Engineering: Mathematical Modeling and Optimization Principles (2 credits) CHEG 861 Data Science for Chemical and Biomolecular Engineering (2 credits)

Soft Matter Concentration
CHEG 830 Continuum Transport in Materials (2 credits)
CHEG 832 Soft Materials, Colloids, and Polymers (2 credits)

No Concentration
Any combination of two 2-credit modules of advanced chemical engineering coursework not otherwise counted towards the student's core course requirements.

In general, MChE students will not funded. A 3.00 GPA must be maintained throughout the program. Students should be aware that theses must come to an end in a reasonable period of time (typically 18 months).

APPENDIX A – **Example Curricula for the Ph.D.**

Sample Curriculum 1: Ph.D. in Chemical Engineering with Biomolecular Concentration (Soft Materials Option in FALL II)

FALL I
CHEG 807 Modeling, Analysis, and Acquisition of Data (2 credits)

FALL II
CHEG 811 Chemical Interfaces and Surfaces (2 credits)
CHEG 810 Molecular Thermodynamics (2 credits)

FALL (REGULAR)
CHEG 800 Chemical and Biomolecular Engineering Seminar (1 credit)
CHEG 820 Kinetic Processes (2 credits)
CHEG 821 Diffusive Transport Processes (2 credits)
CHEG 6xx/8xx Technical Elective

SPRING I
CHEG 840 Rate Processes & Dynamics for Microbial Systems (2 credits)

SPRING II
CHEG 843 Rate Processes & Dynamics for Mammalian Cellular Systems (2 credits)

SPRING (REGULAR)
CHEG 803 Advanced Scientific Communication (2 credits)
CHEG 6xx/8xx Technical Elective

ADDITIONAL COURSES
CHEG 800 Chemical and Biomolecular Engineering Seminar (1 credit)
CHEG 6xx/8xx Technical Elective or Module
CHEG 969 Doctoral Dissertation (9 credits; after candidacy)

Sample Curriculum 2: Ph.D. in Chemical Engineering with Biomolecular Concentration (Data and Systems Option in FALL I)

FALL I
CHEG 802 Introduction to Data and Systems Analysis (2 credits)

FALL II
CHEG 807 Modeling, Analysis, and Acquisition of Data (2 credits)
CHEG 810 Molecular Thermodynamics (2 credits)

FALL (REGULAR)
CHEG 800 Chemical and Biomolecular Engineering Seminar (1 credit)
CHEG 820 Kinetic Processes (2 credits)
CHEG 821 Diffusive Transport Processes (2 credits)
CHEG 6xx/8xx Technical Elective

SPRING I
CHEG 840 Rate Processes & Dynamics for Microbial Systems (2 credits)

SPRING II
CHEG 843 Rate Processes & Dynamics for Mammalian Cellular Systems (2 credits)

SPRING (REGULAR)
CHEG 803 Advanced Scientific Communication (2 credits)
CHEG 6xx/8xx Technical Elective

ADDITIONAL COURSES
CHEG 800 Chemical and Biomolecular Engineering Seminar (1 credit)
CHEG 6xx/8xx Technical Elective or Module
CHEG 969 Doctoral Dissertation (9 credits; after candidacy)

Sample Curriculum 3: Ph.D. in Chemical Engineering (no concentration)

FALL I
CHEG 802 Introduction to Data and Systems Analysis (2 credits)

FALL II
CHEG 811 Chemical Interfaces and Surfaces (2 credits)
CHEG 807 Modeling, Analysis, and Acquisition of Data (2 credits)
CHEG 810 Molecular Thermodynamics (2 credits)

FALL (REGULAR)
CHEG 800 Chemical and Biomolecular Engineering Seminar (1 credit)
CHEG 820 Kinetic Processes (2 credits)
CHEG 821 Diffusive Transport Processes (2 credits)

SPRING I

SPRING II
CHEG 843 Rate Processes & Dynamics for Mammalian Cellular Systems (2 credits)

SPRING (REGULAR)
CHEG 803 Advanced Scientific Communication (2 credits)
CHEG 6xx/8xx Technical Elective
CHEG 6xx/8xx Technical Elective

ADDITIONAL COURSES
CHEG 800 Chemical and Biomolecular Engineering Seminar (1 credit)
CHEG 6xx/8xx Technical Elective or Module
CHEG 969 Doctoral Dissertation (9 credits; after candidacy)

Sample Curriculum 4: Ph.D. in Chemical Engineering (no concentration; Data and Systems Option in FALL II)

FALL I
CHEG 802 Introduction to Data and Systems Analysis (2 credits)

FALL II
CHEG 807 Modeling, Analysis, and Acquisition of Data (2 credits)
CHEG 810 Molecular Thermodynamics (2 credits)

FALL (REGULAR)
CHEG 800 Chemical and Biomolecular Engineering Seminar (1 credit)
CHEG 820 Kinetic Processes (2 credits)
CHEG 821 Diffusive Transport Processes (2 credits)
CHEG 6xx/8xx Technical Elective

SPRING I
CHEG 840 Rate Processes & Dynamics for Microbial Systems (2 credits)

SPRING II
CHEG 861 Data Science for Chemical and Biomolecular Engineering (2 credits)

SPRING (REGULAR)
CHEG 803 Advanced Scientific Communication (2 credits)
CHEG 6xx/8xx Technical Elective

ADDITIONAL COURSES
CHEG 800 Chemical and Biomolecular Engineering Seminar (1 credit)
CHEG 6xx/8xx Technical Elective or Module
CHEG 969 Doctoral Dissertation (9 credits; after candidacy)

APPENDIX B – Qualifying Exam Evaluation Rubrics

UD Chemical & Biomolecular Eng. Qualifying Exam - Individual Committee Assessment

Student Name:_____ Committee Member: _____

Purpose: The individual assessments provided by each committee member will serve as valuable input for the overall committee discussion. These assessments help ensure that all aspects of the student's performance are considered and individual committee member's viewpoints are heard. This form is to be completed *every* committee and will be distributed to the student following the exam finalization.

Completing this Form:

- *Each* committee member is required to fill out this form independently before the committee discussion. Ensure that your assessment reflects your evaluation of the student's performance in each of the 7 categories with an X.
- Providing specific comments on this form is optional. If you choose to include comments in the section at the bottom, they should be clear and constructive, as they will be seen by students. The advisor will document specific comments and feedback during the committee discussion to ensure all perspectives are captured.
- Use this form to participate in the committee evaluation discussion

Submitting this Form:

- Once the exam concludes, send / hand this completed form to the student's advisor to be submitted along with the Committee Summary Outcome form. This should be done promptly to facilitate the compilation of feedback and the committee discussion.

Exam Outcome Determination:

- The preliminary outcome of the exam will be determined during the collaborative discussion among all committee members. The committee will work together to reach a consensus on the student's performance and the outcome of the exam based on the individual evaluations. The advisor will summarize the committee's discussion and the agreed-upon exam outcomes in the Committee Summary Outcome form.
- These outcomes will be discussed during a faculty meeting to finalize exam results. Any deviation from the committee summary will be updated by the advisor on the Committee Summary Outcome, which will be given to students.

Exam Result Distribution:

- Final exam results will be distributed by letter to the individual students. Students will receive the Committee Summary Outcome and the Individual Committee Assessment forms at the same time. This provides the student with comprehensive feedback on all aspects of their performance.

		Expectations		
		Exceeds	Meets	Does Not Meet
OVERALL (combined oral + written)	Category 1: Literature & Background • Relevant background/contextual literature synthesized • Knowledge gap in the field pertinent to project identified • Innovation / novelty of project pervasively articulated • Accurate context of previous and ongoing work provided	☐	☐	☐
	Category 2: Formulation & Progress • Feasible approach (plan of work and timeline) to achieve the project goals has been constructed • Complete description of accurate data collection processes (workflow and analyses) demonstrated • Appropriate methods and tools described • Evidence of technical capabilities demonstrated	☐	☐	☐
	Category 3: Creative & Critical Thinking • Effective problem solving demonstrated • Ability to interpret data and identify next steps / alternatives exhibited • Anticipated outcomes, challenges, barriers, and alternatives considered	☐	☐	☐

		Expectations		
		Exceeds	Meets	Does Not Meet
Written document	Category 4: Proposal Effectiveness • Evident and compelling central message constructed • Context, audience, and scope appropriate • Conventions of the discipline and genre implemented correctly • Appropriate and recent sources included • Scientific language choices enhance the document's effectiveness			
	Category 5: Technical Writing Elements • Writing is clear, concise, and with evidence of proofreading performed • Logical structure with appropriate sections applied • Clear and compelling figures included • The required format was followed (references, length)			
Oral exam	Category 6: Presentation Elements • Presentation crafted logically • Compelling visuals used and easily grasped by audience • Tone and posture convey professionalism and enthusiasm			
	Category 7: Response to Questions • Articulate and accurate responses to questions • Breadth and depth of topic mastery demonstrated • Dialogue with audience achieved			

Optional notes to student:

UD Chemical & Biomolecular Eng. Qualifying Exam - Committee Summary Outcome

Student Name:_____ Advisor(s): _____

Committee Members: _____

Purpose: This form consolidates the committee's discussion and contributing factors to the final decision regarding the student's exam performance. This form is to be completed *only* by the student's advisor (or one advisor if the student is co-advised) and will be distributed to the student following the exam finalization.

Discussion Procedure:

- Using the individual committee member forms as a guide, begin a systematic discussion of each evaluation category.
  - Note: the advisor(s) should facilitate the discussion following the review criteria but the discussion and evaluation is performed by the qualifier committee.
  - Advisor feedback should be incorporated only if requested by the committee.
- The committee members should provide a few verbal comments in each category to help the advisor capture the committee's collective feedback and discuss the strengths and weaknesses in each review criteria.
- For each category, the committee should agree on the level of expectation achieved
  - Any discrepancies or significant differences in individual assessments should be addressed and resolved
- The final outcome of the exam will be determined through collaborative discussion among all committee members.

Completing this Form:

- The advisor will summarize the committee's discussion by providing notes in indicated sections, identify agreed-upon levels of expectation for each category (using an X), and the final exam outcomes in this form during the exam.
- Notes addressing committee discussion points in each category should be completed by the advisor.
- Any discrepancies or significant differences in assessments should be included and how they were resolved.
- Give / send the completed form and the individual committee member assessments to Mark Blenner & Mary Walsh immediately after the exam completion but prior to the faculty meeting

Exam Outcome Determination:

- The preliminary outcome of the exam will be determined through a collaborative discussion among all committee members. The committee will work together to reach a consensus on the student's performance and the outcome of the exam based on the individual evaluations.
- These outcomes will be discussed during a faculty meeting to finalize exam results. Any deviation from the committee summary will be updated by the advisor on this form (Committee Summary Outcome), which will be given to students.

Exam Result Distribution:

- Final exam results will be distributed by letter to the individual students. Students will receive the Committee Summary Outcome and the Individual Committee Assessment forms at the same time. This provides the student with comprehensive feedback on all aspects of their performance.

		Expectations		
		Exceeds	Meets	Does Not Meet
OVERALL (combined oral + written)	Category 1: Literature & Background • Relevant background/contextual literature synthesized • Knowledge gap in the field pertinent to project identified • Innovation / novelty of project pervasively articulated • Accurate context of previous and ongoing work provided	☐	☐	☐
	Notes:			
	Category 2: Formulation & Progress • Feasible approach (plan of work and timeline) to achieve the project goals has been constructed • Complete description of accurate data collection processes (workflow and analyses) demonstrated • Appropriate methods and tools described • Evidence of technical capabilities demonstrated	☐	☐	☐

1/3

	Notes:			
	Category 3: Creative & Critical Thinking • Effective problem solving demonstrated • Ability to interpret data and identify next steps / alternatives exhibited • Anticipated outcomes, challenges, barriers, and alternatives considered	☐	☐	☐
	Notes:			
		Expectations		
		Exceeds	Meets	Does Not Meet
Written document	Category 4: Proposal Effectiveness • Evident and compelling central message constructed • Context, audience, and scope appropriate • Conventions of the discipline and genre implemented correctly • Appropriate and recent sources included Scientific language choices enhance the document's effectiveness	☐	☐	☐
	Notes:			
	Category 5: Technical Writing Elements • Writing is clear, concise, and with evidence of proofreading performed • Logical structure with appropriate sections applied • Clear and compelling figures included • The required format was followed (references, length)	☐	☐	☐
	Notes:			
Oral exam	Category 6: Presentation Elements • Presentation crafted logically • Compelling visuals used and easily grasped by audience • Tone and posture convey professionalism and enthusiasm	☐	☐	☐
	Notes:			
	Category 7: Response to Questions • Articulate and accurate responses to questions • Breadth and depth of topic mastery demonstrated • Dialogue with audience achieved	☐	☐	☐
	Notes:			

Outcome reached by the consensus of the evaluating committee:

- ☐ Pass
- ☐ Pass with Commendation
- ☐ Conditional Pass*
- ☐ Does Not Pass*

**The specific nature of Conditional Pass and Does Not Pass is determined by the entire faculty. Specifically, what are the conditions for the Conditional Pass and what path is left for a student that Does Not Pass (Checkpoint Masters, Terminal Masters, Terminal Coursework Masters).*

Actions or Comments from the Committee:

APPENDIX C: Overview of formal requirements & milestones for progression of Ph.D. candidacy and completion

Coursework

Complete CHEG Core Coursework (with at least a B-)
☐ **CHEG 802 or CHEG 811**
☐ **CHEG 807**
☐ **CHEG 810**
☐ **CHEG 820**
☐ **CHEG 821**
☐ **CHEG 803**

Complete CHEG Seminar Requirements
☐ **CHEG 800 (First Semester)**
☐ **CHEG 800 (Fourth Semester)**

Complete CHEG Module Requirements
☐ **CHEG 840/843/850/851/860/861/830/832**
☐ **CHEG 840/843/850/851/860/861/830/832**

Complete CHEG Technical Electives (at least 7 credits, 3 of which MUST be at 800-level)
☐ **CHEG 8XX**
☐ **CHEG 6XX/8XX**
☐ **CHEG 6XX/8XX**

Complete CHEG Doctoral Dissertation Research (9 credits, taken after completing all but the second CHEG800, and after entering candidacy)
☐ **CHEG 969**

Advisor Selection
☐ **Hear Presentations From Faculty (September)**
☐ **Meet with Advisors and their Research Groups (September - October)**
☐ **Submit Preferences for Advisors (mid-late October)**
☐ **Receive Advisor Assignment (mid-late November)**

Teaching Assistance
☐ **Requirement #1 (2nd Year)**
☐ **Requirement #2 (2nd / 3rd Year)**

Qualifying Exam
☐ **Identify 2 faculty members from CBE who will serve on your Ph.D. committee (and your quals committee)**
☐ **Written Document is due 3 weeks before the week of oral qualifying exams.**
☐ **Oral qualifying exams are scheduled 2 weeks before the start of the Fall semester (or Spring semester)**
☐ **Pass the Qualifying Exam**
☐ **Complete the Doctoral Candidacy Form after completing all coursework (except the second CHEG 800).**

Dissertation and Dissertation Committee

- ☐ **Identify external committee member once admitted to candidacy.**
- ☐ **Participate in 2nd year talks.**
- ☐ **Hold a formal committee meeting prior to starting the 3rd year.**
- ☐ **Informal or Formal dissertation committee update.**
- ☐ **Participate in 4th year talks.**
- ☐ **Hold a penultimate committee meeting ~6 months before final defense.**
- ☐ **Complete final defense.**
- ☐ **Deposit edited and approved dissertation.**