

# MACROMOLECULAR SCIENCE, PHD

**Degree:** Doctor of Philosophy (PhD)  
**Field of Study:** Macromolecular Science

## Program Overview

Courses leading to the Doctor of Philosophy (PhD) degree in macromolecular science are offered within the Case School of Engineering. They are designed to increase the student's knowledge of macromolecular science and of their own basic area of scientific interest, with application to specific polymer research problems. Research programs derive particular benefit from close cooperation with graduate programs in chemistry, physics, materials science, chemical engineering, biological sciences, and other engineering areas. The interdisciplinary academic structure allows the faculty to fit the individual program to the student's background and career plans. Basic and advanced courses are offered in polymer synthesis, physical chemistry, physics, biopolymers, and applied polymer science and engineering. A laboratory course in polymer characterization instructs students in the use of modern experimental techniques and equipment. Graduate students are also encouraged to take advanced course work in polymer solid state physics, physical chemistry, synthesis, rheology, and polymer processing.

## Graduate Program Rules

Graduates entering the Department of Macromolecular Science and Engineering are subject to the academic rules of the University, of the School of Engineering, and of the Department. Consult the Graduate Student Handbook.

A short abstract of important points include:

- GPA requirements are described below in the Departmental Rules.
- A student receiving a "U" in a course is automatically placed on probation and must remove themselves from probation within one year (usually by repeating the course). If a course is repeated, both original and revised grades will count in the grade point average.
- Some students are admitted on a probationary basis and must achieve a 3.0 GPA after two semesters to remain in good standing (this is a rule of the Engineering School).
- Students entering the graduate program for a PhD will need to fill out the Academic Program **by the end of their second semester**.
- All students are required to serve as teaching assistants. Responsibilities as a TA include serving as an instructor, lab assistant, recitation leader, grader, or tutor in an undergraduate course. After fulfilling the required teaching assistant program, UNIV 400, students will **make sure that three teaching courses (400T, 500T, and 600T) are listed on their Academic Program**. Completion of this teaching requirement will be monitored by Graduate Studies and is required in order to graduate.

## Engineering School Rules

Most of these rules are incorporated in the number and type of courses required by the Department. However, Case School of Engineering PhD students are required to:

- maintain full-time status as a PhD bound student;
- maintain a grade point average of 3.2 or above; and
- continue making satisfactory academic progress as certified by their advisor.

## Departmental Rules

- Students in the PhD program receiving a GPA below 2.50 in any two consecutive semesters will be asked to terminate their graduate study program.
- The GPA requirement established by the university at various stages of the graduate program shall exclude PhD thesis credits which will be graded "S" or "U" until a final grade is given at the end of the program. Hence a student must maintain a minimum GPA of 3.0 (for a PhD) in coursework. (As mentioned above, Case School of Engineering PhD students must maintain a GPA of 3.2 or above.)
- Coursework may be transferred from another university, subject to Graduate Committee approval if:
  - the courses duplicate requirements of the department;
  - the courses were in excess of the undergraduate degree requirements; or
  - the courses were taken in a graduate program elsewhere;
  - a grade of B or better was achieved in those courses;
  - a petition is made to and approved by the Graduate Committee of the Department
  - the transferred grades will not count in the GPA at CWRU
- The Department reserves the right to withhold financial support to a student if that student takes an undue amount of time in completing their PhD requirements (normally no longer 5 years after initial registration of EMAC 701).
- A PhD student must pass the written Qualifying Exam within 18 months after enrollment with an MS degree into the PhD program. A PhD student must pass the written Qualifying Exam within 24 months after enrollment with a BS degree into the PhD program. A student only has two chances to pass the Qualifying Exam. Students will be asked to answer 4 mandatory questions – one from each of the following five areas: Polymer Synthesis; Polymer Physical Chemistry; Polymer Physics; Applied Polymer Science; Seminars (from the previous year)
 

Two elective questions will be chosen from a number of questions from all elective courses offered in the Department. NOTE: The Qualifying Exam is given twice per year respectively on the first Friday at the beginning and the first Friday after the end of the Spring semester. For PhD students enrolled in a spring semester, those with MS must pass the Qualifying Exam at the end of their second spring semester, and those with BS must pass it at the beginning of their third spring semester.
- The Research Qualifying Exam (RQE) is designed to test the student's knowledge of the chosen field as well as their originality and ability to perform high quality, independent research. It consists of a written research proposal and an oral defense. All PhD students who hold an MS degree must pass the RQE within 2 years of enrolling in the PhD program, while students with a BS degree must do so within 2.5 years. Successful passing of the Written Qualifying Exam (not to be confused with the written portion of this RQE) is a prerequisite to taking the RQE. Students have two chances to pass the RQE and no student will be allowed to continue on to a PhD degree if they have not successfully taken it. A conditional pass with major revision (see below) requires modification to the

written or oral portion, at the examination committee's discretion, within ten business days and following guidelines by the examination committee. A second exam, if required due to failure of the first exam, must be taken within six months of the first exam with at least one examination committee member remaining the same. Passing the exam constitutes advancement to candidacy and is required for enrolling in EMAC 701.

- g. At least three (3) weeks prior to the RQE oral defense, the student will submit to the graduate chairperson a research proposal title with a one-paragraph synopsis of the research problem and approach, along with suggestions for two members ((i) and (ii), below) of the three member examining committee. The examining committee will consist of three faculty members: (i) a member (or intended member) of the student's Thesis Advisory Committee, (ii) an expert in the research proposal area and (iii) a faculty member selected systematically and in a neutral manner by the Graduate Committee. The student's primary thesis advisor or co-advisors is/are excluded from the examining committee. Upon establishing the examining committee, the student will arrange with the committee for the date, time, and location of the RQE. The student will then distribute the written research proposal to the examining committee five full business days before the defense. It should be no less than 15 and no more than 20 pages of double-spaced text with 1" margins on all sides. No more than 5 pages can be devoted to the proposal introduction or background. Figures, tables, and schemes should not exceed five pages in total. Literature citations are in addition to this page count. The oral presentation will be chaired by a designated chairperson from the examining committee. It should contain only limited background material, focusing primarily on execution of the proposed research. The oral presentation should last 20-30 minutes, with questions from faculty being for clarification only. Following the presentation, the examining committee will ask questions for the student to answer concerning the proposal. On the basis of the written proposal and oral defense (presentation and question responses), the faculty will then confer and tender a decision of pass, conditional pass with major revision, or fail, immediately. The decision will be communicated to the student and graduate chairperson in writing within one business day.
- h. All PhD students are required to fulfill their teaching requirement by registering for the three teaching courses, 400T, 500T, and 600T that will be posted to the departmental roster each semester. Completion of the teaching requirement will be monitored by Graduate Studies, and these three teaching courses **must appear both on the Program of Study form and the student's transcript.**
- i. It is expected that all students will present the results of their research in a Departmental Seminar. This is mandatory for students enrolled in the PhD program. Attendance and registration for the EMAC 677 Colloquium in Macromolecular Science and Engineering seminars are also mandatory.
- j. The department requires the equivalent of six credit hours of departmental assistance. This requirement takes the form of grading, laboratory assistance and/or general departmental duties and is designed to utilize no more than three hours/week of a student's time. The departmental service requirement must be completed within the first two semesters of study. However, the departmental service requirement form **must be turned in at the end of each semester until the obligation is met.**
- k. Vacation Policy. Graduate students in the department who receive fellowship support for 12 months are normally entitled to two weeks

vacation plus national holidays. Alternative arrangements may be made with the student's advisor, giving ample advance notice. In certain situations, it is possible to take a leave of absence without financial support.

- l. Prior to graduation, a student is required to clean out his/her laboratory space including removal of waste solvents and hazardous material.
- m. Failure to comply with all of the above course requirements may result in termination or delay in graduation.

## PhD Policies

For PhD policies and procedures, please review the School of Graduate Studies section of the General Bulletin.

## Program Requirements

The PhD program consists of 36 hours of coursework, including the departmental core courses and 18 credit hours of PhD thesis (EMAC 701) are required for the PhD degree, in addition to passing the research qualifying exam (oral proposal) and the written qualifying exam.

Of the coursework credit requirements, the core courses are designated as "depth" courses (12 credits). In addition, all students will take a minimum of two breadth courses in basic science and/or other departments in the School of Engineering (for a total of six credits). The remaining breadth requirements (up to 18 credits) are satisfied by course modules taken in Macromolecular Science and Engineering.

Each doctoral student is responsible for becoming sufficiently familiar with the research interests of the department or program faculty to choose in a timely manner a faculty member who will serve as the student's research advisor. The research advisor is expected to provide mentorship in research conception, methods, performance, and ethics, as well as focus on development of the student's professional communication skills, building professional contacts in the field, and fostering the professional behavior standard of the field and research in general.

The research advisor also assists with the selection of three other faculty to serve as the required additional members of the dissertation advisory committee. This committee must be formed within the second semester following admission. Throughout the development and completion of the dissertation, these members are expected to provide constructive criticism and helpful ideas generated by the research problem from the viewpoint of their particular expertise. Each member will make an assessment of the originality of the dissertation, its value, the contribution it makes and the clarity with which concepts are communicated, especially to a person outside the field.

The doctoral student is expected to arrange meetings and maintain periodic contact with each committee member. A meeting of the full committee for the purpose of assessing the student's progress should occur at least once a year until the completion of the dissertation.

For students entering the PhD program with an MS degree, 18, instead of 36 credit hours, of coursework is required. Other requirements for a PhD remain the same as described above. Normally students should orient their training around their main area of interest/expertise and in relation to their research program. For those enrolled in the MD/PhD

degree program, all 18 course credits for breadth and depth courses must be taken within the Medical School Program.

The core courses designated as depth courses are:

| Code     | Title  | Hours |
|----------|--|-------|
| EMAC 401 | Polymer Foundation Course I: Organic Chemistry   | 3     |
| EMAC 402 | Polymer Foundation Course II: Physical Chemistry | 3     |
| EMAC 403 | Polymer Foundation Course III: Physics           | 3     |
| EMAC 404 | Polymer Foundation Course IV: Engineering        | 3     |

Students are required to take all four depth courses (12 credits), but on the approval of the instructor, can be excused from one or more of the courses if the relevant course content is not satisfied by a course taken in prior undergraduate or graduate degrees. However, the excused credits must be fulfilled by taking additional breadth courses. NOTE: While EMAC 401 and EMAC 402, and EMAC 404 are offered at the same time in the Fall and Spring semesters, respectively, students can still sign up for both courses, since one is offered in the first half and the other in the second half of the semester.

Two courses in basic science and/or engineering are required. These courses can be taken in other departments of the School of Engineering, or the departments of Mathematics, Biology, Biochemistry, Chemistry, or Physics as approved by the advisor.

As part of the course requirements, all students are required to register for EMAC 677 (the Friday departmental seminars) which will be graded with either "Pass" or "No Pass."

Students who have taken EMAC 370 and EMAC 376 as undergraduates can use these courses to fulfill one or more of the depth requirements in the Department of Macromolecular Science and Engineering for the MS and PhD degree. However, the credits for this course cannot be applied towards the course credit requirements for the graduate degree. Exceptions are possible for the combined BS/MS program.