

# MACROMOLECULAR SCIENCE, MS

**Degree:** Master of Science (MS)  
**Field of Study:** Macromolecular Science

## Program Overview

Courses leading to the Master of Science (MS) 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:

- a. GPA requirements are described below in the Departmental Rules.
- b. 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.
- c. 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).
- d. Students entering the graduate program for a PhD will need to fill out the Academic Program **by the end of their second semester**.
- e. 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:

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

## Departmental Rules

- a. The GPA requirement established by the university at various stages of the graduate program shall exclude MS 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 in coursework.
- b. Thesis-Focused Track MS students must give a departmental seminar (as part of the student lecture series).
- c. Project-Focused Track MS degrees are limited to non-fellowship students.
- d. 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
- e. The Department reserves the right to withhold financial support to a student if that student takes an undue amount of time in completing their MS requirements (normally no longer than 3 years for MS).
- f. It is expected that all students will present the results of their research in a Departmental Seminar. Attendance and registration for the EMAC 677 seminars are also mandatory.
- g. 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**.
- h. 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.
- i. Prior to graduation, a student is required to clean out their laboratory space including removal of waste solvents and hazardous material.
- j. Failure to comply with all of the above course requirements may result in termination or delay in graduation.

## Graduate Policies

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

## Program Requirements

### Master's Thesis-Focused Track

The minimum requirement to complete a master's degree under the Thesis-Focused Track is 30 hours. Of the 30 hours, at least 18 hours must be coursework, and 9 hours must be EMAC 651. At least 18 semester hours of coursework, including thesis, must be at the 400 level or higher.

All Thesis-Focused MS students must take 6 credits of departmental fundamentals courses including the lab component. Please note: Once a student begins registration of EMAC 651, the student must register for at least one credit hour of this course every semester until graduation. The normal residency period for an MS degree is 2 years.

Elective and core courses can be taken via Distance Learning or by transfer (transfers need to be approved by the chair of the department and dean of graduate studies; core courses also need instructors' approval).

MS students will generally be required to take the core courses:

EMAC 401

EMAC 402

EMAC 403

EMAC 404

Plus an additional 6 credit hours of coursework for Thesis-Focused courses to be approved by their advisor.

For completion of a master's degree in the Thesis-Focused Track, an oral examination (defense) of the master's thesis is required. The examination is conducted by a committee of three university faculty members. The candidate's thesis advisor usually serves as the chair of the examining committee. The chair of the department or the curricular program faculty appoints members of the committee. The examining committee must agree unanimously that the candidate has passed the thesis examination.

### Master's Project-Focused Track

The master's Project-Focused Track is available for individuals who live out of state or are working full-time. A research report and oral examination are required before graduation. This option requires 30 total credit hours; categorized by the following:

- 3-6 cr. hrs. need to be project credit (independent study) which needs to be approved by advisor
- 21-24 course credits (of which 9 must be based in Macromolecular Science); and
- 6 core course credits

Each candidate for the master's degree under Project-Focused Track must satisfactorily pass a comprehensive examination, which is administered by the department or curricular program committee. The examination may be written or oral or both. A student must be registered during the semester in which any part of the comprehensive examination is taken. If not registered for other courses, the student will be required to register for one semester hour of EXAM 600, before taking the examination.

Elective and core courses can be taken via Distance Learning or by transfer (transfers need to be approved by the chair of the department

and dean of graduate studies; core courses also need instructors' approval).

MS students will generally be required to take the core courses:

EMAC 401

EMAC 402

EMAC 403

EMAC 404

Plus an additional 15 credit hours of coursework for Project-Focused courses to be approved by their advisor.

### Master's Course-Focused Track

The Course-Focused MS degree program requirements consist of the completion of 30 hours of approved coursework at the 400 level or higher, satisfactory completion of the culminating course-focused experience, i.e. passing the course ENGR 600 with requirements defined by the student's curricular program, and additional requirements as specified by the program. Students should consult with their academic advisor and/or department to determine the detailed requirements within this framework.

## Master of Science in Engineering with Specialization

### Advanced Films and Packaging Systems

The Department of Macromolecular Science and Engineering at Case Western Reserve University offers a Master's Degree track in Advanced Films and Packaging Systems. This program is designed to be completed over 12 months but can be spread out over multiple years. Options for either a thesis-based or a course-based Master's are available.

Through a 30 credit hour curriculum, students explore and learn how to apply the fundamental principles of macromolecular science and engineering toward emerging challenges and opportunities in the utilization of plastics in films and packaging. The department offers a unique intersection of deep expertise polymer synthesis, structure-property relationships, and processing which can be applied to benefit an industry with a global economic impact of at least \$1 trillion annually.

### Core Course Requirements (9 credits):

Code	Title	Hours
EMAC 436		2
EMAC 437	Advanced Polymeric Films	2
EMAC 438		3
EMAC 450	The Business of Polymers	2

### Fire Science and Engineering

The Case School of Engineering at Case Western Reserve University offers an MS graduate program in Fire Science and Engineering. Students will choose either a Master of Science in Macromolecular Science and Engineering or a Master of Science in Mechanical Engineering, both with a concentration in fire science. Case Western Reserve offers a unique intersection of expertise in macromolecular and combustion science and mechanical and chemical engineering, making us singularly suited to cover all aspects of fire protection, safety, and flammability.

Through a 30 credit hour curriculum, students explore and learn how to apply the fundamental principles of fire behavior and dynamics, protection and suppression systems, polymeric materials structure, properties and

selection and more. The program is designed to be completed in one year but can be spread out over multiple years.

The Fire Science and Engineering program at Case Western Reserve covers all aspects of combustion and fire suppression. After graduating from this degree program, students will be ready to apply their thorough understanding of:

- The chemistry of fire and materials
- Flammability logistics
- Fire dynamics and fire behavior
- Fire risk assessment
- Fire protection engineering
- Combustion
- Fire and safety-related codes
- Human behavior and life safety analysis
- Structural fire protection
- Passive fire protection systems
- Polymer engineering

#### Core Course Requirements (18 credits):

Code	Title	Hours
EMAC 404	Polymer Foundation Course IV: Engineering	3
EMAE 457	Combustion	3
EMAC/EMAE 461	Chemistry of Fire Safe Polymers and Composites	3
EMAC/EMAE 463	Fire Dynamics	3
EMAC/EMAE 464	Fire Protection Engineering	3

#### Elective tracks:

Choose one of the following two elective tracks:

##### *Elective Track I: Macromolecular Science and Engineering (9 credits)*

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 405	Polymer Characterization Laboratory	3

##### *Elective Track II: Mechanical Engineering (9 credits)*

Code	Title	Hours
EMAE 453	Advanced Fluid Dynamics I	3
EMAE 459	Advanced Heat Transfer	3
EMAE 558	Conduction and Radiation	3
ECIV 424		3

#### Degree Options

The Fire Science and Engineering master's degree track comprises 30 credit hours, which may be all coursework or include an MS thesis (9 credit hours) or a project (3 to 6 credit hours). Students can choose to receive a Master of Science in Macromolecular Science and Engineering with a specialization in Fire Science and Engineering, or a Master of Science in Mechanical Engineering with a specialization in Fire Science and Engineering.

All students will take six core fire protection engineering courses. Other courses can be chosen from the elective track for macromolecular science and engineering or mechanical engineering. The materials track focuses on polymer chemistry and materials, and the chemistry

of flammability and fire suppression. The mechanical track follows a traditional mechanical engineering/combustion approach to fire protection and suppression, but with specialization classes in polymers.

The track can be finished in one year or in multiple years. Students have the option of completing a thesis or research project at their employers' laboratories with Case Western Reserve faculty members as co-advisors.

For additional information, please contact:

Gary Wnek, Chair of the Department of Macromolecular Science and Engineering

Ya-Ting Liao, Assistant Professor in the Department of Mechanical and Aerospace Engineering

#### Academic Calendar

This fire protection engineering degree is offered over three semesters: 12 credits in the fall semester; 12 credits in the spring semester; and 6 credits in the summer. See the university's academic calendar.

#### How to Apply

Application to the Fire Science and Engineering program is handled through the university's School of Graduate Studies. Students will need to know whether they wish to apply for the MS in Macromolecular Science and Engineering or the MS in Mechanical Engineering.

Students interested in applying to the Fire Science and Engineering program should already have a bachelor's degree in Chemistry, Chemical Engineering, Mechanical Engineering or Materials Science & Engineering and have taken the GRE. Additional application requirements include a statement of objectives, academic transcripts, and three letters of recommendation. International students will also need to take the Test of English as a Foreign Language (TOEFL). Read more about the university's full application procedure requirements here.

When you are ready to apply, electronic applications can be submitted here.