POLYMER SCIENCE AND ENGINEERING, BSE

Degree: Bachelor of Science in Engineering (BSE)
Major: Polymer Science and Engineering

Program Overview

In 1970, the department introduced a program leading to the Bachelor of Science in Engineering degree with a major in Polymer Science and Engineering, which is designed to prepare the student both for employment in polymer-based industry and for graduate education in polymer science.

The Case School of Engineering is proud that the polymer science and engineering program was the first such undergraduate program in the country to receive accreditation from the Engineering Council for Professional Development. The curriculum combines courses dealing with all aspects of polymer science and engineering with basic courses in chemistry, physics, mathematics, and biology, depending on the needs and interests of the student. The student chooses a sequence of technical electives, in consultation with a faculty advisor, allowing a degree of specialization in one particular area of interest, e.g., biomaterials, chemical engineering, biochemistry, or physics. In addition to required formal laboratory courses, students are encouraged to participate in the research activities of the department, both through part-time employment as student laboratory technicians and through the senior project requirement: a one or two semester project that involves the planning and performance of a research project.

Polymer science undergraduates are also strongly encouraged to seek summer employment in industrial laboratories during at least one of their three years with the department. In addition to the general undergraduate curriculum in Polymer Science and Engineering, the department offers two specialized programs which lead to the Bachelor of Science in Engineering with a major in Polymer Science and Engineering. The cooperative program contains all the course work required for full-time resident students plus one or two six-month cooperative sessions in polymer-based industry. The company is selected by the student in consultation with his or her advisor, depending on the available opportunities. The dual-degree program allows students to work simultaneously on two baccalaureate level degrees within the university. It generally takes five years to complete the course requirements for each department for the degree. The BS/MS program leads to the simultaneous completion of requirements for both the master's and bachelor's degrees. Students with a minimum GPA of 3.0 may apply for admission to this program in their junior year.

The Bachelor of Science in Engineering degree program in Polymer Science and Engineering is accredited by the Engineering Accreditation Commission of ABET, under the commission's General Criteria and Program Criteria for Materials Engineering.

Program Educational Objectives

The program will produce graduates who:

(1) Are competent, creative, collaborative, and highly valued polymer engineers and scientists in industry, academia, or government.

(2) Are flexible and adaptable in the workplace, possess the capacity to embrace new opportunities of emerging technologies, sustainability initiatives, and leadership and teamwork opportunities, all affording impactful engineering careers.

(3) Are prepared to continue their lifelong professional development, for example, by obtaining advanced degrees in polymer science and engineering or other professional fields, including medicine, law, management, finance or public policy.

(4) Act with the global, ethical, societal, ecological, and commercial awareness expected of practicing engineering professionals.

Learning Outcomes

As preparation for achieving the above educational objectives, the Bachelor of Science in Engineering degree program with a major in Polymer Science and Engineering is designed so that students attain:

- an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- an ability to communicate effectively with a range of audiences
- an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
- an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
- an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Co-op and Internship Programs

Opportunities are available for students to alternate studies with work in industry or government as a co-op student, which involves paid full-time employment over seven months (one semester and one summer). Students may work in one or two co-ops, beginning in the third year of study. Co-ops provide students the opportunity to gain valuable hands-on experience in their field by completing a significant engineering project while receiving professional mentoring. During a co-op placement, students do not pay tuition but maintain their full-time student status while earning a salary. Alternatively or additionally, students may obtain employment as summer interns.

Undergraduate Policies

For undergraduate policies and procedures, please review the Undergraduate Academics section of the General Bulletin.

Accelerated Master's Programs

Undergraduate students may participate in accelerated programs toward graduate or professional degrees. For more information and details of the

policies and procedures related to accelerated studies, please visit the Undergraduate Academics section of the General Bulletin.

Program Requirements

Students seeking to complete this major and degree program must meet the general requirements for bachelor's degrees and the Unified General Education Requirements. Students completing this program as a secondary major while completing another undergraduate degree program do not need to satisfy the school-specific requirements associated with this major.

Code	Title	Credit Hours
Required Mathematics, Science and Engineering Courses:		
MATH 121	Calculus for Science and Engineering I	4
MATH 122	Calculus for Science and Engineering II	4
or MATH 124	Calculus II	
MATH 223	Calculus for Science and Engineering III	3
or MATH 227	Calculus III	
MATH 224	Elementary Differential Equations	3
or MATH 228	Differential Equations	
PHYS 121	General Physics I - Mechanics	4
or PHYS 123	Physics and Frontiers I - Mechanics	
PHYS 122	General Physics II - Electricity and Magnetism	4
or PHYS 124	Physics and Frontiers II - Electricity and Magnetism	
CHEM 111	Principles of Chemistry for Engineers	4
ENGR 130	Foundations of Engineering and Programming	3
ENGR 145	Chemistry of Materials	4
ENGR 200	Statics and Strength of Materials	3
ENGR 210	Introduction to Circuits and Instrumentation	4
ENGR 399	Impact of Engineering on Society	3
Total Credit Hours		**43**

Traditional Track

Code	Title	Credit Hours
EMAC 270	Introduction to Polymer Science and Engineering	3
EMAC 276	Polymer Properties and Design	3
EMAC 351	Physical Chemistry for Engineering	3
EMAC 352	Polymer Physics and Engineering	3
EMAC 355	Polymer Analysis Laboratory	3
EMAC 370	Polymer Chemistry	3
EMAC 372	Polymer Processing and Testing Laboratory	3
EMAC 375	Fundamentals of Non-Newtonian Fluid Mechanics and Polymer Rheology	3
EMAC 376	Polymer Engineering	3
EMAC 377	Polymer Processing	3
EMAC 378	Polymer Engineer Design Product	3
EMAC 398	Polymer Science and Engineering Project I	3
Three Technical Electives [a]		9
Natural Science Elective [b]		3-4
Choose one of the following:		
BIOC 307	Introduction to Biochemistry: From Molecules To Medical Science	
PHYS 221	Introduction to Modern Physics	
PHYS 349	Methods of Mathematical Physics I	
STAT 312	Basic Statistics for Engineering and Science	
Total Credit Hours		**48-49**

a Can include 3 or 6 credit hours of EMAC 125 and/or EMAC 325.
b Chosen in consultation with the student's academic advisor.

Biomaterials track

Code	Title	Credit Hours
Required Courses:		
EBME 201	Physiology-Biophysics I	3
EBME 202	Physiology-Biophysics II	3
EBME 306	Introduction to Biomedical Materials	3
EMAC 270	Introduction to Polymer Science and Engineering	3
EMAC 276	Polymer Properties and Design	3
EMAC 351	Physical Chemistry for Engineering	3
EMAC 352	Polymer Physics and Engineering	3
EMAC 355	Polymer Analysis Laboratory	3
EMAC 370	Polymer Chemistry	3
EMAC 376	Polymer Engineering	3
EMAC 377	Polymer Processing	3
EMAC 378	Polymer Engineer Design Product	3
EMAC 398	Polymer Science and Engineering Project I	3
Natural Science Elective [a]		**3**
Choose one of the following:		
BIOC 307	Introduction to Biochemistry: From Molecules To Medical Science	
BIOL 214	Genes, Evolution and Ecology	
BIOL 215	Cells and Proteins	
BIOL 362	Principles of Developmental Biology	
Technical Electives:		**9**
Choose three of the following:		
EBME 305	Materials for Prosthetics and Orthotics	
EBME 316	Biomaterials for Drug Delivery	
EBME 325	Introduction to Tissue Engineering	
EBME 350	Quantitative Molecular, Cellular and Tissue Bioengineering	
EBME 406/ EMAC 471	Polymers in Medicine	
EBME 426	Nanomedicine	
EMAC 125 & EMAC 325	First Year Research on Polymers and Undergraduate Research in Polymer Science [b]	
Total Credit Hours		**51**

a Chosen in consultation with the student's academic advisor.
b 3 credit hours of research may be substituted for one of the technical electives.

Sample Plan of Study

Traditional Track

First Year

Fall		Credit Hours
CHEM 111	Principles of Chemistry for Engineers	4
ENGR 130	Foundations of Engineering and Programming	3
MATH 121	Calculus for Science and Engineering I	4
Academic Inquiry Seminar, Breadth, or Elective course [a]		3
Breadth, or Elective course [a]		3
	Credit Hours	**17**
Spring		
ENGR 145	Chemistry of Materials	4
MATH 122	Calculus for Science and Engineering II	4
PHYS 121	General Physics I - Mechanics	4
Academic Inquiry Seminar, Breadth, or Elective course [a]		3
	Credit Hours	**15**

Second Year

Fall		
CHEM 223	Introductory Organic Chemistry I	3
EMAC 270	Introduction to Polymer Science and Engineering	3
MATH 223	Calculus for Science and Engineering III	3
PHYS 122	General Physics II - Electricity and Magnetism	4
Breadth, or Elective course [a]		3
	Credit Hours	**16**
Spring		
CHEM 224	Introductory Organic Chemistry II	3
EMAC 276	Polymer Properties and Design	3
ENGR 200	Statics and Strength of Materials	3
MATH 224	Elementary Differential Equations	3
Breadth, or Elective course [a]		3
	Credit Hours	**15**

Third Year

Fall		
CHEM 290	Chemical Laboratory Methods for Engineers	3
EMAC 351	Physical Chemistry for Engineering	3
Breadth, or Elective course [a]		3
Technical Elective [b]		3
Natural Science Elective		3
	Credit Hours	**15**
Spring		
EMAC 376	Polymer Engineering	3
EMAC 355	Polymer Analysis Laboratory	3
EMAC 352	Polymer Physics and Engineering	3
ENGR 399	Impact of Engineering on Society	3
Breadth, or Elective course [a]		3
Technical Elective [b]		3
	Credit Hours	**18**

Fourth Year

Fall		
ENGR 210	Introduction to Circuits and Instrumentation	4
EMAC 370	Polymer Chemistry	3
EMAC 375	Fundamentals of Non-Newtonian Fluid Mechanics and Polymer Rheology	3
EMAC 377	Polymer Processing	3
EMAC 398	Polymer Science and Engineering Project I [c]	3
	Credit Hours	**16**
Spring		
EMAC 372	Polymer Processing and Testing Laboratory	3
EMAC 378	Polymer Engineer Design Product	3
Technical Elective [b]		3
Open elective		3
Open elective		3
	Credit Hours	**15**
	Total Credit Hours	**127**

a Unified General Education Requirement.
b Technical sequence must be approved by department advisor.
c Preparation for the polymer science project should commence in the previous semester.

Biomaterials Track

First Year

Fall		Credit Hours
CHEM 111	Principles of Chemistry for Engineers	4
ENGR 130	Foundations of Engineering and Programming	3
MATH 121	Calculus for Science and Engineering I	4
Academic Inquiry Seminar, Breadth, or Elective course [a]		3
Breadth, or Elective course [a]		3
	Credit Hours	**17**
Spring		
ENGR 145	Chemistry of Materials	4
MATH 122	Calculus for Science and Engineering II	4
PHYS 121	General Physics I - Mechanics	4
Academic Inquiry Seminar, Breadth, or Elective course [a]		3
	Credit Hours	**15**

Second Year

Fall		
EBME 201	Physiology-Biophysics I	3
EMAC 270	Introduction to Polymer Science and Engineering	3
MATH 223	Calculus for Science and Engineering III	3
PHYS 122	General Physics II - Electricity and Magnetism	4
Breadth, or Elective course [a]		3
	Credit Hours	**16**

Spring		
EBME 202	Physiology-Biophysics II [b]	3
EMAC 276	Polymer Properties and Design	3
ENGR 200	Statics and Strength of Materials	3
MATH 224	Elementary Differential Equations	3
Breadth, or Elective course [a]		3
	Credit Hours	**15**
Third Year		
Fall		
CHEM 223	Introductory Organic Chemistry I [b]	3
CHEM 290	Chemical Laboratory Methods for Engineers	3
EBME 306	Introduction to Biomedical Materials	3
EMAC 351	Physical Chemistry for Engineering	3
Breadth, or Elective course [a]		3
	Credit Hours	**15**
Spring		
CHEM 224	Introductory Organic Chemistry II [b]	3
EMAC 376	Polymer Engineering	3
EMAC 303	Structure of Biological Materials	3
EMAC 355	Polymer Analysis Laboratory	3
Technical Elective [c]		3
Natural Science Elective		3
	Credit Hours	**18**
Fourth Year		
Fall		
ENGR 210	Introduction to Circuits and Instrumentation	4
EMAC 370	Polymer Chemistry	3
EMAC 375	Fundamentals of Non-Newtonian Fluid Mechanics and Polymer Rheology	3
EMAC 377	Polymer Processing	3
Breadth, or Elective course [a]		3
	Credit Hours	**16**
Spring		
EMAC 378	Polymer Engineer Design Product	3
EMAC 398	Polymer Science and Engineering Project I [d]	3
ENGR 399	Impact of Engineering on Society	3
Technical Elective		3
Technical Elective		3
	Credit Hours	**15**
	Total Credit Hours	**127**

a Unified General Education Requirement.
b Suggested for pre-med students.
c EMAC 355 is strongly recommended.
d Preparation for the polymer science project should commence in the previous semester.