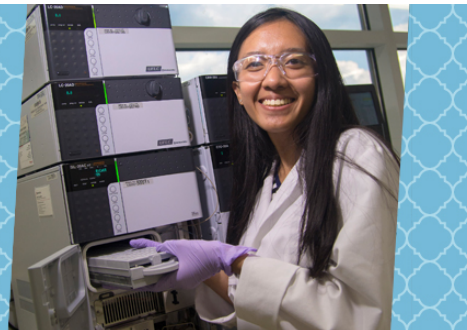


## A MINOR THAT COMPLEMENTS YOUR MAJOR

Expand your expertise while pursuing  
your undergraduate degree



### Minor in Polymer Science and Polymer Engineering

**Program Description:** This minor is a 6 course/18 credit program that provides students a broad foundation in polymer science and polymer engineering through the core curriculum; practical experience through a laboratory course or research experience in polymer science or polymer engineering; and advanced knowledge in areas such as polymer chemistry, polymer physics, polymer processing, polymer characterization through upper level electives.

**Majors:** The minor is suitable for any STEM major including engineering, natural sciences or math seeking to complement their primary major with in-depth knowledge of polymer science and polymer engineering.

**Program Timeline:** This minor is designed to be completed by taking one course per semester. For a student entering with no previous college credit it is expected they will begin the minor in the fall of their sophomore year after they have completed the initial math and chemistry pre-requisites.

**Why should you get a minor in Polymer Science and Polymer Engineering?** This minor offers students the opportunity to capitalize on the world-class teaching and research environment in the School of Polymer Science and Polymer Engineering to obtain a distinguishing credential for launching their career in the vibrant, thriving polymer industry central to both the Northeast Ohio and the broader U.S. economy.

#### Quick Facts:

##### Ohio Polymer Industry\*

- Ohio is the #1 producer of both plastic and rubber products, according to the U.S. Census Bureau based on employment. Also the \$5.49 billion of plastics and rubber products produced in Ohio ranks first in the nation according to the US Bureau of Economic Analysis. >\$50 billion contributed to Ohio's GDP by the polymer industry.
- 76 out of 88 Ohio counties are home to at least one polymer company, totaling 1,150 polymer establishments in the state.
- Over 81,000 skilled employees constitute Ohio's polymer workforce
- Ohio's polymer industry contributes 8% of all US jobs
- \$61,400 is the average annual salary for resins and synthetic rubber industry
- 104 investments have been announced by 97 Ohio polymer companies, totaling in \$663 million with 4,600 new jobs expected

\*Source: Polymer Ohio, <https://polymerohio.org/resources/polymer-facts-stats/>, accessed 1/27/2020.

## **Curriculum Guide**

### **Core Curriculum (All Courses Required)**

|                                                    |           |
|----------------------------------------------------|-----------|
| 9821:201 Introduction to Polymer Science           | 3 credits |
| 9821:202 Introduction to Polymer Engineering       | 3 credits |
| 9821:301 Polymer Materials Science and Engineering | 3 credits |

### **Laboratory Experience (3 credits – choose one course<sup>1</sup>)**

|                                                       |             |
|-------------------------------------------------------|-------------|
| 9841:451 Polymer Engineering Laboratory               | 3 credits   |
| 9841:497 Honors Project                               | 3 credits   |
| 9841:498/598 Research Problems in Polymer Engineering | 1-3 credits |
| 9841:499 Polymer Engineering Design Project           | 3 credits   |
| 9871:405 Polymer Science Laboratory                   | 3 credits   |
| 9871:497 Honors Project in Polymer Science            | 1-3 credits |
| 9871:499 Research Problems in Polymer Science         | 1-3 credits |

1. 9841:498/9871:497/9871:499 May be taken multiple semesters to satisfy 3 credit requirement

### **Elective Courses (6 credits – choose two courses<sup>2</sup>)**

|                                       |           |
|---------------------------------------|-----------|
| 9841:422 Polymer Processing           | 3 credits |
| 9841:450 Properties of Solid Polymers | 3 credits |
| 9871:403 Polymer Chemistry            | 3 credits |
| 9871:404 Polymer Physics              | 3 credits |

2. Elective courses in other departments (e.g. Biomedical Engineering, Chemical and Biomolecular Engineering, Chemistry, Physics may be taken as elective courses with permission of the Dean of the School of Polymer Science and Polymer Engineering)



### Core Courses

#### **9821:201 Introduction to Polymer Science 3 credits**

Pre-requisites: 3450:221 Analytical Geometry/Calculus I AND 3150:151 Principles of Chemistry I

Introduction to the field of polymer science including molecular weight distributions, polymerization, chain statistics, polymer mixtures, rubber elasticity, polymer glasses, semi-crystalline polymers and viscoelasticity.

#### **9821:202 Introduction to Polymer Engineering 3 credits**

Pre-requisites: 3450:222 Analytical Geometry/Calculus II AND 3650:291 Elementary Classical Physics I  
Lecture & Lab

Introduction to the field of polymer engineering including classification of polymer materials, mechanical properties, fundamentals of polymer melt flow, polymer processing operations, and compounding.

#### **9821:301 Polymer Materials Science and Engineering 3 credits**

Pre-requisites: 3450-223 Analytical Geometry – Calculus III  
Co-requisites: 3150-313 Physical Chemistry I OR 4600-300 Thermodynamics

Introduction to the materials science and engineering of polymers. Topics covered are the phase behavior and morphology of polymer solutions and blends, glassy polymers, polymer crystallization, materials characterization, and multi-component polymer materials.



### Laboratory/Research Experience Electives

#### **9841:451 Polymer Engineering Laboratory 3 credits**

Pre-requisites: 9821:202 Introduction to Polymer Engineering OR 4200:408 Polymer Engineering

Laboratory course on polymer engineering. Topics covered include thermal, mechanical, and chemical analysis of polymeric materials as well as design of experiments.

**9841:497 Honors Project      3 credits**

Prerequisite: Senior standing in the Honors Program

Individual creative project in mechanical polymer engineering, supervised by faculty member of the department.

**9841:498/598 Research Problems in Polymer Engineering      1-3 credits**

Pre-requisites: Permission of Department Chair of Polymer Engineering

Provides students an opportunity to perform research on contemporary topics in polymer engineering with the guidance of polymer engineering faculty members. The students develop skills in conducting laboratory research and analysis, writing and presentation of research results.

**9841:499 Polymer Engineering Design Project      3 credits**

Co-requisite: 4600:400 or permission of instructor

Analysis and design of mechanical polymer systems.

**9871:405 Polymer Science Laboratory      3 credits**

Pre-requisites: 9821:301 Polymer Materials Science and Engineering OR 4200:408 Polymer Engineering OR 9871:403 Polymer Chemistry

Laboratory course covering the synthesis and characterization of polymers

**9871:497 Honors Project in Polymer Science      1-3 credits**

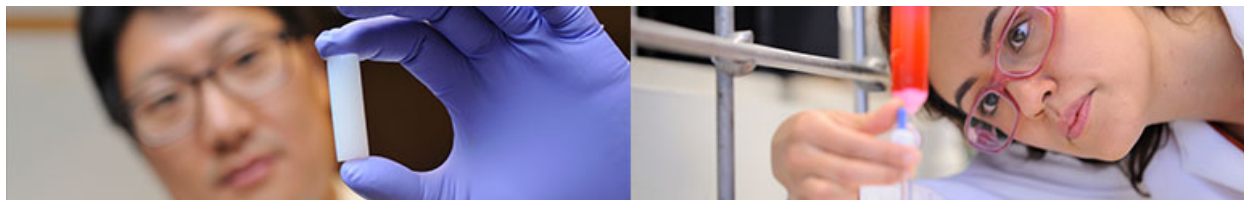
Pre-requisites: Sophomore, junior or senior standing in Honors College and permission of honors preceptor in the home department.

Independent research leading to completion of honors thesis under guidance of project adviser. May be repeated for a total of 10 credits.

**9871:499 Research Problems in Polymer Science      1-3 credits**

Pre-requisites: Permission of Department Chair of Polymer Science

Faculty-supervised undergraduate research problems in polymer science, culminating in a written report.



### **Elective Courses**

#### **9841:422 Polymer Processing                    3 credits**

Pre-requisites: 4600:310 Fluid Mechanics AND 4600:315 Heat Transfer OR 4200:321 Transport Phenomena AND 4200:351 Fluid & Thermal Operations

This is an undergraduate course on the processing of polymers. Topics covered are polymer rheology and specific types of processing operations including compounding, extrusion, injection molding, thermoforming, and additive manufacturing.

#### **9841:450 Properties of Solid Polymers                    3 credits**

Pre-requisites: 9821:301 Polymer Materials Science and Engineering OR 4300:202 Mechanics of Solids OR 4200:408 Polymer Engineering

Mechanical behavior of solid polymers including elastic and plastic deformation, viscoelasticity, fatigue and failure.

#### **9871-403 Polymer Chemistry                    3 credits**

Pre-requisites: 3150:263 Organic Chemistry Lecture I AND 3150:313 Physical Chemistry Lecture I

Provides the fundamental bases for understanding and comprehending the basic principles associated with the synthesis of polymers using a number of traditional and contemporary polymerization techniques with an emphasis on the mechanisms, kinetics, stereochemistry and resulting properties of polymers.

#### **9871:404 Polymer Physics                    3 credits**

Pre-requisites: 9801:301 Polymer Materials Science and Engineering OR 4200:408 Polymer Engineering OR 3450-223 Analytical Geometry - Calculus III AND 3150-313 Physical Chemistry I

Advanced overview of polymer physics including scaling theories, chain dynamics, statistical mechanics of elasticity, the physics of glassy polymers and crystallization kinetics.