

POLYMER SCIENCE AND POLYMER ENGINEERING

The School of Polymer Science and Polymer Engineering offers an undergraduate Bachelor of Science in Polymer Science and Polymer Engineering, and an undergraduate minor in Polymer Science and Polymer Engineering appropriate for undergraduate science and engineering majors. Research experiences for one to three credits per semester are also offered, starting at the freshman level. The School is home to a number of graduate programs in Polymer Science and Polymer Engineering at the master's and doctoral levels.

- Polymer Science and Polymer Engineering, BS (<https://bulletin.uakron.edu/undergraduate/colleges-programs/engineering-polymer-science/polymer-science-polymer-engineering/>)
- Polymer Science and Polymer Engineering, Minor (<https://bulletin.uakron.edu/undergraduate/colleges-programs/engineering-polymer-science/polymer-science-polymer-engineering/polymer-science-polymer-engineering-minor/>)
- Undergraduate Research in Polymer Science and Polymer Engineering, Certificate (<https://bulletin.uakron.edu/undergraduate/colleges-programs/engineering-polymer-science/polymer-science-polymer-engineering/undergraduate-research-certificate/>)

Interdisciplinary - Polymer Science & Engineering (PSPE)

PSPE 100 Introduction to Polymers (3 Units)

Polymers are ubiquitous in modern society. They are in everything from everyday products (tires, paint, and milk jugs) to specialty items (bullet proof vests, lithium batteries, and graphite shaft golf clubs) to the human body (DNA and proteins). This undergraduate course introduces students to unique properties of polymers starting from their early history and discovery to modern day efforts in advanced materials, recycling and sustainability. (Formerly 9821:100)

PSPE 201 Introduction to Polymer Science (3 Units)

Prerequisites: CHEM 151 and MATH 221. 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. (Formerly 9821:201)

PSPE 202 Introduction to Polymer Engineering (3 Units)

Prerequisites: MATH 222 and PHYS 291. Introduction to the field of polymer engineering including classification of polymer materials, mechanical properties, fundamentals of polymer melt flow, polymer processing operations and compounding. (Formerly 9821:202)

PSPE 281 Polymer Science for Engineers (2 Units)

Prerequisites: CHEM 151 and CHEM 152. Chemical bonds and structure of organic molecules, polymer chain structure, amorphous and crystalline morphology and structural characterization, polymerization and copolymerization, experimental demonstrations, typical solid-state and flow properties. (Formerly 9821:281)

PSPE 301 Polymer Materials Science and Engineering (3 Units)

Corequisites: CHEM 313 or PHYS 340 or MECE 300 or permission. 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. (Formerly 9821:301)

PSPE 310 Impacts of Polymers on Modern Life (3 Units)

Prerequisite: High school chemistry of equivalent. Qualitative introduction to plastics and polymers, intended for non-science majors. Course explores the history and use of polymers in commercial products including food, cosmetics, and medicine. The course will also explore the socioeconomic trade-offs in the use of polymers, where quality of life, food safety, lifesaving technologies are weighed against environmental and health impacts. (Formerly 9821:310)

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PSPE 381 Polymer Morphology for Engineers (3 Units)

Prerequisites: PSPE 281, CHEM 151, and PHYS 292. Fundamental understanding of solid structure, crystallography and morphology, processed polymers, co-polymers and their blends. (Formerly 9821:381)

PSPE 411 Special Topics in Polymer Science and Polymer Engineering (3 Units)

Prerequisite: Permission of instructor. Special topics in polymer science and polymer engineering is an elective course focused on advancing students' knowledge in specialized topics in polymers. (Formerly 9821:411)

PSPE 605 Polymer Physical Chemistry (4 Units)

Fundamentals of polymer chain characteristics, common polymerization types, and overview of polymer physical chemical behavior. (Formerly 9801:605)

PSPE 615 Polymer Characterization (4 Units)

Prerequisite: PSPE 605. Introduction to widely used polymer characterization techniques (3cr) with accompanying experiments (1cr). (Formerly 9801:615)

PSPE 635 Rheology, Processing and Evaluation of Polymeric Materials (4 Units)

Prerequisite: PSPE 605. Introduction to several types of polymer processing and several tests of properties (3cr) with accompanying lab environments (1cr). (Formerly 9801:635)

PSPE 645 Research, Problem Solving and Communication of Technical Information (3 Units)

Prerequisite: PSPE 605. Introduction to the research and development enterprise, problem solving, and the communication of technical information to various audiences. (Formerly 9801:645)

PSPE 665 Emerging Markets & Technologies (3 Units)

Prerequisites: PSPE 605, PSPE 615, and PSPE 635. Overview of emerging markets and technologies involving polymers as well as analyses of these technologies with respect to life cycle, carbon footprint, and sustainability. (Formerly 9801:665)

Polymer Engineering (PLYE)

PLYE 101 Tools for Polymer Science and Polymer Engineering (2 Units)

This is an introductory course for Polymer Science and Polymer Engineering (PSPE) undergraduate major. Topics include an overview of the PSPE major and profession; use of spreadsheet software and MATLAB for calculations and curve fitting; individual and group written and oral presentations; and engineering and professional ethics. Engineering design will be introduced through a teamwork activity. (Formerly 9841:101)

PLYE 102 Tools for Polymer Technology (2 Units)

Prerequisite: PSPE 100. The course trains students in tools they will need for the Associate in Applied Science of Polymer Technology degree program. These include basic word-processing skills, use of spreadsheet generating software for data analysis and graphing using examples drawn from polymer applications.

PLYE 206 Introduction to Coatings (3 Units)

Prerequisites: CHEM 101 and PSPE 100. This associates-level course introduces students to coating technologies, methods of application, coatings testing, and practical components of coatings. Students will be able to understand what the different coatings are, how they are applied, what physical properties they exhibit and how to measure these properties

PLYE 207 Troubleshooting in Polymer Technology (1 Unit)

Prerequisites: CHEM 101, PLYE 102, PHYS 261, and EEET 120. Pre/Corequisites: PLYS 203 and PLYS 204. This associates-level course trains students on calibration techniques and sources of effective error in common equipment used in the elastomer, plastic, and coatings industries.

PLYE 321 Polymer Fluid Mechanics (3 Units)

Prerequisites: CHEE 321, senior standing, and full admission to an engineering major in the College of Engineering and Polymer Science. This undergraduate course introduces the rheological properties and flow characteristics of polymer fluid systems. It covers non-Newtonian viscosity of polymer melts and solutions, viscoelasticity of polymer melts and solids, measurement methods, and interpretation of rheological properties. (Formerly 9841:321)

PLYE 324 Quantitative Polymer Analysis (3 Units)

Prerequisites: MATH 223, MATH 335, and full admission to an engineering major in the College of Engineering and Polymer Science. This is an undergraduate course on quantitative analysis problems in polymer engineering. This course will allow the students to learn and use necessary analytical methods in designing and optimizing processes in the field of the polymer. The solution to the linear and nonlinear first and higher-order differential equations are provided by analytical methods. Students will be exposed to various concepts in linear algebra and will use dimensional analysis tools, such as the Buckingham theorem to identify key parameters that govern the physics of the problem. Furthermore, different techniques, such as separation of variables, similarity transformation, and furrier transform, to solve partial differential equations will be covered. (Formerly 9841:324)

PLYE 330 Polymer Thermodynamics (3 Units)

Prerequisites: MATH 223 and full admission to an engineering major in the College of Engineering and Polymer Science. This undergraduate course provides an introduction to thermodynamics including the fundamental laws, equations of state, phase equilibria, binary blends, and their corresponding phase diagrams. Polymeric materials are emphasized in the implementation of thermodynamics. (Formerly 9841:330)

PLYE 333 Polymer Thermodynamics Laboratory (2 Units)

Prerequisite: Full admission to an engineering major in the College of Engineering and Polymer Science. Corequisite: PLYE 330. Laboratory course providing hands-on experiments in polymer thermodynamics. (Formerly 9841:333)

PLYE 422 Polymer Processing (3 Units)

Prerequisite: Full admission to an engineering major in the College of Engineering and Polymer Science. Pre/Corequisite: CHEE 321 or MECE 310. Polymer processing technology. Basic studies of flow in extrusion, molding, and other processing methods. (Formerly 9841:422)

PLYE 423 Injection Molding and Mold Design (3 Units)

Prerequisites: PLYE 321, PLYE 422, senior standing and full admission to an engineering major in the College of Engineering and Polymer Science. This course presents an in-depth analysis of injection molding processes for manufacturing of an array of polymer-based articles used in consumer, automotive, and aerospace industries. The knowledge garnered in PLYE 321 Polymer Fluid Mechanics and PLYE 422 Polymer Processing will form the basis for elaborating the influence of polymer melt flow in the mold, heat transfer out of the mold, polymer chain orientation, and polymer chain crystallization on the quality of injection molded products and their properties. (Formerly 9841:423)

PLYE 424 Additive Manufacturing with Polymers (3 Units)

Prerequisites: PLYE 321, PLYE 422, senior standing and full admission to an engineering major in the College of Engineering and Polymer Science. This course presents the essence of additive manufacturing technology of polymers to keep senior undergraduate students abreast on the paradigm shift in manufacturing of products that vary widely in dimensions, e.g., from a few millimeters to almost a meter with minimal wastes. Cases of additive manufacturing with thermoplastic and thermosetting polymers are discussed. Product designs, machines, and materials selection are covered. (Formerly 9841:424)

PLYE 425 Introduction to Blending & Compounding Polymers (3 Units)

Prerequisites: CHEE 321 or MECE 310 or permission. Nature of polymer blends and compounds and their applications. Preparation and technology using batch and continuous mixers, mixing mechanisms. (Formerly 9841:425)

PLYE 427 Mold Design (3 Units)

Prerequisites: CHEE 321 or MECE 310 or permission. Molding methods to manufacture polymeric products. Machinery, materials, molds, equipment, computer-aided design. (Formerly 9841:427)

PLYE 450 Engineering Properties of Polymers (3 Units)

Prerequisite: CHEE 305 or CIVE 201 or PSPE 202. Mechanical behavior of solid polymers including elastic and plastic deformation, viscoelasticity, fatigue and failure. (Formerly 9841:450)

PLYE 451 Polymer Engineering Laboratory (3 Units)

Prerequisites: PLYE 321, PLYE 422, senior standing and full admission to an engineering major in the College of Engineering and Polymer Science. This course teaches students how to conduct laboratory experiments on rheological characterization of polymer melts, rubber and plastics extrusion, extrudate swell, injection and compression molding, 3-D printing, and impact and tensile testing. (Formerly 9841:451)

PLYE 496 Senior Design Project I (3 Units)

Prerequisites: PLYE 324, PLYE 330, senior standing and full admission to an engineering major in the College of Engineering and Polymer Science. Corequisite: PLYE 422. This is a design course in which the students will be actively involved in implementing design principles to synthesize new materials, to evaluate the performance of polymer materials, to design a processing scheme, or manufacture polymer products. The students will acquire skills in identification and ranking of factors, identification of materials systems, development of design of experiments, and evaluation of factors. The learning outcomes will be documented in detailed project reports. (Formerly 9841:496)

PLYE 497 Honors Project (1-3 Units)

Prerequisites: Senior standing in the Honors Program and full admission to an engineering major in the College of Engineering and Polymer Science. This is a design course in which the students will be actively involved in implementing design principles to synthesize new materials, to evaluate the performance of polymer materials, to design a processing scheme, or manufacture polymer products. The students will acquire skills in identification and ranking of factors, identification of materials systems, development of design of experiments, and evaluation of factors. The learning outcomes will be documented in detailed project reports. (Formerly 9841:497)

PLYE 498 Research Problems in Polymer Engineering (1-9 Units)

Prerequisite: Permission of Department Chair. Faculty-supervised undergraduate research problems in polymer engineering culminating in a written report. (Formerly 9841:498)

PLYE 499 Senior Design Project II (3 Units)

Prerequisites: PLYE 321, PLYE 496, PLYS 405, senior standing and full admission to an engineering major in the College of Engineering and Polymer Science. This is a capstone course in which the students demonstrate mastery of the learning outcomes of this undergraduate degree program by completing challenging projects that have societal value. (Formerly 9841:499)

Gen Ed: Capstone

Polymer Science (PLYS)

PLYS 203 Introduction to Plastics (3 Units)

Prerequisites: CHEM 101 and PSPE 100. This associates-level course introduces students to plastic technologies, processing, and practical components of plastics. Students will be able to understand what the different plastics are, how they are used, how they are recycled, what physical properties they exhibit, and how they are processed into goods and products.

PLYS 204 Introduction to Elastomers (3 Units)

Prerequisites: CHEM 101 and PSPE 100. The course introduces students to what elastomers are, several common classes of elastomers, key concepts for describing elastomers and their behavior, compounding, and curing. Students are instructed in performance of several common workshop operations with elastomers and testing of elastomer properties.

PLYS 265 Organic Polymer Chemistry Laboratory (2 Units)

Prerequisites: CHEM 153 and CHEM 152. Pre/Corequisite: CHEM 263. This undergraduate course provides an introduction to the lab techniques essential to organic chemistry through the context of polymer science. Techniques including extraction, chromatography, crystallization, and structure analysis are covered. (Formerly 9871:265)

PLYS 313 Physics of Living Systems (3 Units)

Introduction to the interdisciplinary study of biological systems through the lens of the physical sciences. Learn how discovery-driven research between biology and physics leads to biomimetic advances and applications. (Formerly 9871:313)

PLYS 340 Polymer Characterization Fundamentals (3 Units)

Prerequisites: PSPE 201 and PLYE 330. Pre/Corequisite: PLYS 404. This undergraduate course provides an understanding of the most common methods of characterization of polymer molecular structure, solid morphology, and physical properties. (Formerly 9871:340)

PLYS 350 Sustainable Polymers (3 Units)

Pre/Corequisite: CHEM 263. This undergraduate course introduces students to sustainable plastic technologies, challenges, and the principals of the circular economy. Students will be able to understand the how different kinds of plastics are recovered, sorted, and recycled (or not). Topics covered include polymer recycling, composting, bio-based plastics, and life cycle analysis. (Formerly 9871:350)

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PLYS 401 Introduction to Elastomers (3 Units)

Prerequisites: CHEM 314 (or equivalent) or permission. An introduction to the science and technology of elastomeric materials and gels, including hydrogels. Lecture and laboratory. (Formerly 9871:401)

PLYS 402 Introduction to Plastics (3 Units)

Prerequisite: CHEM 314 (or equivalent) or permission. An introduction to the science and technology of plastic materials. Lecture and laboratory. (Formerly 9871:402)

PLYS 403 Polymer Chemistry (3 Units)

Prerequisite: CHEM 263 or permission. This undergraduate course 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 the polymers. Students are expected to have a strong foundation in mathematics, physics and chemistry. (Formerly 9871:403)

PLYS 404 Polymer Physics (3 Units)

Prerequisites: MATH 222 and PHYS 291. Advanced overview of polymer physics including scaling theories, chain dynamics, rubber elasticity, glassy polymers and crystallization. (Formerly 9871:404)

PLYS 405 Polymer Science Laboratory (3 Units)

Prerequisites: CHEE 408 or PSPE 301 or PLYS 403 or permission. Laboratory course with experiments on the synthesis and characterization of polymers. (Formerly 9871:405)

PLYS 460 Polymeric Biomaterials (3 Units)

Prerequisites: PLYS 403 and junior or greater standing. Pre/Corequisites: PLYS 340 and PLYS 404. This course will teach students the fundamentals of polymeric biomaterials. The course will cover the synthesis, characterization, processing and applications of polymeric biomaterials in medicine. (Formerly 9871:460)

PLYS 497 Honors Project in Polymer Science (1-3 Units)

Prerequisites: 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. (Formerly 9871:497)

PLYS 499 Research Problems in Polymer Science (1-9 Units)

Prerequisite: Permission. Faculty-supervised undergraduate research problems in polymer science, culminating in a written report. (Formerly 9871:499)