SCHOOL OF POLYMER SCIENCE AND POLYMER ENGINEERING

The University of Akron's College of Polymer Science and Polymer Engineering (CPSPE) was inaugurated in July of 1988 by combining the Department of Polymer Science, then in the Buchtel College of Arts and Sciences, with the Department of Polymer Engineering, then in the College of Engineering. Starting fall of 2020, the CPSPE was renamed the School of Polymer Science and Polymer Engineering (SPSPE). The School offers both M.S. and Ph.D. degrees in either Polymer Science or in Polymer Engineering (thesis required), a Master of Polymer Science and Polymer Engineering (non-thesis option), and a graduate certificate in Elastomer Science and Engineering. At the undergraduate level, the SPSPE offers a bachelor's degree and a polymer minor. The organization of the School includes complementary research centers and facilities with instrumentation and support staff, which provides a research focus for faculty and graduate students.

The program is one of the largest and broadest in the U.S., dating back to 1909, and is recognized as being among the world's best. Its traditional strengths in new polymer synthesis and their manufacturing processes which compound, shape, and assemble polymer products, have been complemented in the past two decades by computational simulations, morphological, surface and optical characterization, as well as a number of added specializations, such as new, federally funded programs in nanotechnologies, sustainability, biomimicry, energy generation, batteries and photonics that have permitted a much stronger focus on active polymer devices and assemblies. School of Polymer Science and Polymer Engineering faculty members have generated over 200 active patents and have licensed technologies that have been commercialized worldwide.

School Website (https://www.uakron.edu/cpspe/)

- Elastomer Science and Engineering, Certificate (https://bulletin.uakron.edu/graduate/colleges-programs/engineering/polymer-science-engineering/elastomer-science-engineering-certificate/)
- Master of Polymer Science and Polymer Engineering (https://bulletin.uakron.edu/graduate/colleges-programs/engineering/polymer-science-engineering/master-polymer-science-engineering/)
- Polymer Engineering, MSPE (https://bulletin.uakron.edu/graduate/colleges-programs/engineering/polymer-science-engineering/polymer-engineering-mspe/)
- Polymer Engineering, PhD (https://bulletin.uakron.edu/graduate/colleges-programs/engineering/polymer-science-engineering/polymer-engineering-phd/)
- Polymer Science, MS (https://bulletin.uakron.edu/graduate/colleges-programs/engineering/polymer-science-engineering/polymer-science-ms/)
- Polymer Science, PhD (https://bulletin.uakron.edu/graduate/colleges-programs/engineering/polymer-science-engineering/polymer-science-phd/)

Polymer Engineering (PLYE)

PLYE 525 Introduction to Blending and Compounding of Polymers (3 Units)
Prerequisite: Permission of instructor. Nature of polymer blends and compounds and their applications. Preparation and technology using batch and continuous mixers. Mixing Mechanisms. (Formerly 9841:525)

PLYE 527 Mold Design (3 Units)
Prerequisite: Permission of instructor. Molding methods to manufacture polymeric products. Machinery, materials, molds, equipment, computer-aided design. (Formerly 9841:527)

PLYE 550 Engineering Properties of Polymers (3 Units)
Prerequisite: Permission of instructor. Introduction to engineering properties and polymer processing. Analyzing mechanical polymer tests in glassy, rubbery, and fluid states. Product design, rheology, rheometry, and polymer processing concepts. (Formerly 9841:550)

PLYE 551 Polymer Engineering Laboratory (3 Units)
Prerequisite: Permission of instructor. Laboratory experiments on the rheological characterization of polymer melts, fabrication of engineering products, structural investigation of polymeric parts. (Formerly 9841:551)

PLYE 600 Interfacial Phenomena in Soft Matter (3 Units)
This course covers intermolecular Interactions, (de)wetting, adsorption, adhesion and friction, colloidal stability, nucleation, and assembly process. (Formerly 9841:600)

PLYE 601 Seminar in Polymer Engineering (1 Unit)
Presentations of recent research on topics in polymer engineering by internal and external speakers. (Formerly 9841:601)

PLYE 610 Polymer Engineering Analysis (3 Units)
Quantitative analysis methods central to Polymer Engineering, with applications including materials flow, deformation, and characterization. (Formerly 9841:610)

PLYE 611 Fundamentals of Polymer Structure Characterization (3 Units)
Characterization of orientation, morphology, superstructure in polymers using x-ray, light scattering, birefringence, dichroism. Crystallography, unit cell determination. (Formerly 9841:611)

PLYE 621 Rheology of Polymer Fluids (3 Units)
Experimental methods of determination of rheological properties of polymer melts, solutions, elastomers. Structure-flow behavior relationships, viscoelastic fluid theory, application to extrusion, fiber, film processing molding. Structure development in processing. (Formerly 9841:621)

PLYE 622 Analysis & Design of Polymer Processing Operations I (3 Units)
Prerequisite: PLYE 621. Mathematical modeling and engineering design analysis of polymer processing operations including extruder screws, injection molds, dies, fibers, film formation. (Formerly 9841:622)

PLYE 623 Analysis & Design of Polymer Processing Operations II (3 Units)
Prerequisite: Permission of instructor. Basic studies on non-isothermal phenomena in polymer engineering emphasizing crystallization, vitrification, frozen-in orientation and residual stresses, applications, including fiber spinning and film extrusion. (Formerly 9841:623)

PLYE 631 Engineering Properties of Solid Polymers (3 Units)
Transitions as a function of polymer structure, optical characteristics, mechanical including ultimate properties, viscoelastic behavior of elastomers and plastics, large strain behavior E emphasis on experimental methods. Evaluation of properties of polymeric solids and application to polymer processing technologies. (Formerly 9841:631)

PLYE 641 Polymer Chem & Thermodynamics (3 Units)
Physico-chemical properties of amorphous and crystalline polymers. Glass transitions, crystallization, molecular orientation and morphology of important commercial polymers, fabricated products and composite materials. (Formerly 9841:641)

PLYE 650 Introduction to Polymer Engineering (3 Units)
Basic concepts of polymer engineering taught in lecture-laboratory format intended for orientation of new graduate students. (Formerly 9841:650)

PLYE 651 Polymer Engineering Laboratory (3 Units)
Prerequisite: PLYE 622. Rheological characterization of polymer melts, rubber and plastic extrusion, extrudate swell, injection and compression molding, crystallization behavior, x-ray diffraction, film blowing, impact and tensile testing. (Formerly 9841:651)

PLYE 661 Polymerization Reactor Engineering (3 Units)
Polymerization kinetics, classical reactor design, comparison of polymerization in batch and continuous stirred tank reactors, flow patterns around agitators, tubular reactors, reactor stability. (Formerly 9841:661)

PLYE 666 Research Methods (3 Units)
This course will focus on providing guidance to beginning graduate students on general concepts that are typically encountered in research including: 1. Scientific method; 2. Ethics in research; 3. Scientific paper writing; 4 Scientific presentations. (Formerly 9841:666)

PLYE 675 Carbon-Polymer Nanotechnology (3 Units)
Prerequisite: Permission of instructor. This course focuses on the fundamental aspects of nanotechnology in general and basic knowledge of polymer/carbon nanoscience and nanotechnology in particular. (Formerly 9841:675)

PLYE 680 Polymer Coatings (3 Units)
Prerequisite: Permission of instructor. This course is an introduction to coating science. The synthesis of polymeric binders and pigments used in commodity coatings will be the focus of the first part of the course. The second part of the course will focus on coatings formulation and end-use applications for commodity coatings. (Formerly 9841:680)

PLYE 699 Masters Thesis (1-6 Units)
(May be repeated) Supervised original research in specific area of polymer engineering. (Formerly 9841:699)

PLYE 712 Rheo-Optics of Polymers (2 Units)
Applications of rheo-optical methods as means of determining stress fields in polymeric glasses and fluids during deformation, rheo-optical properties of polymers in glassy, rubbery and fluid states. Theory of dynamic birefringence and its application to mechanical relaxations of amorphous and semi-crystalline polymers, and recent experimental results. (Formerly 9841:712)

PLYE 715 Advanced Characterization of Functional Polymers (3 Units)
Prerequisites: PLYE 611 and PLYE 623 or equivalent (with permission of instructor). This course will focus on the advanced structural and functional property characterization techniques including optical, electrical, magnetic and others. A particular focus will be the influence of the history of polymer processing on these properties. (Formerly 9841:715)

PLYE 720 Molecular Aspects of Polymer Rheology (2 Units)
Prerequisite: PLYE 621. Molecular theory for concentrated solutions and melts of flexible homopolymers, molecular rheology of miscible polymer blends, block copolymers, and liquid crystalline polymers. (Formerly 9841:720)

PLYE 721 Rheology & Processing Two-Phase Polymer Systems (2 Units)
Prerequisite: PLYE 622 or equivalent. Particle-particle interactions, mixing devices and design, theoretical hydrodynamics of suspensions of rigid particles, experimental studies of rheological behavior, phenomenological theories representing suspension behavior, dispersion of droplets to form an emulsion, phase morphology development and rheological properties of blends. (Formerly 9841:721)

PLYE 722 Advanced Modelling of Polymer Processing (2 Units)
Prerequisite: Permission of instructor. Modeling of processing operations including extrusion molding, fiber and film processing, computer-aided design. (Formerly 9841:722)

PLYE 723 Rheology & Processing of Elastomers (2 Units)
Interpretation of rheological properties and critical study and analysis of processing operations including behavior in internal mixers, screw extruders, die systems and vulcanization molding. (Formerly 9841:723)

PLYE 724 Advanced Extrusion & Compounding (2 Units)
Principles of operation and flow in single and twin screw extruders, screw design, characteristics of internal mixers, analysis and simulation of flow. (Formerly 9841:724)

PLYE 725 Chemorheology & Processing of Thermosets (2 Units)
Prerequisite: PLYE 621 or PLYE 622. Rheological behavior of thermosets, vulcanization of rubbers, time-temperature-transition relationships in thermosets, reaction injection molding, compression/transfer molding, pultrusion. (Formerly 9841:725)

PLYE 727 Advanced Polymer Rheology (3 Units)
Prerequisite: PLYE 621 or equivalent. Second level course in non-linear constitutive equation for viscoelastic, viscoplastic, viscoelastic-plastic polymeric materials. Utility and applicability to polymer processing problems. Recent developments in the field. (Formerly 9841:727)

PLYE 728 Numerical Methods in Polymer Engineering (3 Units)
Prerequisites: PLYE 621, PLYE 622, PLYE 623, and PLYE 631. Basics of generally accepted numerical methods. Numerical problems in polymer solid mechanics and technological applications. Numerical problems in polymer fluid mechanics and polymer processing. Commercial softwares. (Formerly 9841:728)

PLYE 731 Stress Analysis of Polymers & Composites (2 Units)
Prerequisite: PLYE 631. The design of rubber mounts, bearings and sandwich components with demonstration of finite element methods. Classical plates and shells theories with applications to composite structures. (Formerly 9841:731)

PLYE 745 Liquid Crystals (2 Units)
Prerequisite: Permission of instructor. Structure of low molecular weight and polymeric liquid crystals, characterization, physical properties including optical properties, phase transitions, structure-property relationships, processing of polymeric species. (Formerly 9841:745)

PLYE 747 Polymer Colloids (3 Units)
Prerequisite: Permission of instructor. Colloidal dispersions, phase stability, aggregation structures, thermodynamics, kinetics of phase transitions in polymer colloids. Emulsion and solution polymerization, organic/inorganic hybrid materials, coating technology. Rheology of colloidal polymers. (Formerly 9841:747)

PLYE 749 Phase Transitions in Polymer Blends and Alloys (3 Units)
Prerequisite: Permission of instructor. Elucidating thermodynamics of polymer blends, block copolymers, crystalline/liquid crystalline polymers, and kinetics of phase transitions. Structure development and modeling of reactive polymer blends. (Formerly 9841:749)

PLYE 761 Injection and Compression Molding Fundamentals (2 Units)
Prerequisite: Permission of instructor. This course provides fundamental knowledge in physical, thermal and rheological properties required for injection and compression molding including theoretical and experimental aspects of various molding processes. (Formerly 9841:761)

PLYE 770 Polymer Nanocomposites (3 Units)
Prerequisite: Permission of instructor. Develops understanding on synthesis, characterization, processing and properties of polymer nanocomposite materials involving nanoscale fillers in conjunction with thermosetting, thermoplastic, and elastomeric polymer matrices. (Formerly 9841:770)

PLYE 773 Advanced Polymer Coating Technology (3 Units)
Prerequisite: PLYE 641 or equivalent. This is a graduate course on the coating technology of polymers. Topics covered include the polymeric binders in radiation-curable coatings, coatings for electronic packaging, waterborne coatings, the chemistry of dyes, the coatings science of pigments, and the chemistry of polymer degradation. (Formerly 9841:773)

PLYE 777 Modeling of Nanoscale Materials (3 Units)
Prerequisite: Permission of instructor. Introduces molecular simulation methods (Monte Carlo, molecular dynamics)and their application to polymer-related materials at the molecular and coarse-grain levels. (Formerly 9841:777)

PLYE 778 Advanced Functional Polymers (3 Units)
Prerequisites: PLYE 611 and PLYE 641. This is a graduate course on advanced functional polymers, semiconducting polymers. Topics covered are synthesis and optoelectronics of semiconducting (conjugated) polymers and their applications in various electronic devices. (Formerly 9841:778)

PLYE 780 Electrochemical Energy Storage (3 Units)
This is a graduate course on electrochemical energy storage. Topics covered are the fundamental science of electrochemical engineering, fuel cells, supercapacitors, batteries, and battery-supercapacitor hybrid devices.

PLYE 797 Advanced Topics in Polymer Engineering (2-3 Units)
(May be repeated) Prerequisite: Permission of instructor. Advanced special topics intended for Ph.D. students in polymer engineering. (Formerly 9841:797)

PLYE 898 Preliminary Research (1-15 Units)
(May be repeated) Prerequisites: Completion of qualifying examination, approval of Student Advisory Committee. Preliminary investigation of Ph.D. dissertation subject. (Formerly 9841:898)

PLYE 899 Doctoral Dissertation (1-15 Units)
(May be repeated) Prerequisite: Completion of candidacy examination of Student Advisory Committee. Original research by a Ph.D. candidate. (Formerly 9841:899)

Polymer Science (PLYS)

PLYS 601 Polymer Chemistry (4 Units)
Prerequisite: CHEM 264 and CHEM 314 or equivalent course or permission of instructor. Introduction to fundamentals and practical aspects of (co)polymer synthesis and reactions of polymers; use of polymerization kinetics and thermodynamics to understand polymerization mechanisms; structure-reactivity relationships. (Formerly 9871:601)

PLYS 604 Special Projects in Polymer Science (1-3 Units)
Prerequisite: permission. Research projects of limited nature assigned to student entering polymer science program. Intended to familiarize student with typical problems and techniques in this field. (Formerly 9871:604)

PLYS 607 Seminar in Polymer Science I (1 Unit)
Prerequisite: limited to first-and second-year resident graduate students. Participants are to present a 25-minute lecture on some aspect of polymer science and to participate in discussions of lectures presented by other seminar participants. (Formerly 9871:607)

PLYS 613 Polymer Science Laboratory (3 Units)
Pre/Corequisite: PLYS 601 or PLYS 631 or PLYS 674. Laboratory experiments focused on common techniques for polymer molecular characterization and characterization of polymer morphology, with a few polymer synthesis experiments. (Formerly 9871:613)

PLYS 615 Laboratory Computer Applications in Polymer Science (3 Units)
Prerequisites: Basic knowledge of computer programming and permission of instructor. Laboratory use of computers in polymer science research for data acquisition, data analysis, graphing, and preparation of reports and thesis. (Formerly 9871:615)

PLYS 631 Polymer Physics I (4 Units)
Prerequisites: 2 semester of undergraduate physics or permission of instructor. First half of an overview of polymer physics including the deal chain, chain in dilute solution, solution thermodynamics, polymer blends, and gels and networks. (Formerly 9871:631)

PLYS 632 Polymer Physics II (4 Units)
Prerequisite: PLYS 631 or permission of instructor. Phenomenological description of viscolasticity in polymers; molecular models for chain dynamics of solutions and melts; mechanical properties of polymers; polymer crystallization; electrical properties. (Formerly 9871:632)

PLYS 674 Polymer Characterization (2 Units)
Prerequisite: PLYS 631 or permission of instructor. Principles of operation, strategies for experimentation design and concepts of data interpretation for most important characterization techniques applied in polymer science and engineering. (Formerly 9871:674)

PLYS 685 Introduction to Biomacromolecules (2 Units)
Prerequisites: 2 semesters of undergraduate chemistry or permission of instructor. Develops understanding of biomacromolecular structure and function, hierarchical self-assembly, functions of biological materials (e.g. silk, collagen) and principles for bio-inspired materials design. (Formerly 9871:685)

PLYS 699 Master's Thesis (1-6 Units)
Prerequisite: permission. For properly qualified candidate for master's degree. Supervised original research in polymer science, under direction of faculty member, followed by submission of thesis. (Formerly 9871:699)

PLYS 711 Special Topics: Polymer Science (1-3 Units)
Prerequisite: permission. Topics of current interest in polymer science, encompassing chemistry, physics or technological aspects of macromolecular substances, including laboratory work where applicable. (Formerly 9871:711)

PLYS 711-1 Numerical Methods for Scientists and Engineers (1-3 Units)
Prerequisite: permission. The objective of the course is to introduce students with numerical methods that can be applied to solve problems encountered in broad areas of science and engineering. The topics covered in the course include, but not limited to, roots of equations, matrix operation, optimization, curve fitting, Fourier transformation and filtering, numerical integration and ordinary differential equation. We may consider other topics based on students' interests. The course involves the application of numerical methods to scientific problems through the development of computer programs using MATLAB and other similar languages. Many students found this course to be very helpful in analyzing their experimental data.

PLYS 712 Special Topics: Polymer Science (2 Units)
Prerequisite: permission. Topics of current interest in polymer science, encompassing chemistry, physics or engineering aspects of macromolecular science. (Formerly 9871:712)

PLYS 720 Elastomers (2 Units)
Pre/Corequisites: PLYS 601 and PLYS 631 or equivalent as determined by instructor. The course will provide a comprehensive coverage of the fundamental aspects of elastic soft materials, their chemical, physical and mechanical properties as related to their current technological applications. (Formerly 9871:720)

PLYS 899 Doctoral Dissertation (1-16 Units)
Open to properly qualified students accepted as candidates for Doctor of Philosophy in Polymer Science depending on the availability of staff and facilities. (Formerly 9871:899)

Polymer Science and Polymer Engineering (PSPE)

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)