

**Department of Materials Science and Engineering**  
**MSE 433 Materials Science & Engineering**  
**Polymer Science and Technology (3 credits)**

**Catalog Description:** An introduction of preparative methods of polymers; physical chemistry of polymeric molecules in solution, liquid, and solid phase; thermodynamics of polymers; methods of characterization; mechanical properties, fabrication techniques, properties of commercial polymers. Physical and organic chemistry of polymers for persons with a basic training in chemistry, physics, or engineering.

**Prerequisites:**

One quarter of physical chemistry and one quarter of organic chemistry.

**Textbook: Polymer Science and Technology, Joel R. Fried**

Reference book: Textbook of Polymer Science, Fred W. Billmeyer

**Course Objectives:** The student will be able to

3. Describe polymer structure and systems
4. Analyze properties of polymeric systems
5. Evaluate polymer systems for specific applications
6. Apply their knowledge to developing polymer processing techniques

**Topics Covered:**

Week I	Introduction of Polymers <ul style="list-style-type: none"><li>- Basic Concepts of Polymer Science</li><li>- Polymer Structure and Molecular Weight</li></ul>
Week II	Polymerization <ul style="list-style-type: none"><li>- Step-Growth (condensation) Polymerization: Mechanisms and Kinetics</li><li>- Chain-Growth Polymerization: Effects of Temperature and Pressure</li></ul>
Week III	Ionic and Coordination Chain Polymerization <ul style="list-style-type: none"><li>- Similarities and Contrasts in Ionic Polymerization</li><li>- Cationic Polymerization, Anionic Polymerization</li><li>- Coordination Polymerization, Ring-opening Polymerization</li></ul>
Week IV	The Solid-State Properties of Polymers <ul style="list-style-type: none"><li>- The Amorphous State</li><li>- The Crystalline State</li><li>- Thermal Transition and Properties</li><li>- Mechanical Properties</li></ul>
Week IV	Characterization <ul style="list-style-type: none"><li>- Measurements of Molecular Weight and Size</li><li>- End-group Analysis</li><li>- Light Scattering</li><li>- Gel Permeation Chromatography</li></ul>
Week V	Analysis and Testing of Polymers <ul style="list-style-type: none"><li>- Spectroscopic Methods</li><li>- Microscopy</li></ul>

Week VI	- Thermal Analysis and Physical Testing Viscoelasticity and Rubber elasticity - Dynamic-Mechanical analysis
Week VII	- Dielectric Analysis Properties of Commercial Polymers - Polyolefins, Polyesters, Polyamides, Polycarbonates - Fluorine-containing Polymers - Engineering and Specialty Polymers
Week VIII	- High Temperature Polymers - Thermosets
Week IX	Degradation, Stability, and Environmental Issues - Polymer Degradation and Stability - Management of Plastics in the Environment
Week X	Polymer Processing - Molding - Extrusion

**Class Schedule:**

Three, 50 minute class periods per week

**Contribution of course to meeting the professional component:**

This course introduces the concepts of polymer science to the students, and allows them to develop an understanding of structure/property/processing/performance relationships in polymeric systems.

**Contribution of course to program objectives:**

This course provides students with specific applications of advances science and engineering to polymeric systems, including properties and processing, along with the analysis of real engineering problems.

**Prepared by:** A. Jen, Professor, April, 2001