BE/ME/MS 504
Polymers and Soft Materials

Tuesday and Thursdays 1:30 pm – 3:15 pm
Location: MCS B21
Spring 2018

Instructor

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Course Description

The course is an introduction to polymer science at the graduate and advanced undergraduate level. Topics include polymerization, molecular weight and polydispersity, molecular size and configuration, solution properties, thermodynamics, the glassy and rubbery states, crystallization, viscoelasticity, elastic properties, and multiphase systems.

Course Goal

The goal of the course is to introduce the student to polymers, their synthesis, characterization, and properties, so that one can understand what makes these materials unique in their applications, better understand the literature in the field, and effectively use these materials in research.

Learning Outcomes

Those students who participate fully in the course and complete all assignments will be able to:

- Classify polymers based on their method of preparation, chemical structure, macromolecular architecture, and bulk properties.
- Describe the mechanisms for step and chain polymerization, analyze the kinetics and calculate expected molecular weight and molecular weight distributions.
- Discuss the experimental methods used to determine molecular weight, chain size and chemical composition, and analyze the results obtained.
- Describe and use the relationships between polymer structure and glass transition temperature, melting temperature, and bulk crystallinity.
- Describe the mechanical and transport properties of polymers in terms of fundamental quantities, and describe the experimental methods used for the determination of these properties.

Prerequisites

Graduate or advanced undergraduate standing in a physical science or engineering

Course Materials

The textbook for the course is *Introduction to Polymers, Third Edition*, by R. J. Young and P. A. Lovell, 2011 (CRC Press). There is a soft cover edition of the book available. All readings will be from the book, supplemented by handouts when necessary.

Grading

Course grades will be based on:

- Homework 10%
- Exam 1 30%
- Exam 2 30%
- Exam 3 30%

Homework assignments are meant to be formative to prepare for the exams. Hence, they will be graded for completion and solutions will be covered in class so that students can check their work. Any suspected violation of the Academic Conduct Code on exams will be immediately referred to the College of Engineering Academic Conduct Committee. (http://www.bu.edu/academics/policies/academic-conduct-code/),

Course Topics

The following is an approximate order of the topics to be covered in the course.

Topic	Chapters in Textbook
Basic concepts, nomenclature, classification	1.1 - 1.3; 2.1 - 2.4
Polymer Synthesis: step polymerization, chain polymerization, copolymerization	3.1 - 3.3; 4.1 - 4.4, 4.6; 5.1 - 5.3; 6.1 - 6.4; 9.1 - 9.5
Polymer Solutions: thermodynamics, chain dimensions, characterization techniques	10.1 - 10.4; 11.1 - 11.5; 12.1 - 12.2; 13.1 - 13.2; 14.1 - 14.3; 15.1 - 15.6
Bulk Polymers – Structure: amorphous state, crystalline state, multiphase polymers	16.1 - 16.4; 17.1 - 17.8; 18.1 - 18.3
Bulk Polymers – Properties: rubber elasticity, viscoelasticity, swelling, yield*, crazing*, composites*, diffusion* * actual topics will be time permitting	19.1 - 19.3; 20.1 - 20.9; 21.1 - 21.5; 22.1 - 22.3, 22.5; 24.1 - 24.7 Handout on diffusion in polymers

Important dates during the semester:
1/31 – last day to add course, last day for undergraduate students to change to audit
2/22 – last day to drop course without a W, last day for graduate students to change to audit
3/30 – last day to drop course with a W