Materials Science and Engineering of Polymers

14:150:361

Required text:	Materials Science of Polymers for Engineers, Osswald & Menges, Hanser Publishing, New York (1996).
Grade Basis	2 Hourly Exams = 25% Final Exam = 35% Homework, attendance and quizzes=15%

Course Outline

Week	Title	Description
1A	Introduction	Scope of polymers studies, statistical data on their use, general properties
1B	Polymerization	Basic step polymerization, basic chain polymerization. IUPAC nomenclature
2	Structure of Polymers	Bonds and intermolecular attraction, macromolecules, molecular weight, arrangement of molecules (configuration, conformation, stereoregularity)
3	Copolymers and polymer additives	Copolymer configurations and examples. Stabilizopolymer configurations and examples. Stabilizers, fillers, flame retardants,blowing agents.
4	Thermal properties of polymers	The glass transition, physical properties, crystallization and structures resulting from crystallization, semicrystalline polymer.
5	Physical measurements	Differential scanning calorimetry, modulated vs. unmodulated mode, the relationships between T_g, T_m, and T_c. Thermomechanical analysis.
6A	Review	
6B	Hourly #1	
7	Rheology of polymer melts	Specialized measurement methods for polymers, including melt flow indexing and capillary flow viscometry. Elongation viscosity. Viscosity of curing thermoset polymers.
8	Stress/strain behaviors	Viscoelasticity, creep and stress relaxation in polymers and polymer composites.
9	Solidification of Polymers/Rubber Elasticity	Thermoplastics, thermosets, residual stresses. Origin of entropy elasticity, elastomers, thermoplastic elastomers
10	Processing Methods	Extrusion, injection molding, film drawing, fiber spinning, blowing and blow molding.
11A	Hourly #2	
11B	Mixing of polymer blends	Distributive mixing, dispersive mixing, mixing devices; plasticization; polymer additives for stabilization and functional properties.
12	Polymer blends	Alloys, immiscible polymer blends, compatibilizers. Properties of commercial multi-phase systems, block copolymers
13	Mechanical design properties	Overview of stress strain curve features, brittle versus ductile failure, impact properties and test methods, chemical degradation
14	Optical properties and permeation behavior	Refractive index, photoelasticity and birefringence; transparency, reflection, absorption, and transmittance. Color. Diffusion and permeation

Course Overview and Objectives

This course is an introductory course to provide a polymer science and engineering background to material science students. The course is instructed at an intermediate level and will present enough information to enable materials engineers to understand the basic principals and behaviors of common polymer and polymer composite systems. Furthermore, in conjunction with a good design background, students will be able to select polymers for targeted applications and design elementary polymer components. This is a junior/senior level undergraduate course that requires prerequisites of chemistry and thermodynamics.

Instructor, Meeting Time and Location

Instructor:	Professor Richard Lehman 609.203.2501 rllehman@rutgers.edu Office: CCR 103 Hours: after class or by arrangement
Meeting time:	MTH 12:00 – 1:20
Location	SEC-203 or as notified by instructor

ABET A - L Content

A	[Apply math, science, engineering]	30%
F	[Prof/ethical responsibility]	10%
G	[Communications]	20%
H	[Global/economic/environmental]	10%
I	[Lifelong Learning]	20%
J	[Contemporary issues]	10%