MSE 4775: Polymer Science and Engineering I (required)

Catalog Description: (3-0-3)
Prerequisites: MSE 2001 and CHEM 2311
An introduction to the chemistry, structure, and formation of polymers, physical states and transitions, physical and mechanical properties of polymer fluids and solids.

Textbook: Paul C. Painter and Michael M. Coleman, Essentials of Polymer Science and Engineering, Destech Publications, Inc., ISBN: 978-1932078756.

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Topics Covered:

1. Introduction to 4775; Review on Organic Functional Groups
2. Introduction to Polymers
3. Molecular Weight (MW) and MW Distribution
4. Step-Growth Polymerization
5. Chain Growth Polymerization: Free Radical Polymerization; Ionic Polymerization (Anionic and Cationic); Coordination Polymerization
6. Polymer Conformation
7. Thermodynamics of Polymer Solution
8. Thermodynamics of Polymer Blends
9. Kinetics of Polymer Blends
10. Measurements of Molecular Weight and Size
11. Glass Transition of Polymers
12. Morphology and Crystallization in Semicrystalline Polymers
13. Mechanical and Rheological Properties of Polymers
14. Rubber Elasticity

Course Outcomes:

(1). Be familiar with chemical structure and chemical formulas of common polymeric materials
(2). Distinguish different polymerization reactions and mechanisms.
(3). Predict conversion and molecular weight resulting from polymerization reactions.
(4). Estimate the thermodynamic interaction and miscibility of polymer solution and polymer blend
(5). Characterize molecular weight and molecular weight distribution in terms of common parameters
(6). Analyze date from measurement techniques to obtain molecular weight of polymers
(7). Identify the physical states and transition temperatures of polymers
(8). Predict how molecular weight affects thermal and mechanical properties of polymer solid and melt
(9). Describe the viscoelastic behavior of polymers and construct basic viscoelastic models.
(10). Use available information on polymers to predict the response to applied stress and strain.

Correlation between Course Outcomes and Student Outcomes:

Course Outcomes	Student Outcomes										
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
1. Be familiar with chemical structure and chemical formulas of common polymeric materials	X					X					X
2. Distinguish different polymerization reactions and mechanisms	X				X	X				X	X
3. Predict conversion and molecular weight resulting from polymerization reactions	X				X	X					X
4. Estimate the thermodynamic interaction and miscibility of polymer solution and polymer blend	X				X	X					X
5. Characterize molecular weight and molecular weight distribution in terms of common parameters	X				X	X					X
6. Analyze data from measurement techniques to obtain molecular weight of polymers	X				X	X				X	X
7. Identify the physical states and transition temperatures of polymers	X				X	X				X	X
8. Predict how molecular weight affects thermal and mechanical properties of polymer solid and melt	X				X	X					X
9. Describe the viscoelastic behavior of polymers and construct basic viscoelastic models	X				X	X					X
10. Use available information on polymers to predict the response to applied stress and strain	X				X	X					X
Entire Course	**3**	**0**	**0**	**0**	**3**	**2**	**0**	**0**	**0**	**1**	**2**
0 = None or insignificant; 1 = Some; 2 = Moderate; 3 = Strong											

School of Materials Science and Engineering Student Outcomes:

(a) an ability to apply knowledge of mathematics, science and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning

(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.