**MAT 511-202101**

**Polymer Chemistry and Physics**

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**Course Content**

Fundamental principles of polymer chemistry and physics will be offered. In polymer chemistry polymerization reactions, kinetics and thermodynamics will be studied. Utilization of kinetic and thermodynamic parameters for the synthesis of different types of polymer structures, and the process conditions will be evaluated. A basic understanding of the reaction parameters for controlling polymerization rates, molecular weights, structural features and mechanical properties will be given. Glass transition and crystallization in polymers and their effects on physical properties will be studied. A working knowledge of polymer chemistry and physics will be provided by laboratory experiments.

**Objectives**

To introduce Materials Science and Engineering graduate students to the basic concepts of polymer chemistry and physics, and to provide sufficient background to students to understand polymeric materials.

**Recommend or Required Reading**

**Textbook**

Principles of Polymerization, by Odian, Wiley-Interscience (ISBN: 0471610208)

**Readings**

Polymer Chemistry, by Sebastian Koltzenburg, Michael Maskos, Oskar Nuyken, Springer-Verlag Berlin Heidelberg 2017 (ISBN 978-3-662-49277-2)

Polymer Synthesis: Theory and Practice, by Dietrich Braun, Harald Cherdron Matthias Rehahn, Helmut Ritter, Brigitte Voit - Springer-Verlag Berlin Heidelberg (ISBN 978-3-642-28979-8)

Principles of Polymer Chemistry , by A. Ravve Springer-Verlag Berlin Heidelberg (ISBN 978-1-4614-2211-2)

**Assessment Methods and Criteria**

Midterm and Final Exam 60% (Exam and Assignments)

Laboratory experiments and reports 40% (Quiz 15, Experiment 10, Report 15)

**Course Outline**

* Intro and basic concepts and history of polymeric materials
* Intro and basic concepts and classification, industrially important Polymers
* Radical chain polymerization
* Radical polymerization in bulk, solution and emulsion-Heterogeneous polymerization
* Ionic chain polymerization
* Step growth polymerization
* Ring opening polymerization
* Copolymerization
* Post polymerization, block/graft copolymer synthesis
* The basics of Plastic processing
* Polymers and the Environment
* Current Trends in Polymer Science
* Industrially relevant Polymerization process
* Polymeric materials design by chemistry and compounding

**Learning Outcomes**

Upon successful completion of Polymer Chemistry and Physics (MAT 511), students are expected to be able to:

* Comprehend fundamental principles of polymer chemistry and physics
* Analyze polymerization reactions, kinetics and thermodynamics and evaluate the synthesis of different types of polymer structures, and the process conditions
* Identify the reaction parameters for controlling polymerization rates, molecular weights, structural features and mechanical properties.
* Investigate the molecular structures of the single chain, of polymers in dilute solution and in the bulk state Identify Physical properties of polymer mixtures, blends and gels
* Analyze glass transition and crystallization in polymers and their effects on physical properties.
* Gain working knowledge of polymer chemistry and physics by laboratory experiments.
* Able to design new polymeric materials by choosing appropriate monomers to synthesize, and/or make a formulation by compounding.