Polymer Physics begins with a brief introduction to polymer structure, nomenclature and synthetic methods. This is followed by a description of polymer “states”: molten, glassy and crystalline. Physical properties are described and analyzed via structure-property relations. Grades will be based on three in class tests, 3 homework assignments, a short paper and a presentation. The overall objective is to develop a clear understanding of the principles of polymer physics and to learn to solve polymer physics problems. This course is designed to fit the needs of both graduate and undergraduate students.

**Attendance:** While attendance is not mandatory, the instructor highly recommends that all students attend classes.

**Prerequisites:** Organic Chemistry Required

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Grades: Two non-cumulative, take-home tests and three homework assignments will be given throughout the course. Each student will make a 15 minute presentation during the months of November and December. A 5-page paper will be turned in with each presentation. The final grade will be based on 50% for the tests, 30% for the homework and 10% for the paper and 10% for presentation. The +/- grade system will be used to assign grades.

S-U POLICY: (CAS policy: 00-01 S/U contracts must be negotiated in writing within the first three weeks of the term. See online catalogue University policy.)

INCOMPLETE GRADE POLICY: (USF policy: “An ‘I’ grade indicates incomplete coursework and may be awarded to student only when a small portion of the student’s work is incomplete and only when the student is otherwise earning a passing grade.”

NOTES AND TAPES: Note and tapes are not permitted for purposes of sale.
RELIGIOUS PREFERENCE: Religious Preference Absence Policy (Students who anticipate the necessity of being absent from class due to the observation of a major religious observance must provide advance notice of the date(s) to the instructor, in writing.)
PAPERS AND ASSIGNMENTS: Date after which uncollected exams and papers will no longer be kept: 12/01/11

ACADEMIC DISHONESTY: Any student found cheating will be given an FF grade. The University of South Florida has an account with an automated plagiarism detection service which allows instructors to submit student assignments to be checked for plagiarism. I reserve the right to submit assignments to this detection system. Assignments are compared automatically with a huge database of journal articles, web articles, and previously submitted papers. The instructor receives a report showing exactly how a student’s paper was plagiarized. For more information, go to www.turnitin.com.

DISABILITIES: Any student with a disability is encouraged to meet with me privately during the first week of class to discuss accommodations. Each student must bring a current Memorandum of Accommodations from the Office of Student Disability Services which is prerequisite for receiving accommodations. Accommodated examinations through the Office of Student Disability Services require two weeks notice. All course documents are available in alternate format if requested in the student’s Memorandum of Accommodations.
Emergency: In the event of an emergency, it may be necessary for USF to suspend normal operations. During this time, USF may opt to continue delivery of instruction through methods that include but are not limited to: Blackboard, Elluminate, Skype, and email messaging and/or an alternate schedule. It’s the responsibility of the student to monitor Blackboard site for each class for course specific communication, and the main USF, College, and department websites, emails, and MoBull messages for important general information.

Course Content:

Part 1. Polymer Fundamentals:
The course begins with a brief explanation of basic polymer concepts for those who have not taken a formal polymer course. Fundamental definitions are presented. Molar mass, thermal transitions and configurational states are introduced. Common industrial polymers are described. After this introduction, new comers to the polymer field will feel comfortable embarking on a journey into the field of Polymer Physics.

Part 2. Polymers "States":
This section opens with a discussion of thermoelastic behavior and the theory of rubber elasticity. Tire recycling applications are presented. Polymer solubility is discussed with references to ways of predicting solution properties. This includes an in depth analysis of solution properties using the three dimensional solubility parameter approach. The next topic is that of the amorphous glassy state. This non-equilibrium "state" is described and related to changes in mechanical properties that occur upon aging. The topic of the molten state is accompanied by a description of liquid crystalline polymers that are so widely used in high tech applications. Fundamental rheological properties are introduced. The semicrystalline nature of polymers is related to effects on thermal and mechanical properties. Defects in the crystalline structure are discussed with reference to determination of per cent crystallinity and lamella size. Crystallization kinetics are discussed. Chain orientation in lamellae is discussed with reference anisotropic behavior. Dendrimer structures are analyzed with reference to their behavior as high polymers. The viscoelastic nature of the glass transition and secondary relaxations in polymers is presented.

Part 3. Polymers Synthesis:
This section teaches polymerization and kinetics. The systems studied are: step and chain polymerization, step, free radical, ionic, coordination synthesis. Copolymerization-chain, step and reactivity ratios are also presented.

Part 3. Polymer Physical Properties:
Thermal analysis methods and mechanical testing of polymers is discussed. Thermal Mechanical Analysis, Dynamic Mechanical Analysis, Modulated Differential Scanning Calorimetry and Thermal Gravimetric Analysis are discussed in some detail.

EXAM AND HOMEWORK SCHEDULE:
There is a recommendation to combine content into the due dates in the syllabus to clarify to students which content they will be responsible for on each assignment and exam.

DATE

August 26  
First Day of class

September 16  
Homework 1 assigned
Introductory concepts, molecular weight and measurement
Chapters 1, 2, and 3 in the assigned text.

30  
Exam posted
Chapters 3, 4, 5 and 6:
Molecular weight calculations, mechanical properties,
mixtures and diffusion

October 7  
Exam 1 due 8:00 AM

30  
Homework 2 assigned
Chapters 7, 8, and 9
Step, free radical and copolymerization

November 6  
Homework 2 due in class

13  
Exam 2 posted
Chapters 11, 12, and 13
Ionic polymerizations, reaction engineering and
biopolymers

20  
Exam 2 due 8:00 AM
November  25    Presentation begin (Topics are presented during the first week of class. Students pick topics by the 3rd week of class. Guidelines for papers and presentations are outlined in the 4th week of class.)

November  27    Holiday

December  2, 4    Presentations and paper due in class

- Focuses on applications of polymer chemistry, engineering, and technology
- Explains terminology, applications, and versatility of synthetic polymers
- Connects polymerization chemistry with engineering applications
- Contains practical lead-ins to emulsion polymerization, viscoelasticity, and polymer rheology, the field of polymers has advanced considerably. A key feature of the third edition is the inclusion of new concepts such as polymer nanocomposites and metalloocene catalysts in existing chapters as well as new chapters covering selected contemporary topics such as behavior of natural polymers, polymer dynamics, and diffusion in polymers. The book has been completely reorganized to become more aligned with how instructors currently teach the course. In addition there are several enhancements to the book's pedagogy that make it more appealing to both instructors and students, including the addition of new worked examples and new figures to better illustrate key concepts, and new of end-of-chapter exercises, many of them based on recently published research and relevant industrial data.

- Chapter 1 - Introductory Concepts and Definitions
- Chapter 2 - Basic Principles of Polymer Molecular Weights
- Chapter 3 - Practical Aspects of Molecular Weight Measurements
- Chapter 4 - Mechanical Properties of Polymer Solids and Liquids
- Chapter 5 - Polymer Mixtures
- Chapter 6 - Diffusion in Polymers
- Chapter 7 - Step-Growth Polymerizations
- Chapter 8 - Free-Radical Polymerization
- Chapter 9 - Copolymerization
- Chapter 10 - Dispersion and Emulsion Polymerizations
- Chapter 11 - Ionic and Coordinated Polymerizations
- Chapter 12 - Polymer Reaction Engineering
- Chapter 13 - Biopolymers