SYLLABUS

CHBE 412/512 Polymer Materials Engineering

SPRING 2007 - *BEVILL A023 - MWF 9:00 - 9:50 am*

Instructor: Prof. Chris Brazel
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TA: Mr. Linfeng Wu, Bevill A103

Course Web Page: http://bama.ua.edu/~cbrazel/ (Teaching section)

Course Text: ***Fundamentals Principles of Polymeric Materials.*** *Stephen L. Rosen*, 2nd ed.
New York: John Wiley & Sons, 1993.

Reference Texts

Principles of Polymer Systems, Ferdinand Rodriguez (available at Rodgers Library):
Concise Polymeric Materials Encyclopedia, Joseph Salamone (in my office)

COURSE OBJECTIVES

This course is designed as a senior level and introductory graduate-level elective to teach the fundamentals of polymer systems, including polymer chemistry, mechanics and characterization. The course is taught at an introductory level aimed at students with a strong background in chemistry (especially organic), materials science, and chemical engineering. Students will become familiar with processing methods, commercial polymers and their industrial uses, and design factors to create materials with desirable end-use properties. The elective nature of the course allows it to build upon a number of courses in the chemical engineering curriculum, including organic chemistry, materials engineering, reactor design engineering, fluid flow operations, thermodynamics, statistics, and physics.

GRADING	ChBE 412 (100 pts)	ChBE 512/Honors (120 pts)
Assignments/Homework	20 pts	20 pts
Exam I	20 pts	20 pts
Exam II	20 pts	20 pts
Final Exam (III)	20 pts	20 pts
Product Profile & Presentation	20 pts	20 pts
Research Review/Current Trends Report/Presentation		20 pts

The University of Alabama grading system applies to this course.

DUE DATES

Homework will be assigned throughout the semester, with due dates being usually 1 week after assignment. Late homework will not be accepted. Homework will be returned promptly and solutions posted on the class web site. For all students, a product profile report and presentation will be done during the semester (individual assignment). Topics should be selected by February 23, and all reports are due on March 28. 10 minute presentations will be spread out between March 28 and April 10, with the presentation dates selected by the instructor. An additional paper and presentation will be required of students seeking honors or graduate (512) credit, with the topic selection due March 7, and the papers due on April 27th.

EXAMS

The exam format will be closed/open book. The tests will be given in 2 parts, with a closed book portion to test general knowledge and retention of concepts. Calculation problems will be given in an open book/open notes format. Exams I and II will be 50 minutes. Tentative exam dates are:

Exam I Friday, Feb. 16
Exam II Friday, Apr. 20
Final Exam Thursday, May 10, 8:00 - 10:30 am; Cumulative

If you know that you will miss an exam, arrangements can be made to take the exam prior to the scheduled time. Otherwise, for an excused absence, a missed exam will be made-up by doubling the weight of the cumulative final exam.

OUTLINE OF COURSE

The course will follow the general outline:

- Nomenclature and Chemical Bonding
- Chemical Synthesis of Polymers
- Material Properties (Optical, Thermal, Mechanical and Solution)
- Polymer Processing and Viscoelasticity

More specifically, the sections are broken down as:

Subject	Chapters
Definition of Polymers/Survey of Industrial uses	Ch 1
Types and nomenclature (block, co, random, graft)	Ch 2
Bonds, angles and lengths; chain length	Ch 3
Stereoisomerism	Ch 4
Concepts of Polymer Molecular Weights, Statistical Averages	Ch 6
Molecular Weights: M_n & M_w; Polydispersity	Ch 6
Techniques to determine Molecular Weight: Cloud Point, Visc.	Ch 6
Techniques to det. MW: optical scattering, osmometry, GPC	Ch 6
Polymer Synthesis: Step-Growth polymerization/polycondensatn	Ch 9
Polymer Synthesis: Polycondensation materials; gelation	Ch 9
Polymer Synthesis: Free Radical Polymerization: mechanism	Ch 10
Polymer Synthesis: Kinetics of Free Radical Polymerizations	Ch 10
Copolymer Synthesis; Specialty Techniques- anionic, cationic	Ch 12
Bulk vs. Solution polymerization; emulsion/suspension polyztn	Ch 13
Polymerization Reactors	
Polymer Morphology/Crystallinity	Ch 5
Liquid Crystals- Nematic/Smectic phases	Ch 5
The Glass Transition Temperature	Ch 8
Factors Influencing Glass Transitions	Ch 8
Polymer Modifiers- Fillers, Plasticizers	Ch 8/20
Mini-presentations: Introducing Industrial Polymers	
Polymer Solution Physical Chemistry: Theta Temperatures	Ch 7
Polymer-Solvent Interaction Parameter	Ch 7
Polymer Processing- formulation, molding	Ch 19
Polymer Processing- Extrusion, casting	Ch 19
Rubber Elasticity Theory	Ch 14
Rubber Elasticity	Ch 14
Mechanical Properties/Viscoelasticity	Ch 18
Modulus; Dynamic Mechanical Testing	Ch 18
Polymer Melts- Viscous Flow/ Non-Newtonian Fluid Mechanics	Ch 15
Creep Flow; Polymer Relaxation	Ch 18
Time temperature Superposition/WLF Equation	Ch 18
Visit to Radici-Spandex Plant	
Presentations	
Wrap-up/Discussion; new trends in polymer engineering	

PRODUCT PROFILES

One individual assignment for everyone enrolled in the Spring 2007 course will be to prepare a product profile sheet (2 pages maximum) that includes the basic information on how a certain polymer-based product is made: What polymers are commonly used to make it? are any additives used? What type of process is used? What properties are important to the function of the polymer?

Students will select their product from a list of many possible products by February 23 (e.g., fire-resistant clothing, automobile tires, tennis rackets, …) and present their subject to the class beginning March 28th.

Further information on this assignment will be given during the semester.

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CHBE 512 & Honors STUDENTS ONLY:

REVIEW OF CURRENT RESEARCH

To earn 500-level credit for the polymer course, an additional assignment is required.
Here, students enrolled in CHBE 512 will select two related papers (one a research review article and the other a general interest article from a scientific publication- such as Science, Nature, Scientific American, etc.) and prepare a paper discussing and reviewing the recent trends in the selected field. Suggested topics and additional information will be given later in the semester. Topic selection is due March 7, with papers and presentations due on April 27.

ACADEMIC HONOR CODE

All students in attendance at The University of Alabama are expected to be honorable and observe standards of conduct appropriate to a community of scholars. The University of Alabama expects from its students a higher standard of conduct than the minimum required to avoid discipline. At the beginning of each semester and on tests and projects at the discretion of the professor, each student will be expected to sign an Honor Pledge.

HONOR PLEDGE

I promise or affirm that I will not at any time be involved with cheating, plagiarism, fabrication, or misrepresentation while enrolled as a student at The University of Alabama. I have read the Academic Honor Code, which explains disciplinary procedures that will results from the aforementioned. I understand that violation of this code will result in penalties as severe as indefinite suspension from the University.

PLAGIARISM STATEMENT

The University of Alabama is committed to helping students to uphold the ethical standards of academic integrity in all areas of study. Students agree that their enrollment in this course allows the instructor the right to use electronic devices to help prevent plagiarism. All course materials are subject to submission to Turnitin.com for the purpose of detecting textual similarities. Turnitin.com will be used as a source document to help students avoid plagiarism in written documents.

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* The syllabus is accurate as of 01/09/07, but the instructor reserves the right to alter the schedule for sound pedagogical reasons if necessary. Due notice will be given for changes in the syllabus.