Course Name: Polymer Synthesis and Structure

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Course Number: WSE 535

Course Credits--include number of hours course meets per week/term in lecture, recitation, laboratory, etc.

Three credit hours and three lectures per week

Prerequisites, Co-requisites and Enforced Prerequisites

3 credit hours of undergraduate organic chemistry course or CH 331 or CH 334.

Course Content--concise outline of topics and/or activities

This course will overview various synthetic methods for making polymers. This course also discusses structure of polymer molecules and role of that structure in properties. Specific topics for each lecture are outlined in the attached table.

Measurable Student Learning Outcomes

After taking this course, students should be able to:

1) Draw representative structures of various synthetic and natural polymers
2) Remember and understand some basic properties and applications for various synthetic and natural polymers
3) Know how to write synthetic schemes for various synthetic polymers
4) Understand and remember various polymerization methods
5) Know how to adjust polymerization variables for preparation of polymers with defined properties.

Evaluation of Student Performance

The student performance will be graded as follows: 20% homework, 40% exam #1, and 40% exam #2. Homework is given approximately once a week and each homework accounts for about 2% of the grade. The exam # 1 covers lectures related to polymer synthesis and the exam #2 covers lectures related to polymer structures.

Learning Resources--textbooks, lab manuals, etc…indicate if required or optional

Textbook: Malcolm P. Stevens, Polymer Chemistry An Introduction, third edition, New York, Oxford University Press, 1999
A number of handouts may be given for some lectures. Extensive notes will be provided on polymer conformations.

Statement Regarding Students with Disabilities

Accommodations are collaborative efforts between students, faculty and Services for Students with Disabilities (SSD). Students with accommodations approved through SSD are responsible for contacting the faculty member in charge of the course prior to or during the first week of the term to discuss accommodations. Students who believe they are eligible for accommodations but who have not yet obtained approval through SSD should contact SSD immediately at 737-4098.

Link to Statement of Expectations for Student Conduct, i.e., cheating policies
http://oregonstate.edu/admin/stucon/achon.htm

Polymer Synthesis and Structure Taught by Kaichang Li and John Nairn Three credit hours and three lectures per week		
week	lecture	topics
1	1	Introduction, definitions, polymerization processes, nomenclature, and industry polymers
	2	Free radical vinyl polymerization: free radical initiators, techniques for free radical polymerization (bulk, suspension, solution, and emulsion), kinetics and mechanism of polymerization, monomer reactivity, and copolymerization
	3	Free radical polymerization-continued
2	4	Controlled/"living" radical vinyl polymerization: ATRP (Atom Transfer Radical Polymerization) and RAFT (reversible addition-fragmentaion chain transfer radical polymerization)
	5	Vinyl polymerization with ionic initiators: cationic polymerization and anionic polymerization
	6	Vinyl polymerization with complex coordination catalysts: Ziegler-Natta catalysts and metathesis polymerization
3	7	Reactions of vinyl polymers: functional group reactions, ring-forming reactions, crosslinking, block and graft copolymer formation, and polymer degradation.
	8	Step-reaction and ring-opening polymerization
	9	Polyethers, polysulfides, and related polymers
4	10	Polyesters, polyamides and related polymers
	11	Phenol-, urea-, and melamine-formaldehyde polymers
	12	Inorganic and partially inorganic polymers: poly(sulfur nitride), polysiloxanes, polysilanes, phosphnitrilic polymers, organometallic polymers, and coordination polymers

5	13	Miscellaneous organic polymers
	14	Natural polymers: natural rubber and lignin
	15	Polysaccharides: cellulose, starch, and other polysaccharides
6	16	Proteins: wool, silk, collagen, spider web, and regenerated protein
	17	Exam #1
	18	Polymer chain conformations, end-to-end distance, and characteristic ratio
7	19	Vector analysis of chains, freely-jointed chain, equivalent freely-jointed chain, and freely-rotating chain
	20	Hindered rotating chain and rotational isomeric states in main-chain bonds
	21	Rotational isomeric state model
8	22	Excluded volume effects, unperturbed and actual end-to-end distance
	23	Monte Carlo computer simulations of polymer chain properties
	24	Rubber elasticity, entropy elasticity, and elastomers
9	25	Stress-strain behavior of elastomers
	26	Types of elastomers and creating new elastomers
	27	Polymer solids, amorphous polymers, glass transition (thermodynamics and kinetics)
10	28	Free-volume theory and physical aging
	29	Semicrystalline polymers, melting point, degree of crystallinity, unit-cell structures
	30	Bulk semicrystalline polymers, lamellae, and spherulites