

CHEM 455

COURSE NAME / NUMBER

LEARNING OBJECTIVES / GOALS / OUTCOMES/ LEARNING OUTCOMES:

The course is designed to enable students to appreciate the significance of polymer chemistry in all aspects of modern life, and to investigate and understand:

1. The applications of organic and inorganic chemistry to the preparation, properties and structures of polymers.
2. The use of physical methods to test and characterize polymers.
3. The relationship between structure and properties of polymers.
4. Industrial polymer technology.
5. The preparation and properties of biomedical polymers.

METHODS:

Presentation of the course will be by inter-related theory classes ("lectures") and discussion periods ("seminars"). Audio-visual aids will be used where appropriate. Students will be expected to be conversant with the use of an academic library.

PRIOR LEARNING ASSESSMENT RECOGNITION (PLAR):

Credit can be awarded for this course through PLAR YES _____ NO X

METHODS OF OBTAINING PLAR:**TEXTBOOKS, REFERENCES, MATERIALS:**

Polymer Chemistry, 3rd Edn. - R.B. Seymour and C.E. Caraher, 1992.

SUPPLIES / MATERIALS:**STUDENT EVALUATION:**

Evaluation will be based on the following system:

First In-Term Test	20%
Second In-Term Test	20%
Problem Sets	10%
Oral or written presentations	10%
Final Examination	40%

COURSE CONTENT:

The course will be based on the required text (Seymour and Carraher), and chapter numbers are from the text. The course will also make use of reprinted materials.

Part a: Synthetic Polymers.

1. **Introduction.** Origins of polymer science and the polymer industry. Nomenclature and definitions.
2. **Synthesis of Polymers.** Condensation, free-radical, ionic, Ziegler-Natta and other classes of polymerization reactions. Co-polymerization reactions.
3. **Characterization of Polymers.** Polymer structure. Rheology of polymer melts and solutions. Determination of molar mass of polymers. Physical tests: stress-strain relationships, deformation mechanisms and electrical properties.
4. **Reactions of Polymers.** Reactions of polyolefins, polyenes, polyamides, pendant aliphatic and aromatic groups. Condensation and chelation reactions. Reactivity of end-groups.
5. **Inorganic Polymers.** Inorganic reaction mechanisms. Condensation organometallic polymers. Coordination polymers. Addition polymers. Portland cement, silicon dioxide, asbestos, graphite and diamond. High-temperature superconductors.

Part b: Biological Polymers.

6. **Extraction and Purification.** Chromatography, electrophoresis, ultracentrifugation and other techniques.
7. **Proteins.** The peptide bond. Primary, secondary, tertiary and quaternary structure. Enzymes, hormones and antibodies. Structural proteins: collagen, keratin, fibroin, elastin, actin, myosin and chitin.
8. **Nucleic Acids.** Primary and secondary structure of deoxyribonucleic acid and ribonucleic acid. Replication and repair of deoxyribonucleic acid. Transcription and replication of ribonucleic acid. Messenger RNA and the genetic code. Mechanisms of protein synthesis. Control of nucleic acid function. Cancer and reverse transcription. Mutations. Antibiotics and nucleic acid function. Recombinant DNA.
9. **Polysaccharides.** Glycosidic and other bonds. Structures. Homopolysaccharides. Heteropolysaccharides. Glycosaminoglycans. Bacterial polysaccharides. Biosynthesis, chemical synthesis and industrial utilization of polysaccharides.
10. **Rubber and Lignin.** Rubber and gutta percha. Elasticity and structure. Biosynthesis. Chemical synthesis of polyisoprenes. Biosynthesis of lignin. Properties of lignin.

ADDITIONAL SUPPORTING MATERIALS:**Books:**

Young, R.J. and Lovell, P.A. *Introduction to Polymers*. 2nd Edn. Chapman and Hall, 1991.

MacGregor, F. and Greenwood, R.J. *Polymers in Nature*. John Wiley and Sons, 1980.

Bovey, Frank A. *Chain Structure and Conformation of Macromolecules*. Academic Press, 1982.

Billmeyer, Fred W. *Textbook of Polymer Science*. John Wiley and Sons, 1989.

Kroschwitz, N. *Polymers: Biomaterial and medical Applications*. John Wiley and Sons, 1989.

Muzzarelli, Ricardo A. *Chitin*. Oxford University Press, 1977.

Dawids, F. *Polymers: Their Properties and Blood Compatibility*. Kluwer Academic Publishers, 1989.

Elias, Hans-Georg. *Mega-Molecules*. Springer-Verlag 1987.

Seymour, R. and Carraher, C.E. *Giant Molecules*. John Wiley, 1990.

Benham, R. and Kinstle, J. *Chemical Reactions on Polymers*. A.C.S., 1988.

Szycher, M. and Robinson, W.J. *Synthetic Biomedical Polymers*. Technomic Publishing, 1980.

Nevell, T.P. and Jeronian, S.H. *Cellulose Chemistry and its Applications*. Ellis Horwood Ltd, 1985.