20CY208 POLYMERS AND ELECTOMERS

Hours Per Week :

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Course Description and Objectives:

This course is primarily aimed to give an in-depth knowledge on some of the aspects of polymer technology related to industrial relevance. The course covers the physical chemistry aspects of speciality polymers, their properties and applications, which is intended towards design of polymeric material for specific application. Physicochemical properties of hybrid polymer nanocomposite materials and their details will be covered to make the student realise the importance of nanomaterials and hybrid material for commercial applications.

Course Outcomes:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes
1	Analyze theoretical and thermodynamic aspects of polymers in both bulk and solution phase
2	Analyze various methodologies of polymer synthesis.
3	Evaluate properties and characteristics of polymers related to various applications.
4	Design specialty polymers with various anchoring groups relevant to industrial applications.
5	Apply polymer isolation concept to hybrid nanocomposites to improve the mechanical properties.

Unit - I :

Introduction to Polymers and Polymer Solutions

Types of Polymers, Applications, Different types of M.Wt and its significance, Polymerisation techniques, Thermodynamics of polymer solution: Flory-Huggins theory(liquid lattice theory), modified Flory-Huggins theory, entropy of mixing, enthalpy and free energy of mixing, dilute polymer solutions (Flory-Krigbaum theory), advantages and limitation of FH and FK theories.

Unit - II:

Polymerisation Mechanism, Kinetics and Reactivity ratio

Types**:** Radical, cationic, anionic and condensation polymerization, Kinetics and reactivity ratio of co-polymerisation, thermodynamic aspects of polymerization, Controlled Living Radical Polymerisation: nitroxide mediated polymerization (NMP), metal-catalyzed living radical polymerization (ATRP), reversible addition-Fragmentation Chain Transfer (RAFT) radical polymerization, coordination polymerization.

Unit - III:

Polymer Characterisation and Properties

For functional group characterisation: IR, UV, NMR. For M.Wt estimation : NMR, GPC, light Scattering. Thermal analysis: TGA, DSC, DTG, DMA. Rheology of polymers and polymer solution. Mechanical properties of polymers, Thermal properties.

Unit - IV:

Speciality polymers :

Liquid crystalline polymers, conducting polymers, electroluminescent polymers, inorganic polymer, biomedical polymers, Poly electrolytes-water soluble charged polymers, solid polymer electrolytes (SPE), polymer colloids, polymeric gels, crosslinked polymers: synthesis, properties and applications, Elastomers- Natural and synthetic elastomers, Industrial application of Elastomers

Unit - V :

Polymeric composites:

Fundamental concepts, methods of fabrication, factors influencing the performance of polymer composites-aspect ratio, void content, length of the fiber, nature of the fiber. Structure property relationship between fiber and matrix, modifications of the fiber surface, degree of interaction between fiber and matrix, wetting behavior, degree of cross linking etc., Nanocomposite: Polymer/ CNTs and Polymer/Nano clay based composites.

Suggested Books and References:

1. Text Book of Polymer Science, 3rd Edition (1984), F. W. Billmayer, Jr., Willey-Interscience, New York.
2. Principle of Polymer Sciences, P. Bahadur and N.V. Sastry, Narosa Publishing House, New Delhi (2002)
3. Polymer Sciences, V.R. Gowarikar, N.V. Vishwanathan, J. Shreedhar , Wiley Eastern, New Delhi (1986)
4. Plastic Materials- J A Brydson; Newnes-Butterworths, 3rd Ed. 1979, p.73.
5. Handbook of analysis of synthetic polymers and plastics- J Urbansky and others; John Wiley, 1977.
6. Polymer Chemistry- An Introduction- M P Stevens; 2nd Ed, Oxford Univ. Press, 1990.
7. Industrial chemicals- W L Paith, D B Keyes ad R L Clark; John Wiley and Sons.
8. J.M.G Cowie. Polymers: Physics and Chemistry of Modern Materials. Blackie. London, 1992.
9. P.J. Flory. A Text Book of Polymer Science. Cornell University Press. Ithacka, 1953. 5. F. Ullrich, Industrial Polymers, Kluwer, N.Y. 1993.
10. Thermal characterization of polymeric materials, by Turi E.A., Academic press Inc.
11. Polymer science, a material science H.B. Vol I & Ii by Jenkins, A.D., North Holland publishing co., Amsterdam London
12. Odian, G. Principles of Polymerization (Wiley, 2004)
13. Sun, S. F. Physical Chemistry of Macromolecules, 2nd edn. (Wiley, 2004)