2. Engel, T.; Reid, P.(2012),**Physical Chemistry**, Prentice-Hall. Chapter 26.

Teaching Learning Process:

Conventional methods of teaching i.e. lectures, PPTs, Hands on practice of molecule centric problems with maximum characterization parameters and recently designed lead drug molecules

Assessment Methods:

- Assignment based on Theoretical designing of small molecules of drug prospective
- Presentation on fundamentals of drug designing and molecular modelling
- Test
- Semester end examination

Keywords:

Molecular modelling, Quantum Mechanical Method, Cartesian Coordinates, Molecular Dynamics, Force Field, Software of Computational Chemistry.

Course Code: CHEMISTRY –DSE-6
Course Title: Polymer Chemistry
Total Credits: 06 (Credits: Theory-04, Practical-02)
(Total Lectures: Theory- 60, Practical-60)

Objectives:

The primary objective of this paper is to help the student to know about the synthesis, properties and applications of polymers.

Learning Outcomes:

By the end of this course, students will be able to:

- Know about history of polymeric materials and their classification
- Learn about different mechanisms of polymerization and polymerization techniques
- Evaluate kinetic chain length of polymers based on their mechanism
- Differentiate between polymers and copolymers
- Learn about different methods of finding out average molecular weight of polymers
- Differentiate between glass transition temperature (Tg) and crystalline melting point (Tm)
- Determine Tg and Tm
- Know about solid and solution properties of polymers
- Learn properties and applications of various useful polymers in our daily life.

This paper will give glimpse of polymer industry to the student and help them to choose their career in the field of polymer chemistry.

Unit 1:

Introduction and history of polymeric materials:

History of polymeric materials, Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers

Functionality and its importance:

Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization Bifunctional systems, Poly-functional systems

(Lectures: 12)

Unit 2:

Kinetics of Polymerization

Mechanism of step growth polymerization, kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic), Mechanism and kinetics of copolymerization, polymerization techniques

(Lectures: 8)

Unit 3:

Glass transition temperature (Tg) and determination of Tg, Free volume theory, WLF equation, Factors affecting glass transition temperature (Tg).

Crystallization and crystallinity: Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

Nature and structure of polymers-Structure Property relationships

(Lectures: 14)

Unit 4:

Determination of molecular weight of polymers (M_n, M_w, etc.) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index

Polymer Solution

Criteria for polymer solubility and Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy and free energy change of mixing of polymers solutions.

Polymer Degradation

Thermal, oxidative, hydrolytic and photodegradation

(Lectures: 16)

Unit 5:

Properties of Polymers

(Physical, thermal, Flow & Mechanical Properties) Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novolac), polyurethanes, silicone polymers, polydienes, Polycarbonates, Conducting Polymers: polyacetylene, polyaniline, poly(p-phenylene sulphide, polypyrrole, polythiophene

(Lectures: 10)

Practical:

(Credits: 2, Laboratory periods: 60)

Chemistry Lab: Polymer chemistry

Polymer synthesis

1. Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA)/MethylAcrylate (MA).
2. Preparation of nylon 6,6
3. Redox polymerization of acrylamide
4. Precipitation polymerization of acrylonitrile
5. Preparation of urea-formaldehyde resin
6. Preparations of novalac resin/resold resin.
7. Microscale Emulsion Polymerization of Poly(methylacrylate).

Polymer characterization

1. Determination of molecular weight of polyvinyl propylidene in water by viscometry:

2. Determination of the viscosity-average molecular weight of poly(vinyl alcohol) (PVOH) and the fraction of head-to-head monomer linkages in the polymer.

3. Determination of molecular weight by end group analysis of polymethacrylic acid.

Polymer analysis

1. Estimation of the amount of HCHO in the given solution by sodium sulphite method

2. IR studies of polymers

3. DSC (Differential Scanning Calorimetry) analysis of polymers

4. TG-DTA (Thermo-Gravimetery-Differential Thermal Analaysis) of polymers

Suggested Additional Experiment:

1. Purification of monomer.
2. Emulsion polymerization of a monomer.

References:

Theory:

1. Carraher,C. E. Jr. (2013), **Seymour's Polymer Chemistry**, Marcel Dekker, Inc.
2. Odian, G. (2004), **Principles of Polymerization**, John Wiley.
3. Billmeyer, F.W. (1984),**Text Book of Polymer Science**, John Wiley.
4. Ghosh, P. (2001),**Polymer Science & Technology**, Tata Mcgraw-Hill.
5. Lenz, R.W. (1967),**Organic Chemistry of Synthetic High Polymers**, Intersecience (Wiley).

Practical:

1. Allcock, H.R.; ; Lampe, F. W.; Mark, J. E.(2003),**Contemporary Polymer Chemistry**, Prentice-Hall.
2. Fried, J.R. (2003), **Polymer Science and Technology**, Prentice-Hall.
3. Munk, P.; Aminabhavi, T. M. (2002), **Introduction to Macromolecular Science,** John Wiley & Sons.
4. Sperling, L.H.(2005),**Introduction to Physical Polymer Science**, John Wiley & Sons.

Teaching-Learning Process:

- Teaching learning process for the course is visualized as largely student-focused.
- Transaction through an intelligent mix of conventional and modern methods.
- Engaging students in cooperative learning.
- Learning through quiz design.
- Problem solving to enhance comprehension.

Assessment Methods:

Assessmentwill be done on the basis of regular class test, presentations and assignments as a part of internal assessment during the course as per the curriculum. End semester university examination will be held for both theory and practical. In practical, assessment will be done based on continuous evaluation, performance in the experiment on the date of examination and viva voce.

Keywords:

Bonding, Texture, Polymerization, Degradation, Polymer solution, Crystallization, Properties, Applications.