AMCH26 POLYMER ENGINEERING

UNIT-1 INTRODUCTION

1.1 Defining polymers, Basic chemistry of polymers
1.2 Classification and types, Bonding in Polymers,
1.3 Molecular weight and Molecular Weight Distribution
1.4 Thermoplastic /Thermosetting polymers, Elastomers, Resins,
1.5 Adhesives, Coatings, Fibers, Composites
1.6 Solvents, Solutions, Blends, melts, Additives,
1.7 Fillers, Examples of industrial and high performance polymers

UNIT-2 STEP- GROWTH (CONDENSATION) POLYMERIZATION

2.1 Features, Definition of functionality
2.2 Functionality principle, Derivation of Carother's Equation
2.3 Effect of stoichiometric imbalance on molecular weight, Mechanism, Kinetics

UNIT-3 FREE-RADICAL ADDITION (CHAIN-GROWTH) POLYMERIZATION

3.1 Mechanism, Kinetics of homogeneous polymerization
3.2 Experimental determination of rate of polymerization
3.3 Instantaneous average chain lengths,
3.4 Temperature dependence of rate and chain length, Gel effect or Auto acceleration
3.5 Kinetic chain length, Chain transfer, Inhibitors and Retarders

UNIT-4 IONIC AND CO ORDINATION CHAIN (ADDITION) POLYMERIZATION

4.1 General features of ionic-chain addition polymerization
4.2 Mechanism and kinetics of cationic polymerization,
4.3 Mechanism and average degree of polymerization
4.4 Kinetics of anionic polymerization, Mechanism and kinetics of coordination polymerization

UNIT-5 COPOLYMERIZATION

5.1 Basic concept
  a. Technical significance
  b. Steady-state assumptions in free-radical copolymerization
  c. the co-polymer equation
  d. Instantaneous molar composition of formed
5.2 Monomer reactivity rations
  a. Significance and methods of Determination
  b. Types of copolymers
5.3 Variation of Composition with conversion
5.4 Average copolymer composition
5.5 Cumulative composition of copolymer
  a. Mechanisms

5.6 Kinetics a. Block and graft copolymers

UNIT-6 POLYMERIZATION SYSTEMS

6.1 Design criteria, Bulk polymerization (quiescent and stirred), Solution polymerization
6.2 Suspension Polymerization, Emulsion polymerization
6.3 Smith-Ewart kinetics, Deviations from the Smith-Ewart kinetics
6.4 Interfacial polycondensation, Comparison of the various processes, advantages and disadvantage, Heat transfer and mixing in polymerization reactors

UNIT-7 CHARACTERIZATION OF MOLECULAR WEIGHT

7.1 Types of average molecular weight, Molecular weight and degree of polymerization
7.2 Polydispersity and Molecular Weight Distribution in polymers, Common techniques for measurement of average molecular weights
7.3 Viscometry, End-group analysis, Gel permeation chromatography

UNIT-8 POLYMER RHEOLOGY AND MORPHOLOGY

8.1 Definition of rheology
8.2 Newtoniam and non-Newtonian fluids, Flow curves, Apparent Viscosity, Power law
8.3 Viscoelasticity, Free volume or molecular hole concept
8.4 Definition of morphology, Requirements for crystallinity
8.5 Effects on mechanical and optical properties

UNIT-9 POLYMER DEGRADATION

9.1 General types, Thermal, Mechanical, Oxidative, hydrolytic, ultrasonic, high-energy radiation, photo degradation, Antioxidants and Stabilizers

UNIT-10 POLYMER PROCESSING

10.1 Blow molding, Injection molding, Compression Molding
10.2 Extrusion, Calendaring, sheet forming or Thermoforming, Casting, Coating
10.3 Powder-coating technique, Fluidized-bed coating technique, Laminating
10.4 Fiber spinning, Bi-axial orientation, Reinforced reaction injection molding
10.5 Filament winding, Pultrusion, Design considerations with polymers, processing characteristics, engineering challenges in processing.

Reference Books:

1. Fundamentals of Polymer Engineering by Anil Kumar and Rakesh Gupta
2. Principles of Polymer Systems by F Rodriguez