SS859 INTRODUCTION TO POLYMER SCIENCE AND TECHNOLOGY
3-1-0-4

Course Objectives:
This course is aimed at imparting basic knowledge to students about polymers and structure-property correlation in polymers and polymer composites. Students will be able to understand various applications of polymers, polymer blends and polymer composites in membrane separations, biomedical applications, fuel cells, paints etc.

Unit 1: Introductory Polymer Science
Classification of polymers, Molecular weight distribution, Molecular weight averages, Poly dispersity index, Polymer synthesis: Step growth and Chain growth polymerization, Different polymerization techniques, Thermodynamics of polymer solutions- Flory-Huggins theory, Measurement of molecular weight by gel permeation chromatography, Intrinsic viscosity measurements, Light scattering methods.

Unit 2: Physical and Mechanical Properties of Polymers

The amorphous state, the glass transition, factors affecting glass transition temperature, Thermodynamics of glass transition, Secondary relaxation processes, Crystalline state of polymer chains, Melting, Crystallization kinetics, Determination of melting and crystallization temperature, Structure-property correlation, Mechanical properties and testing, Viscoelasticity

Unit 3: Natural, Synthetic Polymers and Polymer Blends

Biopolymers- Proteins, Polysaccharides, Naturally occurring elastomers, Commodity thermoplastics- Polyolefins, Vinyl polymers, Thermoplastic polyesters, Thermoplastic elastomers, Thermosets such as epoxy, unsaturated polyesters, Engineering Polymers: Polyamides, ABS, Polycarbonates, Polysulfones, Polyphenylenesulfide, Specialty Polymers: Polyimides, Ionic polymers, Liquid crystalline polymers, Additives and polymer blends, polymer composites/nanocomposites

Unit 4: Polymer Processing and Rheology

Basic processing operations such as extrusion, molding, calendaring, Introduction to polymer rheology- Newtonian and non-Newtonian fluids, Constitutive equations, Elastic properties of polymeric fluids, Melt instabilities, Rheometry.

Unit 5: Applications of Polymers and Polymer Composites for Advanced Technologies

Membrane separations, Biomedical engineering and drug delivery, Light emitting diodes, Fuel cells, Solar cells, EMI shielding, Anticorrosion coatings, Paints.

Reference Books

1. Joel R Fried, *Polymer Science & Technology*, 2nd Ed., PHI learning Pvt.Ltd., 2009.
2. J. Brydson, *Plastic Materials*, 7th Ed., CBS publishers and Distributors, 2005.
3. G. Odien, *Principles of Polymerization*, 3rd Ed., Wiley Interscience Publications, 1991.
4. F. W. Billmeyer, *Textbook of Polymer Science*, 1st Ed., Wiley – India Pvt. Ltd., 2012.
5. G. Pritchard, *Plastics Additives, An A – Z reference*, Springer – VerlagGmbh, 1997.

6. L. A. Utracki (Ed.), *Polymer Blends Handbook* (Part – 1 & 2), Springer, 2003.

Course Outcomes:

On completion of this course students will be able to:

CO1. Acquire knowledge on polymer classification and molecular weight determination of polymers
CO2. Understand physical and mechanical properties of polymers
CO3. Understand basic polymer processing operations and rheology
CO4. Apply the basic ideas acquired related to polymers and polymer composites to tailor make the properties for different applications