MANGALORE UNIVERSITY

Department of Materials Science

MSc Materials Science

MSS 505: **POLYMER SCIENCE** (3 Credits)

Objectives: Polymers are the fascinating materials for both functional and structural applications. The course provides an introduction to the various aspects of synthesis and properties of polymers. This will also provide insight in to the appropriate use of these materials.

Expected course outcomes: The student should gain a sound foundation in the area so that advanced topics in polymer science can be easily understood. Also, by learning the characterisation techniques, one can handle the analytical tools for qualitative interpretation and reasoning of experiments on polymers materials.

Unit I

Introduction - Monomers, polymers-Linear, branched, cross linked, stereo regular, thermoplastic, thermoset, copolymers, crystalline & amorphous polymers, degree of crystallinity, molecular interactions & chemical bonding, flexibility, free volume, free volume & packing density- WLF parameters & free volume, configuration and conformation, dimensions of polymer coil, polymer melting &glass transition, polymer blends & interpenetrating network.
Molecular weight distribution-weight, number & viscosity average molecular weight, determination-end group, viscosity, light scattering, ultracentrifuge, gel permeation chromatography. Criteria of polymer solubility - thermodynamics of polymer dissolution, solubility parameter, Flory Huggins theory, Newtonian & nonnewtonian flow, size & shape of polymer in solution, application of phase rule to polymer systems.
14 hours

Unit II

Synthesis & Processing- Chain polymerization-Free radical, cationic, anionic, coordination-Mechanism & Kinetics Step polymerization - polyaddition, polycondensation – Mechanism & Kinetics, Copolymerisation - Kinetics, reactivity ratios.

Methods of polymerization - bulk, suspension, solution, emulsion, condensation Processing-moulding-compression, injection, blow, extrusion, casting, spinning Synthesis, properties & applications of thermoplastics-vinyl polymers, polyvinilidine chloride, polycarbonate, polyamide, polyimide, polyurethanes, Rubber – natural and synthetic – processing, vulcanization, properties and applications. Cellulose and its derivatives. Thermosets- phenolic, amino, epoxy, polyester, silicone polymers Liquid crystal polymers, Biomaterials, Biomedical polymers, different types of packaging materials and applications, polymer adhesives.
14 hours

Unit III

Physical properties and Charecterization - Mechanical properties- Tensile testing-stress-strain plots of different types of polymers Viscoelastic behavior, Rubber elasticity, factors

influencing the strength of polymer Electrical properties- Dielectric relaxation, theory & mechanism of electrical conduction, semiconducting & conducting polymers, applications.

Optical properties- refractive index, birefringence, UV, IR Spectroscopy.

Thermal properties - Heat capacity of amorphous & crystalline polymers, polymer degradation, Thermal analysis – DSC, TMA, TG.

Acoustic properties- Dynamic modulus of elasticity, loss modulus, velocity of propagation and absorption coefficient of elastic waves in polymers, experimental determination of modulus of elasticity of solid polymers. 14 hours

References

1. Polymer Science –V R Gowarikar, N V Viswanath, Jayadev Sridhar (Wiley Eastern, 1987)
2. Polymer Chemistry – Bill Meyer Fred (Wiley Interscience, 1984)
3. Polymer Chemistry - An introduction – Raymond B Seymour & Charles E carraher Jr (Marcel Dekker, 1987)
4. Polymer Chemitry – M Mishra (Wiley Eastern, 1993)
5. Physical Chemistry of Polymers – A Tager (Mir Pub., 1978)
6. An introduction to Polymer Physics – I I Perepechko (Mir Pub., 1978)
7. Principles of Polymer Science – F Rodrigues (Mcgraw Hill, 1974)
8. Acoustic Methods of investigating polymers – I I Perepechko (Mir Pub., 1975)
9. Polymer Science and technology – Joel R Fried (Printice Hall, 1993)