12. Surface Chemistry: Adsorption – Sylvin Morris (Sarup and Sons, 2005)
13. Adsorption: Surface Chemistry – Tusher P (Rajat Publ., 2004)
14. Solid State Chemistry – Chakrabarty D K (New age Int., 2010)
15. The Physics and Chemistry of Solids – Elliott Stephen (Wiley, 2010)
16. Industrial Electrochemistry – Pletcher Derek (Chapman and Hall, 1982)
17. Principles and Applications of Electrochemistry – Crow D R (Chapman and Hall, 1984)
18. Solved Problems in Electrochemistry: For University and Industry; including answers to unsolved problems – Dominique L Piron (Overseas Press Ltd., 2009)
19. Nano electrochemistry – Amemiya Shigeru (CRC Press, 2015)

MSS 454 POLYMER SCIENCE (3 Credits)

Objectives: The objectives of this course are to (i) teach the basic concepts and terminology of polymer science, structure and properties of polymers. (ii) comprehend the principles behind synthesis and processing of polymer materials. (iii) identify and discuss the various applications in industries and daily life. (iv) focus on physical, chemical, thermal, optical, mechanical, and electrical properties of polymers.

Expected course outcomes: By the end of this course, students will be able to (i) describe the structure, properties and applications of plastics, resins, and rubbers. (ii) distinguish between polymers and small molecules in terms of their chemical and physical behaviour. (iii) characterize the polymers such as molecular weight, glass transition temperature, melting point, crystallinity, viscosity and mechanical properties. (iv) list and identify several polymers of industrial and household applications. (v) acquire knowledge and skills for placements in plastics/polymer industries.

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 & non-Newtonian flow, size & shape of polymer in solution. Problems. 14 hours

Unit II

Synthesis & Processing - Chain polymerization- free radical, cationic, anionic, coordination- mechanism and kinetics. Step polymerization- polyaddition, polycondensation –mechanism and 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, PEKK, and PEEK. Liquid crystal polymers, biomaterials, biomedical polymers, packaging materials, adhesives, and significances. Recent developments in polymer engineering. 14 hours

Unit III

Physical properties and characterization - free volume, viscosity, Mechanical properties- Tensile testing, stress-strain plots of different types of polymers. Viscoelastic behaviour, rubber like elasticity, factors influencing the strength of polymer. Electrical properties- dielectric relaxation, capacitance, CV measurement, applications.

Optical properties- refractive index, birefringence, UV, IR spectroscopy. Thermal properties - heat capacity of amorphous and 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. Properties and characterization of polymer blends. 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 Chemistry – M Mishra (Wiley Eastern, 1993)
5. Physical Chemistry of Polymers – A Tager (Mir Pub., 1978)
6. An Introduction to Polymer Physics – 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)
10. Polymer Science and Technology – Premamoy Ghosh (McGraw Hill, 2011)
11. Developments in Polymer Degradation – Grassie N (Applied Science, 1984)
12. Experiments in Polymer Science – Hundiwale D G (New Age Int., 2009)
13. Applied Polymer Science – Arun Kumar Singh (Anmol, 2012)
14. Principles of Polymer Science – Bahadur P, Sastry N V (Narosa, 2005).

MSS 455 THIN FILMS (3 Credits)

Objectives: The objectives of this course are to (i) prepare the students with a strong foundation on thin film technology, its importance and applications. (ii) discuss various deposition techniques for the growth of thin films and their limitations. (iii) explain unique optical and electrical properties with suitable examples. (iv) relate their applications in new fields such as quantum well devices and spintronics.

Expected course outcomes: By the end of this course, (i) students will acquire a comprehensive knowledge of fundamentals of thin films. Students will be able to (ii) distinguish characteristic properties of thin films from thick films. (iii) describe various deposition parameters and their effect on structure and properties of thin film. (iv) undertake research on thin film growth and their characterization techniques and in academic/industries. (v) acquire the necessary knowledge and skills for placements in semiconductor, microprocessor industries.

Unit I