

PLPC2004 POLYMER STRUCTURE & PROPERTIES RELATIONSHIP (3-0-0)

Course Objectives:

The course aims to deepen understanding of polymer structure's influence on mechanical properties and evaluate thermal, electrical, and optical characteristics based on this knowledge. Students will apply theoretical concepts to analyze and predict properties, enhancing problem-solving skills for diverse engineering applications

Module- I: (10 hours)

Structure of polymers -Linear, branched, cross linked, and polymers-Homochain and hetero atomic chain polymers-Copolymers-Linear and cyclic arrangement - Prediction of polymer properties, group contribution techniques, topological techniques- Volumetric properties-molar volume, density, Van der Waals volume-Coefficient of linear thermal expansion and volumetric thermal expansion-Pressure Volume temperature (PVT) relationship.

Mechanical properties-Stress-strain properties of polymers-Effect of polymer structure on modulus of elasticity, tensile strength, flexural strength, impact strength, yield strength, fracture toughness – Craze in glassy polymers-Ductile brittle transition. Effect of additives on mechanical properties of polymers-Creep, stress relaxation, and fatigue.

Module- II (10 hours) Thermodynamic and transition properties

Transition temperature in polymers, glass transition (T_g), melt transition (T_m), relationship between T_g and T_m - other transitions like β -transitions, upper and lower glass transition temperatures - Prediction of T_g and T_m of polymers by group contributions. Calorimetric properties – Heat capacity, specific heat, latent heat of crystallization and fusion, enthalpy and entropy- Calculation of heat capacities of polymers.

Module- III (08 hours) Electrical properties

Effect of polymer structure on dielectric constant, power factor, dissipation factor, and loss factor effect of frequency of voltage and temperature on dielectric properties- Prediction of molar polarization and effective dipole moment. Effect of additives on electrical properties of polymers.

Module- IV (08 hours) Optical properties

Optical properties- Effect of polymer structure on optical properties-clarity, transparency, haze, transmittance, reflectance, and gloss – Prediction of refractive indices of polymers by Group contributions.

Module- V (09 hours) Chemical Properties-

Cohesive energy, cohesive energy density, solubility parameter, determination of Solubility parameter of polymers – Prediction of solubility parameter- Effect of polymer structure on solubility in solvents and oils-Influence of structure in prediction of flame retardancy, water repellency - Chemical resistance of polymers – Polymer toxicity

Books:

1. D.W. Van Krevelen And P.J. Hoftyzen, "Properties Of Polymer, 3rd Edition Elsevier Scientific, Publishing Company Amsterdam - Oxford - Newyork . 1990.
2. J.E. Mark Ed.AIP, Physical Properties of Polymers Hand Book, Williston, Vt, 1996.

Course outcomes: After the completion of this course, students will be able to:

CO1 Build understanding of polymer structure and mechanical properties.

CO2 Analyses and evaluate thermal properties of polymers.

CO3 Analyses and evaluate the electrical and optical properties using knowledge of polymer structure.

CO4 Evaluating the effect of structure on polymer properties.

CO5 Analyze chemical properties of polymers.