SEMESTER –VI

POLYMER SCIENCE

Category I

(B.Sc. Honours in Polymer Science in four years)

DISCIPLINE SPECIFIC CORE COURSE – 16

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
POLYMER BLENDS AND COMPOSITES	**4**	**2**	**0**	**2**	**Class 12th with Physics, Chemistry, Mathematics**	**-**

Learning objectives

- To gain knowledge of polymer composites and its basic construction
- To learn about preparation, properties and characterization of polymer blends.

Learning outcomes

After studying this paper, students will be able to

- Understand various techniques for preparation of polymer blends
- Understand the types and forms of reinforcement materials used in composites
- Apply different production techniques for fabrication of polymer composites

SYLLABUS OF DSC-16

THEORY COMPONENT-

UNIT 1: **(6 Lectures)**

BASIC CONCEPT OF BLENDS

Definition of blends, types of blends (plastic-plastic, rubber-rubber and plastic-rubber blends), differences between: copolymer and IPNs, blends, alloys and composites; concept of miscibility, concept of free energy of mixing, phase equilibria, Flory-Huggins theory, spinodal, binodal and critical phase, Gibb's phase rule

UNIT 2: **(6 Lectures)**

PREPARATION AND PROPERTIES OF BLENDS

Methods of blending, compatibilizers, methods of compatibilization, factors affecting miscibility of polymer blends, effect of composition on properties (rheology, morphology, mechanical and thermal)

UNIT 3: **(6 Lectures)**

CHARACTERIZATION TECHNIQUES OF BLENDS

Applications of the following techniques: IR, microscopy (TEM, SEM and optical), TGA, DSC, DMA, viscosity, refractive index

UNIT 4: **(6 Lectures)**

POLYMER COMPOSITES

Definition; classification of composites; dispersed phase: (reinforcing fillers, non-reinforcing fillers), and (particulate matter, fibrous structure and platelet structures), continuous phase: thermoset matrix, thermoplastic matrix and high-performance resins, mechanism of reinforcement, various factors affecting reinforcements

UNIT 5: **(6 Lectures)**

DESIGN AND FABRICATION OF COMPOSITES

Fabrication techniques: Prepreg technology, injection and compression molding, vacuum bag molding, hand-lay-up process, spray-up technique, filament winding process, fibre placement process, Pultrusion, reaction transfer molding, laminating techniques, expansion processes, fabrication processes: adhesion, cohesion and mechanical processes & FRPs.

Design of a few polymer composite: basic design practice – material considerations, product considerations and design considerations, rule of mixture

PRACTICAL COMPONENT (60 Lectures)

- To prepare polymer blends by melt, solution and latex blending.
- To check the compatibility of blends by using microscope/DSC
- Determination of Lower and Upper Critical Solution Temperature of a polymer.
- To study the miscibility of the polymer blend using ultrasonic method.
- To study the miscibility of the polymer blend using viscosity method.
- To study the miscibility of the polymer blend using refractive index method.
- Determination of miscibility of polymer blends by density measurement method.
- Preparation of FRP laminates by hand lay-up technique.
- Evaluate the effect of filler loading on mechanical properties of a composite.
- Fabrication of composites by various techniques.
- Characterization (thermal and mechanical) of blends and composites.
- Determine the refractive indices of polymer blends by using abbe's refractometer.

ESSENTIAL/RECOMMENDED READINGS

- Paul D.R., Bucknall C.B., (2000) Polymer Blends Vol. 1 & Vol. 2, Wiley-Interscience.
- Robeson L.M., (2007) Polymer Blends, Hanser Gardner.
- Singh R.P., Das C.K., Mustafi S.K., (2002) Polymer Blends and Alloys, Asian Books Private Limited.

SUGGESTIVE READINGS

- Utracki L.A., (2003) Polymer Blends Handbook Vol. 1 & Vol. 2, Kluwer Academic Pub.
- Bhowmick A.K., De S.K., (1990) Thermoplastic Elastomers from Rubber-Plastic Blends, Ellis Horwood Publishers Ltd.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.