BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE- PILANI, HYDERABAD CAMPUS
Second Semester 2022-2023
Course Handout (Part-II)

Date: 16 Jan, 2022

In addition to Part I (General Handout for all courses appended to the Time Table), this portion gives further specific details regarding the course.

Course No. **: CHE G522**
Course Title **: Polymer Technology**
Instructor-in-Charge **: D.PURNIMA**
Lab Instructor :Jashaswinee Swain

1. Course Description:
Polymerization techniques; classification of polymers; mechanism and kinetics of formation of polymers; techniques for determination of different types of molecular weights; polymer structure; polymer solution thermodynamics; definition and measurement of glass transition and crystalline melting temperatures; viscoelastic behaviour; degradation and stability; polymer processing; and applications.

2. Scope & Objective:
Polymers have become an essential part of everyday life and are used extensively in a wide range of applications, from medical appliances, sporting and electrical goods to automotive, construction etc. Polymer engineers need to apply the traditional skills of chemical engineers, such as plant design, process design, thermodynamics, and transport phenomena, to various problems involving the production and use of polymers. More than half the chemical engineers in the world are working with polymers in one form or another.
This course is designed to learn the fundamentals of polymer technology from the basics of polymer chemistry, structure, synthesis, and processing to more advanced topics, including structure-property relationships and end-use polymer design, solution thermodynamics, polymer mechanical properties, applications of polymeric materials, and how to choose the appropriate polymer for a particular application and polymer rheology and processing, where transport phenomena enter into the polymer technology. This course also gives an exposure to the students in the field of advancement of the course through projects related to recent research topics.

3. Text Book:
Joel R. Fried, "Polymer Science and Technology", Prentice Hall of India, Pvt. Ltd., New Delhi, 1995

4. Reference Books:
R1. Fred W. Billmeyer, Jr, "Textbook of Polymer Science", John Wiley & Sons, New York, 3rd ed., 1994.
R2. Alfred Rudin, "Polymer Science and Engineering", Academic Press, USA, 2nd ed., 1999.
R3. V.R.Gowarikar,"Polymer Science",New age International(P) Limited,1st Edition.
R4. William D.Callister,Jr.,"Material Science and Engineering",WileyIndia(P)Ltd.,2007.

5. Course Plan:

Lecture No.	Learning Objectives	Topics to be covered	Reference Chapter/Sec. (Book)
1-2	Introduction to Polymer Science	Classification of polymers, polymer structure, chemical structure and thermal transition	1 (TB)
3-4	Molecular weight & Method of moments	Molecular weight averages, Molecular weight distribution	1 (R2)
5-10	Synthesis of High Polymers	Step growth polymerization Chain growth polymerization	2.1 (TB) 2.2 (TB)
11	Polymerization Techniques	Bulk polymerization, Solution polymerization, Suspension polymerization & Emulsion polymerization.	2.3 (TB)
12	Special Topics in polymer synthesis	Metathesis, Group transfer polymerization	2.5 (TB)
13-18	Solution properties, thermodynamics and molecular weight determination	Thermodynamics of polymer solutions, membrane osmometry, vapour pressure osmometry, light scattering method, intrinsic-viscosity measurements, gel-permeation chromatography.	3 (TB)
19-21	Solid-state properties of polymers	Amorphous state, chain entanglements & reptation, glass transition, crystalline state, crystalline melting temperature,	4 (TB) 11 (R2)

		crystallization kinetics, techniques to determine crystallinity	
22-25	Thermal transition & properties	Fundamental thermodynamic relationship, thermal transition in polymeric material, determination of Tg by dilatometry and calorimetry.	4 (TB)
26-28	Mechanical properties	Test to determine mechanical performance in polymers Static test: tensile, shear Transient test: creep test, stress relaxation, impact & cyclic test	4 (TB)
29-30	Viscoelasticity	Introduction to viscoelasticity, Dynamic-mechanical analysis, Mechanical models of viscoelastic behavior	5 (TB)
31-33	Polymer Rheology	Introduction to Polymer Rheology, Analysis of Simple Flows, Rheometry.	11(TB)
34-35	Polymer processing	Extrusion, moulding, spinning calendaring, coating.	11 (TB)
36	Polymer degradation, stability and environmental issues	Thermal degradation oxidative & UV-stability, management of plastics in environment.	6 (TB)
37	Polymer additives	Fillers, plasticizers, stabilizers, colourants, flame retardants	7 (TB), 17 (R1)
38-40	Commodity Thermoplastics	Polyolefins, vinyl polymers, thermoplastic polyesters	8 (TB)
41	Network Polymers	Thermosets, elastomers	9 (TB)
42	Engineering and specialty polymers	Engineering plastics, specialty polymers	10 (TB)

5. Evaluation Scheme:

No.	Component	Duration	Weightage	Date and Time	Venue	Nature
1.	Mid Semester test	90 min	20%	13/03 9.30 - 11.00AM		OB
2.	Quizzes	10 min	15%			CB
3.	Lab	120min	20%			OB
4.	Project (one)	--	15%			OB
5.	Comprehensive	3 hrs	30%	08/05 FN		CB

6. Lab Experiments:

1. Solvent casting
2.Melt extrusion
3. Preparation of specimen using injection molding
4. Preparation of specimen using compression molding
5. To find surface area using BET
6. Estimation of filler content in polymer composite
7. Optical microscopy, scanning electron microscopy
8. Testing of samples using universal testing machine and impact tester
9. FTIR/Melt flow indexer
10. Characterization of thermal properties using DSC and TGA.
11.. Characterization of sample using XRD
12. Demo of pultrusion, rotational molding, 3 D printing.
13. Demo of Confocal microsopy
14.Demo of Polymer coating
15.Demo of pattern making on polymers

7. Chamber Consultation Hour: To be announced in the class.
8. Notices: All notices concerning this course will be displayed on the Chemical Engineering otice Board.
9. Make-up Policy: Make-up will be granted only for genuine cases with valid justification and prior permission of Instructor-in-charge.
10. **Academic Honesty and Integrity Policy**: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable

Instructor-in-charge
CHE G522