

BHASKARACHARYA COLLEGE OF APPLIED SCIENCE

Category I

B.Sc. (Honours) Polymer Science

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		
Chemistry and Engineering of Polymer Reactions (CEPR)	4	3	0	1	12 th with PCM	--

Learning Objectives

- To learn about the different polymerizations
- To study kinetics of chain growth and step growth polymerization
- To understand general concepts, principles, kinetics and methodology of polymerization

Learning outcomes

The Learning Outcomes of this course are as follows:

- Know about overview of aspects of polymer engineering
- Understand essential fundamentals and chemistry of the polymerization processes.
- Learn about various terms such as reaction initiation, propagation and termination

SYLLABUS OF DSC-4

UNIT – I

06 Hours

INTRODUCTION

Introduction to polymerization process, control of polymer synthesis; thermodynamic and kinetic control, diffusion control, polymer end chain control & control strategies, Introduction to reactor design, Interpretation of batch reactor data; design equations for ideal reactors, namely batch, CSTR, plug flow, design equation for single reaction systems using batch and semi batch, CSTR, PFR, Multiple reactor system; reactor in series and parallel, preference of type of reactor used

UNIT – II

09 Hours

RADICAL CHAIN POLYMERIZATION

Introduction, thermodynamic and kinetic aspect of radical chain polymerization, rate of polymerization, kinetic chain length, Mayo's equation, cage efficiency, selection criteria of initiators, ceiling temperature, Tromsdorff effect, inhibition and retardation Ziegler-Natta catalyst and stereoregular polymerizations, Radical chain copolymerization (reactivity ratio, copolymer equations)

UNIT – III

06 Hours

REDOX & OTHER INITIATIONS

Initiation in aqueous media, initiation in non-aqueous media, rate of redox polymerization, photochemical initiation, rate of photo-polymerization, initiation by ionizing radiation, electrolytic polymerization, plasma polymerization.

UNIT – IV

09 Hours

IONIC CHAIN & CONTROLLED POLYMERIZATIONS

Classification of ionic species, effect of solvents, initiation, propagation and termination in ionic polymerization, cationic polymerization, anionic polymerization, introduction of Atom Transfer Radical Polymerization (ATRP), Reversible Addition-Fragmentation Chain Transfer Polymerization (RAFT) and Nitroxide mediated polymerization (NMP)

UNIT – V

09 Hours

STEP GROWTH POLYMERIZATION

Reaction engineering of step growth polymerization: basic properties & examples of commercially important polymers, reactivity of functional groups kinetics of step polymerization, self-catalyzed & external catalysis of polymerization, molecular weight distribution in linear & nonlinear polymerization, effect of non-equivalence of functional groups, equilibrium considerations,

UNIT – VI

06 Hours

POLYMERIZATION TECHNIQUES

Bulk, solution, precipitation, suspension & emulsion polymerization.

Practical

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30 Hours

- To prepare polystyrene/poly(methyl methacrylate) by bulk polymerization and determine the rate of polymerization.
- To study the effect of reaction temperature on free radical polymerization of styrene/MMA.
- To study the effect on initiator concentration of free radical polymerization of styrene/MMA.
- Redox initiated polymerization of MMA & investigate the effect of viscosity on polymerization kinetics
- Redox polymerization of acrylamide
- To investigate Trommsdorff effect in bulk polymerization of MMA
- Solution polymerization of methyl methacrylate/styrene.
- Suspension polymerization of styrene/MMA.
- Emulsion polymerization of styrene/ methyl methacrylate.
- Preparation of Poly (vinyl butyral).

Essential/recommended readings

- Odian, G., (2004) Principles of Polymerization, Wiley-interscience.
- Billmeyer F.A., (2011) Textbook of Polymer Science, John-Wiley & Sons.
- Seymour R.B., Carraher C.E., (2003) Polymer Chemistry, Marcel Dekker.
- Flory P.J., (2007) Principles of Polymer Chemistry, Asian Books Private Limited.
- Levenspiel, O. (1998). Chemical reaction engineering. John Wiley & Sons.

Suggestive readings

- Brydson J.A., (2016) Plastics Materials, Butterworth Heinemann, 8th Edition.
- Lenz, R. W. (1967). Organic chemistry of synthetic high polymers.
- Gowarikar V.R., (2019) Polymer Science, New Age International Publishers Ltd, 3rd Edition

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