University of Kerala

Discipline	CHEMISTRY				
Course Code	**UK4DSCCHE203**				
Course Title	**CONCEPTS OF POLYMER CHEMISTRY**				
Type of Course	**DSC**				
Semester	4				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Higher secondary level chemistry				
Course Summary	To know the concept of polymerization and types of polymers; To understand the characteristics of polymers; To acquire knowledge about the polymerization techniques and polymer processing; To know the chemistry of individual polymers; To have an idea about the recent advances in polymer sciences				

Detailed Syllabus:

Module	Unit	Content CONCEPTS OF POLYMER CHEMISTRY	Hrs 75
I	**INTRODUCTION TO POLYMERS**		**9**
	1	Definition - Monomer, polymer and polymerization - classification of polymers on the basis of (i) origin - Natural, semi synthetic, synthetic, (ii) Physical properties and applications- Rubbers, plastic, fibers (iii) Thermal response - thermoplastics, thermosetting	3
	2	Structure- Homopolymers (linear, branched, cross link or network), Copolymers (Random, Alternate, Block, Graft)	2
	3	Crystallinity - non-crystalline (amorphous), semi-crystalline Mode of formation - Addition, Condensation Polymerization (definition and examples only)	2
	4	Methods of polymerization - Bulk, Solution, Suspension Polymerization (definition and examples only)	2
II	**CHARACTERISTICS OF POLYMERS**		**9**
	5	Glass transition temperature (Tg) - definition – Factors affecting Tg – relationships between Tg and molecular weight and melting point.	3

		Significance of Tg and Tm. Introduction to DTA and DSC as thermal characteristics.	
	6	Molecular weight of polymers. Number average, weight average, sedimentation and viscosity average molecular weights. Degree of polymerization- polydispersity index.	3
	7	Polymer degradation - basic idea of thermal, photo and oxidative degradation of polymers - mechanistic pathways, Autooxidation, effect of environmental factors.	3
III	**POLYMERIZATION TECHNIQUES AND PROCESSING**		**9**
	8	Bulk, solution, suspension, emulsion and melt condensation polymerizations.	4
	9	Polymer processing - calendaring - die-casting, rotational casting-compression moulding - injection moulding - blow moulding - extrusion moulding and reinforcing.	5
IV	**CHEMISTRY OF SOME COMMERCIAL POLYMERS ADVANCES IN POLYMERS**		**18**
	10	Preparation, properties and uses of the following polymers- Thermoplastics: polyethylene, polypropylene, polystyrene, polyacrylonitrile, polyvinyl chloride, nylon, polyester.	3
	11	Thermosetting: Phenol formaldehyde resin, urea formaldehyde resin, melamine formaldehyde, epoxy resin, polycarbonate.	3
	12	Elastomers: Natural rubber and synthetic rubber, Styrene and neoprene rubber. Vulcanization of natural rubber, Buna -N, Buna-S	3
	13	Biodegradable polymers (Basic idea only). Biomedical polymers - contact lens, dental polymers, artificial heart, kidney, skin and blood cells.	3
	14	High temperature and fire-resistant polymers-silicones-polyphosphazenes.	3
	15	Conducting polymers: Polysulphur nitrile, polyphenylene, polypyrrole and polyacetylene, polyaniline.	3
V	**PRACTICALS: POLYMER CHEMISTRY EXPERIMENTS**		**30**
	16	**A. Determinations of Physical properties of polymers**	5
		Solubility, density, softening and melting behaviour	
	17	**B. Analysis of polymers**	15
		Preliminary investigation	
		Elemental analysis	
		Classification of polymers	
		Identification tests	
	18	**C. Preparation of polymers**	10
		Preparation of polystyrene	
		Preparation of Polyaniline	
		Preparation of phenol-formaldehyde resin	

References:

1. V.R. Gowarikar, N. V. Viswanathan and J. Sreedhar. *Polymer Science*, Wiley Eastern, 1995.
2. F.W. Billmeyer, *Text Book of Polymer Science*, 3rd edition, John Wiley and sons, New York, 2002.
3. R. J. Young & P. A. Lovell, *Introduction to polymers,* Chapman & Hall, London. Second edition. Wiley online library 1991.
4. G.S. Mishra, *Introduction to polymer chemistry,* Wiley Eastern Ltd., New Delhi.
5. Wayne. R. Sorenson, Fred Sweeny, Tod. W. Campbell. *Preparation methods of polymer chemistry* - John Wiley & son, INC., Publication. 2001.
6. K.J.Saunders, *Organic Polymer Chemistry,* 2nd Edition, Chapman & Hall.1973, Newage publishers 1993.
7. *Laboratory Experiments in Chemistry I & II, University Practical Book of Chemistry*, University of Mumbai.
8. Dr. Kuruvilla Joseph, Dr. G. D. Gem Mathew- *Advanced practical polymer chemistry*- polymer publication, 2001.
9. D.G. Hundiwale, V.D. Athawale, U. R. Kapadi, V.V. Gite., *Experimental in polymer science* - New age International (P) Limited, Publishers 2009.
10. Wayne R. Sorenson, Tod W. Campbell. *Preparative method in polymer science.*
11. J. Urbanski W. Czerwinski, K. Janicka, F. Majewska & H. Zowall, *Analysis of synthesis polymer & plastics*- Ellis Horwood limited- 1st edition 1977.
12. J. Urbanski. *Handbook of Analysis of Synthetic Polymers and Plastics*- 1977, Ellis Horwood Ltd, publisher.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand the fundamental principles and characteristics of polymers, including their structure, properties, and applications in various industries.	Ap	PSO-1,2,3
CO-2	Analyse and interpret the thermal behaviour, molecular weight characteristics and degradation mechanisms of polymers by correlating glass transition and melting phenomena with molecular parameters and environmental influences.	An	PSO-1,2,3,4
CO-3	Evaluate the suitability and efficiency of different polymerization techniques and processing methods for producing polymers with required properties and performance in specific applications.	E	PSO-1,2,3,4

CO-4	Design and evaluate polymer systems by selecting and tailoring the preparation, properties and applications of thermoplastics, thermosets, elastomers, biodegradable, biomedical, high-temperature and conducting polymers to meet specific industrial and societal needs.	C	PSO-1,2,3,4,5
CO-5	Proficiency in the experimental determination of physical properties, analysis and preparation of polymers.	C	PSO-1,2,3

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: CONCEPTS OF POLYMER CHEMISTRY

Credits: 3:0:1 (Lecture:Tutorial:Practical)

CO No.	CO	PO/ PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PO-1,6 PSO-1,2,3	Ap	F, C	L	-
2	CO-2	PO-1,2,6 PSO-1,2,3,4	An	F, C	L	-
3	CO-3	PO-1,2,3,6 PSO-1,2,3,4	E	F, C	L	-
4	CO-4	PO-1,2,3,6 PSO-1,2,3,4,5	C	C, P	L	-
5	CO-5	PO-1,2,3,6 PSO-1,2,3,4,5	C	P, M	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO 1	3	3	2	-	-	1	-	-	-	-	2	-	-
CO 2	2	3	3	2	-	2	1	-	-	-	2	-	-

CO 3	2	3	2	2	-	1	2	1	-	-	2	-	-
CO 4	2	3	3	2	2	2	2	2	-	-	2	-	-
CO 5	2	3	3	2	2	2	1	2	-	-	2	-	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓		✓	✓
CO 5	✓		✓	✓