University of Kerala

Discipline	CHEMISTRY				
Course Code	**UK4DSECHE204**				
Course Title	**POLYMER CHEMISTRY II**				
Type of Course	**DSE**				
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	1. Basic knowledge in polymer chemistry 2. UK3DSECHE204 (preferable)				
Course Summary	The course deals with molecular forces and bonding in polymers, properties of polymers, including molecular weight distribution, kinetics of polymerization, degradation processes, and the unique characteristics of biopolymers and biodegradable polymers. Also, there is a module of practicals based on polymer chemistry.				

Detailed Syllabus:

Module	Unit	Content POLYMER CHEMISTRY II	Hrs 75
I	**MOLECULAR FORCES AND BONDING IN POLYMERS**		**9**
	1	Primary structure – polarity of monomers. Secondary structure – conformation and configuration. Tertiary structure – crystalline and amorphous polymers.	3
	2	Polar and non-polar interactions. Segmental mobility and total mobility of polymer chains. Solid, liquid, glassy and rubbery states.	2
	3	Amorphous and crystalline behaviours. Tg and Tm. Viscoelastic deformation. Determination of Tg. Factors influencing Tg (molecular geometry, molecular mass, plasticisers, copolymerization) relationship between Tg and Tm. Importance of Tg. Factors influencing crystalline state, polymer single crystals, spherulites.	4
II	**PROPERTIES OF POLYMERS**		**15**
	4	Molecular weight and molecular weight distribution – number, weight and viscosity average molecular weights of polymers	2
	5	methods of determining molecular weight, practical significance of molecular weight distribution, size of polymers.	2
	6	Introductory concepts of kinetics of polymerization and Carother's relation.	3

	7	Glassy state, glass transition temperature, TGA, factors affecting GTT, crystallinity in polymers.	2
	8	Viscosity, solubility, optical properties, electrical properties, thermal properties, mechanical properties of polymers	3
	9	Polymer processing- compression moulding, casting, extrusion, fibre spinning, injection moulding, thermoforming, vulcanization of elastomers	3
III	**POLYMER DEGRADATION**		**9**
	10	Process of degradation. Random and chain end degradation.	2
	11	Methods of degradation: thermal degradation – factors affecting thermal stability;	2
	12	mechanical degradation – milling and mastication;	1
	13	photodegradation – photo stabilisers	1
	14	oxidative degradation – oxidants and antioxidants;	1
	15	hydrolytic degradation, degradation by high energy radiation, chemical degradation	2
IV	**BIOPOLYMERS AND BIODEGRADABLE POLYMERS**		**12**
	16	DNA and RNA – structure and functions. Structure of proteins,	3
	17	Preparation, properties and applications of cellulose derivatives: cotton and rayon: cellulose plastics: cellulose acetate,cellulose nitrate & regenerated cellulose.	3
	18	Structure and applications of starch, shellac, chitin and chitosan. Commercial applications of natural polymers-lignin, kerogen, amber, asphaltenes.	4
	19	Biodegradable polymers, examples. Biomedical applications of polymers.	2
V	**PRACTICALS – POLYMER CHEMISTRY**		**30**
		I. Determination of: 1. Ammonia content 2. Total solid content 3. Dry rubber content 4. KOH number. 5. Acid value 6. Iodine value 7. Estimation of hydroxyl groups 8. Estimation of nitrogen in polymeric and related samples.	
		II. Determination of: 1. Ash content; 2. Volatile matter 3. Metal (Cu, Fe and Th) content of dryrubber.	
		III. Qualitative analysis of plastics and rubbers	
		IV. Synthesis of different polymers involving various polymerization processes and techniques.	

References:

1. Malcon P. Steves, *Polymer chemistry-An introduction*, 3rd edition, Oxford University Press.
2. F. W. Billmayer, *Text book of Polymer Science*, 3rd edition, John Wiley &Sons.
3. R. Gowariker, N. V. Viswanathan &J. Sreedhar, *Polymer Science*, New Age International Publishers.
4. P. Bahadur& N. V. Sastry, *Principles of Polymer Science*, Narrora Publishing House, 2nd Edition, New Delhi.
5. Premamoy Ghosh, *Polymer Science & Technology*, 3rd edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi
6. G. Odian, *Principles of polymerization*, 3rd edition, John Wiley &Sons.
7. G. S. Misra, *Introductory Polymer Chemistry New age* International Publishers & Distributors, New Delhi.
8. K. Ahluwalia& A. Misra, *Polymer Science-A Text Book*, Ane Books, India, New Delhi.
9. J. R. Fried, *Polymer Science & Technology*, Prentice Hall of India Pvt. Ltd, New Delhi.
10. J. Urbanski, W. Czerwinski, K. Janickaet al. *Handbook for analysis of synthetic polymer and plastics*, Ellis Harwood Ltd.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Demonstrate a thorough understanding of molecular forces and bonding in polymers	An	PSO-1,2,3
CO-2	Identify the properties of polymers.	An	PSO-1,2,3
CO-3	demonstrate a comprehensive understanding of polymer degradation processes	E	PSO-1,2,3
CO-4	Realize the necessity of biodegradable substitutes for a sustainable development	C	PSO-1,2,3
CO-5	Develop practical skills in polymer synthesis and analysis	C	PSO-1,2,34,5

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

Name of the Course: POLYMER CHEMISTRY II

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-1,2,6 PSO-1,2,3	An	F, C	L	-
2	CO-2	PO-1,2,6 PSO-1,2,3	An	F, C	L	-
3	CO-3	PO-1,2,6 PSO-1,2,3	E	F, C	L	-
4	CO-4	PO-1,2,6 PSO-1,2,3	C	P	L	-
5	CO-5	PO-1,2,3,6 PSO-1,2,34,5	C	P	-	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	2	2	-	-	2	1	-	-	-	2	-	-
CO 2	3	2	2	-	-	2	1	-	-	-	2	-	-
CO 3	3	2	2	-	-	2	2	-	-	-	2	-	-
CO 4	2	2	2	-	-	2	1	-	-	-	2	-	-
CO 5	3	2	3	1	2	3	2	1	-	-	3	-	-

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	✓	✓	✓	✓