UNIVERSITY OF MADRAS

B.Sc. DEGREE PROGRAMME IN CHEMISTRY

SYLLABUS WITH EFFECT FROM 2023-2024

<table>
<tr><td>Title of the Course</td><td colspan="7">POLYMER SCIENCE</td></tr>
<tr><td>Paper No.</td><td colspan="7">EC VIII (EC-8)</td></tr>
<tr><td>Category</td><td>Elective</td><td>Year
Semester</td><td>III
VI</td><td>Credits</td><td>2</td><td>Course Code</td><td>324E6C</td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td></td><td>4</td><td></td><td colspan="2">-</td><td colspan="3">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Knowledge on functional groups and reaction mechanisms</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">The course aims at providing an overall view of
• classification of polymers, preparation of polymers
• kinetics of polymerization and characterization of polymers
• analytical techniques used to characterize polymers
• reactions of polymers
• speciality polymers like PVC, PMMA</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I
Introduction
Difference between polymer and macromolecule – classification– synthetic and natural, organic and inorganic, thermoplastic and thermosetting. Plastics, elastomers, fibres and liquid resins.

Techniques of polymerization
Bulk, solution, emulsion and suspension polymerization</td></tr>
<tr><td></td><td colspan="7">Unit – II
Kinetics of polymerization
Kinetics of condensation and addition polymerisation; ionic, free radical, copolymerisation and coordination polymerisation – reactivity ratios – block and graft copolymers.
Characterisation of polymers

Appearance, feel and hardness, density, effect of heat, solubility, combustion, tensile strength, shear, stress, impact strength, mechanical, thermomechanical and rheological properties of polymers in viscoelastic state.</td></tr>
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	UNIT III **Molecular Weight and Properties of Polymers** Molecular Weight of Polymers-Number Average and Weight Average, Molecular Weight Distribution, Determination of Molecular Weight polydispersity index – membrane and vapour phase osmometry, light scattering - Zimm plot, ultracentrifuge – sedimentation velocity and sedimentation equilibrium – viscometry – gel permeation chromatography Thermal properties of polymers – Glass Transition Temperature-State of Aggregation and State of Phase Transitions, Factors influencing Glass Transition Temperature, Importance of Glass Transition Temperature, Heat Distortion Temperature, TGA / DTA, Crystallinity of Polymers: Crystalline Behaviour, Degree of Crystallinity
	UNIT IV Reactions of Polymers-Hydrolysis, Acidolysis, Aminolysis, Addition and Substitution Reactions (One Example Each) Cyclisation, Cross-Linking and Reactions of Specific Functional Groups in the Polymer **Polymer technology** Processing of polymers – casting, thermoforming, moulding – extrusion, compression, blow moulding – foaming, lamination, reinforcing – processing of fibres – melt, wet and dry spinning.
	UNIT V **Speciality polymers** Polyelectrolytes, conducting polymers, polymeric supports for solid phase synthesis, biomedical polymers, liquid crystalline polymers, electroluminescent polymers – two examples of each of these polymers. Polyethylene, PVC, PMMA, polyester; rubber – synthetic and natural, vulcanisation of rubber. **Polymer Degradation** Types of Degradation - Thermal, Mechanical, Ultra Sound, Photo
	Radiation and Chemical Degradation Methods. Rubber-Natural and Synthetic-Structure, Mechanism of Vulcanisation Biodegradable and Non-Biodegradable Polymers.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/ JAM /TNPSC others to be solved (To be discussed during the Tutorial hours)

Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. Gowariker V.R, N.V. Viswanthan and Jayadev Sreedhar. Polymer Science. 2. New Delhi: New Age International,2015 3. Misra G.S. Introductory Polymer Chemistry. New Delhi: Wiley Eastern,2010. 4. Bahadur P and Sastry N V. Principles of Polymer Science. New Delhi: Narosa Publishing House,2005 5. Ahluwalia, V.K. Anuradha Mishra, *Polymer Science A Text Book*, Ane Books India: New Delhi,2008. 6. Morrison, R. R.; Boyd, R. N.; Bhattacharjee, S. K. *Organic Chemistry*, 7thed.; Pearson: New Delhi,2011.
Reference Books	1. Billmeyer, F.W. Polymer Science. India: Wiley-Interscience,2007. 2. Seymour, R. B.; Carraher Jr.C.E. Polymer Chemistry: An Introduction, Marcel Dckker Inc : New York, 1981. 3. Sinha, R. Outlines of Polymer Technology, Prentice Hall of India: New Delhi,2000. 4. Joel R. Fried, Polymer Science and Technology, 3rded.; Prentice Hall of India: New Delhi, 2014.
Website and e-learning source	1. https://polymerdatabase.com 2. http://amrita.vlab.co.in/?sub=2&brch=190&sim=603&cnt=1 3.http://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/polymers.htm 4.http://nsdl.niscair.res.in/bitstream/123456789/406/2/Molecular+weights+of+polymers.pdf

Course Learning Outcomes (for Mapping with POs and PSOs) On completion of the course the students should be able to

CO1: explain classification of polymers, elastomers, fibres and liquid resins
CO2: explain addition and condensation polymerization, mechanical properties of polymers
CO3: determine the molecular weight of polymers, and explain the thermal properties of polymers
CO4: explain reactions of polymers and polymer processing
CO5: discuss speciality polymers like PVC, PMMA, rubbers, biodegradable polymers

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	S	M

CO2	M	S	S	S	M	S	S	M	M	M
CO3	S	S	S	M	S	S	S	M	S	M
CO4	S	S	S	S	S	S	S	M	M	M
CO5	S	M	S	S	S	S	S	M	M	S

CO-PO Mapping (Course Articulation Matrix)

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PO's and CO's