

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: M. Sc. (Polymer Science)

Programme Specific Outcome (PSO):

- PSO1** Learn basics of Organic Chemistry/Physical Chemistry/ Analytical Chemistry/ Polymer chemistry, polymerization reactions.
- PSO2** Basic understanding of the polymerization kinetics
- PSO3** Understand the concept of molecular weights, average molecular weights, number average/weight average molecular weights and the significance of dispersity index
- PSO4** Ability to distinguish between polymerization techniques like free radical polymerization, bulk polymerization, solution polymerizations
- PSO5** Learn about the various properties of polymeric materials
- PSO6** Advanced understanding and application of processing techniques used in industries at various levels including fabrication techniques
- PSO7** Hands-on practice of basics and advanced experiments intended for research applications and industrial practice of manufacture of polymers
- PSO8** To learn about industrial and biomedical applications of different polymers.
- PSO9** Research Training/exposure through literature survey/ definition of problems/ laboratory work/ collection and interpretation of data/ presentation/defence.

Department of Applied Chemistry
Faculty of Technology and Engineering,
The Maharaja Sayajirao University of Baroda
**Teaching and Examination Scheme for the Four Semester Course in
Master of Science (Polymer Science)
(With effect from 2024-25 progressively)**

<u>Sr. No.</u>	<u>Code No.</u>	<u>Subject</u>	<u>Teaching hrs/week</u>	<u>Examination Marks</u>	<u>Total Marks</u>
<u>First Semester of M.Sc.-I (Polymer Science)</u>					
1.	ACH2110	Advanced Organic Chemistry	4	100	
2.	ACH2111	Advanced Physical Chemistry	4	100	
3.	ACH2112	Fundamentals of Polymer Science-I	4	100	
4.	ACHXXXX	Analytical Chemistry	4	100	
5.	ACH2110L	Advanced Organic Preparations (TW/Practical/Viva)	4	50	
6.	ACH2111L	Advanced Physical Chemistry (TW/Practical/Viva)	4	50	
			24		500
<u>Second Semester of M.Sc.-I (Polymer Science)</u>					
7.	ACH2210	Fundamentals of Polymer Science-II	4	100	
8.	ACH2211	Polymer Blends & Composites	4	100	
9.	ACH2212	Characterization of Polymers	4	100	
10.	ACH2213	Industrial and Speciality Polymers-I	4	100	
11.	ACHXXXX	Synthesis & Characterization of Polymers	6	50	

			22		450
<u>First Semester of M.Sc.-II (Polymer Science)</u>					
12.	ACHXXXX	Rubber and Adhesives	4	100	
13.	ACH2314	Polymer Processing	4	100	
14.	ACH2315	Industrial and Speciality Polymers-II	4	100	
15.	ACH2313L	Analytical Chemistry TW/Practical/Viva	4	50	
16.	ACH2316L	Polymer Processing & Testing Laboratory	6	50	
17.	ACH2317	Seminar	2	50	
			24		450
<u>Second Semester of M.Sc.-II (Polymer Science)</u>					
18.	ACH2409	Project	24	200	
			24		200
				Grand Total	1600

	The Maharaja Sayajirao University of Baroda				Academic Year				2024-25		
Faculty Technology and Engineering											
Department of Applied Chemistry											
M.Sc. (Polymer Science): Regular Programme											
Year	I	Core / Elective / Foundation			Credits / Hours per week				04		
		ACH2110: Advanced Organic Chemistry									
Semester	I	Year of Introduction: 2020 Year of Syllabus Revision: 2024			Maximum Marks / Grade				100 (70 UA + 30 IA)		
Mode of Transaction		Lectures and Tutorials									
Course Outcome (CO) ACH2110											
CO1 To learn some important organic name reactions and the role of reagents in organic synthesis.											
CO2 To study various molecular rearrangements and their mechanistic applications.											
CO3 To learn the importance and chemistry of five and six-membered heterocyclic compounds with two hetero atoms.											
CO4 To understand the tautomerism and reactivity in organic chemistry.											
CO5 To study the stereoisomerism and understanding of conformational analysis with respect to spectral techniques.											
CO6 To study the structure, stability, preparation and reactions involving organic intermediates.											
CO7 To study about the retrosynthetic approach in organic chemistry with examples.											
Unit No.	Topic/Unit			Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/Entrepre	Relevance to Local (L)/ National (N)/	Relation to Gender (G), Environment and

							neurship (Ent)/ Skill Develop ment (SD)	Regional (R)/Glob al (G) develop mental needs	Sustaina bility (ES), Human Values (HV)and Professio nal Ethics (PE)
1.	<u>Advanced Organic Synthesis (Reactions and Reagents):</u> Reactions: (i) Birch Reduction (ii) Hofmann elimination (iii) Michael addition (iv) Stephen reaction Reagents: (i) Diborane (ii) LiAlH ₄ (iii) Dicyclohexylcarbodiimide (DCC) (iv) Dichlorodicyanobenzoquinone (DDQ)	08	13	2, 3	CO1	PSO1 PSO6	Emp	G	ES
2.	<u>Molecular Rearrangements-I:</u> (i) Tiffeneau-Demjanov rearrangement (ii) Benzil-Benzilic acid rearrangement (iii) Neber rearrangement (iv) Wolf rearrangement	07	12	1,3, 5	CO2	PSO1 PSO6			
3.	<u>Molecular Rearrangements-II:</u> (i) Schmidt rearrangement (ii) Baeyer–Villiger rearrangement (iii) Favorskii rearrangement (iv) Hofmann-Martius rearrangement	05	10	1,3, 5	CO2	PSO1 PSO6			
4.	<u>Heterocyclic Compounds:</u> Classification, Nomenclature, Synthesis and importance of Five and six membered heterocyclic compounds with two hetero atoms eg. Pyrazole, Oxazole, Thiazole, Pyrimidine. Fused ring systems: Indole and Carbazole	07	12	2,3,5	CO3	PSO1 PSO6			
5.	<u>Tautomerism and Reactivity:</u> Cationotropy and anionotropy, Mechanism of Prototropic transformation, Factors affecting acidity/basicity, Superacids, Superbases and their applications	05	10	1,2	CO4	PSO1 PSO6			
6.	<u>Stereochemistry:</u> Relative stability and reactivity of diastereoisomers, Conformational analysis, Applications of Dipole moment, IR, NMR and Raman spectra in conformational analysis	08	13	2,3,4	CO5	PSO1 PSO5			
7.	<u>Reactive Intermediates:</u> Structure, stability, Preparations and reactions involving (i) Free radicals (ii) Carbocations (iii) Non- classical	08	13	1,2	CO6	PSO1 PSO6			

	Carbocations (iv) Carbanions (v) Carbenes (vi) Nitrenes								
8.	<u>Retrosynthetic Analysis:</u> The disconnection approach, Logic and concepts, Synthons and Synthons equivalent, Control elements, <i>Umpolung</i> methods, Linear and convergent syntheses, Illustration of some synthetic approaches.	12	17	2,3,4,6	CO7	PSO1 PSO5 PSO6			
Reference Books:									
1.	Organic synthesis: The Disconnection Approach - Stuart Warren (2 nd edition, John Wiley & Sons) 2007.								
2.	Designing Organic Synthesis – A Programmed Introduction to the Synthon Approach: Stuart Warren (John Wiley & Sons) 1994.								
3.	Text book of organic chemistry Vol. I - I. L. Finar (6 th edition, Pearson Education, From Book Vistas, New Delhi, India) 2010 & Vol. II - I. L. Finar (6 th edition, Pearson, India) 2011.								
4.	Organic Reactions, Stereochemistry and Mechanism: P.S. Kalsi (4 th edition, New Age International Private Ltd) 2017.								
5.	Heterocyclic Chemistry: J. A. Joule & K. Mills, (4 th edition, Chapman & Hall) 1995.								
6.	Organic chemistry - R. T. Morrison and R. N. Boyd (7 th edition, Pearson) 2010.								
7.	Organic chemistry by Jerry March (6 th edition, John Wiley & Sons, Inc., Hoboken, New Jersey) 2007.								
8.	Reaction Mechanism in Organic chemistry - Peter Sykes (6 th edition, Pearson) 2003.								
9.	Organic Chemistry: Reactions and Reagents by O. P. Agrawal (3 rd edition, Goel Publishing House) 2023								
10.	Stereochemistry of Organic Compounds by E.L. Eliel (1 st Edition, Wiley) 2008								
11.	Organic Chemistry by T. W. G. Solomons, C. B. Fryhle and S. A. Snyder (Global Edition, Wiley) 2017								
12.	March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure by M. B. Smith (7 th Edition, Wiley Eastern Ltd) 2016								

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Chemistry		Academic Year		2024-25					
M.Sc. (Polymer Science): Regular Programme										
Year	I	Core / Elective / Foundation ACH2111: Advanced Physical Chemistry	Credits / Hours per week				04			
Semester	I	Year of Introduction: 2020 Year of Syllabus Revision: 2024	Maximum Marks / Grade				100 (70 UA + 30 IA)			
Mode of Transaction		Lectures and Tutorials								
Course Outcome (CO) ACH2111										
CO1 Understanding the limitation of Newtonian Mechanics and introduction to basic concepts of quantum and statistical thermodynamics.										
CO2 Learn about the rates of chemical reactions and the thermodynamic basis for orders of reactions.										
CO3 Similar to chemical reactions, learn about the trigger for photochemical reactions.										
CO4 Understand the colloidal state that is different from that of the liquids and solids.										
CO5 Understanding the solid state and the phase equilibria & the electrochemical basis for the ionic state.										
CO6 This section with lead to the understanding of the solid state at the ionic & the molecular level and how this effects the catalytic properties of solids.										
Unit No.	Topic/Unit		Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship	Relevance to Local (L)/ National (N)/ Regional	Relation to Gender (G), Environment and Sustaina

							(Ent)/ Skill Develop ment (SD)	(R)/Glob al (G) develop mental needs	bility (ES), Human Values (HV)and Professio nal Ethics (PE)
1.	<u>Statistical Thermodynamics:</u> Limitations of classical thermodynamics, Statistical thermodynamics. Maxwell-Boltzmann distribution, Molecular Partition functions and their significance, thermodynamic information from partition function, Sackur-Tetrode equation.	09	14	1, 2	CO1	PSO1	Emp	G	ES
2.	<u>Chemical Kinetics:</u> Thermodynamic formulation of transition state theory, consecutive reactions, chain reactions, branching chain reactions and parallel reaction, determination of activation energy.	08	14	2,3	CO2	PSO1 PSO2 PSO3			
3.	<u>Photochemistry:</u> Laws of photochemistry, quantum yield, Franck-Condon principle, Photo physical processes: Jablonski diagram and Charge transfer processes.	07	12	2,3,4	CO3	PSO1 PSO2			
4.	<u>Solution behaviours of surfactants & macromolecules:</u> Association colloids, Surfactants, micelle formation and cmc, surface films, Langmuir-Blodgett film, introduction to conformation and configuration of macromolecular chains, random coils, helices and sheets.	08	12	2,3,6	CO4	PSO2 PSO3			
5.	<u>Phase Equilibrium:</u> Three component systems and their graphical representation, ternary system consisting of liquids, two salts and water (a) having common ion and (b) salts forming double salt.	08	13	1,3,4	CO5	PSO2 PSO3 PSO6			
6.	<u>Electrochemical Processes:</u> Different electrochemical reactions, rapid electrochemical reactions, organic electrode processes, electro catalysis. Polarization: Its causes,	07	15	1,2,3	CO5	PSO2 PSO3 PSO5			

	decomposition voltage and concentration polarization, polarography, theory and applications, constant potential electrolysis, anodic stripping voltammetry, cyclic voltammetry.								
7.	<u>Solid State Chemistry:</u> Structural principles in solid state chemistry, bonding in solids-nature of packing in solids-types of sites/voids and their geometrical considerations – Types of water in crystals. (b) Defects in solids, defects in stoichiometric compounds – metal excess and metal deficient cases, detection of defects-consequences of defects-creation of F centers.	06	10	1,2,4,5	CO6	PSO1 PSO2 PSO4			
8.	<u>Surface Phenomenon:</u> Adsorption, Langmuir isotherms, Catalysis choice with respect to reaction velocity, selectivity and economics, Heterogenised homogenous catalysis – catalysis by supported metal ion and metal complexes – shape selective catalysis – phase transfer catalysis – Biocatalysts/Enzymes as catalysts – solid acid catalysts for automobile emission control.	07	10	2,3,5,6	CO6	PSO1 PSO2 PSO3			

Reference Books:

1.	Physical Chemistry - P. W. Atkins (6 th Edition, Oxford University Press) 1998.
2.	Chemical Kinetics - K. J. Laidler (3 rd edition, New york Harper & Row) 1987.
3.	Fundamentals of Photochemistry – K. K. Rohatgi, Mukherjee (Revised edition, New Delhi: Wiley Eastern Ltd.) 1992.
4.	Molecular Spectroscopy – C. N. Banwell and Elaine M. McCash (5 th edition, McGraw Hill Education (India) Pvt. Ltd.) 2003.
5.	Elements of Physical Chemistry – S. Glasstone (15 th edition, D. Van Nostrand Company Inc,) 2006.
6.	Principles of Physical Chemistry – B. R. Puri, L. R. Sharma, M. S. Pathania (6 th edition, ShobanLalNagin Chand & Sons) 1993.
7.	Modern Electrochemistry – Vol. I & II - J. O. M. Bockris & Technology series (2 nd edition, Springer-Verlag New York, LLC) 1999.
8.	Catalysis – J. C. Kuriacose (IIT, Madras, Science & Technology Series) (Macmillan Publishers India Pvt. Ltd.) 1980.
9.	Heterogeneous Catalysis – D. K. Chakravorty (5 th edition, Tata – McGraw Hill New Delhi) 2006.
10.	Principles and Practice of Heterogeneous catalysis – J. M. Thomas and W. J. Thomas (2 nd edition, Wiley VCH) 2010.

11.	Polorographic Electrochemistry – L. Meltes (2 nd edition, Wiley-Interscience, New York) 1965.
12.	Advanced Physical Chemistry by Gurdeep Raj (4 th Edition, Krishna Prakashan) 2016

									nal Ethics (PE)
1.	Introduction to polymers, classification of polymers, natural and synthetic polymers, monomers and polymers.	06	11	1,2	CO1	PSO1 PSO2	Emp	G	ES
2.	Chemistry of Polymerization, addition (chain) polymerization, condensation (Step) polymerization, polymerization of cyclic compounds.	07	12	1,2,3	CO2	PSO1			
3.	Polymerization Techniques and Synthesis: Bulk, Emulsion, Dispersion, Melt and Solution polymerization.	08	13	2,3	CO3	PSO2			
4.	Molecular weight (MW) determination and Size of Polymers: Number average (Mn), Weight average (Mw), Sedimentation average (Mz) and Viscosity average (Mv) molecular weights. Derivation of Mn and Mw. MW and degree of Polymerization, Polydispersity and Mw distribution curves. Chemical and geometrical Structure of Polymers, Glass transition temperature (GTT), factors effecting GTT, MW and melting point. Polymers and X-ray diffraction – degree of crystallinity in polymers, polymer crystallization, crystallisability, factors affecting crystallinity in polymers, spherulites, helix structure, effect of crystallinity on the properties of polymers.	08	13	2,3,4	CO4	PSO3			
5.	Kinetics of free radical polymerization, initiator efficiencies, autoacceleration, kinetic chain length, inhibition and retardation.	08	13	3,4,5	CO5	PSO2 PSO4			
6.	Kinetics of ionic polymerizations, cationic polymerization, anionic polymerization.	07	12	3,4,5	CO5	PSO2 PSO4			
7.	Condensation polymerization, chemical reactivity of homologous series of monomeric compounds, theory of reactivity of large molecules, kinetics of condensation polymerization.	08	13	2,3,5,6	CO6	PSO6			
8.	Copolymerization, the composition of addition copolymers, monomer reactivity ratios, determination of monomer reactivity ratios.	08	13	2,3,5,6	CO6	PSO4 PSO6			
Reference Books:									
1.	Polymer Science –V. R. Gowarikar, N. Vishwanathan & J. Sreedhar (New Age International (P) Ltd) 2001.								
2.	Text book of Polymer Science – F. W. Billmeyer, (Wiley Interscience) 1971.								
3.	Principles of Polymer Chemistry – P. J. Flory (Cornell University Press) 1953.								

4.	Physical Chemistry of Polymers – A. Tager (MIR Publishers) 1978.
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	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Chemistry		Academic Year	2024-25
	M.Sc. (Polymer Science): Regular Programme			
Year	I	Core / Elective / Foundation ACHXXX: Analytical Chemistry	Credits / Hours per week	04
Semester	I	Year of Introduction: 2020 Year of Syllabus Revision: 2024	Maximum Marks / Grade	100 (70 UA + 30 IA)
Mode of Transaction		Lectures and Tutorials		
Course Outcome (CO) ACHXXX CO1 Learn about the fundamentals of analyzing data and the errors that manifest during measurements. CO2 Understand the physical fundamentals of spectroscopy i.e. interaction of light with matter. CO3 Learn about the infrared and ultraviolet spectroscopic techniques and their interpretation. CO4 Understand the General fundamentals of thermal analysis. CO5 Understand basics of AAS/ESR/AES spectroscopic techniques. CO6 Learn about the mass spectroscopic technique to identify molecular fragments.				

Unit No.	Topic/Unit	Contact Hours	Weightage (%)	BT Level	CO	PSO	Element s of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G) development needs	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)
1.	<u>Fundamentals of Spectroscopy:</u> Principles-Electronic, Rotational and Vibrational Spectra, Selection rules, energy levels, molecular vibrations, rotational and vibrational Raman Spectra of diatomic molecules,	07	12	1,2,3	CO2	PSO1 PSO5	Emp	G	ES
2.	<u>UV-VIS and IR Spectroscopy:</u> UV-Visible spectroscopy - Laws of absorption, absorption by Organic and Inorganic Systems, Instrumentation and Applications. IR-modes of vibrations in polyatomic molecules, Instrumentation, Fourier Transform methods, Interpretation of spectra, Applications.	08	13	1,2,3	CO3	PSO1 PSO2			
3.	<u>Nuclear Magnetic Resonance Spectroscopy:</u> Theory, Principles, Instrumentation, Improving of NMR spectrum, Basic concept of ¹³ C NMR and MRI.	08	13	2,3,4	CO1	PSO1 PSO6			
4.	<u>Thermal Analysis:</u> Thermo gravimetric analysis (TGA, DTA), Differential Scanning Calorimetry – Principles, Instrumentation and Applications.	07	12	2,3,4	CO4	PSO1 PSO3			
5.	<u>Atomic Absorption and Emission Spectroscopy:</u> Atomic absorption Spectroscopy (AAS), Theoretical principles and instrumentation in Absorption flame photometry, Analytical	08	13	2,3,4	CO5	PSO1 PSO5			

	Applications. Flame Emission Spectroscopy – Principles, instrumentation and applications. ICP-AES (Inductively coupled plasma atomic emission spectroscopy)								
6.	<u>ESR and Mossbauer Spectroscopy:</u> Principles, Instrumentation and Analytical applications of both the techniques.	07	12	2,3,4,5	CO5	PSO1 PSO7			
7.	<u>Chromatography:</u> Introduction, Classification, Adsorption and Partition Chromatography, Ion Exchange Chromatography, TLC, GC, HPLC, Applications in qualitative and quantitative analysis.	07	12	2,3,4,5	CO6	PSO1 PSO7 PSO8			
8.	<u>Mass Spectroscopy:</u> Introduction, Fragmentation pattern of functionalized Organic molecules, McLafferty rearrangement, Ortho effect, Metastable ions, Application of Mass Spectrometry- Prediction of molecular formula.	08	13	2,3,4,6	CO6	PSO1 PSO7 PSO8			
Reference Books:									
1.	Instrumental Methods of Chemical Analysis by Willard Merrit & Dean (7 th edition, CBS Publisher) 2012.								
2.	Instrumental Methods of Chemical Analysis by Ewing (4 th edition, McGraw-Hill Companies) 1975.								
3.	Instrumental Methods of Chemical Analysis by B. K. Sharma (5 th edition, Goel Publishing House) 1981.								
4.	R.M. Silverstein; G. Clayton; T.C. Morrill, Spectrometric Identification of Organic Compounds (5 th edition, John Wiley & Sons, New York) 1991.								
5.	Analytical Chemistry by Gary D. Christian (6th edition, John Wiley & sons, Inc.) 2004.								
6.	Quantitative Analysis by R. A. Day, Jr., A. L. Underwood (6th edition, Prentice –Hall of India Private Limited, New Delhi) 2006.								
7.	Instrumental Methods of Analysis by B. Sivasankar (Oxford University Press) 2012.								
8.	Modern Analytical Chemistry by David Harvey (McGraw-Hill International edition) 2000.								
9.	Spectroscopy of Organic compounds by P. S. Kalsi (7 th Edition, New Age International) 2016								

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Chemistry		Academic Year				2024-25			
M.Sc. (Polymer Science): Regular Programme										
Year	I	Core / Elective / Foundation (ACH2110L): Advanced Organic Preparations -TW/Practical/Viva	Credits / Hours per week				04			
Semester	I	Year of Introduction: 2020 Year of Syllabus Revision: 2024	Maximum Marks / Grade				50			
Mode of Transaction		Term work, Practical & Viva								
Course Outcome (CO) ACH2110L CO1 To carry out various organic transformations on lab-scale and study their mechanistic implications. CO2 To understand synthesis of various precursors related to important organic compounds.										
Unit No.	Topic/Unit		Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G) developmental needs	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professionalism

									nal Ethics (PE)
1.	<u>Preparations:</u> Preparation of Methyl Orange from Sulphanilic Acid	06	10	3,5	CO1	PSO9	Emp	G	ES
2.	Preparation of p-Nitroaniline from Acetamide	06	10	2,4,5	CO1	PSO9			
3.	Preparation of m-Nitroaniline from m-Dinitrobenzene	06	10	2,4	CO1	PSO9			
4.	Preparation of 4-n-Butoxybenzoic acid from p-Hydroxybenzoic Acid	06	10	2,4	CO1	PSO9			
5.	Preparation of Nerolin from β -Naphthol	06	10	2,4	CO1	PSO9			
6.	Preparation of Dibenzalacetone from Benzaldehyde	06	10	2,4,5	CO2	PSO9			
7.	Preparation of Cinnamic acid from Malonic acid	06	10	2,4,5	CO2	PSO9			
8.	Preparation of Benzoic acid from Benzanilide.	06	10	2,3,4	CO2	PSO9			
9.	Preparation of Adduct of Anthracene and Maleic anhydride.	06	10	2,3,4,5	CO2	PSO9			
10.	Preparation of 2,5-Dihydroxyacetophenone from Hydroquinone. Any other new preparation of current interest	06	10	2,4,5	CO2	PSO9			
Reference Books:									
1.	Advanced Practical Organic Chemistry by Vishnoi N. K. (3 rd edition, Vikas Publishing House Pvt. Ltd.) 2009.								
2.	Vogel's Textbook of Practical Organic Chemistry-B.S. Furniss, A.J. Hannaford, P.W.J. Smith, A.R. Tatchell (5 th edition, Longman Scientific & Technical) 2005.								

	The Maharaja Sayajirao University of Baroda		Academic Year		2024-25						
Faculty Technology and Engineering											
Department of Applied Chemistry											
M.Sc. (Polymer Science): Regular Programme											
Year	I	Core / Elective / Foundation ACH2111L: Advanced Physical Chemistry-TW/Practical/Viva		Credits / Hours per week					04		
Semester	I	Year of Introduction: 2020 Year of Syllabus Revision: 2024		Maximum Marks / Grade					50		
Mode of Transaction		Term work, Practical & Viva									
Course Outcome (CO) ACH2111L											
CO1 To understand kinetic aspects of first and second order chemical reactions.											
CO2 To understand partitioning and precipitation process through physical experiments.											
CO3 To understand application of various physico-chemical methods for the determination of various reaction products											
CO4 To understand aggregation process of surface-active compounds.											
Unit No.	Topic/Unit			Contact Hours	Weightage (%)	BT Level	CO	PSO	Element s of Employa bility (Emp)/ Entrepre neurship (Ent)/ Skill	Relevan ce to Local (L)/ National (N)/ Regional (R)/Glob al (G)	Relation to Gender (G), Environ ment and Sustaina bility (ES),

							Develop ment (SD)	develop mental needs	Human Values (HV)and Professio nal Ethics (PE)
1.	Investigation of the hydrolysis of an ester in the presence of acid and calculation of energy of activation.	06	09	2,3	CO1	PSO7	Emp	G	ES
2.	Investigation of the reaction between potassium persulfate & potassium iodide and calculation of rate constant	06	09	2,3	CO1	PSO7			
3.	Determination of partition coefficient of I ₂ between H ₂ O and CCl ₄ .	06	09	2,4,5	CO2	PSO7			
4.	Mutual solubility curve of two immiscible liquids and the critical solution temperature of the phenol-water system and determination of the effect of electrolyte on the critical solution temperatures of Phenol water system.	06	09	2,4,5	CO2	PSO7			
5.	Determination of the solubility product constant (k _{sp}) of a sparingly soluble salt through the measurement of the conductance of its saturated solution.	05	09	2,4,5	CO3	PSO7			
6.	Finding the molecular weight of the given polymer by the viscosity method	05	09	2,3,4,5	CO3	PSO7			
7.	Finding the critical micelle concentration of a surfactant solution by conductivity method.	05	09	2,3,5	CO4	PSO7			
8.	Study of adsorption of organic acids using charcoal	05	09	2,3	CO2	PSO7			
9.	Determination of composition of acid mixtures by conductivity titration method.	05	09	2,3,5	CO3	PSO7			
Reference Books:									
1.	Vogel's Textbook of Quantitative Chemical Analysis -J. Mendham, R. C. Denney, J. D. Barnes and M. J. K. Thomas, (6th edition, Prentice Hall) 2000.								
2.	Advanced Physical Chemistry Experiments, A. Gurtu, J.N. Gurtu (Pragati Prakashan) 2014.								
3.	Experiments in Physical Chemistry, J. M. Wilson R. J. Newcombe A. R. Denaro (2 nd edition, Pergamon) 1968.								
4.	Advanced Practical Physical Chemistry by J. B. Yadav (4 th Edition, Goyal Publishing House, Meerut) 1981								

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Chemistry				Academic Year				2024-25			
M.Sc. (Polymer Science): Regular Programme												
Year	I	Core / Elective / Foundation (ACH2210): Fundamentals of Polymer Science-II				Credits / Hours per week				04		
Semester	II	Year of Introduction: 2020 Year of Syllabus Revision: 2024				Maximum Marks / Grade				100 (70 UA + 30 IA)		
Mode of Transaction		Lectures and Tutorials										
Course Outcome (CO) New Course												
CO1 Understanding the synthesis of polymers by different techniques.												
CO2 Learn about the chemical modification of polymers.												
CO3 Learn about the bulk scale polymerization of commodity plastics.												
CO4 Understand the concepts of molecular weights and molecular weight distributions.												
CO5 Understand basics polymer chains and their solution and rheological behavior.												
CO6 Understand the electrical and mechanical properties of polymers based on their structural features.												
Unit No.	Topic				Contact Hours	Weightage (%)	BT Level	CO	PSO	Element s of Employa bility (Emp)/ Entrepre neurship (Ent)/ Skill Develop ment (SD)	Relevan ce to Local (L)/ National (N)/ Regional (R)/Glob al (G)	Relation to Gender (G), Environ ment and Sustaina bility (ES), Human Values (HV)and Professio

									nal Ethics (PE)
1.	Synthesis of some polymers – isolation, purification and fractionation, vinyl polymerization, metathesis polymerization.	07	12	1,2	CO1	PSO1 PSO2	Emp	G	ES
2.	Polymer reactions, hydrolysis, acidolysis, aminolysis, polymer degradation, thermal degradation, mechanical degradation and photodegradation, role of anti-oxidants in the degradation process.	08	13	1,2	CO2	PSO2 PSO6			
3.	Homogeneous Ziegler-Natta polymerization, stereo regular polymers, polyethylene, polypropylene, polymerization of dienes, heterogeneous Ziegler-Natta polymerization.	08	13	1,2,3	CO3	PSO2 PSO6			
4.	Measurement of number average molecular weight and weight average, end group analysis, Osmometry, Sedimentation, Cryoscopy and light scattering.	08	13	2,3,4	CO4	PSO3			
5.	Polymer solutions, Thermodynamic treatment of dissolution process, Flory-Huggins theory of polymer solutions, size and shape of polymers in solution, viscosity of dilute polymer solutions, viscosity of concentrated polymer solutions.	08	13	2,5,6	CO5	PSO1 PSO6			
6.	Rheological properties of polymers in liquid state, dependence of viscosity on the shear rate and shear stress, temperature independent viscosity characteristics.	07	12	2,3	CO5	PSO3 PSO5			
7.	Electrical properties of polymers, dielectric strength and dielectric loss, effect of chemical constitution of polymers on dielectric loss.	07	12	2,3,6	CO6	PSO6			
8.	Mechanical properties of polymers, viscoelastic behavior of polymers, Maxwell & Kelvin Voigt elements, creep.	07	12	2,3,6	CO6	PSO3 PSO6			
Reference Books:									
1.	Polymer Science –V. R. Gowarikar, N. Vishwanathan & J. Sreedhar (New Age International (P) Ltd.) 2001.								
2.	Polymer Chemistry-An Introduction by Malcolm P. Stevens (3rd Ed., Oxford University Press) 1999.								
3.	Physical Chemistry of Polymers – A. Tager (MIR Publishers) 1978.								

 सत्यं शिवं सुन्दरम्	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Chemistry				Academic Year				2024-25			
M.Sc. (Polymer Science): Regular Programme												
Year	I	Core / Elective / Foundation (ACH2211): Polymer Blends & Composites			Credits / Hours per week				04			
Semester	II	Year of Introduction: 2020 Year of Syllabus Revision: 2024			Maximum Marks / Grade				100 (70 UA + 30 IA)			
Mode of Transaction		Lectures and Tutorials										
Course Outcome (CO) ACH2211												
CO1 This course will introduce the concepts of mixing or blending of two or more polymers to achieve higher properties.												
CO2 Understand the correlation between the flow properties and the mixing of polymer chains.												
CO3 Learn about the different types of blending to achieve superior properties.												
CO4 Understand the liquid crystalline state.												
CO5 Understand the theoretical basis of blending/mixing of polymers.												
CO6 Learn about the microstructure analysis of blend by different techniques.												
Unit No.	Topic				Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Develop	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human

							ment (SD)		Values (HV)and Professio nal Ethics (PE)
1.	Compatibilization and reactive blending, thermodynamic miscibility, PE/Ps blends, Nylon blends Polycarbonate blends.	06	11	1,2	CO1	PSO1 PSO4	Emp	G	ES
2.	Rheology of polymer blends miscibility and flow behavior of polymer blends, flow behavior of immiscible polymer blends.	07	12	1,2	CO2	PSO5			
3.	Toughened thermoplastics, blocks and graft copolymers in thermoplastic blends, toughened thermosets, toughening mechanisms. Interpenetrating polymer networks (IPN's).	08	13	2,3	CO3	PSO5			
4.	Blends containing liquid crystal polymers, effect of LCP's on processing of polymers, reinforcement using LCP's.	08	13	2,3,5	CO4	PSO5 PSO6			
5.	Processing of blends, mechanism of dispersion, construction and operating principles of compounders, single screw kneaders, twin-screw compounders.	07	12	2,3,5	CO5	PSO5 PSO6			
6.	Theoretical aspects of blends and alloys, rule of mixtures, Takayanagi model, Voigt and Reuss bounds.	08	13	1,2,3	CO5	PSO5 PSO6			
7.	Composites, fibre composites, fillers, compounding of polymers, masterbatches, colour components of masterbatches.	08	13	2,3,6	CO6	PSO5 PSO6			
8.	Blend microstructures, techniques for study of microstructure, light microscopy, SEM, TEM and thermal analysis.	08	13	2,3,4	CO6	PSO5 PSO6			
Reference Books									
1.	Polymer Blends and Alloys, Frisch & Klempner (Wiley) 1978.								
2.	Polymer Blends and Alloys, M. J. Folkes and P.S. Hope (Chapman & Hall) 1993.								
3.	Polymer Blends, D. R. Paul and S. Newman (Academic Press, N.Y) 1978.								

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Chemistry				Academic Year			2024-25				
M.Sc. (Polymer Science): Regular Programme												
Year	I	Core / Elective / Foundation (ACH2212): Characterization of Polymers			Credits / Hours per week			04				
Semester	II	Year of Introduction: 2020 Year of Syllabus Revision: 2024			Maximum Marks / Grade			100 (70 UA + 30 IA)				
Mode of Transaction		Lectures and Tutorials										
Course Outcome (CO) ACH2212												
CO1 Understand the molecular weight determination by wet methods.												
CO2 Learn about the other methods of molecular weight determination by viscosity method.												
CO3 Learn about the physical method of determining molecular weight.												
CO4 Learn about the colligative properties to determine molecular weights of polymers.												
CO5 Understand the characterization of molecular configuration of polymers by NMR.												
CO6 Understand the thermal behavior of polymers by different techniques.												
Unit No.	Topic				Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/	Relevance to Local (L)/ National (N)/ Regional (R)/Global	Relation to Gender (G), Environment and Sustainability

							Skill Develop ment (SD)	al (G)	(ES), Human Values (HV)and Professio nal Ethics (PE)
1.	Determination of molecular weight by end group analysis, relation between polymer chain length and end groups.	08	13	2,3,4	CO1	PSO1 PSO3	Emp	G	ES
2.	Molecular weight determination by viscosity, relation between viscosity average molecular weight and absolute molecular weights.	07	12	2,3,4	CO2	PSO3			
3.	Molecular weight determination by light scattering, Mie theory and light scattering by polymer chains, MALDI.	08	13	2,3,4	CO3	PSO3			
4.	Cryoscopy methods for determination of molecular weights.	06	11	2,3,4	CO4	PSO3			
5.	Structural characterization by NMR, determination of reactivity ratios.	07	12	1,2,3	CO5	PSO3 PSO6			
6.	Thermal analysis, TGA and DTA with specific examples.	08	13	1,2,3	CO6	PSO6 PSO7			
7.	Differential scanning calorimetry and dynamic mechanical analysis.	08	13	1,2,3	CO6	PSO6 PSO7			
8.	Chromatographic characterization, Gel permeation chromatography.	08	13	1,2,3,4	CO6	PSO3 PSO6			
Reference Books:									
1.	Polymer Blends and Alloys, Frisch & Klempner (Wiley) 1978.								
2.	Polymer Blends and Alloys, M. J. Folkes and P.S. Hope (Chapman & Hall) 1993.								
3.	Polymer Blends, D. R. Paul and S. Newman (Academic Press, N.Y) 1978.								



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M.Sc. (Polymer Science): Regular Programme

Year	I	Core / Elective / Foundation (ACH2213): Industrial and Speciality Polymers-I	Credits / Hours per week					04		
Semester	II	Year of Introduction: 2020 Year of Syllabus Revision: 2024	Maximum Marks / Grade					100 (70 UA + 30 IA)		
Mode of Transaction		Lectures and Tutorials								
Course Outcome (CO) ACH2213										
CO1 Understand the difference between manufacture of small volume & high-volume production of polymer products. CO2 Learn about the small volume polymers like LCPs. CO3 Learn about the small volume high strength polymer fibers. CO4 Understand the small volume highly conducting polymers. CO5 Learn about the raw materials for low volume high value polymers with unique properties. CO6 Learn about the raw materials analysis for low volume high value polymer precursors.										
Unit No.	Topic		Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship	Relevance to Local (L)/ National (N)/ Regional	Relation to Gender (G), Environment and Sustaina

							(Ent)/ Skill Develop ment (SD)	(R)/Glob al (G)	bility (ES), Human Values (HV)and Professio nal Ethics (PE)
1.	Introduction to industrial polymers, structure property correlation with mechanical and thermal properties.	07	12	1,2	CO1	PSO5 PSO6	Emp	G	ES
2.	Liquid crystalline polymers, synthesis and structure property correlations.	08	13	1,2,3	CO2	PSO5 PSO7			
3.	Optical and electro optical properties, solar cell applications of polymers.	07	12	2,3,4	CO2	PSO1 PSO7			
4.	High strength polymers, Kevlar fibers, carbon fibers.	07	12	2,3,4,5	CO3	PSO5			
5.	Inorganic and partially inorganic polymers, silicone based polymers, poly (sulphur nitride), polyphosphazenes, carborane polymers.	08	12	2,3,5,6	CO4	PSO5			
6.	Conducting polymers, polyacetylenes and polyanilines, poly(p-phenylene).	07	13	2,3	CO5	PSO5			
7.	Raw materials for industrial polymers, manufacturing techniques, Applications at cryogenic and high temperatures, case studies involving engineering and space applications.	08	13	1,2,3	CO6	PSO4 PSO5			
8.	Modern quality control techniques, processing effects on structure, property and performance, role of reinforcement fillers, coupling agents, plasticizers, anti-degradants, pigments etc.	08	13	2,3,4,6	CO6	PSO5 PSO7			
Reference Books:									
1.	High performance polymers, R. B. Seymour (Elsevier) 1986.								
2.	Polymer Blends, D. R. Paul and S. Newman (Academic Press, N.Y) 1978.								
3.	Introduction to Industrial polymers, H. Ulrich (Munchen Hanser Publications) 1982.								
4.	Liquid-crystal polymers, N. A. Plate (Plenum Press, N. Y) 1993.								
5.	Side chain liquid crystal polymers, C. B. McArdle (Springer Netherlands) 1989.								

6.	Liquid crystalline polymers, Athene Margaret Donald, A. H. Windle, Simon Hanna (Cambridge University Press) 2006.
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	Faculty Technology and Engineering									
	Department of Applied Chemistry									
M.Sc. (Polymer Science): Regular Programme										
Year	I	Core / Elective / Foundation ACHXXXX: Synthesis & Characterization of Polymers	Credits / Hours per week					06		
Semester	II	Year of Introduction: 2020 Year of Syllabus Revision: 2024	Maximum Marks / Grade					50		
Mode of Transaction		Term work, Practical & Viva								
Course Outcome (CO) ACHXXXX										
CO1 To learn about the preparation of various polymers involving addition/condensation reactions.										
CO2 To study about solution polymerization.										
CO3 To learn about various characterization techniques used to determine structure of the synthesized polymers.										
Unit No.	Topic/Unit		Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/	Relevance to Local (L)/ National	Relation to Gender (G), Environ

							Entrepreneurship (Ent)/ Skill Development (SD)	(N)/ Regional (R)/Global (G) developmental needs	ment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)
1.	Synthesis of PMMA and determination of molecular weight	17	18	2,3	CO1	PSO7	Emp	G	ES
2.	Synthesis of PS	17	18	2,3	CO1	PSO7			
3.	Synthesis of Polyester	17	18	2,3	CO1	PSO7			
4.	Solution polymerization	17	18	2,3	CO2	PSO7			
5.	Characterization of the synthesized polymers by (i) Viscosity (ii) End group analysis (iii) Cryoscopy	22	28	2,3,5	CO3	PSO7			
Reference Books:									
1.	Experimental Methods in Polymer Science, Toyochi Tanaka (Elsevier) 2000.								
2.	Experiments in Polymer Science, D. G. Hundiware, V. D. Athawale, U. R. Kapadi, V. V. Gite (New Age International Private Limited) 2008.								

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Chemistry	Academic Year	2024-25						
M.Sc. (Polymer Science): Regular Programme									
Year	II	Core / Elective / Foundation ACHXXX: Rubbers and Adhesives	Credits / Hours per week	04					
Semester	I	Year of Introduction: 2020 Year of Syllabus Revision: 2024	Maximum Marks / Grade	100 (70 UA + 30 IA)					
Mode of Transaction		Lectures and Tutorials							
Course Outcome (CO) ACHXXX									
CO1 Understanding the difference between rubbers & macromolecules.									
CO2 Learn about the chemical reactions on rubbers.									
CO3 Understanding between natural rubbers and synthetic rubbers.									
CO4 Understand the usefulness of tough rubbers which can be molded.									
CO5 Understand the fundamental of adhesives and the physical basis of adhesion phenomenon.									
CO6 Learn the different types of synthetic adhesives their manufacture and functionality.									
Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/	Relevance to Local (L)/ National (N)/ Regional (R)/Glob	Relation to Gender (G), Environment and Sustainability

							Skill Develop ment (SD)	al (G)	(ES), Human Values (HV)and Professio nal Ethics (PE)
1.	Natural and synthetic rubbers, chemistry of isoprene, butadiene.	08	12	1,2	CO1	PSO1 PSO6	Emp	G	ES
2.	Cross linking of rubbers, vulcanization process, different vulcanization agents.	09	13	1,2	CO2	PSO2 PSO5			
3.	Styrene-Butadiene rubber, its manufacture and applications, polybutadiene, EPDM.	09	13	1,2,3	CO3	PSO4 PSO6			
4.	Thermoplastic elastomers, polyurethanes.	08	12	2,3,4	CO4	PSO2 PSO5			
5.	Theory of adhesion and cohesion, surface characteristics for adhesion, wetting and spreading, surface preparation and application methods.	08	12	1,2,4	CO5	PSO1 PSO6			
6.	Acrylic acid and its polymerization and copolymerization, low molecular weight polymers for adhesive applications.	08	12	2,3,5	CO6	PSO4 PSO6			
7.	Cyano acrylates, synthesis and adhesive properties, silicone adhesives, sealants and coupling agents.	09	13	2,3	CO6	PSO1 PSO6			
8.	Epoxy based adhesives and their applications, hot melt adhesives.	09	13	2,3	CO6	PSO4 PSO5 PSO6			
Reference Books:									
1.	Polymer Science –V. R. Gowarikar, N. Vishwanathan & J. Sreedhar (New Age International (P) Ltd.) 2001.								
2.	Text book of Polymer Science – F. W. Billmeyer (Wiley Interscience) 1971.								
3.	Principles of Polymer Chemistry – P. J. Flory (Cornell University Press) 1953.								
4.	Physical Chemistry of Polymers – A. Tager (MIR Publishers) 1978.								



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M.Sc. (Polymer Science): Regular Programme

Year	II	Core / Elective / Foundation (ACH2314): Polymer Processing	Credits / Hours per week					04		
Semester	I	Year of Introduction: 2020 Year of Syllabus Revision: 2024	Maximum Marks / Grade					100 (70 UA + 30 IA)		
Mode of Transaction		Lectures and Tutorials								
Course Outcome (CO) ACH2314										
CO1 Learn about manufacture of polymeric material cellulose from natural sources like wood. CO2 Learn about the manufacture of rubber products including processing. CO3 Learn the fundamentals of processing of polymers including the flow behavior. CO4 Understand the different techniques of polymer processing based on the product profile. CO5 Understand basics of different models of flow and viscosity of melts. CO6 Understand the design of moulds and extruders.										
Unit No.			Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/	Relevance to Local (L)/ National	Relation to Gender (G), Environ

							Entrepreneurship (Ent)/ Skill Development (SD)	(N)/ Regional (R)/Global (G)	ment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)
1.	Various forms of polymers in practical applications, conversion of cellulose pulp to paper and board, regeneration of cellulose, rayon, different cellulose films.	07	12	1,2,3	CO1	PSO6	Emp	G	ES
2.	Rubber processing, synthetic polymers, molding thermoplastic and thermoset resin films, fibers, foams.	07	12	2,3	CO2	PSO5			
3.	Fluid mechanics of polymer processing, rheological behavior of melts, analysis of simple flows, extrusion-flows, extrusion flow analysis.	08	13	1,2	CO3	PSO6			
4.	Injection molding, RIM, blow molding, calendaring, crystallization, mixing analysis of fine spinning, film forming methods, experimental techniques for measuring rheological properties, viscosity of dilute and concentrated polymer solutions, normal stresses, die-swell ratio	08	13	1,2	CO4	PSO7			
5.	Molecular theories, hydrodynamic shielding, Debye-Bueche theory of Non Newtonian viscosity of polydisperse polymer systems, molecular entanglement theory, Williams's theory, Thermodynamic properties of polymer melts.	07	12	1,2	CO5	PSO1			
6.	Processing techniques: melt and dry blending, extrusion, dough and sheet molding, calendaring, die casting, rotational casting, film casting compression moulding, blow moulding etc.	08	13	1,2,3	CO5	PSO6			
7.	Designing extrusion dies like spider die and coat hanger type die with calculations of the pressure drop /flow profiles.	08	13	2,3,6	CO6	PSO6 PSO7			
8.	Screw extrusions design and scale up, cooling profile and injection pressure in injection molding dies, simulation of fiber spinning.	07	12	2,3,6	CO6	PSO1 PSO6			
Reference Books:									

1.	Polymer processing, J. M. Mc Kelvery (John Wiley & Sons) 1962.
2.	Rheology in Polymer Processing, C. D. Han (Academic Press) 1976.

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Chemistry	Academic Year	2024-25							
M.Sc. (Polymer Science): Regular Programme										
Year	II	Core / Elective / Foundation (ACH2315): Industrial and Speciality Polymers-II	Credits / Hours per week					04		
Semester	I	Year of Introduction: 2020 Year of Syllabus Revision: 2024	Maximum Marks / Grade					100 (70 UA + 30 IA)		
Mode of Transaction		Lectures and Tutorials								
Course Outcome (CO) ACH2315 CO1 Understanding the nature of water-soluble polymers. CO2 Learn about the polymers for medical applications. CO3 Learn about polymers used for water and wastewater treatment. CO4 Understand polymer composites with nano fillers. CO5 Understand basics of naturally occurring polymers used in industry. CO6 Understand the naturally occurring polymers like DNA & proteins.										
Unit No.	Topic		Contact Hours	Weightage (%)	BT Level	CO	PSO	Element s of Emplova	Relevan ce to Local	Relation to Gender

							bility (Emp)/ Entrepre neurship (Ent)/ Skill Develop ment (SD)	(L)/ National (N)/ Regional (R)/Glob al (G)	(G), Environ ment and Sustaina bility (ES), Human Values (HV)and Professio nal Ethics (PE)
1.	Water-soluble polymers, Chemistry of water-soluble polymers.	07	12	1,2	CO1	PSO1 PSO3	Emp	G	ES
2.	Polymers in Biomedical applications, polymers for drug delivery systems, acrylic hydrogels, poly alkyl sulphone.	07	12	1,2,3	CO2	PSO8			
3.	Polymers in separation science, asymmetric membranes, polysulphones, polyacrylonitrile.	08	13	2,3,4	CO3	PSO8			
4.	Polymer nanocomposites, fillers for advanced applications, carbon nanotubes as reinforcement for polymers.	08	13	2,3,4,6	CO4	PSO1 PSO8			
5.	Carbohydrate polymers, cellulose, regenerated cellulose, starch, derivatives of starch, polysaccharides.	07	12	2,3,4,6	CO5	PSO1 PSO5			
6.	Natural polymers, lignin, asphaltenes, shellac.	08	13	1,2	CO5	PSO1			
7.	Biopolymers-1-Proteins, polypeptides, protein structure, synthesis of polypeptides and proteins, folding of proteins and their function, wool, silk & collagen.	08	13	1,2,3	CO6	PSO5			
8.	Biopolymers-2: Nucleic acid structure, nucleic acid synthesis, their structure and biological property correlations.	07	12	1,2,3	CO6	PSO8			
Reference Books:									
1.	High performance polymers, R. B. Seymour (Elsevier) 1986.								
2.	Polymer Blends, D. R. Paul and S. Newman (Academic Press, N.Y) 1978.								
3.	Introduction to Industrial polymers, H. Ulrich (Munchen Hanser Publications) 1982.								

4.	Liquid-crystal polymers, N. A. Plate (Plenum Press, N. Y) 1993.
5.	Side chain liquid crystal polymers, C. B. McArdle (Springer Netherlands) 1989.
6.	Liquid crystalline polymers, Athene Margaret Donald, A. H. Windle, Simon Hanna (Cambridge University Press) 2006.
7.	Lehninger Principles of Biochemistry, David L Nelson, Michael Cox (7 th Edition, Macmillan Publications) 2017.

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	Faculty Technology and Engineering										
	Department of Applied Chemistry										
	M.Sc. (Polymer Science): Regular Programme										
Year	I	Core / Elective / Foundation (ACH2313L): Analytical Chemistry - TW/Practical/Viva			Credits / Hours per week					04	
Semester	II	Year of Introduction: 2020 Year of Syllabus Revision: 2024			Maximum Marks / Grade					50	
Mode of Transaction		Laboratory, Term work and Viva									
Course Outcome (CO) ACH2313L											
CO1 To understand non-aqueous titration.											
CO2 To learn about analysis of metal ions, vitamins, proteins and environmental samples.											
CO3 To learn about analysis of acid mixtures from strong and weak acids.											
Unit No.	Topic/Unit			Contact Hours	Weightage (%)	BT Level	CO	PSO	Element s of Employability	Relevance to Local (L)/	Relation to Gender (G),

							(Emp)/ Entrepre- neurship (Ent)/ Skill Develop- ment (SD)	National (N)/ Regional (R)/Glob- al (G) develop- mental needs	Environ- ment and Sustaina- bility (ES), Human Values (HV)and Professio- nal Ethics (PE)
1.	To determine the molecular weight of the given amine by non-aqueous titration.	06	10	2,4,5	CO1	PSO3 PSO9	Emp	G	ES
2.	To determine the molecular weight of the given organic acid by non-aqueous titration.	06	10	2,4,5	CO2	PSO3 PSO9			
3.	To determine the percentage purity of ascorbic acid.	06	10	2,3,4	CO2	PSO9			
4.	To determine the concentration of the ferric ions by spectroscopic technique.	06	10	2,3,4	CO2	PSO9			
5.	To determine the strength of HCl & CH ₃ COOH Solutions in mixture by using pH meter.	06	10	2,4,5	CO3	PSO9			
6.	To determine the dissolved oxygen present in a water sample.	06	10	2,5,6	CO2	PSO9			
7.	To determine COD in a given sample of water.	06	10	2,5,6	CO2	PSO9			
8.	To determine % of protein in a given sample of milk.	06	10	2,3,4	CO2	PSO9			
9.	To determine % of Vitamin C in a given tablet.	06	10	2,3,4,5	CO2	PSO9			
10.	To determination of milk adulteration by Conductivity Measurement. Any other experiment of current interest.	06	10	2,3,4	CO2	PSO9			
Reference Books:									
1.	Essential of Physical Chemistry by Puri, Sharma and Pathania (47 th edition, Vishal Publisher) 2017.								
2.	Vogel's Textbook of Quantitative Chemical Analysis -J. Mendham, R. C. Denney, J. D. Barnes and M. J. K. Thomas (6 th Edition, Prentice Hall) 2000.								

3.	Advanced Physical Chemistry Experiments, A. Gurtu, J.N. Gurtu (Pragati Prakashan) 2014.
4.	Experiments in Physical Chemistry, J. M. Wilson R. J. Newcombe A. R. Denaro (2 nd edition, Pergamon) 1968.

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	Faculty Technology and Engineering											
		Department of Applied Chemistry										
M.Sc. (Polymer Science): Regular Programme												
Year	II	Core / Elective / Foundation ACH2316L: Polymer Processing & Testing Laboratory- TW/Practical/Viva		Credits / Hours per week					06			
Semester	I	Year of Introduction: 2020 Year of Syllabus Revision: 2024		Maximum Marks / Grade					50			
Mode of Transaction		Term work, Practical & Viva										
Course Outcome (CO) ACH2316L												
CO1 To learn about working of Twin Screw Extruder/ rubber compounding.												
CO2 To study about physical measurement of strength of plastic, rubber, fiber.												
CO3 To learn about the identification of polymers through different chemical tests.												
CO3 To learn about the flow behavior of polymers in melt and solution.												
Unit	Topic/Unit			Contact	Weightage	BT	CO	PSO	Element	Relevan	Relation	

No.		Hours	(%)	Level			s of Employa bility (Emp)/ Entrepre neurship (Ent)/ Skill Develop ment (SD)	ce to Local (L)/ National (N)/ Regional (R)/Glob al (G) develop mental needs	to Gender (G), Environ ment and Sustaina bility (ES), Human Values (HV)and Professio nal Ethics (PE)
1.	Demonstration of working of single screw and double screw extruder.	15	16	1,2	CO1	PSO7	Emp	G	ES
2.	Demonstration of rubber compounding.	15	16	1,2	CO1	PSO7			
3.	Measurement of tensile test or plastic, rubber and fiber.	15	16	2,3	CO2	PSO7			
4.	Measurement of impact test.	15	16	2,3	CO2	PSO7			
5.	Identification of a polymer by various chemical tests.	15	16	2,3,5	CO3	PSO7			
6.	Measurement of viscosity by Brookfield viscometer and Fann viscometer.	15	20	2,3,4	CO4	PSO7			
Reference Books:									
1.	Extruding Plastics- A practical processing handbook, Dominick Rosato (Springer) 1998.								
2.	Polymer Testing- Wolfgang Grellmann, Sabine Seidler, Paul I. Anderson (2 nd Edition, Elsevier) 2014.								



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M.Sc. (Polymer Science): Regular Programme										
Year	II	Core / Elective / Foundation ACH2317: Seminar	Credits / Hours per week					2		
Semester	I	Year of Introduction: 2020 Year of Syllabus Revision: 2024	Maximum Marks / Grade					50		
Mode of Transaction		Seminar-Theory								
Course Outcome (CO) ACH2317										
CO1 To read and understand the published literature on polymers, selection of topic, preparation of report and its presentation.										
Unit No.	Topic/Unit		Contact Hours	Weightage (%)	BT Level	CO	PSO	Element s of Employa bility (Emp)/ Entrepre neurship (Ent)/ Skill Develop ment	Relevan ce to Local (L)/ National (N)/ Regional (R)/Glob al (G) develop mental	Relation to Gender (G), Environ ment and Sustaina bility (ES), Human Values (HV)and

							(SD)	needs	Professional Ethics (PE)
1.	Preparation, presentation and report of seminars based on advanced topics related to Polymer Science.	30	100	2,4,5,6	CO1	PSO9	Emp, SD	G	ES
Reference Books/ Journals/Information:									
1.	Various Scientific Journals/ Newsletters related to ACS, RSC, Elsevier, Wiley, Springer publishing groups etc.								

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M.Sc. (Polymer Science): Regular Programme										
Year	II	Core / Elective / Foundation ACH2409: Project	Credits / Hours per week					24		
Semester	II	Year of Introduction: 2020 Year of Syllabus Revision: 2024	Maximum Marks / Grade					200		
Mode of Transaction		Laboratory Experiments, discussion, presentation and viva								
Course Outcome (CO) ACH2409										
CO1 To understand and carry out independent literature survey, design and execution of experiment related to small polymer-based research problems, analysis/compilation/ interpretation of data together with making of a scientific dissertation report followed by presentation.										
Unit No.	Topic/Unit		Contact Hours	Weightage (%)	BT Level	CO	PSO	Element s of Employa bility (Emp)/ Entrepre neurship (Ent)/ Skill Develop ment (SD)	Relevan ce to Local (L)/ National (N)/ Regional (R)/Glob al (G) develop mental	Relation to Gender (G), Environ ment and Sustaina bility (ES), Human Values (HV)and

									needs	Professional Ethics (PE)
1	Literature survey, design, execution, analysis of results, presentation and report of small research problems based on advanced topics related to Polymer Science.	360	100	2,3,4,5,6	CO1	PSO9				
Reference Books/Journals:										
1.	Various Scientific Journals related to ACS, RSC, Elsevier, Wiley, Springer publishing groups etc.									