

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

Programme Name: MSc. (Applied Chemistry)

Programme Specific Outcome (PSO)

- PSO1** Learn basics of theoretical aspects of inorganic/ physical and organic chemistry/green chemistry/ chemical engineering and develop methodology/process to understand and solve various industrial problems.
- PSO2** Various aspects of industrial pollutions and control together with analysis of some important chemicals.
- PSO3** To understand the importance of various specialized materials viz. porous /nonporous catalysts, drugs, vitamins, fuels, oil/fat, superconductors, supramolecules together with the knowledge of IPR.
- PSO4** To learn about various aspects of manufacturing/processes of different organic/inorganic chemicals.
- PSO5** Advanced understanding and application of modern computational techniques used in industries at various levels including nondestructive evaluation and device fabrication.
- PSO6** Introduction to various aspects of Inorganic/Bio-inorganic/organic/polymer synthesis, characterization and data interpretation of different synthesized materials.
- PSO7** Research Training/exposure through literature survey/ definition of problems/ laboratory work/ collection and interpretation of data/ presentation/defence.
- PSO8** To understand various industrial aspects of management, production and economics.
- PSO9** To understand about various chemical engineering operations.
- PSO10** Learn about basic concepts of corrosion in metals and its control with the help of various protective agents/processes.

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 (Applied Chemistry)
(With effect from AY 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 (Applied Chemistry)</u>					
1	ACH2114	Advanced Inorganic Chemistry	4	100	
2	ACH2115	Advanced Organic Chemistry	4	100	
3	ACH2116	Advanced Physical Chemistry	4	100	
4	ACH2118	Analytical Chemistry	4	100	
5	CID2102	Industrial Economics and Functional Management	4	100	
6	ACH2117L	Advanced Inorganic Preparations	4	50	
7	ACH2106L	Advanced Organic Preparations (Practical)	4	50	
8	ACH2116L	Advanced Physical Chemistry (Practical)	4	50	
			32		650
<u>Second Semester of M.Sc.-I (Applied Chemistry)</u>					
9	ACH2216	Chemical Process Industries – I	4	100	
10	ACH2217	Chemical Process Industries – II	4	100	
11	ACH2215	Materials Science	4	100	
12	ACH2218	Drugs	4	100	
13	CHL2212	Chemical Engineering Operations and Calculations	4	100	

14	ACH2201L	Chemical and Instrumental Analysis and Quality Control- TW, Practical and Viva	4	50	
15	AMT2223	Computational Techniques in Chemistry	2	50	
16	AMT2223L	Computational Techniques in Chemistry- TW/Viva	2	50	
17	MEC2252L	Engineering Drawing – TW, Practical and Viva	2	50	
			30		700
<u>First Semester of M.Sc.-II (Applied Chemistry)</u>					
1	ACH2321	Petrochemicals	4	100	
2	ACH2322	Surfactants	4	100	
3	ACH2323	Heavy Chemicals	4	100	
4	ACH2330	Industrial Chemistry	4	100	
5	CHL2301	Chemical Engineering Kinetics and Process control	4	100	
6	ACH2332L	Advanced Organic Synthesis- TW/Practical	6	100	
7	ACH2311	Seminars and Industrial Visits	4	50	
			30		650
<u>Second Semester of M.Sc.-II (Applied Chemistry)</u>					
8	ACH2413	Agrochemicals and Fertilizers	4	100	
9	ACH2412	Dyes and Textile Auxiliaries	4	100	
10	ACH2414	Industrial Pollution	4	100	
11	ACH2418	Polymers, Plastics and Resins	4	100	
12	ACH2411	Instrumental Methods of Chemical Analysis	2	50	

13	ACH2419L	Dissertation Projects*	10	150	
		OR			
14	ACH2420L	Special Applied Chemistry Practicals-TW, Practical and Viva*	10	150	
			28		600
				Grand Total	2600

*SS of M.Sc. – II (Applied Chemistry): (1) Dissertation Projects (2) Special Applied Chemistry Practicals-TW, Practical and Viva. These papers will be offered on merit based of 1st year M.Sc. (Applied Chemistry) result. The First Ten (10) students securing highest aggregate marks in the merit of first year M.Sc.-I result will be offered subject: Dissertation Projects and rest of the students will be offered subject: Special Applied Chemistry Practicals-TW, Practical and Viva.

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Chemistry		Academic Year		2024-25						
M.Sc. (Applied Chemistry): Regular Programme											
Year	I	Core / Elective / Foundation ACH2114: Advanced Inorganic Chemistry		Credits / Hours per week				04			
Semester	I	Year of Introduction: 1974 Year of Syllabus Revision: 2024		Maximum Marks / Grade				100 (70 UA + 30 IA)			
Mode of Transaction		Lectures and Tutorials									
Course Outcome (CO) ACH2114											
CO1 Introduction to basic concepts of group theory to understand the structure of molecules/compounds with respect to their shapes or geometry.											
CO2 Learn about the metal-carbon bonds in metal olefinic complexes together with bonding in sandwich compounds.											
CO3 Learn about magnetic bodies with respect to magnetically dilute and/or concentrated systems in the light of theoretical approaches.											
CO4 To understand the formation, mechanism and geometry of transition metal complexes.											
CO5 To learn about the role of various metal ions in biologically important systems.											
CO6 To understand the various industrially important inorganic polymers.											
CO7 To learn about various corrosion processes, their sources and physical and chemical controlling methods.											
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>Symmetry and Group theory:</u> Symmetry elements and Symmetry operations, representation of Symmetry operations as matrices, definition of groups, Sets of Symmetry operations of molecules satisfying the conditions of a group, generators, classes of operations, Similarity transformation theorem, reducible and irreducible representations, derivation of character table- C_{2v} point group using Great Orthogonality Theorem.	10	16	1, 2	CO1	PSO1	Emp	G	ES
2.	<u>Organometallic Compounds (OMCs):</u> Classification based on the nature of Metal-Carbon bond; Carbenes, Carbynes and Carbide alkyl metal complexes; Bonding in π -metal olefin and π -metal acetylene complexes; Classification of ligands in OMCs based on (i) hapticity (ii) number of electrons contributed by the ligand for carbon – ligand bonding. 18-electron rule, Counting the effective number of electrons, basis for 18 electron rule, role of π – bonding ligand in stabilizing complexes, Explanation for exceptions of the 18- electron rule.	09	15	1,2,3	CO2	PSO1 PSO3			
3.	<u>Magnetochemistry of Transition Metal Complexes:</u> Basic terms used in magneto chemistry, Orbital magnetic moment, Spin magnetic moment, Types of magnetism - Measurement of magnetic susceptibility, Magnetic Behavior of Transition Metal Complexes – Valence Bond approach and Crystal Field approach	07	12	2	CO3	PSO1 PSO3			
4.	<u>Reaction Mechanisms in Coordination Compounds:</u> Substitution reactions in octahedral complexes, SN^1 and SN^2 mechanism – Types of intermediates formed, Lability and Inertness of Transition Metal complexes – Valence Bond and Crystal Field theories, Lability of Non – transition Metal complexes, Mechanism of Acid/ Base hydrolysis in octahedral complexes, Substitution reactions in square Planar Complexes- Trans effect, Oxidation – Reduction reactions - Outer and inner sphere mechanisms, Two electron transfer reactions.	07	12	2,3	CO4	PSO1 PSO6			

5.	<u>Bioinorganic Chemistry</u> : Importance of Biological systems – Iron in Haemoglobin and myoglobin, cooperative effect, Zinc as ideal bio-site and its role in carbonic anhydrase, Role of Alkali metals - Na ⁺ - K ⁺ pump. Biological functions and toxicity of some elements, Metal ions and ligands in therapy.	08	13	3,6	CO5	PSO1 PSO6			
6.	<u>Inorganic Polymers</u> : Synthesis, Structure, Properties and applications of P – N based polymers- Polyphosphazenes; S –N based polymers- Chain polymers and network polymers, and Silicone-based polymers	05	08	3,6	CO6	PSO1 PSO6			
7.	<u>Corrosion</u> : Introduction, Dry or chemical corrosion, wet or electrochemical Corrosion, mechanism, pilling bed worth rule. Types of corrosion-galvanic corrosion, concentration cell corrosion, Differential aeration corrosion, soil corrosion, Pitting corrosion, Intergranular corrosion, Microbial corrosion, Stress corrosion, Waterline corrosion, Erosion corrosion, Factors influencing corrosion.	07	12	2,3, 5	CO7	PSO1 PSO10			
8.	<u>Corrosion Control and Protective Coatings</u> : Corrosion Control: Proper designing, using pure metal, using metal alloys, cathodic protection, modifying the environment, use of Inhibitors. Protective coatings: Types, Paints, Pigments, drying oils, varnishes, enamels, lacquers.	07	12	2,3,5	CO7	PSO1 PSO10			

Reference Books:

1.	Chemical Applications of Group Theory - F. A. Cotton (3 rd edition, Wiley-Eastern, Wiley-Interscience Publication, New Delhi) 1986.
2.	Group Theory and its chemical Applications - P. K. Bhattacharya (2 nd edition, Himalaya Publishers) 2017.
3.	A Simple Approach to Group Theory in Chemistry-S. Swarnalakshmi, T. Saroja, R.M. Ezhilarasi (Universities Press (India) Pvt. Ltd.) 2008.
4.	Symmetry and Spectroscopy of Molecules- K. Veera Reddy (2 nd edition, New Age International Publishers) 2009.
5.	Organometallic Chemistry-A Unified Approach, R.C. Mehrotra, A. Singh (Revised 2 nd edition, New Age International Publishers) 2014.
6.	Elements of Magnetochemistry- R. L. Dutta and A. Syamal (2 nd edition, Affiliated East-West Press) 1993.
7.	Inorganic Chemistry of Biological processes – M.N. Hughes (John Wiley and sons, London) 1972.
8.	Bio-Inorganic Chemistry – E. Ochiai (Thomas Springfield Boston, Mass.: Allyn and Bacon, 1977.
9.	Inorganic Biochemistry - G. L. Eichorn Vol. I & II (Elsevier, London, Wiley-VCH) 2007.

10.	Bio-Inorganic Chemistry - R. W. Hay (Ellis Horwood Ltd, Publisher) 1984.
11.	A Textbook of Inorganic Polymers- G. R. Chatwal and A. K. Bhagi, Himalaya Publishing House, 2001.
12.	Inorganic Chemistry - Puri, Sharma and Kalia (33 rd edition, Milestone publishers& distributors) 2017.
13.	Inorganic Chemistry-Principles of Structure and Reactivity –J.E. Huheey, E.A. Keiter, R.L. Keiter, O.K. Medhi (4 th edition, Pearson) 2006.
14.	Fundamentals of Corrosion: Mechanisms, Causes, and Preventative Methods by Philip A. Schweitzer (1 st Edition, CRC Press Inc) 2009

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Chemistry		Academic Year					2024-25		
M.Sc. (Applied Chemistry): Regular Programme										
Year	I	Core / Elective / Foundation ACH2115: Advanced Organic Chemistry	Credits / Hours per week					04		
Semester	I	Year of Introduction: 1974 Year of Syllabus Revision: 2024	Maximum Marks / Grade					100 (70 UA + 30 IA)		
Mode of Transaction		Lectures and Tutorials								
Course Outcome (CO) ACH2115										
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 Carbocations (iv) Carbanions (v) Carbenes (vi) Nitrenes	08	13	1,2	CO6	PSO1 PSO6			

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 Synthons 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. (Applied Chemistry): Regular Programme										
Year	I	Core / Elective / Foundation ACH2116: Advanced Physical Chemistry	Credits / Hours per week				04			
Semester	I	Year of Introduction: 1974 Year of Syllabus Revision: 2024	Maximum Marks / Grade				100 (70 UA + 30 IA)			
Mode of Transaction		Lectures and Tutorials								
Course Outcome (CO) ACH2116 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	Element s of Employa bility (Emp)/ Entrepre neurship (Ent)/	Relevan ce to Local (L)/ National (N)/ Regional (R)/Glob	Relation to Gender (G), Environ ment and Sustaina bility

							Skill Develop ment (SD)	al (G) develop mental needs	(ES), Human Values (HV)and Professio nal Ethics (PE)
1.	<u>Statistical Thermodynamics:</u> Limitations of classical thermodynamics, Statistical thermodynamics. Maxwell-Boltzmanm 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, decomposition voltage and concentration polarization, polarography, theory and applications, constant potential electrolysis, anodic stripping voltammetry, cyclic voltammetry.	07	15	1,2,3	CO5	PSO2 PSO3 PSO5			

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

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Chemistry		Academic Year	2024-25						
M.Sc. (Applied Chemistry): Regular Programme										
Year	I	Core / Elective / Foundation ACH2118: Analytical Chemistry	Credits / Hours per week					04		
Semester	I	Year of Introduction: 1974 Year of Syllabus Revision: 2024	Maximum Marks / Grade					100 (70 UA + 30 IA)		
Mode of Transaction		Lectures and Tutorials								
Course Outcome (CO) ACH2118										
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 Employa bility (Emp)/ Entrepre neurship (Ent)/ Skill Develop	Relevan ce to Local (L)/ National (N)/ Regional (R)/Glob al (G)	Relation to Gender (G), Environ ment and Sustaina bility (ES), Human

							ment (SD)	develop mental needs	Values (HV)and Professio nal 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 Applications. Flame Emission Spectroscopy – Principles, instrumentation and applications. ICP-AES (Inductively coupled plasma atomic emission spectroscopy)	08	13	2,3,4	CO5	PSO1 PSO5			
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. (Applied Chemistry): Regular Programme										
Year	I	Core / Elective / Foundation CID2102: Industrial Economics and Functional Management	Credits / Hours per week				04			
Semester	I	Year of Introduction: 1974 Year of Syllabus Revision: 2024	Maximum Marks / Grade				100 (70 UA + 30 IA)			
Mode of Transaction		Lectures and Tutorials								
Course Outcome (CO) CID2102										
CO1 To understand basics of Management and role of communication.										
CO2 To understand plant layout and factors affecting it.										
CO3 To learn about personal function and various motivation theories related to recruitment process.										
CO4 To understand marketing and financial matters with respect to demand and supply.										
CO5 To study cost and revenue analysis related to production and microeconomics/macroeconomics.										
CO6 To understand Industrial Growth and Productivity of various industries.										
Unit No.	Topic/Unit		Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/	Relevance to Local (L)/ National (N)/ Regional(R)/	Relation to Gender (G), Environment and Sustainability (ES), Human

							Skill Develop ment (SD)	Global (G) develo pmenta l needs	Values (HV)and Professiona l Ethics (PE)
1.	<u>Functions of Management:</u> Management-Definition, Features of Management, Management Functions- Planning, Organizing, Directing, Staffing, Controlling, Managerial Skills-Technical, Human Conceptual, Managerial Roles-Interpersonal, Informational, Decisional, Communication – Meaning & Process of Communication, Types of Communication –Vertical (Upward & Downward) Lateral and Informal.	10	16	1, 2	CO1	PSO8	Emp	G	ES
2.	<u>Production Function:</u> Plant Location-Meaning and Factors affecting plant location, (Primary and Secondary Factors), Plant Layout-Meaning & Factors affecting plant layout, Types of Layout (Product, Functional, & Combined).	09	15	2,3,5	CO2	PSO8			
3.	<u>Personnel Function & Motivation:</u> Recruitment – Meaning and Definition, Sources of Recruitment in India, Selection – Meaning and Definition, Selection Process, Meaning and Theories of Motivation, Maslow’s Need Theory, Herzberg’s two factor theory.	07	12	3,4,5	CO3	PSO8			
4.	<u>Marketing & Financial Function:</u> Marketing – Meaning, Definition and Core Concepts, Philosophies of Marketing, Channels of Distribution – Definition and Types of Channels, Steps in Channel Design Decisions, Capital Structure – Concept & Definition, Sources of Finance	07	12	3,4,5,6	CO4	PSO8			
5.	<u>Demand and Supply:</u> Definition of economics, Law of Demand & Supply, Demand & Supply Determinants, Elasticity Market Equilibrium (Price Determination), Application of micro economics to Industrial problems.	08	13	2,3,5	CO4	PSO8			
6.	<u>Cost and Revenue Analysis:</u> Production and Cost Function, Cost Concepts, Short Run and Long Run Cost Analysis, Market Structure and Revenue Analysis, Break Even Analysis, Application of micro economics to Industrial problems.	05	08	3,4,6	CO5	PSO8			
7.	<u>Macro Economics:</u> Macro Economic Concepts, Circular flow of Income, National Income Accounting, Monetary and Fiscal Policy, Industrial Policies.	07	12	2,3,6	CO5	PSO8			

8.	<u>Industrial Growth and Productivity:</u> Classification of Industries, Project Appraisal, Cost-Benefit Analysis, Industrial productivity-concept, meaning and factors.	07	12	3,4, 6	CO6	PSO8			
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Reference Books:

1.	Principles of Engineering Economic Analysis – John A. White, Marvin H. Agee and Kenneth E Case Chapter 3 to 7.
2.	Managerial Economics – Eugene F Bringham and James L Papas, The Dryden Press, Hinsdale, Illinois, Chapter 4,8,10,11,13 and Appropriate Sections.
3.	Cost Engineering Analysis – William R. Park, John Wiley and Sons, Chapter 2 to 8,10,11.
4.	Managerial and Engineering Economy – George A. Taylor, East West Indian Edition, Chapters 2 to 9,12,18.
5.	Economic Theory and Operations Analysis – W J Baumol, Prentice Hall of India, Chapters 18,19.
6.	Economics – Paul A Samuelson.
7.	Introduction to managerial Economics – Christopher I Savage and John R Small, Chapters 4,6,8,9.
8.	Elements of Cost Benefit Analysis – E J Mishan.
9.	Principles & Practices of Management – L.M. Prasad.
10.	Fundamentals of Business Organization & Mgt. – Y.K. Bhushan.
11.	Management – James A.F. Stoner, R. Edward Freeman.
12.	Essentials of Management – Harold Koontz, Heinz Weihrion.
13.	Marketing Management – Philip Kotler.
14.	Production and Operations Management – Chunawala & Patel.

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Chemistry		Academic Year					2024-25		
M.Sc. (Applied Chemistry): Regular Programme										
Year	I	Core / Elective / Foundation ACH2117L: Advanced Inorganic Preparations	Credits / Hours per week					04		
Semester	I	Year of Introduction: 1974 Year of Syllabus Revision: 2024	Maximum Marks / Grade					50		
Mode of Transaction		Term work, Practical and Viva								
Course Outcome (CO) ACH2117L										
CO1 To understand the theoretical and practical aspects of the synthesis of double salts.										
CO2 To understand the theoretical and practical aspects of the synthesis of metal complexes/chelate compounds.										
CO3 To understand the theoretical and practical aspects of the synthesis of Inorganic materials/compounds.										
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 Professio

								needs	nal Ethics (PE)
1.	Preparation of the following compounds /Double salts • Chrome Alum $K_2SO_4 \cdot Cr_2(SO_4)_3 \cdot 24H_2O$ • Ferrous ammonium sulphate $FeSO_4(NH_4)_2SO_4 \cdot 6H_2O$ complex salt	06	10	2,3,4	CO1	PSO1 PSO7	Emp	G	ES
2.	Trisethylenediamine Ni(II)sulphate $Ni[(NH_2CH_2CH_2NH_2)_3]SO_4$	06	10	2,3,4	CO1	PSO1 PSO7			
3.	Tetraammine Cu(II)sulphate $[Cu(NH_3)_4]SO_4$	06	10	2,3,4	CO2	PSO1 PSO7			
4.	Sodium trioxalatoferratetrihydrate $Na_3[Fe(C_2O_4)_3] \cdot 3H_2O$	06	10	2.3.4	CO2	PSO1 PSO7			
5.	Potassium diaquobisoxalatocuprate(II)	06	10	2,3,4	CO2	PSO1 PSO7			
6.	Hexaamminenickel(II)chloride $[Ni(NH_3)_6]Cl_2$	06	10	2,3,4	CO2	PSO1 PSO7			
7.	Hexaamminecobalt(III)chloride $[Co(NH_3)_6]Cl_2$	06	10	2,3,4	CO2	PSO1 PSO7			
8.	Binuclear Cu(II) Salen complex	06	10	2,3,4	CO2	PSO1 PSO7			
9.	Lead Chromate $PbCrO_4$	06	10	2,3,4,5	CO3	PSO1 PSO7			
Reference Books:									
1.	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.								
2.	Advanced Inorganic Analysis- S. K. Agarwal and Keemtilal (11 th Edition, Pragati Prakashan) 2011.								
3.	Laboratory Manual of Inorganic Preparations- H.T. Vulte, 2007.								

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Chemistry		Academic Year				2024-25			
M.Sc. (Applied Chemistry): Regular Programme										
Year	I	Core / Elective / Foundation ACH2106L: Advanced Organic Preparations	Credits / Hours per week				04			
Semester	I	Year of Introduction: 1974 Year of Syllabus Revision: 2024	Maximum Marks / Grade				50			
Mode of Transaction		Term work, Practical & Viva								
Course Outcome (CO) ACH2106L										
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	Element s of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G) develop mental needs	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics

									(PE)
1.	<u>Preparations:</u> Preparation of Methyl Orange from Sulphanilic Acid	06	10	3,5	CO1	PSO7	Emp	G	ES
2.	Preparation of p-Nitroaniline from Acetamide	06	10	2,4,5	CO1	PSO7			
3.	Preparation of m-Nitroaniline from m-Dinitrobenzene	06	10	2,4	CO1	PSO7			
4.	Preparation of 4-n-Butoxybenzoic acid from p-Hydroxybenzoic Acid	06	10	2,4	CO1	PSO7			
5.	Preparation of Nerolin from β -Naphthol	06	10	2,4	CO1	PSO7			
6.	Preparation of Dibenzalacetone from Benzaldehyde	06	10	2,4,5	CO2	PSO7			
7.	Preparation of Cinnamic acid from Malonic acid	06	10	2,4,5	CO2	PSO7			
8.	Preparation of Benzoic acid from Benzanilide.	06	10	2,3,4	CO2	PSO7			
9.	Preparation of Adduct of Anthracene and Maleic anhydride.	06	10	2,3,4,5	CO2	PSO7			
10.	Preparation of 2,5-Dihydroxyacetophenone from Hydroquinone. Any other new preparation of current interest	06	10	2,4,5	CO2	PSO7			
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.								

								needs	Professional 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. (Applied Chemistry): Regular Programme										
Year	I	Core / Elective / Foundation ACH2216: Chemical Process Industries-I	Credits / Hours per week				04			
Semester	II	Year of Introduction: 1974 Year of Syllabus Revision: 2024	Maximum Marks / Grade				100 (70 UA + 30 IA)			
Mode of Transaction		Lectures and Tutorials								
Course Outcome (CO) ACH2216 CO1 Introduction to basic concepts of chemical processing and various synthesis routes of Inorganic Materials. CO2 To learn about the various types of paints and pigments together with the constituents of paints and formulation for various purposes. CO3 To learn about various ceramic, Refractories, abrasives, pottery, porcelain and enamel materials in the light of their manufacturing processes and uses. CO4 To learn about basic concepts of glass making oxides- role of network formers, modifiers and intermediate oxides, manufacturing process of glass. CO5 To learn about synthesis and applications of various carbon allotropes together with importance of graphite, amorphous carbon electrode, and carbon fibers. CO6 To learn about synthesis of various cementing materials and role of additives with respect to their quality improvement. CO7 To learn about water conditioning for industry, physical methods of sterilization, desalination, demineralization and electro dialysis. CO8 To understand about various nuclear reactions, nuclear fuels and nuclear reactors and processing of nuclear materials.										
Unit No.	Topic/Unit		Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneursh	Relevance to Local (L)/ National (N)/ Regional(R)/Global	Relation to Gender (G), Environment and Sustainability (ES),

							ip (Ent)/ Skill Develo pment (SD)	(G) developme ntal needs	Human Values (HV)and Professio nal Ethics (PE)
1.	<u>Chemical Processing and Routes to Synthesis of Inorganic Materials:</u> Chemical Processing – general concepts; Soft chemistry routes - Sol-gel method of synthesis, intercalation, ion exchange method. Deposition of thin films-CVD technique, Liquid phase epitaxy, vapour phase epitaxy, molecular beam epitaxy, Spray pyrolysis. High purity crystal growth. Microwave assisted synthesis.	10	16	2,3	CO1	PSO4	Emp	G	ES
2.	<u>Paints and Inorganic Pigments:</u> Pigments - Manufacture of white, black and basic colour Inorganic Pigments, characteristics. Constituents of paints, formulation of paints for various purposes, manufacture of paints, Special paints, Emulsion paints.	08	14	2,3,4	CO2	PSO4			
3.	<u>Ceramics:</u> Manufacture and uses of following classes of ceramic materials - Refractories, Abrasives, Enamels.	08	13	2,3,4,6	CO3	PSO3 PSO4			
4.	<u>Glass Manufacture:</u> Basic concepts in glass making - role of network formers, network modifiers and intermediate glass making oxides. Manufacture of ordinary glass – melting, Shaping, Annealing; Varieties of glass, Special glasses.	08	13	2,3,6	CO4	PSO1 PSO4			
5.	<u>Industrial Carbon:</u> Manufacture of various carbon modifications - Lamp black, carbon black, Activated carbon by chemical activation and gas activation process. Reactivation, regeneration of activated carbon, Applications. Manufacture of graphite – and amorphous carbon electrodes, carbon fibers.	08	13	2,3,5,6	CO5	PSO1 PSO3 PSO5			
6.	<u>Advanced Cementitious Materials:</u> Manufacture of Portland cement-Setting and hardening of cement, Special cements, Colored cements, Blended cements- additives (plasticizers, organic additives) for quality improvements.	06	09	2,3,4	CO6	PSO3 PSO4			
7.	<u>Water Conditioning for Industry:</u> Sterilization and disinfection of water chemical and physical methods of sterilization, desalination, Demineralization, Electrodialysis.	06	10	2,3,4,5,6	CO7	PSO4			

8.	<u>Nuclear Industries:</u> Nuclear reactions, Nuclear Fuels, Nuclear reactors, Processing nuclear materials, Isotopes and Isotope separation	06	12	1,2,3	CO8	PSO2 PSO6			
Reference Books:									
1.	Industrial Chemistry – B. K. Sharma (Goel Publishing House, Merrut) 2014.								
2.	Dryden’s outlines of Chemical Technology – Gopala Rao and Sitting (3 rd edition, East-West Press) 2010.								
3.	Shreeve’s Chemical Process Industries – George T. Austin (5 th edition, Mcgraw Hill Int.) 2017.								
4.	Speciality Inorganic Chemicals Ed. - W. E. Thomson (Royal Society of Chemistry) 1996.								
5.	Reigel’s Industrial Chemistry – James. A, Kent (9 th edition, CBS Publishers) 1997.								
6.	Engineering Chemistry-Fundamentals and Applications-Shikha Agarwal (Cambridge University Press) 2015.								
7.	Chemical Approaches to Synthesis of Inorganic Materials – C N R Rao (1 st edition, Wiley Eastern) 1995.								

							Develo pment (SD)	ntal needs	Professio nal Ethics (PE)
1.	<u>Petroleum Refining Operations:</u> Theories of origin of petroleum, Petroleum refining using bubble tower, chemical purification of refined fractions, Knocking, Octane and Cetane number.	08	12	1,3,4,6	CO5	PSO2 PSO4 PSO6			
2.	<u>Petroleum Reforming Operations:</u> Methods to increase octane number of Gasoline, Pyrolysis and cracking – fixed bed and moving bed catalytic cracking, Vis breaking, reforming and isomerization.	08	12	1,3,4,6	CO5	PSO2 PSO4 PSO6			
3.	<u>Fermentation:</u> Factors for successful fermentation process, Terminology of various penicillins, Therapeutic uses, chemistry of penicillin, chemical changes during fermentation, commercial production of penicillin – surface culture and submerged culture fermentations. Recovery of penicillin, Disposal of wastes.	07	15	1,2,3	CO2	PSO4 PSO6			
4.	<u>Cellulose Industries:</u> Introduction – structure, chemical and physical properties, Derivatives of cellulose, Manufacturing of Acetate Rayon, Cupra Rayon, Viscose Rayon, Lyocell.	08	12	2,3,4	CO4	PSO4 PSO6			
5.	<u>Synthetic Fibers:</u> Classification, Manufacturing and uses of Nylons (6 and 66), Terylene, Dynel and Orlon fibers.	08	12	2,3,4,6	CO3	PSO3 PSO4			
6.	<u>Rubber Industries:</u> Production of Natural and synthetic rubbers, Carbon black in rubber, Vulcanization chemicals and processing, Tire productions	07	15	1, 2,3	CO1	PSO4 PSO6			
7.	<u>Explosives:</u> Characteristics, synthesis, physical, chemical biological effects and uses. Explosives –Dynamite, TNT, TNP, EDNA, RDX, PETN etc.	07	11	2,3,4	CO6	PSO2 PSO5 PSO6			
8.	<u>Military Gases:</u> Characteristics, synthesis, physical, chemical and biological effects and uses Military gases – Nitrogen mustard, phosgene, organo-phosphoric compounds and Hexachloro ethane.	07	11	2,3,4	CO6	PSO2 PSO5 PSO6			
Reference Books:									

1.	Cellulose Chemistry and its applications eds. - T. P. Nevell and S. H. Zeramian (Ellis Horwood Ltd, Publisher) 1985.
2.	Recent Advances in the Chemistry of Cellulose and Starch ed. J. Honeyman (1 st edition, Interscience Publisher, New York, Heywood) 1959.
3.	A Textbook of Synthetic Drugs – O. D. Tyagi and M. Yadav (Anmol Publications) 2002.
4.	Synthetic Organic Chemistry – G. R. Chatwal (4 th edition, Himalaya Publishing House) 2017.
5.	Dryden's Outlines of Chemical Technology – M. Gopalarao, Marshal Sitting (3 rd edition, Affiliated East-West Press Pvt Ltd.) 2010.
6.	Industrial Fermentation-C. A. Undercoffler and Richard D. J. Hickeryvol I & II. (Chemical Publishing Company) 1954.
7.	Biochemical and Biological Engineering Science- N. Blakeboough, Vol. I (1 st edition, Academic press) 1967.
8.	Chemistry and Technology of Explosives – T. Urbanski Vol. I-IV (4 th edition, Pergamon Press) 1984.
9.	Text book of Polymer Science – F. W. Billmeyer (Wiley Interscience) 1971.
10.	Rubber Processing by J. L. White (Carl Hanser Verlag) 1995.

	The Maharaja Sayajirao University of Baroda		Academic Year		2024-25					
	Faculty Technology and Engineering									
		Department of Applied Chemistry								
M.Sc. (Applied Chemistry): Regular Programme										
Year	I	Core / Elective / Foundation ACH2215: Materials Science	Credits / Hours per week		04					
Semester	II	Year of Introduction: 1974 Year of Syllabus Revision: 2024	Maximum Marks / Grade		100 (70 UA + 30 IA)					
Mode of Transaction		Lectures and Tutorials								
Course Outcome (CO) ACH2215										
CO1 Introduction to basic concepts of strength of materials.										
CO2 Learn the basics of nanomaterials and their behavior at nanodimensions and their characterization.										
CO3 Learn about the fundamentals of membranes and membrane-based separations.										
CO4 To understand the formation, mechanism and molecular structure of liquid crystalline materials.										
CO5 Learn about the lubricants.										
CO6 To understand the chemistry of some important macrocyclic compounds and their applications.										
Unit No.	Topic/Unit		Contact Hours	Weightage (%)	BT Level	CO	PSO	Element s of Employa bility (Emp)/ Entrepre neurship (Ent)/ Skill Develop	Relevan ce to Local (L)/ National (N)/ Regional (R)/Glob al (G) develop	Relation to Gender (G), Environ ment and Sustaina bility (ES), Human

							ment (SD)	mental needs	Values (HV)and Professio nal Ethics (PE)
1.	<u>Strength of Materials:</u> Elastic, anelastic and viscoelastic behavior, stress-strain curves, spring-dashpot models, fracture in solids, ductile fracture and brittle fracture, methods of protection against fracture	08	16	1, 2,3	CO1	PSO1 PSO3	Emp	G	ES
2.	<u>Science of Nanomaterials:</u> Chemical methods of synthesis of nanomaterials, Metal / Metal oxide nanoparticles, Self-assembly and supramolecular based materials	07	15	2,3,4	CO2	PSO1 PSO3 PSO6			
3.	<u>Synthesis, Properties and Applications of materials:</u> Superconducting materials - concepts, types, high Tc superconductor, Fast ion conductors (NAFION and NASICONs), Insulating materials- concept, dielectric properties, insulating materials, thermal insulators	07	12	2,3,4	CO2	PSO1 PSO3 PSO6			
4.	<u>Membrane Materials and Membrane Technology:</u> Types of materials for membrane applications, polymeric membranes, asymmetric membranes, surface modifications for membrane applications, concepts of reverse osmosis, ultrafiltration and electrodialysis	08	12	2,3,5,6	CO3	PSO3 PSO5			
5.	<u>Liquid Crystalline Materials:</u> Thermotropic & Lyotropic liquid crystals, Structure - Property relationship, Smectic, nematic and cholesteric liquid crystals, globular and discotic liquid crystals, liquid crystalline polymers. Applications of liquid crystals in chemistry, electronics, medicine and non-destructive testing.	08	13	2,3,5,6	CO4	PSO1 PSO6			
6.	<u>Industrial Zeolites and its Applications:</u> MELS (Molecularly Engineered Layered Structures) – pillared layered compounds, Clay materials, Clathrasils, Zeosils, porosils, micro- and meso-porous compounds – Hetero and iso-poly acids.	06	08	1,2,3	CO5	PSO3 PSO6			
7.	<u>Carbon-based Materials:</u> Methods of preparations and Applications of Fullerenes, Carbon nanotubes, Graphene, Graphitic carbon nitride, Nano / Quantum dots	09	12	2,3,6	CO6	PSO1 PSO3 PSO6			
8.	<u>Macrocyclic Materials:</u> Chemistry, Methods of preparations and Applications of Crown	07	12	2,3,6	CO6	PSO1 PSO3			

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Chemistry	Academic Year	2024-25							
M.Sc. (Applied Chemistry): Regular Programme										
Year	I	Core / Elective / Foundation ACH2218: Drugs	Credits / Hours per week					04		
Semester	II	Year of Introduction: 1974 Year of Syllabus Revision: 2024	Maximum Marks / Grade					100 (70 UA + 30 IA)		
Mode of Transaction		Lectures and Tutorials								
Course Outcome (CO) ACH2218 CO1 To learn about replication, translation and growth inhibition of antiviral Agents and methods. CO2 To learn about the structure, synthesis and activity of anti-hypersensitive agents. CO3 To learn about the structure, synthesis and activity of anti-diabetic agents. CO4 To understand the importance of antibiotics, their classification, sources and activity. CO5 To learn about the structures and synthesis and activity of different types of anti-malarial agents. CO6 To understand the role of anti-histamines in allergic conditions and study some important anti-histaminic agents. CO7 To learn about synthesis, structure and activity of some important anti-pyretics, anti-inflammatory and analgesic agents. CO8 To learn about the sources and activity of some important narcotic and non-narcotic agents.										
Unit No.	Topic/Unit		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

[illegible]

1.	Medicinal Chemistry and Drug Discovery Vol. I - III by Burger Alfred, edited by Manfred. E. Wolff, (5 th edition, John Wiley & Sons Inc.) 1995.
2.	Medicinal Chemistry by Gareth Thomas, (2 nd edition, John Wiley & Sons Inc, NY, Toronto) 2008.
3.	Medicinal Chemistry by D. Sriram and P. Yogeeswari (2 nd Edition, Pearson) 2010.

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Chemistry			Academic Year				2024-25			
M.Sc. (Applied Chemistry): Regular Programme											
Year	I	Core / Elective / Foundation CHL2212: Chemical Engineering Operations and Calculations			Credits / Hours per week				04		
Semester	II	Year of Introduction: 1974 Year of Syllabus Revision: 2024			Maximum Marks / Grade				100 (70 UA + 30 IA)		
Mode of Transaction		Lectures and Tutorials									
Course Outcome (CO) CHL2212											
CO1 To understand Fluid flow/ Heat /Mass Transfer operations.											
CO2 To learn about mechanical operations in industry with special reference of size reduction.											
CO3 To learn about unit processes/operations together with basic calculations.											
CO4 To study material and energy balances in typical chemical industries.											
Unit No.	Topic/Unit			Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G) development	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and

							(SD)	needs	Professional Ethics (PE)
1.	<u>Fluid flow operations:</u> Classification of fluids, Laminar & turbulent flow, Basic equations of flow. Flow measurement, flow control (valves), Transportation of fluids.	08	13	2,3,5	CO1	PSO1 PSO4 PSO9	Emp	G	ES
2.	<u>Heat Transfer Operations:</u> Modes of heat transfer, flux equation, classification and selection of heat transfer equipments.	08	13	2,3,4	CO1	PSO1 PSO4 PSO9			
3.	<u>Mass Transfer Operation:</u> Introduction to mass transfer, vapour-liquid contacting equipments their constructional features and operation.	08	13	2,3,4	CO1	PSO1 PSO4 PSO9			
4.	<u>Mechanical Operations:</u> Size reduction of solids, industrial size reduction equipments, mixing of liquids, types of impellers etc. Filtration – basic concepts, filter types, setting & sedimentation, industrial equipments.	08	13	3,4,5	CO2	PSO1 PSO4 PSO9			
5.	<u>Introduction to process calculations:</u> Unit Operations, Unit Processes, Steady state and unsteady state processes, Units and Conversion.	07	13	2,4,5,6	CO3	PSO1 PSO4 PSO9			
6.	<u>Basic Calculations:</u> State properties: Molecular weight, compositions, density, vapor pressure etc. for gas, liquid and solid systems. Thermal properties: Heat capacity, sensible heat, latent heat, heat of reaction, heat of solution, enthalpy calculations etc. for gas, liquid and solid systems.	08	13	2,3,4,5	CO3	PSO1 PSO4 PSO9			
7.	<u>Material and Energy Balances:</u> Material balance equations based on conservation principle. Material balances for non- reactive processes (Unit Operations). Energy balances for closed and open systems based on energy conservation principle. Energy balances for non-reactive processes (Unit Operations).	08	11	1,2,3,5	CO4	PSO1 PSO4 PSO9			
8.	Material balances on processes with recycle, purge, and bypass.	05	11	1,2,3,5	CO4	PSO1 PSO4 PSO9			

Reference Books:

1.	D. M. Himmelblau and J. B. Riggs: Basic Principles and Calculations in Chemical Engineering, 8 th Ed, Prentice Hall.
2.	Thakore and Bhatt: Stoichiometry, 4 th Ed, Tata McGraw- Hill.
3.	W. L. McCabe, J.C. Smith, P. Harriot, 'Unit Operations of Chemical Engineering' 7 th Ed, McGraw Hill, 2006.

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Chemistry			Academic Year				2024-25			
M.Sc. (Applied Chemistry): Regular Programme											
Year	I	Core / Elective / Foundation ACH2201L: Chemical and Instrumental Analysis and Quality Control-TW, Practical and Viva			Credits / Hours per week				04		
Semester	II	Year of Introduction: 1974 Year of Syllabus Revision: 2024			Maximum Marks / Grade				50		
Mode of Transaction		Laboratory, Term work and Viva									
Course Outcome (CO) ACH2201L											
CO1 To understand non-aqueous titrations.											
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	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G) development	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and

							(SD)	needs	Professional Ethics (PE)
1.	To determine the molecular weight of the given amine by non-aqueous titration.	06	10	2,4,5	CO1	PSO2 PSO7	Emp	G	ES
2.	To determine the molecular weight of the given organic acid by non-aqueous titration.	06	10	2,4,5	CO2	PSO2 PSO7			
3.	To determine the percentage purity of ascorbic acid.	06	10	2,3,4	CO2	PSO2 PSO3 PSO7			
4.	To determine the concentration of the ferric ions by spectroscopic technique.	06	10	2,3,4	CO2	PSO2 PSO7			
5.	To determine the strength of HCl & CH ₃ COOH Solutions in mixture by using pH meter.	06	10	2,4,5	CO3	PSO2 PSO7			
6.	To determine the dissolved oxygen present in a water sample.	06	10	2,5,6	CO2	PSO2 PSO7			
7.	To determine COD in a given sample of water.	06	10	2,5,6	CO2	PSO2 PSO7			
8.	To determine % of protein in a given sample of milk.	06	10	2,3,4	CO2	PSO2 PSO7			
9.	To determine % of Vitamin C in a given tablet.	06	10	2,3,4,5	CO2	PSO1 PSO2 PSO6			
10.	To determination of milk adulteration by Conductivity Measurement. Any other experiment of current interest.	06	10	2,3,4	CO2	PSO2 PSO7			

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.

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Mathematics	Academic Year	2024-25							
<u>M.Sc.-I(Applied Chemistry) : Regular Programme</u>										
Year	I	Core / Elective / Foundation AMT 2223: Computational Techniques in Chemistry	Credits / Hours per week					02		
Semester	II	Year of Introduction: 1974 Year of Syllabus Revision: 2024	Maximum Marks / Grade					50 (35 UA + 15 IA)		
Mode of Transaction		Lectures								
Course Outcome (CO) AMT 2223 CO1 Understand the concepts of Calculus and its applications. CO2 Evaluate different techniques of solving Ordinary differential equations. CO3 Develop skills in analyzing the methods of interpolating a given data, learn properties of interpolating polynomials and derive conclusions CO4 Learn numerical integration methods and methods for solving ODE numerically.										
Unit No.	Topic		Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill	Relevance to Local (L)/ National (N)/ Regional (R)/Glob	Relation to Gender (G), Environment and Sustainability (ES),

							Develop ment (SD)	al (G)	Human Values (HV)and Professio nal Ethics (PE)
1	Calculus: Functions of one variable, limit, continuity and differentiability of function of one variable, higher order derivatives, applications of derivatives, indefinite and definite integrals and its applications.	06	25	1,2,3,5	CO1	PSO1, PSO7	EMP, SD	G	ES, HV, PE
2	Differential equations: Differential equations of first order and first degree: separable variable method and linear differential equations, applications of differential equations.	06	25	1,2,3,5	CO2				
3	Interpolation: Finite differences: Forward and backward differences, numerical differentiation using Newton's forward and backward interpolation	06	25	1,2,3,4,5	CO3				
4	Numerical integration and methods to solve ODE: Numerical integration using Trapezoidal and Simpson's rules, numerical methods to solve differential equations: Euler's and Runge-Kutta methods.	06	25	1,2,3,5	CO4				
Reference Books									
1.	B. S. Grewal – Elementry Engineering Mathematics, Khanna publishers.								

2.	Thomas George and Ross Finney – Calculus and Analytical Geometry, Addison-Wesley Publishing Company.
3.	Erwin Kreyszing – Advanced Engineering Mathematics, (6th edition) John Wiley & Sons.
4.	S. S. Sastry – Introductory Methods of Numerical Analysis, 2nd Edition, PHI
5.	Rudra Pratap: Getting started with MATLAB, Oxford University Press (India edition).

	The Maharaja Sayajirao University of Baroda			Academic Year		2024-25		
Faculty Technology and Engineering								
Department of Applied Mathematics								
<u>M.Sc.-I(Applied Chemistry) : Regular Programme</u>								
Year	I	Core / Elective / Foundation			Credits / Hours per week		02	
		AMT2223L: Computational Techniques in Chemistry-TW/Viva						
Semester	II	Year of Introduction: 1975 Year of Syllabus Revision: 2024			Maximum Marks / Grade		50	
Mode of Transaction		Term Work, Practical and Viva						
Course Outcomes (CO) AMT2223L								
CO1 Understand and be able to apply Mathematical software towards the problem solving.								
CO2 Understanding and visualization of graphs.								
CO3 Able to understand different programming statements.								
CO4 Apply programming skills to different numerical techniques for solving interpolation, integration and ODE.								
No.	Programs				Course	BT	CO	PSO

			Code	Level		
1	Introduction of Mathematical Software		AMT 2223L	1,2,3	CO1	PSO1, PSO7
2	Implementing inbuilt commands and functions related to vectors			1,2,3	CO1	
3	Implementing inbuilt commands and functions related to matrices			1,2,3	CO1	
4	Plotting of 2D graphs			1,2,3	CO2	
5	Plotting of 3D graphs			1,2,3	CO2	
6	Programs related to Conditional statements			1,2,3	CO3	
7	Programs related to Looping statements			1,2,3	CO3	
8	Programs related to numerical interpolation using different schemes.			1,2,3,5	CO3	
9	Programs related to numerical integration using different schemes.			1,2,3,5	CO4	
10	Programs related to solving ODE numerically using different schemes.			1,2,3,5	CO4	
11	Inbuilt Symbolic Toolbox.			1,2,3,5	CO1	
12	Inbuilt ODE solvers			1,2,3,5	CO4	

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Chemistry		Academic Year			2024-25				
M.Sc. (Applied Chemistry): Regular Programme											
Year	I	Core / Elective / Foundation MEC2252L: Engineering Drawing – TW, Practical and Viva		Credits / Hours per week			02				
Semester	II	Year of Introduction: 1974 Year of Syllabus Revision: 2024		Maximum Marks / Grade			50				
Mode of Transaction		Laboratory, Term work and Viva									
Course Outcome (CO) MEC2252L											
CO1 To learn use of drawing instruments and understand the basic drawing conventions.											
CO2 Construct and application of types of lines and dimensioning methods.											
CO3 Apply the knowledge of orthographic projection in engineering practices.											
CO4 To understand pipe fitting and construct pipe layouts.											
CO5 Use knowledge of flow process symbols in flow process layouts.											
Unit No.	Topic/Unit			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) develop	Relation to Gender (G), Environment and Sustainability (ES), Human

							ment (SD)	mental needs	Values (HV)and Professio nal Ethics (PE)
1.	<u>Basics of Engineering Drawing</u> - Types of lines, significance of types of line, dimensioning methods, types of dimensioning methods, introduction of engineering drawing instruments and their uses and practice. Geometrical constructions	08	26	1, 2	CO1	PSO1	Emp	G	ES
2.	<u>Orthographic projection</u> - significance of orthographic drawing in chemical industries and plants, introduction of projection, Methods of projections and planes of projection, practice of orthographic projections of equipment used in chemical plants (Heat exchanger, cyclone separator, boilers, Furnace etc)	08	26	2,3	CO2	PSO1			
3.	<u>Pipe Fittings and Pipe layouts</u> - Basic terms used in pipe fittings, types of joints and couplers used in pipe fittings and their symbols, pipe fitting layouts in plants and their symbolic representation.	07	24	2,5,6	CO3	PSO1 PSO7			
4.	<u>Flow Process Layouts</u> - Symbols of chemical plant equipment, flow process chart and their symbolic representation in plant layout. Graphical understanding of flow process.	07	24	2,5,6	CO3	PSO1 PSO7			
Reference Books									
1.	Chemical Engineering Drawing Symbols, D. G. Austin, 1979.								
2.	Engineering Drawing by N. D. Bhatt, V. M. Panchal, Pramod R. Ingle, Charotar Publishing House, 2012.								
3.	Machine Drawing by K. Venkata Reddy, K. L. Narayana, P. Kannaiah, Radiant Publishing House, 2012.								

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

Programme Name: **MSc. (Applied Chemistry)**

Programme Specific Outcome (PSO)

- PSO1** Learn basics of theoretical aspects of inorganic/ physical and organic chemistry/green chemistry/ chemical engineering and develop methodology/process to understand and solve various industrial problems.
- PSO2** Various aspects of industrial pollutions and control together with analysis of some important chemicals.
- PSO3** To understand the importance of various specialized materials viz. porous /nonporous catalysts, drugs, vitamins, fuels, oil/fat, superconductors, supramolecules together with the knowledge of IPR.
- PSO4** To learn about various aspects of manufacturing/processes of different organic/inorganic chemicals.
- PSO5** Advanced understanding and application of modern computational techniques used in industries at various levels including nondestructive evaluation and device fabrication.
- PSO6** Introduction to various aspects of Inorganic/Bio-inorganic/organic/polymer/ catalysts/ nanomaterials synthesis, characterization and data interpretation of different synthesized materials and to learn about chromatographic techniques
- PSO7** Research Training/exposure through literature survey/ definition of problems/ laboratory work/ collection and interpretation of data/ presentation/defence.
- PSO8** To understand various industrial aspects of management, production and economics.
- PSO9** To understand about various chemical engineering operations.
- PSO10** Learn about basic concepts of corrosion in metals and its control with the help of various protective agents/processes.

Department of Applied Chemistry
Faculty of Technology and Engineering,
The Maharaja Sayajirao University of Baroda
Vadodara-390001

**Teaching and Examination Scheme of FS and SS M Sc-II
(Applied Chemistry)
(With effect from AY 2025-26 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.-II (Applied Chemistry)</u>					
1	ACH2321	Petrochemicals	4	100	
2	ACH2322	Surfactants	4	100	
3	ACH2323	Heavy Chemicals	4	100	
4	ACH2330	Industrial Chemistry	4	100	
5	CHL2301	Chemical Engineering Kinetics and Process control	4	100	
6	ACH2332L	Advanced Organic Synthesis- TW/Practical	6	100	
7	ACH2311	Seminars and Industrial Visits	4	50	
			30		650
<u>Second Semester of M.Sc.-II (Applied Chemistry)</u>					
8	ACH2413	Agrochemicals and Fertilizers	4	100	
9	ACH2412	Dyes and Textile Auxiliaries	4	100	

10	ACH2414	Industrial Pollution	4	100	
11	ACH2418	Polymers, Plastics and Resins	4	100	
12	ACH2411	Instrumental Methods of Chemical Analysis	2	50	
13	ACH2419L	Dissertation Projects*	10	150	
		OR			
14	ACH2420L	Special Applied Chemistry Practicals-TW, Practical and Viva*	10	150	
			28		600
				Grand Total	2600

*SS of M.Sc. – II (Applied Chemistry): (1) Dissertation Projects (2) Special Applied Chemistry Practicals-TW, Practical and Viva. These papers will be offered on merit based of 1st year M.Sc. (Applied Chemistry) result. The First Ten (10) students securing highest aggregate marks in the merit of first year M.Sc.-I result will be offered subject: Dissertation Projects and rest of the students will be offered subject: Special Applied Chemistry Practicals-TW, Practical and Viva.

							Skill Develop ment (SD)	al (G) develop mental needs	(ES), Human Values (HV)and Professio nal Ethics (PE)
1.	<u>Principles Involved in the Production of Petrochemicals:</u> Petrochemicals obtained from synthesis gas and natural gas (mainly methane) Methanol, Chloromethanes.	10	15	1, 2	CO1	PSO1 PSO3	Emp	G	ES
2.	<u>Petrochemicals obtained from Synthesis Gas and Natural Gas:</u> Formaldehyde and Perchloroethylene	08	14	2,3	CO1	PSO3			
3.	<u>Products obtained from Acetylene / ethylene dichloride:</u> Production of Acetylene, Vinyl chloride and Acetaldehyde	08	14	2,3	CO2	PSO3			
4.	<u>Products obtained from Ethylene:</u> Ethylene oxide, Ethanol amines, Ethylene dichloride.	08	13	2,3	CO2	PSO3			
5.	<u>Products obtained from Propylene/Propane:</u> Acrylonitrile, Chemicals by Oxo process.	07	12	2,3	CO3	PSO3			
6.	<u>Products obtained from Propylene/Propane:</u> Isopropyl benzene (Cumene), Isopropanol, Isoprene, Acetone.	07	12	2,3	CO3	PSO3			
7.	<u>Products obtained from Butane:</u> Butadiene.	05	08	2,3	CO3	PSO3			
8.	<u>Aromatic Products:</u> Phenol by Cumene process and Raschig process.	07	12	2,3,4	CO4	PSO3			
Reference Books:									
1.	Chemistry and Technology of Basic Organic and Petrochemical Synthesis, Vol. 1 and 2, N. N. Lebedev (Mir Publishers) 1984.								
2.	Dryden's Outlines of Chemical Technology – Gopal Rao and Sittig (3 rd edition, East-West Press) 2010.								
3.	Petrochemicals Industry – Market and Economics; A. B. Hahn. (McGraw hill Publishers) 1992.								
4.	Handbook of Petrochemicals and Processes; Margaret Wells (Gower Pub Co) 1991.								
5.	Industrial Chemistry - Harish kumar (Sarup and Sons Publishers, New Delhi) 2004.								

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Chemistry		Academic Year		2025-26					
M.Sc. (Applied Chemistry): Regular Programme										
Year	II	Core / Elective / Foundation ACH2322: Surfactants	Credits / Hours per week				04			
Semester	I	Year of Introduction: 1974 Year of Syllabus Revision: 2025	Maximum Marks / Grade				100 (70 UA + 30 IA)			
Mode of Transaction		Lectures and Tutorials								
Course Outcome (CO) ACH2322										
CO1 Understand the basic concepts of surfactants.										
CO2 Learn about the anionic surfactants.										
CO3 Learn about cationic surfactants.										
CO4 Learn about nonionic and other types of surfactants.										
CO5 Understand the physical forces that exist between different surfaces.										
CO6 Understand the manifestation of the surfactant behaviour in foaming etc.										
CO7 Learn about the different industrial applications of surfactants.										
Unit No.	Topic/Unit		Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill	Relevance to Local (L)/ National (N)/ Regional (R)/ Glob	Relation to Gender (G), Environment and Sustainability (ES),

							Develop ment (SD)	al (G) develop mental needs	Human Values (HV)and Professio nal Ethics (PE)
1.	<u>Fundamentals of Surfactants</u> Introduction, Classification of surfactants, Problems of Surfactants Industries, Raw materials for surfactant synthesis	07	12	1, 2	CO1	PSO1	Emp	G	ES
2.	<u>Ionic Surfactants:</u> Anionic surfactants - Synthesis and manufacturing processes- Carboxylic acids, Sulphuric acid esters, Alkane sulphonates, petroleum sulphonates, Anionic phosphate surfactants Cationic Surfactants - Synthesis and manufacturing process, Non- quaternary nitrogen bases, Quaternary nitrogen bases – other bases.	07	12	2,3	CO2	PSO4			
3.	<u>Nonionic surfactants:</u> General Review, Hydrophilic intermediates, Polyethylenoxy surfactants, Polyhydroxy surfactants,	07	12	2,3	CO3	PSO4			
4.	<u>Amphotheric and Novel Surfactants:</u> Ampholytic surfactants. New surfactant types: Organosilicon compound, Highly Fluorinated compounds, Polymeric surfactants, Gemini surfactants: synthesis and properties.	07	12	2,3	CO4	PSO4			
5.	<u>Surfactants at interfaces:</u> Adsorption at solid-liquid interfaces, mechanism of adsorption and aggregation, adsorption at liquid-air and liquid-liquid interfaces, Gibbs Adsorption equations, surface concentration and area per molecule	08	13	2,3,4	CO5	PSO4 PSO5			
6.	<u>Bulk Properties of Surfactants:</u> Reduction of surface tension by surfactants, wetting and its modification Foaming and antifoaming, contact angle, spreading	08	13	2,3,5	CO6	PSO5 PSO6			
7.	<u>Emulsification and Detergency:</u> Factors determining stability, inversion, Theories of emulsions, microemulsions, Dispersion and Detergency, Cleaning of surfaces by surfactants, removal of soil from substrate, Special Physical forms of surfactants	08	13	2,3	CO7	PSO5			
8.	<u>Applications of Surfactants:</u> Biosurfactants, Surfactants in Pharmaceuticals and agricultural applications, Surfactants in nanotechnology, Surfactants in Cosmetics	08	13	2,3,6	CO7	PSO3 PSO6			

	and chemical industries								
Reference Books:									
1.	Surface Active Agents and Detergents, vol. 1 and 2 Anthony M. Schwartz and James W. Perry. (Interscience Publishers) 1958.								
2.	Surfactants and Interfacial Phenomena – M. J. Rosen and Joy T. kunjappu (4 th edition, John Wiley & Sons Inc.) 2012.								
3.	Solvent Properties of Surfactant Solutions – K. Shinoda (Marcel Dekker Inc.) 1967.								
4.	Surfactants by K. Holmberg, (Wiley) 2019								
5.	Surfactants and Polymers in Aqueous Solution by K. Holmberg, B. Jonsson, B. Kronberg, B. Lindman (John Wiley & Sons) 2003.								
6.	Industrial Applications of Surfactants by D. R. Karsa (Woodhead Publishing) 1999								

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Chemistry		Academic Year		2025-26					
M.Sc. (Applied Chemistry): Regular Programme										
Year	II	Core / Elective / Foundation ACH2323: Heavy Chemicals	Credits / Hours per week				04			
Semester	I	Year of Introduction: 1974 Year of Syllabus Revision: 2025	Maximum Marks / Grade				100 (70 UA + 30 IA)			
Mode of Transaction		Lectures and Tutorials								
Course Outcome (CO) ACH2323 CO1 Learn about the production process of sulphuric acid and related chemicals. CO2 Learn about various methods involved in production of nitric acid and ammonia along with process related parameters. CO3 Learn about various methods involved in production of caustic soda and related chemicals. CO4 To understand the role of catalysts in industries and study their methods of preparation. CO5 To learn about manufacturing processes of phthalic anhydride and acetic acid industry. CO6 To learn production methods of caprolactam via a series of steps on industrial scale. CO7 To learn about manufacturing process of some important analgesics.										
Unit No.	Topic/Unit		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) develop mental needs	(ES), Human Values (HV)and Professio nal Ethics (PE)
1.	<u>Sulphuric acid Industries:</u> Methods of Production (Contact process): - Physicochemical principles involved, catalysts used, major engineering problems, economics.	08	14	1, 2	CO1	PSO4	Emp	G	ES
2.	<u>Nitrogen Industries:</u> Ammonia – methods of production (Haber’s process): Physicochemical principles involved, catalysts used, major engineering problems, economics. Nitric acid: methods of production (Arc process, Birkland and Eyde’s process), Physicochemical principles involved, catalysts used, major engineering problems, economics.	08	14	1,2,3	CO2	PSO4			
3.	<u>Chloroalkali Industries:</u> Caustic soda, Soda ash and Chlorine-methods of production, physico chemical principles involved, engineering problems and economics.	07	13	1, 2	CO3	PSO4			
4.	<u>Manufacture of Catalysts:</u> Preparative methods, Metals as catalysts, supported metal as catalyst; Synthesis of support materials; Oxides, mixed oxides, monolithic supports. Forms of catalysts and extrusion processes.	06	11	2,3	CO4	PSO3			
5.	<u>Phthalic Anhydride Industry:</u> Manufacture and Uses.	05	09	1,2,3	CO5	PSO4			
6.	<u>Caprolactam:</u> (a) Raw materials, Manufacturing based on cyclohexane (i) Hydrogenation of benzene (ii) Oxidation of cyclohexane (iii) Dehydrogenation of Ketone alcohol (KA-oil) mixture (iv) Oximation of cyclohexanone and Beckmann rearrangement. (v) Synthesis of various oximating agents. (b) Direct photo-oximation of cyclohexane	10	18	1,2,3	CO6	PSO4			
7.	<u>Acetic Acid Industry:</u> Manufacture from acetaldehyde by oxidation, Manufacture from methanol by carbonylation and their applications	07	13	1,2,3	CO5	PSO4			

8.	Manufacture of Analgesics and Anti-pyretic Drugs.	05	09	1,2,3	CO7	PSO4			
Reference Books:									
1.	Outlines of Chemical Technology – C. E. Dryden, Ed. By GopalaRao and Sittig (3 rd edition, East-West Press) 2010.								
2.	Shreeve's Chemical Process Industries – George T. Austin (5 th edition, McGraw Hill Int.) 2017.								
3.	Riegel's Handbook of Industrial Chemistry edited by James A. Kent (10 th edition, Springer US) 2003.								
4.	Catalyst Manufacture – A. B. Stiles and Theodore (2 nd edition, Marcel Dekker N. Y.) 1995.								
5.	Industrial Chemistry – B. K. Sharma (Krishan Prakashan Media (P) Ltd.) 2011.								

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Chemistry		Academic Year		2025-26						
M.Sc. (Applied Chemistry): Regular Programme											
Year	II	Core / Elective / Foundation ACH2330: Industrial Chemistry		Credits / Hours per week				04			
Semester	I	Year of Introduction: 1974 Year of Syllabus Revision: 2025		Maximum Marks / Grade				100 (70 UA + 30 IA)			
Mode of Transaction		Lectures and Tutorials									
Course Outcome (CO) ACH2330 CO1 Introduction to Fuels and their types with respect to their calorific values. CO2 To understand manufacturing of various industrially important polymers. CO3 To learn about role of various types of vitamins, occurrence and sources and diseases caused by their deficiencies. CO4 To understand the fats, oils and waxes, their sources and manufacturing. CO5 To understand various superconducting/ insulating materials their applications in electronic industry. CO6 To learn about various catalytically important porous materials and their role in diverse chemical industries. CO7 To understand intellectual property rights and their role in protecting owner’s rights.											
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.	<u>Fuels:</u> Introduction; Calorific value and its determination; Characteristics of a good fuel; Classification; Advantages and disadvantages of solid, liquid and gaseous fuels; Coal: Definition, selection, Analysis – proximate and ultimate; Gaseous fuels: Producer Gas, Water Gas; carbureted water gas; biogas.	07	12	1, 2	CO1	PSO3	Emp	G	ES
2.	<u>Lubricants:</u> Characteristics, Functions, Classification of lubricants: solid, semi-solid and liquid lubricants and their properties. Different types of Lubricants: Synthesis and Applications, bio lubricants.	08	13	1,2,3	CO2	PSO1 PSO6			
3.	<u>Vitamins:</u> Classification and nomenclature; Vitamin activities; metabolic, physiological or biological functions of vitamins; Vitamin A, Vitamin B complex; Vitamin C: occurrence and sources, isolation, absorption, storage and excretion, diseases caused by deficiency, requirements and structure.	08	13	2,3	CO3	PSO1 PSO3			
4.	<u>Fats, Oils and Waxes:</u> Distinction between fats and oils; Properties; Classification; Manufacture of cotton seed and soya bean oil. Waxes – classification of waxes, some common waxes.	08	13	2,3	CO4	PSO1 PSO3			
5.	<u>Biopolymers:</u> Proteins, polypeptides, protein structure, synthesis of polypeptides and proteins, folding of proteins and their function, Nucleic acid structure, nucleic acid synthesis.	07	13	1,2,3,6	CO5	PSO1 PSO6			
6.	<u>Adhesives</u> Cohesion and Adhesion, Classification of adhesives, preparations of adhesives, Starch, Synthetic resin and cellulose-based adhesives,	09	14	2,3,4,6	CO6	PSO1 PSO3 PSO5			

	Industrial applications								
7.	<u>Patents in Industries:</u> Understanding Intellectual Property Rights (IPR), IPR Tools, Patents related to Pharmaceuticals, Parts of Patent, Filing a patent application and its prosecution in India, Indian patent Act, 1970; American and European Patent Systems	07	12	2,3,5,6	CO7	PSO1 PSO7			
8.	<u>Copyright in Industries:</u> Introduction of copyrights, Importance of Trade Marks, Matter not protected under Trade Mark, Registration of Trade Mark, Infringement and Remedies and Case Laws	06	10	2,3,5,6	CO7	PSO1 PSO7			
Reference Books:									
1.	Industrial Chemistry – B. K. Sharma (Goel Publishing House, Merrut) 2014.								
2.	Engineering chemistry- Jain and Jain, (16 th edition, Dhanpatrai Publishing House) 2015.								
3.	Dryden’s outlines of Chemical Technology – Gopala Rao and Sitting (3 rd edition, East-West Press) 2010.								
4.	Shreeve’s Chemical Process Industries – George T. Austin (5 th edition, Mcgraw Hill Int.) 2017.								
5.	Speciality Inorganic Chemicals Ed. By W. E. Thomson (Royal Society of Chemistry) 1996.								
6.	Reigel’s Industrial Chemistry – James. A, Kent. (9 th edition, CBS Publishers) 1997.								
7.	Lehninger Principles of Biochemistry, David L Nelson, Michael Cox (7 th Edition, Macmillan Publications) 2017.								
8.	Concise Inorganic Chemistry – J. D. Lee (5 th edition, Chapman & II Hall) 1996.								
9.	Patent, Copyright and Trademark by S. Elias, R. Stim.								

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Chemistry		Academic Year					2018-19		
M.Sc. (Applied Chemistry): Regular Programme										
Year	II	Core / Elective / Foundation CHL2301: Chemical Engineering Kinetics and Process Control	Credits / Hours per week					04		
Semester	I	Year of Introduction: 1974 Year of Syllabus Revision: 2018	Maximum Marks / Grade					100 (70 UA + 30 IA)		
Mode of Transaction		Lectures and Tutorials								
Course Outcome (CO) CHL2301 CO1 To understand reactions, dynamics and kinetic data analysis. CO2 To learn development and design of chemical reactors. CO3 To understand essentials of heterogeneous catalysis. CO4 To study about control in the process industry together with block diagram, control dynamics and control loop. CO5 To understand about symbols/ levels and measurements of process variables.										
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 Sustainable

							(Ent)/ Skill Develop ment (SD)	(R)/Glob al (G) develop mental needs	bility (ES), Human Values (HV)and Professio nal Ethics (PE)
1.	Introduction to Chemical Kinetics, classification of chemical reactions, concept of rate of reaction, variables affecting rate of reactions. Kinetics of homogeneous reactions, concentration and temperature dependency of reaction, Molecularity and order of reaction, concept of activation energy	07	12	1, 2	CO1	PSO1	Emp	G	ES
2.	Formulation and analysis of simple and complex rate equations interpretation of rate data using integral and differential method of analysis in constant volume system and varying volume systems concept of catalyzed reactions	07	12	1,2	CO1	PSO1			
3.	Introduction to reactor design concept of ideal reactors. Classification of reactors: concept of space time and space velocity holding time and space time for flow reactors. Development of design expression for flow reactors. Development of design expression for ideal batch reactor, steady state plug flow reactor. Steady state mixed flow reactor and stirred tank reactors for single reaction	09	14	2,3,5	CO2	PSO1 PSO6			
4.	Introduction to heterogeneous reaction systems. Essentials of heterogeneous catalysis, Constructional aspects of packed bed reactors	08	13	1,2,3	CO3	PSO1			
5.	Importance of controls in the process industry, Basic components of control system, block diagram representation of control loop	08	13	2,5,6	CO4	PSO1 PSO2			
6.	Elements of control dynamics	07	12	2,5,6	CO4	PSO1			
7.	Control strategies, Distributed control systems, programmable logic controllers etc.	07	12	2,4,5,6	CO4	PSO4			
8.	Instrumentation symbols & labels, instruments for measurement of process variables: temperature, flow, liquid level and pressure	07	12	2,4,5,6	CO5	PSO4			
Reference Books:									

1.	D C Sikdar, Instrumentation and Process Control (Khanna Publishers) 2016.
2.	Coughanor, 'Process systems analysis and control' (2 nd Ed, McGraw-Hill) 1991.
3.	O. Levenspiel, "Chemical Reaction Engineering" (3 rd Ed, John Wiley & Sons) 1999.
4.	J. M. Smith, 'Chemical Engineering Kinetics' (3 rd Ed, McGraw-Hill) 1981.

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Chemistry		Academic Year				2025-26			
M.Sc. (Applied Chemistry): Regular Programme										
Year	II	Core / Elective / Foundation ACH2332L: Advanced Organic Synthesis-TW/Practical	Credits / Hours per week				6			
Semester	I	Year of Introduction: 1974 Year of Syllabus Revision: 2025	Maximum Marks / Grade				100			
Mode of Transaction		Laboratory, Term work and Viva								
Course Outcome (CO) ACH2332L										
CO1 To learn preparation of various organic compounds (drug/drug intermediate/ liquid crystalline materials/ mosquito repellent/ reactive dyes) using two or three steps synthetic processes involving various reactions.										
CO2 Learn about the separation techniques for binary and ternary mixtures of organic compounds following a systematic method of analysis.										
Unit No.	Topic/Unit		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) develop	Relation to Gender (G), Environment and Sustainability (ES), Human

							ment (SD)	mental needs	Values (HV)and Professio nal Ethics (PE)
1.	Preparation of Anthranilic Acid from Phthalic anhydride	06	06	2,3,4	CO1	PSO6	Emp	G	ES
2.	Preparation of Sulpha drug (p-Amino benzene sulphanilamide	06	06	2,3,4	CO1	PSO6			
3.	Preparation of 4-n-butoxy phenylazo 4'benzoic acid from p-amino benzoic acid	06	06	2,3,4	CO1	PSO6			
4.	N,N-Diethyl m-Toluamide from m-toluic acid	06	06	2,3,4	CO1	PSO6			
5.	Preparation of Acetanilide from Acetophenone	06	06	2,3,4	CO1	PSO6			
6.	Preparation of Acridone from Anthranilic acid	06	06	2,3,4	CO1	PSO6			
7.	Preparation of Reactive Dye from sulphanilic acid	06	06	2,3,4	CO1	PSO6			
8.	Chloramine-T from Toluene (via p-Toluene Sulfonyl Chloride)	06	06	2,3,4	CO1	PSO6			
9.	<u>(II) Separation of Ternary Mixtures based on following types</u> Acid+Phenol+Neutral (APN) Acid+Base+Neutral (ABN) Phenol+Base+Neutral (PBN) Acid+Phenol+Base (APB) Any other new experiment of current interest	42	34	2,3,4	CO2	PSO6			
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 (5 th edition, Pearson) 2005.								

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Chemistry		Academic Year				2019-20			
M.Sc. (Applied Chemistry): Regular Programme										
Year	II	Core / Elective / Foundation ACH2311: Seminars and Industrial Visits	Credits / Hours per week				4			
Semester	I	Year of Introduction: 1974 Year of Syllabus Revision: 2019	Maximum Marks / Grade				50			
Mode of Transaction		Field work-Seminar-Theory								
Course Outcome (CO) ACH2311 CO1 To understand about literature survey, selection of published topic, preparation of report and its presentation. CO2 To take a visit of running chemical industries around Vadodara, Gujarat followed by report preparation.										
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 needs	Relation to Gender (G), Environ ment and Sustaina bility (ES), Human Values (HV)and Professio nal

									Ethics (PE)
1.	Preparation, presentation and report of seminars based on advanced topics related to Applied Chemistry.	18	60	2,4,5,6	CO1	PSO7	Emp, SD	G	ES
2.	Visits to various Industries / R&D laboratories engaged in production of / research in agrochemicals, pharmaceuticals, perfumeries, heavy chemicals, polymers, paints, glass and allied industries etc.	12	40	2,4,5	CO2	PSO7			
Reference Books/ Journals/Information:									
1.	Various Scientific Journals/ Newsletters related to ACS, RSC, Elsevier, Wiley, Springer publishing groups etc.								
2.	Various Chemical, Polymer and Pharma industries of Vadodara, Gujarat.								

		The Maharaja Sayajirao University of Baroda			Academic Year				2025-26		
		Faculty Technology and Engineering									
		Department of Applied Chemistry									
M.Sc. (Applied Chemistry): Regular Programme											
Year	II	Core / Elective / Foundation ACH2413: Agrochemicals and Fertilizers			Credits / Hours per week				04		
Semester	II	Year of Introduction: 1974 Year of Syllabus Revision: 2025			Maximum Marks / Grade				100 (70 UA + 30 IA)		
Mode of Transaction		Lectures and Tutorials									
Course Outcome (CO) ACH2413											
CO1 Introduction to types of insects and insecticides, classification, formulations, applications.											
CO2 Learn about the methods of conventional and current methods of applications of various insecticides.											
CO3 To understand the importance of biofertilizers and their future scope.											
CO4 Learn about Inorganic Fertilizers Types and functions, methods of production and study of various types of soil.											
CO5 To learn about the methods of nitrogenous and phosphatic fertilizers and study of their activity.											
CO6 To understand the concept of mixed fertilizers for improved activity.											
Unit No.	Topic/Unit			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)	develop mental needs	Values (HV)and Professio nal Ethics (PE)
1.	<u>Biocide Chemistry-I:</u> Pesticides: Definition, formulations, classification, (i) Fungicides Inorganic: Copper fungicides, Sulphur fungicides; Organic: Carbamic acid derivatives, Chlorinated aromatics and heterocyclic fungicides; Systemic fungicides	10	16	1, 2, 3	CO1	PSO3	Emp	G	ES
2.	<u>Biocide Chemistry-II:</u> (i) Insecticides - Inorganic: Stomach poisons, contact poisons, Organic: Organochlorines, organophosphorus, carbamates, nitrophenols. Attractants/pheromones, repellents and antifeeding compounds, fumigants (ii) Rodenticides	10	16	1,2,3	CO1	PSO3			
3.	<u>Biocide Chemistry-III:</u> Herbicides – classification and Chemistry, Plant growth hormones; Biopesticides	07	11	3,4	CO2	PSO3			
4.	<u>Pesticidal Applications:</u> Methods for pesticidal applications and Control Release Systems; Agrochemicals for future and Biofertilizers	06	10	5,6	CO3	PSO3			
5.	<u>Introduction to Inorganic Fertilizers:</u> Classification, Nutrient requirement of crops and function, soil condition, Overview of fertilizer industry, basic raw materials for fertilizer manufacture	09	15	1,2	CO4	PSO3			
6.	<u>Phosphatic Fertilizers:</u> Manufacturing process of phosphoric acid, ordinary super phosphate, triple super phosphates, Nitro phosphate and ammonium phosphates (mono- and di-)	07	11	3,6	CO5	PSO4			
7.	<u>Mixed Fertilizers:</u> Bulk Blending, intermediates used in bulk blending, solution fertilizers and suspension fertilizers. Compound fertilizers, Nanofertilizers	06	10	2,3	CO6	PSO3			
8.	<u>Nitrogenous Fertilizers:</u> Manufacturing process and agrochemicals properties of Urea Calcium cyanamide (slow-release nitrogen fertilizer)	07	11	3,6	CO5	PSO4			

Reference Books:

1.	Crop protection in the Tropics–J.P. Singh (3 rd edition, Advent Books division Inc.) 1998.
2.	Pest Control – A survey - Arthur Woods (McGraw Hills. Book Company) 1974.
3.	Modes of action of herbicides - F. M. Ashton and A. S. Crafts (2 nd edition, Willey) 1981.
4.	The Technology of Mineral Fertilizers - I. Modpnvan, N. Popovici and C. Chivu (London, British Sulphur Corp.) 1969.
5.	Fertilizer Nitrogen: Its Chemistry and Technology - V.Sauchell (Reinhold) 1964.
6.	Dryden’s Outlines of Chemical Technology – Gopal Rao and Sittig (3 rd edition, East-West Press) 2010.
7.	Riegel's Industrial Chemistry – James. A, Kent. (9 th edition, CBS Publishers) 1997.
8.	Industrial Chemistry - B. K. Sharma (Goel Publishing house, Meerut) 1998.

							Develop ment (SD)	develop mental needs	Human Values (HV)and Professio nal Ethics (PE)
1.	<u>Introduction:</u> Historical development of synthetic Dyes - Introduction, Nomenclature, Color and constitution, methods of dyeing	08	13	1,2	CO1	PSO1	Emp	G	ES
2.	<u>Classification of Dyes:</u> (i) Based on structure, (ii) Based on mode of application to fibers (iii) Types – Acid dyes, Basic dyes, Direct dyes, Mordant dyes, Vat dyes, Food dyes	08	13	1,2	CO1	PSO1 PSO3			
3.	<u>Dye Intermediates–I:</u> Unit processes for Nitration – Nitrating agents, kinetics and mechanism of Nitration, Nitration of benzene, chlorobenzene and Toluene Continuous and batch Nitration processes, Amination by reduction, methods of reduction, commercial manufacture of Aniline and m-nitro aniline	09	15	2,3	CO2	PSO4 PSO6			
4.	<u>Dye Intermediates–II:</u> Sulfonation– Sulfonating agents, chemical and physical factors in sulfonation, sulfonation of benzene, toluene, Naphthalene and Anthraquinone Continuous and Batch Sulfonation Halogenation, mechanism, chlorination of paraffinic hydrocarbons– benzene and toluene, Alkylation	09	15	2,3	CO2	PSO4 PSO6			
5.	<u>Types of fibers and theories of dyeing methods:</u> Fibres to be dyed, types of forces involved in dyeing, methods of dyeing	05	08	1,3,4	CO5	PSO1 PSO5			
6.	<u>Study of some typical Members (non-benzidine) of various classes of dyes:</u> (i) Acidic azodyes –tartrazine (ii) Basic dyes – saframine, malachite green (iii) Vat dyes - Indigoid and thioindigoid dyes (iv) Substantive and mordant dyes (v) Reactive dyes (vi) Heterocyclic dyes	07	12	2,3,4	CO3	PSO4 PSO6			
7.	<u>Non–Textile Uses of Dyes:</u> Dyes in medicine, leather, paper, color, food and drugs, cosmetics, displays and laser dyes	07	12	2,3,5	CO4	PSO4 PSO5			

8.	<u>Textile Auxiliaries:</u> Fluorescent brighteners and optical whitening agents – stilbene, coumarin, diaryl-imidazolone, naphthalimide and pyrene derivatives, water repellent finishing agents, fireproofing agents	07	12	1,3,4	CO5	PSO1 PSO5			
Reference Books:									
1.	Synthetic Dyes – Vol. 1 to 7 ed. - Venkat Raman (Academic Press) 2012.								
2.	Synthetic Dyes - Lubs (Robert E. Krieger Pub. Co) 1977.								
3.	Dyes and Intermediates - Fiertz, David and Blangley (New York, D. Van Nostrand) 1921.								
4.	Science of surface coating ed. - Chatfield 1962.								
5.	Handbook of Synthetic dyes and pigments - K. M. Shah, (2 nd edition, Multitech Publishing Co., Mumbai) 1998.								

							Skill Develop ment (SD)	al (G) develop mental needs	(ES), Human Values (HV)and Professio nal Ethics (PE)
1.	<u>Green Chemistry</u> : Clean synthesis using alternative reaction media; Super critical solvents in industrial applications, scale up & industrial applications of clean synthesis including asymmetric synthesis.	08	13	1, 2	CO1	PSO1	Emp	G	ES
2.	<u>Chemical Toxicology</u> : Biochemical effects of Hg, Cd, Pb, As, Cu and their speciation, Biochemical effects of cyanide and pesticides, DDT in the food chain, MIC	08	13	2,3,4	CO2	PSO1 PSO2			
3.	<u>Waste Water Treatment Technologies</u> : Terminologies, water pollutants– sources, criteria for detection-pH, acidity, alkalinity, Dissolved solids. - TS, TDS, TSS, DO, BOD, COD, TOC – Treatment levels - pretreatment, primary, secondary and tertiary treatment, sludge disposal	07	12	2,3,4,5	CO3	PSO2 PSO7			
4.	<u>Air Pollution</u> : Air pollutants and their toxic effects– CO, CO ₂ (greenhouse effect) NO _x , SO _x , H ₂ S, Ozone–effects on ozone layer by NO _x and fluorocarbons, particulates – sources, toxic effects, smog – classical, photochemical, sampling and monitoring of air pollutants – control of air pollutants. Motor vehicular pollution and control	07	12	2,3,4,5	CO4	PSO2 PSO7			
5.	<u>Radiological Contamination and Impact of large Radiation Sources on the Environment</u> : Sources of contamination–Natural, Man Made – Breeder reactors, Fuel reprocessing, Nuclear weapons. Radioactive contamination in Drinking water, Regulation and control. Medical applications Radiopharmaceuticals, Radioprotiens Isotope power pace makers, Isotope satellite power unit – summary of benefits and environmental impact	08	13	1,3,4	CO5	PSO2 PSO7			
6.	<u>Thermal Pollution and Environment</u> : Causes of thermal pollution, Effects of thermal pollution, Mechanism of heat dissipation, techniques of heated water discharges, cooling ponds, various cooling towers	08	13	1,3,4	CO5	PSO2 PSO7			
7.	<u>Carbon Capture and Sequestration</u> : Global warming and Climate change, Concept of Carbon Credit and Carbon Footprint, Carbon capture techniques, Carbon dioxide sequestration, Design of Green Belt	08	12	2,4,5,6	CO6	PSO2 PSO6			

	and its advantages								
8.	<u>Waste Management and Recycling- Case Studies:</u> Plastic Recycling, Dye Industry, Evaluation of VOC recovery Systems, Utilization of Fly ash, Fine chemicals	06	12	2,4,5,6	CO7	PSO2			
Reference Books:									
1.	Industrial pollution – N. Irwin Sax (Van Nostrand Reinhold) 1974.								
2.	Industrial Chemistry - B. K. Sharma (Goel Publishing House, Meerut) 1998.								
3.	Principles of Inorganic chemistry – Puri, Sharma and Kalia (33 rd edition, Milestone Publishers & Distributors/ Vishal Publishing Co.) 2017.								
4.	Reigel’s Industrial Chemistry – James. A, Kent. (9 th edition, CBS Publishers) 1997.								
5.	Environmental Chemistry –Samir K. Banerjee (2 nd edition, Prentice-Hall of India Pvt. Ltd) 2004.								
6.	Environmental Chemistry – A. K. De (6 th edition, New Age. International, New Delhi) 2006.								
7.	Profitably Preventing Pollution – M. H. Mehta (Ankur Publishing Co.) 1996.								
8.	Environmental Chemistry of Dyes and Pigments – Abraham Reife and Harold freeman (1 st edition, John Wiley and Sons) 1996.								
9.	Carbon Capture and Storage, Stephen A. Rackley (2 nd edition, Elsevier) 2017.								
10.	Carbon Capture, Storage and Use-Technical, Economic, Environment and Societal Perspectives- Kuckshinrichs, Wilhelm, Hake, Jürgen-Friedrich (Springer) 2015.								
11.	Carbon Capture, Storage and Utilization- M. Goel, M. Sudhakar and R.V. Shahi (TERI press) 2014.								

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Chemistry		Academic Year		2025-26					
M.Sc. (Applied Chemistry): Regular Programme										
Year	II	Core / Elective / Foundation ACH2418: Polymers, Plastics and Resins	Credits / Hours per week				04			
Semester	II	Year of Introduction: 1974 Year of Syllabus Revision: 2025	Maximum Marks / Grade				100 (70 UA + 30 IA)			
Mode of Transaction		Lectures and Tutorials								
Course Outcome (CO) ACH2418										
CO1 Introduction to basic concepts of monomers, polymer formation and polymerization.										
CO2 Learn about the polymerization techniques.										
CO3 Learn about the various reactions on polymers.										
CO4 To understand the concepts of molecular weight in polymers like distribution, molecular weight averages etc.										
CO5 Understand the kinetics of polymerization reactions.										
CO6 Learn about polymer solutions and their behaviour in both aqueous and non-aqueous solvents.										
CO7 Learn the different techniques of polymer processing for various classes of polymers.										
Unit No.	Topic/Unit		Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill	Relevance to Local (L)/ National (N)/ Regional (R)/ Glob	Relation to Gender (G), Environment and Sustainability (ES),

							Development (SD)	al (G) develop mental needs	Human Values (HV) and Professional Ethics (PE)
1.	<u>Chemistry of Polymerization:</u> Chain polymerization (Free-radical, Ionic, and Coordination), Step polymerization (Polycondensation, Ring Opening), miscellaneous polymerization, Copolymerization. Polymerization Techniques (Bulk, Solution, Suspension, and Emulsion)	08	13	1, 2	CO1	PSO1	Emp	G	ES
2.	<u>Synthesis of Individual Polymers and Polymer reactions:</u> Vinyl polymers, polyesters, polyamides, polyurethanes, Elastomers, Phenol-formaldehyde and urea-formaldehyde resins Hydrolysis, Acidolysis, Addition and substitution reactions, reaction of specific groups, cross-linking, cyclisation, Miscellaneous reactions	08	13	1,2,3	CO2	PSO1			
3.	<u>Properties of polymers</u> Glass transition temperature (T _g), Free volume theory for T _g determination, factors effecting T _g , Crystallinity in Polymers, Crystallisability, Spherulites, Helix Structure, Factors affecting crystallinity in Polymers	08	14	2,3,4,5	CO4	PSO1 PSO3			
4.	<u>Characterization of polymers</u> Derivation of Number average (M _n), Weight average (M _w), Sedimentation average (M _z), and Viscosity average (M _v) molecular weights, MW and degree of Polymerization, Polydispersity and Mw distribution curves. Determination of MW – Osmometry, Viscometry, Sedimentation, Cryoscopy, Ebulliometry, Gel permeation chromatography (GPC).	07	13	2,3,4	CO3	PSO1 PSO2			
5.	<u>Kinetics of Polymerization:</u> Free radical, Cationic, Anionic, condensation polymerization, Copolymerization.	07	12	1,2,3	CO5	PSO1 PSO5			
6.	<u>Polymer Solutions:</u> Thermodynamic treatment of dissolution process, Flory–Huggins theory of polymer solutions, size and shape of polymers in solution, Viscosity of dilute & concentrated polymer solutions, light scattering.	06	09	1,2	CO6	PSO1 PSO7			
7.	<u>Techniques of Polymer Processing:</u> Calendering, die casting, rotational casting, film casting, compression moulding, blow moulding, extrusion etc., Fibre spinning	08	13	2,3,4	CO7	PSO1 PSO7			

8.	<u>Applications of Polymers:</u> Polymers for biomedical applications, Polymers in Packaging Industries, Polymers in Tire Industries, Polymers in Coating Applications	08	13	2,3,5	CO7	PSO1 PSO7			
Reference Books:									
1.	Polymer Science –V. R. Gowarikar, N. V. Vishwanathan& J. Sreedhar (2 nd edition, New Age International (P) Ltd.) 2015.								
2.	Text book of Polymer Science – F. W. Billmeyer (3 rd edition, Wiley – Interscience) 2007.								
3.	Principles of Polymer Chemistry – P. J. Flory (1 st edition, Cornell University Press) 1953.								
4.	Physical Chemistry of Polymers – A. Tager (2 nd edition, MIR Publishers) 1978.								
5.	Principles of Polymer Science – P. Bahadur, N. V. Sastry, (2 nd edition, Narosa Publishing House, New Delhi) 2002.								
6.	Plastic Materials and Processing – A Brent Strong (3 rd edition, Pearson) 2005.								
7.	Polymer Chemistry- Charles E. Carraher (10 th edition, CRC Press) 2018								

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Chemistry		Academic Year					2025-26		
M.Sc. (Applied Chemistry): Regular Programme										
Year	II	Core / Elective / Foundation ACH2411: Instrumental Methods of Chemical Analysis	Credits / Hours per week					02		
Semester	II	Year of Introduction: 1974 Year of Syllabus Revision: 2025	Maximum Marks / Grade					50 (35 UA + 15 IA)		
Mode of Transaction		Lectures and Tutorials								
Course Outcome (CO) ACH2411 CO1 To understand methods of analytical data evaluation. CO2 Introduction to basic concepts and applications of various chemical and instrumental analyses. CO3 Application of the different spectral techniques for structure elucidation of chemical 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) development needs	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional

									Ethics (PE)
1.	Evaluation of Analytical data: Basic concepts and problems-based on significant figures, errors, Precision accuracy, F-test, Q-test, t-test.	10	16	1,2	CO1	PSO1 PSO6	Emp	G	ES
2.	Thermal analysis-- TGA, DTA, DSC. Problems based on calculation of weight loss, identification of endotherms, exotherms, interpretation of Thermograms. Chromatographic methods of analysis– HPLC, GC. Problems based on basic concepts, retention time, progress of reactions, % yield etc.	09	15	1,2,3	CO2	PSO1 PSO6			
3.	AAS, UV-VIS - Problems based on concepts.	07	12	1,2,3	CO2	PSO1 PSO6			
4.	Interpretation and Application of the following spectral technique towards Structure elucidation of organic compounds- Mass spectroscopy, UV Spectroscopy, Infrared spectroscopy, ¹ H-NMR Spectra, ¹³ C-NMR Spectra Structure elucidation using a combination of UV, IR, NMR and Mass Spectral data.	07	12	1,2,3,4	CO3	PSO6			

Reference Books:

1.	Spectrometric Identification of Organic Compounds - R.M. Silverstein; G.Clayton; T.C.Morril (8 th edition, John Wiley & sons, New York) 2015
2.	Introduction to Spectroscopy - Donald L. Pavia, Gary M. Lampman, George S. (4 th edition, Kriz Books Cole, New York) 2008.
3.	Principles of Instrumental Analysis - Douglas A. Skoog (6 th edition, Saunders College Publishing, New York) 2006.
4.	NMR Spectroscopy: Basics, Principles, Concepts and Application in Chemistry - H. Gunther (3 rd edition, John Wiley & Sons, New York) 2013.
5.	Nuclear Magnetic Resonance application to organic chemistry - J.D. Roberts (McGraw-Hill, New York) 1959.
6.	Modern NMR Techniques for Chemistry Research – A. E. Derome (Pergamon) 1988.

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Chemistry			Academic Year				2025-26			
M.Sc. (Applied Chemistry): Regular Programme											
Year	II	Optional Merit-Based Elective ACH2419L: Dissertation Projects			Credits / Hours per week				10		
Semester	II	Year of Introduction: 2025			Maximum Marks / Grade				150		
Mode of Transaction		Project Assignment									
Course Outcome (CO) ACH2419L											
CO1 To understand and carry out independent literature survey, design and execution of experiment based small 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 Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevan ce to Local (L)/ National (N)/ Regional (R)/Glob al (G) develop mental needs	Relation to Gender (G), Environ ment and Sustaina bility (ES), Human Values (HV)and Professio nal Ethics (PE)

1	Literature survey, design, execution, analysis of results, presentation and report of small research problems based on advanced topics related to Applied Chemistry	180	100	2,3,4,5,6	CO1	PSO7	Emp, SD	G	ES
Reference Books/Journals:									
1.	Various Scientific Journals related to ACS, RSC, Elsevier, Wiley, Springer publishing groups etc.								

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Chemistry			Academic Year				2025-26		
M.Sc. (Applied Chemistry): Regular Programme											
Year	II	Optional Merit-Based Elective ACH2420L: Special Applied Chemistry Practicals-TW, Practical and Viva			Credits / Hours per week				10		
Semester	II	Year of Introduction: 2025 Year of Syllabus Revision:			Maximum Marks / Grade				150		
Mode of Transaction		Laboratory, Term work and Viva									
Course Outcome (CO) ACH2420L											
CO1 To learn preparation of various organic/inorganic compounds (liquid crystalline materials/ reactive dyes/ polymeric foams/ inorganic nanomaterials/ catalyst) using two or three steps synthetic processes involving various reactions and techniques											
CO2 To learn about the clouding behaviour of non-ionic surfactant											
CO3 To learn about techniques of polymerization reaction.											
CO4 To learn about various chromatographic techniques.											
Unit No.	Topic/Unit			Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G) develop	Relation to Gender (G), Environment and Sustainability (ES), Human Values

							(SD)	mental needs	(HV)and Professio nal Ethics (PE)
1.	Preparation of Liquid Crystal (LC) compound and study its LC behaviour	10	06	2,3,4	CO1	PSO6	Emp	G	ES
2.	Preparation of Polyurethane foam from vegetable oil	10	06	2,3,4	CO1	PSO6			
3.	Preparation of Chloramine-T	10	06	2,3,4	CO1	PSO6			
4.	Study of clouding behaviour of nonionic surfactant	10	06	2,3,4	CO2	PSO6			
5.	Preparation of carbon-based nanomaterials using hydrothermal method	10	06	2,3,4	CO1	PSO6			
6.	Preparation of polystyrene by free radical polymerization	10	06	2,3,4	CO3	PSO6			
7.	Preparation of inorganic catalyst using Sol-gel method	10	06	2,3,4	CO1	PSO6			
8.	Preparation of benzotriazole from o-phenylenediamine	10	06	2,3,4	CO1	PSO6			
9.	Column chromatography/ Paper chromatography	30	18	2,3,4	CO4	PSO6			
10.	To prepare Triptycene from Anthracene	10	06	2,3,4	CO1	PSO6			
11.	Preparation of binuclear copper (II) Schiff base complex and its characterization	10	06	2,3,4	CO1	PSO6			
12.	Solubility studies of pharmaceutically active compounds	10	10	2,3,4	CO1	PSO6			
Reference Books:									
1.	Advanced Practical <i>Organic Chemistry</i> by <i>Vishnoi</i> N. K. (3 rd edition, Vikas Publishing House Pvt. Ltd.) 2009.								
2.	<i>Vogel's Textbook of Practical Organic Chemistry</i> (5 th edition, Pearson) 2005.								
3.	Synthesis of Solid Catalysts by Dr. Krijn P. de Jong (Wiley-VCH Verlag GmbH & Co.) 2009.								
4.	Handbook of Liquid Crystals by John W. Goodby, Peter J. Collings, Takashi Kato, Carsten Tschierske, Helen Gleeson, Peter Raynes (Wiley-VCH Verlag) 2014								
5.	Experiments in Polymer Science, D. G. Hundiware, V. D. Athawale, U. R. Kapadi, V. V. Gite (New Age International Private Limited) 2008.								
6.	Experimental Methods in Polymer Science, Toyochi Tanaka (Elsevier) 2000.								