

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

**Programme Name: M. Sc. (Polymer Science)**

**Programme Specific Outcome (PSO):**

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

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

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

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

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

|    |                                                                                                                                                                                                                                                                                                   |    |    |        |     |              | neurship<br>(Ent)/<br>Skill<br>Develop<br>ment<br>(SD) | Regional<br>(R)/Glob<br>al (G)<br><br>develop<br>mental<br>needs | Sustaina<br>bility<br>(ES),<br>Human<br>Values<br>(HV)and<br>Professio<br>nal<br>Ethics<br>(PE) |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|--------|-----|--------------|--------------------------------------------------------|------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| 1. | <u>Advanced Organic Synthesis (Reactions and Reagents):</u><br>Reactions: (i) Birch Reduction (ii) Hofmann elimination (iii) Michael addition (iv) Stephen reaction<br>Reagents: (i) Diborane (ii) LiAlH <sub>4</sub> (iii) Dicyclohexylcarbodiimide (DCC) (iv) Dichlorodicyanobenzoquinone (DDQ) | 08 | 13 | 2, 3   | CO1 | PSO1<br>PSO6 | Emp                                                    | G                                                                | ES                                                                                              |
| 2. | <u>Molecular Rearrangements-I:</u><br>(i) Tiffeneau-Demjanov rearrangement (ii) Benzil-Benzilic acid rearrangement (iii) Neber rearrangement (iv) Wolf rearrangement                                                                                                                              | 07 | 12 | 1,3, 5 | CO2 | PSO1<br>PSO6 |                                                        |                                                                  |                                                                                                 |
| 3. | <u>Molecular Rearrangements-II:</u><br>(i) Schmidt rearrangement (ii) Baeyer–Villiger rearrangement (iii) Favorskii rearrangement (iv) Hofmann-Martius rearrangement                                                                                                                              | 05 | 10 | 1,3, 5 | CO2 | PSO1<br>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<br>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<br>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<br>PSO5 |                                                        |                                                                  |                                                                                                 |
| 7. | <u>Reactive Intermediates:</u> Structure, stability, Preparations and reactions involving (i) Free radicals (ii) Carbocations (iii) Non- classical                                                                                                                                                | 08 | 13 | 1,2    | CO6 | PSO1<br>PSO6 |                                                        |                                                                  |                                                                                                 |

|                         |                                                                                                                                                                                                                                          |    |    |         |     |                      |  |  |  |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|---------|-----|----------------------|--|--|--|
|                         | Carbocations (iv) Carbanions (v) Carbenes (vi) Nitrenes                                                                                                                                                                                  |    |    |         |     |                      |  |  |  |
| 8.                      | <u>Retrosynthetic Analysis:</u> The disconnection approach, Logic and concepts, Synthons and Synthons equivalent, Control elements, <i>Umpolung</i> methods, Linear and convergent syntheses, Illustration of some synthetic approaches. | 12 | 17 | 2,3,4,6 | CO7 | PSO1<br>PSO5<br>PSO6 |  |  |  |
| <b>Reference Books:</b> |                                                                                                                                                                                                                                          |    |    |         |     |                      |  |  |  |
| 1.                      | Organic synthesis: The Disconnection Approach - Stuart Warren (2 <sup>nd</sup> edition, John Wiley & Sons) 2007.                                                                                                                         |    |    |         |     |                      |  |  |  |
| 2.                      | Designing Organic Synthesis – A Programmed Introduction to the Synthon Approach: Stuart Warren (John Wiley & Sons) 1994.                                                                                                                 |    |    |         |     |                      |  |  |  |
| 3.                      | Text book of organic chemistry Vol. I - I. L. Finar (6 <sup>th</sup> edition, Pearson Education, From Book Vistas, New Delhi, India) 2010 & Vol. II - I. L. Finar (6 <sup>th</sup> edition, Pearson, India) 2011.                        |    |    |         |     |                      |  |  |  |
| 4.                      | Organic Reactions, Stereochemistry and Mechanism: P.S. Kalsi (4 <sup>th</sup> edition, New Age International Private Ltd) 2017.                                                                                                          |    |    |         |     |                      |  |  |  |
| 5.                      | Heterocyclic Chemistry: J. A. Joule & K. Mills, (4 <sup>th</sup> edition, Chapman & Hall) 1995.                                                                                                                                          |    |    |         |     |                      |  |  |  |
| 6.                      | Organic chemistry - R. T. Morrison and R. N. Boyd (7 <sup>th</sup> edition, Pearson) 2010.                                                                                                                                               |    |    |         |     |                      |  |  |  |
| 7.                      | Organic chemistry by Jerry March (6 <sup>th</sup> edition, John Wiley & Sons, Inc., Hoboken, New Jersey) 2007.                                                                                                                           |    |    |         |     |                      |  |  |  |
| 8.                      | Reaction Mechanism in Organic chemistry - Peter Sykes (6 <sup>th</sup> edition, Pearson) 2003.                                                                                                                                           |    |    |         |     |                      |  |  |  |
| 9.                      | Organic Chemistry: Reactions and Reagents by O. P. Agrawal (3 <sup>rd</sup> edition, Goel Publishing House) 2023                                                                                                                         |    |    |         |     |                      |  |  |  |
| 10.                     | Stereochemistry of Organic Compounds by E.L. Eliel (1 <sup>st</sup> 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 <sup>th</sup> Edition, Wiley Eastern Ltd) 2016                                                                                                 |    |    |         |     |                      |  |  |  |

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

|    |                                                                                                                                                                                                                                                                                    |    |    |       |     |                      | (Ent)/<br>Skill<br>Develop<br>ment<br>(SD) | (R)/Glob<br>al (G)<br>develop<br>mental<br>needs | bility<br>(ES),<br>Human<br>Values<br>(HV)and<br>Professio<br>nal<br>Ethics<br>(PE) |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|-------|-----|----------------------|--------------------------------------------|--------------------------------------------------|-------------------------------------------------------------------------------------|
| 1. | <u>Statistical Thermodynamics:</u><br>Limitations of classical thermodynamics, Statistical thermodynamics. Maxwell-Boltzmann distribution, Molecular Partition functions and their significance, thermodynamic information from partition function, Sackur-Tetrode equation.       | 09 | 14 | 1, 2  | CO1 | PSO1                 | Emp                                        | G                                                | ES                                                                                  |
| 2. | <u>Chemical Kinetics:</u><br>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<br>PSO2<br>PSO3 |                                            |                                                  |                                                                                     |
| 3. | <u>Photochemistry:</u><br>Laws of photochemistry, quantum yield, Franck-Condon principle, Photo physical processes: Jablonski diagram and Charge transfer processes.                                                                                                               | 07 | 12 | 2,3,4 | CO3 | PSO1<br>PSO2         |                                            |                                                  |                                                                                     |
| 4. | <u>Solution behaviours of surfactants &amp; macromolecules:</u><br>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<br>PSO3         |                                            |                                                  |                                                                                     |
| 5. | <u>Phase Equilibrium:</u><br>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<br>PSO3<br>PSO6 |                                            |                                                  |                                                                                     |
| 6. | <u>Electrochemical Processes:</u><br>Different electrochemical reactions, rapid electrochemical reactions, organic electrode processes, electro catalysis. Polarization: Its causes,                                                                                               | 07 | 15 | 1,2,3 | CO5 | PSO2<br>PSO3<br>PSO5 |                                            |                                                  |                                                                                     |

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|    | decomposition voltage and concentration polarization, polarography, theory and applications, constant potential electrolysis, anodic stripping voltammetry, cyclic voltammetry.                                                                                                                                                                                                                 |    |    |         |     |                      |  |  |  |
| 7. | <u>Solid State Chemistry:</u><br>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<br>PSO2<br>PSO4 |  |  |  |
| 8. | <u>Surface Phenomenon:</u><br>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<br>PSO2<br>PSO3 |  |  |  |

#### Reference Books:

|     |                                                                                                                                             |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------|
| 1.  | Physical Chemistry - P. W. Atkins (6 <sup>th</sup> Edition, Oxford University Press) 1998.                                                  |
| 2.  | Chemical Kinetics - K. J. Laidler (3 <sup>rd</sup> 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 <sup>th</sup> edition, McGraw Hill Education (India) Pvt. Ltd.) 2003.        |
| 5.  | Elements of Physical Chemistry – S. Glasstone (15 <sup>th</sup> edition, D. Van Nostrand Company Inc,) 2006.                                |
| 6.  | Principles of Physical Chemistry – B. R. Puri, L. R. Sharma, M. S. Pathania (6 <sup>th</sup> edition, ShobanLalNagin Chand & Sons) 1993.    |
| 7.  | Modern Electrochemistry – Vol. I & II - J. O. M. Bockris & Technology series (2 <sup>nd</sup> 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 <sup>th</sup> edition, Tata – McGraw Hill New Delhi) 2006.                                  |
| 10. | Principles and Practice of Heterogeneous catalysis – J. M. Thomas and W. J. Thomas (2 <sup>nd</sup> edition, Wiley VCH) 2010.               |

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



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

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

| Unit No. | Topic/Unit                                                                                                                                                                                                                                                                                              | Contact Hours | Weightage (%) | BT Level | CO  | PSO          | Element s of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD) | Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G) development needs | Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE) |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------|----------|-----|--------------|----------------------------------------------------------------------------------|----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| 1.       | <u>Fundamentals of Spectroscopy:</u><br>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<br>PSO5 | Emp                                                                              | G                                                                                | ES                                                                                                          |
| 2.       | <u>UV-VIS and IR Spectroscopy:</u><br>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<br>PSO2 |                                                                                  |                                                                                  |                                                                                                             |
| 3.       | <u>Nuclear Magnetic Resonance Spectroscopy:</u><br>Theory, Principles, Instrumentation, Improving of NMR spectrum, Basic concept of <sup>13</sup> C NMR and MRI.                                                                                                                                        | 08            | 13            | 2,3,4    | CO1 | PSO1<br>PSO6 |                                                                                  |                                                                                  |                                                                                                             |
| 4.       | <u>Thermal Analysis:</u><br>Thermo gravimetric analysis (TGA, DTA), Differential Scanning Calorimetry – Principles, Instrumentation and Applications.                                                                                                                                                   | 07            | 12            | 2,3,4    | CO4 | PSO1<br>PSO3 |                                                                                  |                                                                                  |                                                                                                             |
| 5.       | <u>Atomic Absorption and Emission Spectroscopy:</u><br>Atomic absorption Spectroscopy (AAS), Theoretical principles and instrumentation in Absorption flame photometry, Analytical                                                                                                                      | 08            | 13            | 2,3,4    | CO5 | PSO1<br>PSO5 |                                                                                  |                                                                                  |                                                                                                             |

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|                         | Applications. Flame Emission Spectroscopy – Principles, instrumentation and applications. ICP-AES (Inductively coupled plasma atomic emission spectroscopy)                                                                       |    |    |         |     |                      |  |  |  |
| 6.                      | <u>ESR and Mossbauer Spectroscopy:</u><br>Principles, Instrumentation and Analytical applications of both the techniques.                                                                                                         | 07 | 12 | 2,3,4,5 | CO5 | PSO1<br>PSO7         |  |  |  |
| 7.                      | <u>Chromatography:</u><br>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<br>PSO7<br>PSO8 |  |  |  |
| 8.                      | <u>Mass Spectroscopy:</u><br>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<br>PSO7<br>PSO8 |  |  |  |
| <b>Reference Books:</b> |                                                                                                                                                                                                                                   |    |    |         |     |                      |  |  |  |
| 1.                      | Instrumental Methods of Chemical Analysis by Willard Merrit & Dean (7 <sup>th</sup> edition, CBS Publisher) 2012.                                                                                                                 |    |    |         |     |                      |  |  |  |
| 2.                      | Instrumental Methods of Chemical Analysis by Ewing (4 <sup>th</sup> edition, McGraw-Hill Companies) 1975.                                                                                                                         |    |    |         |     |                      |  |  |  |
| 3.                      | Instrumental Methods of Chemical Analysis by B. K. Sharma (5 <sup>th</sup> edition, Goel Publishing House) 1981.                                                                                                                  |    |    |         |     |                      |  |  |  |
| 4.                      | R.M. Silverstein; G. Clayton; T.C. Morrill, Spectrometric Identification of Organic Compounds (5 <sup>th</sup> 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 <sup>th</sup> Edition, New Age International) 2016                                                                                                                            |    |    |         |     |                      |  |  |  |

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

|                         |                                                                                                                                                                           |    |    |         |     |      |     |   | nal<br>Ethics<br>(PE) |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|---------|-----|------|-----|---|-----------------------|
| 1.                      | <b>Preparations:</b><br>Preparation of Methyl Orange from Sulphanilic Acid                                                                                                | 06 | 10 | 3,5     | CO1 | PSO9 | Emp | G | ES                    |
| 2.                      | Preparation of p-Nitroaniline from Acetamide                                                                                                                              | 06 | 10 | 2,4,5   | CO1 | PSO9 |     |   |                       |
| 3.                      | Preparation of m-Nitroaniline from m-Dinitrobenzene                                                                                                                       | 06 | 10 | 2,4     | CO1 | PSO9 |     |   |                       |
| 4.                      | Preparation of 4-n-Butoxybenzoic acid from p-Hydroxybenzoic Acid                                                                                                          | 06 | 10 | 2,4     | CO1 | PSO9 |     |   |                       |
| 5.                      | Preparation of Nerolin from $\beta$ -Naphthol                                                                                                                             | 06 | 10 | 2,4     | CO1 | PSO9 |     |   |                       |
| 6.                      | Preparation of Dibenzalacetone from Benzaldehyde                                                                                                                          | 06 | 10 | 2,4,5   | CO2 | PSO9 |     |   |                       |
| 7.                      | Preparation of Cinnamic acid from Malonic acid                                                                                                                            | 06 | 10 | 2,4,5   | CO2 | PSO9 |     |   |                       |
| 8.                      | Preparation of Benzoic acid from Benzanilide.                                                                                                                             | 06 | 10 | 2,3,4   | CO2 | PSO9 |     |   |                       |
| 9.                      | Preparation of Adduct of Anthracene and Maleic anhydride.                                                                                                                 | 06 | 10 | 2,3,4,5 | CO2 | PSO9 |     |   |                       |
| 10.                     | Preparation of 2,5-Dihydroxyacetophenone from Hydroquinone.<br>Any other new preparation of current interest                                                              | 06 | 10 | 2,4,5   | CO2 | PSO9 |     |   |                       |
| <b>Reference Books:</b> |                                                                                                                                                                           |    |    |         |     |      |     |   |                       |
| 1.                      | Advanced Practical Organic Chemistry by Vishnoi N. K. (3 <sup>rd</sup> 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 <sup>th</sup> edition, Longman Scientific & Technical) 2005. |    |    |         |     |      |     |   |                       |



|                         |                                                                                                                                                                                                                                 |    |    |         |     |      | Develop<br>ment<br>(SD) | develop<br>mental<br>needs | Human<br>Values<br>(HV)and<br>Professio<br>nal<br>Ethics<br>(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 <sub>2</sub> between H <sub>2</sub> O and CCl <sub>4</sub> .                                                                                                                        | 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 <sub>sp</sub> ) 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 |                         |                            |                                                                  |
| <b>Reference Books:</b> |                                                                                                                                                                                                                                 |    |    |         |     |      |                         |                            |                                                                  |
| 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 <sup>nd</sup> edition, Pergamon) 1968.                                                                                                           |    |    |         |     |      |                         |                            |                                                                  |
| 4.                      | Advanced Practical Physical Chemistry by J. B. Yadav (4 <sup>th</sup> Edition, Goyal Publishing House, Meerut) 1981                                                                                                             |    |    |         |     |      |                         |                            |                                                                  |

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

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

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

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

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

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



**The Maharaja Sayajirao University of Baroda**  
**Faculty Technology and Engineering**  
**Department of Applied Chemistry**

### Academic Year

2024-25

**M.Sc. (Polymer Science): Regular Programme**

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

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

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|----|-------------------------------------------------------------------------------------------------------------------|
| 6. | Liquid crystalline polymers, Athene Margaret Donald, A. H. Windle, Simon Hanna (Cambridge University Press) 2006. |
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|                                | The Maharaja Sayajirao University of Baroda |                                                                                              | Academic Year            |               | 2024-25  |    |     |                                    |                                   |                                 |
|                                                                                                                 | Faculty Technology and Engineering          |                                                                                              |                          |               |          |    |     |                                    |                                   |                                 |
|                                                                                                                 | Department of Applied Chemistry             |                                                                                              |                          |               |          |    |     |                                    |                                   |                                 |
| M.Sc. (Polymer Science): Regular Programme                                                                      |                                             |                                                                                              |                          |               |          |    |     |                                    |                                   |                                 |
| Year                                                                                                            | I                                           | Core / <del>Elective</del> / Foundation<br>ACHXXXX: Synthesis & Characterization of Polymers | Credits / Hours per week |               |          |    | 06  |                                    |                                   |                                 |
| Semester                                                                                                        | II                                          | Year of Introduction: 2020<br>Year of Syllabus Revision: 2024                                | Maximum Marks / Grade    |               |          |    | 50  |                                    |                                   |                                 |
| Mode of Transaction                                                                                             |                                             | Term work, Practical & Viva                                                                  |                          |               |          |    |     |                                    |                                   |                                 |
| Course Outcome (CO) ACHXXXX                                                                                     |                                             |                                                                                              |                          |               |          |    |     |                                    |                                   |                                 |
| CO1 To learn about the preparation of various polymers involving addition/condensation reactions.               |                                             |                                                                                              |                          |               |          |    |     |                                    |                                   |                                 |
| CO2 To study about solution polymerization.                                                                     |                                             |                                                                                              |                          |               |          |    |     |                                    |                                   |                                 |
| CO3 To learn about various characterization techniques used to determine structure of the synthesized polymers. |                                             |                                                                                              |                          |               |          |    |     |                                    |                                   |                                 |
|                                                                                                                 |                                             |                                                                                              |                          |               |          |    |     |                                    |                                   |                                 |
| Unit No.                                                                                                        | Topic/Unit                                  |                                                                                              | Contact Hours            | Weightage (%) | BT Level | CO | PSO | Element s of Employa bility (Emp)/ | Relevan ce to Local (L)/ National | Relation to Gender (G), Environ |

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

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

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

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|                   | <b>The Maharaja Sayajirao University of Baroda</b><br><b>Faculty Technology and Engineering</b><br><b>Department of Applied Chemistry</b> | <b>Academic Year</b>                                                                   | <b>2024-25</b>                  |                                      |           |            |                                         |                                         |                                        |
| <b>M.Sc. (Polymer Science): Regular Programme</b>                                                  |                                                                                                                                           |                                                                                        |                                 |                                      |           |            |                                         |                                         |                                        |
| <b>Year</b>                                                                                        | <b>II</b>                                                                                                                                 | <b>Core / <del>Elective</del> / Foundation</b><br><b>(ACH2314): Polymer Processing</b> | <b>Credits / Hours per week</b> | <b>04</b>                            |           |            |                                         |                                         |                                        |
| <b>Semester</b>                                                                                    | <b>I</b>                                                                                                                                  | Year of Introduction: 2020<br>Year of Syllabus Revision: 2024                          | <b>Maximum Marks / Grade</b>    | <b>100</b><br><b>(70 UA + 30 IA)</b> |           |            |                                         |                                         |                                        |
| <b>Mode of Transaction</b>                                                                         |                                                                                                                                           | Lectures and Tutorials                                                                 |                                 |                                      |           |            |                                         |                                         |                                        |
| <b>Course Outcome (CO) ACH2314</b>                                                                 |                                                                                                                                           |                                                                                        |                                 |                                      |           |            |                                         |                                         |                                        |
| <b>CO1</b> Learn about manufacture of polymeric material cellulose from natural sources like wood. |                                                                                                                                           |                                                                                        |                                 |                                      |           |            |                                         |                                         |                                        |
| <b>CO2</b> Learn about the manufacture of rubber products including processing.                    |                                                                                                                                           |                                                                                        |                                 |                                      |           |            |                                         |                                         |                                        |
| <b>CO3</b> Learn the fundamentals of processing of polymers including the flow behavior.           |                                                                                                                                           |                                                                                        |                                 |                                      |           |            |                                         |                                         |                                        |
| <b>CO4</b> Understand the different techniques of polymer processing based on the product profile. |                                                                                                                                           |                                                                                        |                                 |                                      |           |            |                                         |                                         |                                        |
| <b>CO5</b> Understand basics of different models of flow and viscosity of melts.                   |                                                                                                                                           |                                                                                        |                                 |                                      |           |            |                                         |                                         |                                        |
| <b>CO6</b> Understand the design of moulds and extruders.                                          |                                                                                                                                           |                                                                                        |                                 |                                      |           |            |                                         |                                         |                                        |
| <b>Unit No.</b>                                                                                    |                                                                                                                                           | <b>Contact Hours</b>                                                                   | <b>Weightage (%)</b>            | <b>BT Level</b>                      | <b>CO</b> | <b>PSO</b> | <b>Elements of Employability (Emp)/</b> | <b>Relevance to Local (L)/ National</b> | <b>Relation to Gender (G), Environ</b> |

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

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

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

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

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

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|         | The Maharaja Sayajirao University of Baroda |                                                                                                            |  | Academic Year |                          |          |    |     | 2024-25                     |                          |                         |
|                                                                                          | Faculty Technology and Engineering          |                                                                                                            |  |               |                          |          |    |     |                             |                          |                         |
| Department of Applied Chemistry                                                          |                                             |                                                                                                            |  |               |                          |          |    |     |                             |                          |                         |
| M.Sc. (Polymer Science): Regular Programme                                               |                                             |                                                                                                            |  |               |                          |          |    |     |                             |                          |                         |
| Year                                                                                     | I                                           | Core / <del>Elective</del> / <del>Foundation</del><br>(ACH2313L): Analytical Chemistry - TW/Practical/Viva |  |               | Credits / Hours per week |          |    |     |                             | 04                       |                         |
| Semester                                                                                 | II                                          | Year of Introduction: 2020<br>Year of Syllabus Revision: 2024                                              |  |               | Maximum Marks / Grade    |          |    |     |                             | 50                       |                         |
| Mode of Transaction                                                                      |                                             | Laboratory, Term work and Viva                                                                             |  |               |                          |          |    |     |                             |                          |                         |
| Course Outcome (CO) ACH2313L                                                             |                                             |                                                                                                            |  |               |                          |          |    |     |                             |                          |                         |
| CO1 To understand non-aqueous titration.                                                 |                                             |                                                                                                            |  |               |                          |          |    |     |                             |                          |                         |
| CO2 To learn about analysis of metal ions, vitamins, proteins and environmental samples. |                                             |                                                                                                            |  |               |                          |          |    |     |                             |                          |                         |
| CO3 To learn about analysis of acid mixtures from strong and weak acids.                 |                                             |                                                                                                            |  |               |                          |          |    |     |                             |                          |                         |
|                                                                                          |                                             |                                                                                                            |  |               |                          |          |    |     |                             |                          |                         |
| Unit No.                                                                                 | Topic/Unit                                  |                                                                                                            |  | Contact Hours | Weightage (%)            | BT Level | CO | PSO | Element s of Employa bility | Relevan ce to Local (L)/ | Relation to Gender (G), |

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

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| 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 <sup>nd</sup> edition, Pergamon) 1968. |

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|    | The Maharaja Sayajirao University of Baroda |                                                                                                                    | Academic Year |                          |           |    |    | 2024-25 |         |         |          |  |
|                                                                                     | Faculty Technology and Engineering          |                                                                                                                    |               |                          |           |    |    |         |         |         |          |  |
|                                                                                     |                                             | Department of Applied Chemistry                                                                                    |               |                          |           |    |    |         |         |         |          |  |
| M.Sc. (Polymer Science): Regular Programme                                          |                                             |                                                                                                                    |               |                          |           |    |    |         |         |         |          |  |
| Year                                                                                | II                                          | Core / <del>Elective</del> / Foundation<br>ACH2316L: Polymer Processing & Testing<br>Laboratory- TW/Practical/Viva |               | Credits / Hours per week |           |    |    |         | 06      |         |          |  |
| Semester                                                                            | I                                           | Year of Introduction: 2020<br>Year of Syllabus Revision: 2024                                                      |               | Maximum Marks / Grade    |           |    |    |         | 50      |         |          |  |
| Mode of Transaction                                                                 |                                             | Term work, Practical & Viva                                                                                        |               |                          |           |    |    |         |         |         |          |  |
| Course Outcome (CO) ACH2316L                                                        |                                             |                                                                                                                    |               |                          |           |    |    |         |         |         |          |  |
| CO1 To learn about working of Twin Screw Extruder/ rubber compounding.              |                                             |                                                                                                                    |               |                          |           |    |    |         |         |         |          |  |
| CO2 To study about physical measurement of strength of plastic, rubber, fiber.      |                                             |                                                                                                                    |               |                          |           |    |    |         |         |         |          |  |
| CO3 To learn about the identification of polymers through different chemical tests. |                                             |                                                                                                                    |               |                          |           |    |    |         |         |         |          |  |
| CO3 To learn about the flow behavior of polymers in melt and solution.              |                                             |                                                                                                                    |               |                          |           |    |    |         |         |         |          |  |
|                                                                                     |                                             |                                                                                                                    |               |                          |           |    |    |         |         |         |          |  |
| Unit                                                                                | Topic/Unit                                  |                                                                                                                    |               | Contact                  | Weightage | BT | CO | PSO     | Element | Relevan | Relation |  |

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

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|                                                                                                  | <b>The Maharaja Sayajirao University of Baroda</b><br><b>Faculty Technology and Engineering</b><br><b>Department of Applied Chemistry</b> |                                                                           | <b>Academic Year</b>            |                      |                 |           |            | <b>2024-25</b>                                                                        |                                                                                       |                                                                                            |
| <b>M.Sc. (Polymer Science): Regular Programme</b>                                                                                                                                 |                                                                                                                                           |                                                                           |                                 |                      |                 |           |            |                                                                                       |                                                                                       |                                                                                            |
| <b>Year</b>                                                                                                                                                                       | <b>II</b>                                                                                                                                 | <b>Core / <del>Elective</del> / Foundation</b><br><b>ACH2317: Seminar</b> | <b>Credits / Hours per week</b> |                      |                 |           |            | <b>2</b>                                                                              |                                                                                       |                                                                                            |
| <b>Semester</b>                                                                                                                                                                   | <b>I</b>                                                                                                                                  | Year of Introduction: 2020<br>Year of Syllabus Revision: 2024             | <b>Maximum Marks / Grade</b>    |                      |                 |           |            | <b>50</b>                                                                             |                                                                                       |                                                                                            |
| <b>Mode of Transaction</b>                                                                                                                                                        |                                                                                                                                           | Seminar-Theory                                                            |                                 |                      |                 |           |            |                                                                                       |                                                                                       |                                                                                            |
| <b>Course Outcome (CO) ACH2317</b><br><br><b>CO1</b> To read and understand the published literature on polymers, selection of topic, preparation of report and its presentation. |                                                                                                                                           |                                                                           |                                 |                      |                 |           |            |                                                                                       |                                                                                       |                                                                                            |
|                                                                                                                                                                                   |                                                                                                                                           |                                                                           |                                 |                      |                 |           |            |                                                                                       |                                                                                       |                                                                                            |
| <b>Unit No.</b>                                                                                                                                                                   | <b>Topic/Unit</b>                                                                                                                         |                                                                           | <b>Contact Hours</b>            | <b>Weightage (%)</b> | <b>BT Level</b> | <b>CO</b> | <b>PSO</b> | <b>Element s of Employa bility (Emp)/ Entrepre neurship (Ent)/ Skill Develop ment</b> | <b>Relevan ce to Local (L)/ National (N)/ Regional (R)/Glob al (G) develop mental</b> | <b>Relation to Gender (G), Environ ment and Sustaina bility (ES), Human Values (HV)and</b> |

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

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|                                                                                                                                                                                                    | <b>The Maharaja Sayajirao University of Baroda</b><br><b>Faculty Technology and Engineering</b><br><b>Department of Applied Chemistry</b> | <b>Academic Year</b>                                               | <b>2024-25</b>                  |                      |                 |           |            |                                                                                            |                                                                                       |                                                                                            |
| <b>M.Sc. (Polymer Science): Regular Programme</b>                                                                                                                                                                                                                                   |                                                                                                                                           |                                                                    |                                 |                      |                 |           |            |                                                                                            |                                                                                       |                                                                                            |
| <b>Year</b>                                                                                                                                                                                                                                                                         | <b>II</b>                                                                                                                                 | <b>Core / <del>Elective</del> / Foundation</b><br>ACH2409: Project | <b>Credits / Hours per week</b> |                      |                 |           |            | <b>24</b>                                                                                  |                                                                                       |                                                                                            |
| <b>Semester</b>                                                                                                                                                                                                                                                                     | <b>II</b>                                                                                                                                 | Year of Introduction: 2020<br>Year of Syllabus Revision: 2024      | <b>Maximum Marks / Grade</b>    |                      |                 |           |            | <b>200</b>                                                                                 |                                                                                       |                                                                                            |
| <b>Mode of Transaction</b>                                                                                                                                                                                                                                                          |                                                                                                                                           | Laboratory Experiments, discussion, presentation and viva          |                                 |                      |                 |           |            |                                                                                            |                                                                                       |                                                                                            |
| <b>Course Outcome (CO) ACH2409</b>                                                                                                                                                                                                                                                  |                                                                                                                                           |                                                                    |                                 |                      |                 |           |            |                                                                                            |                                                                                       |                                                                                            |
| CO1 To understand and carry out independent literature survey, design and execution of experiment related to small polymer-based research problems, analysis/compilation/ interpretation of data together with making of a scientific dissertation report followed by presentation. |                                                                                                                                           |                                                                    |                                 |                      |                 |           |            |                                                                                            |                                                                                       |                                                                                            |
|                                                                                                                                                                                                                                                                                     |                                                                                                                                           |                                                                    |                                 |                      |                 |           |            |                                                                                            |                                                                                       |                                                                                            |
| <b>Unit No.</b>                                                                                                                                                                                                                                                                     | <b>Topic/Unit</b>                                                                                                                         |                                                                    | <b>Contact Hours</b>            | <b>Weightage (%)</b> | <b>BT Level</b> | <b>CO</b> | <b>PSO</b> | <b>Element s of Employa bility (Emp)/ Entrepre neurship (Ent)/ Skill Develop ment (SD)</b> | <b>Relevan ce to Local (L)/ National (N)/ Regional (R)/Glob al (G) develop mental</b> | <b>Relation to Gender (G), Environ ment and Sustaina bility (ES), Human Values (HV)and</b> |

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