Bachelor of Science (B.Sc.) Industrial Chemistry Undergraduate

B. Sc. (UG) Semester – II (**Revised -** Effective from JUNE 2025)

Course Code (Major)	US02MAICH01	**Title of the Course**	Industrial Aspects of Chemistry
Total Credits of the Course	4	**Hours per Week**	4

Course Objectives:	This course aims to: 1. Basic knowledge of Petrochemicals, Adsorption and Catalysis chemistry. 2. The fundamental concepts of Statistics and data analysis.

Course Content		
Unit	**Description**	**Weightage**
1.	Petroleum: Introduction, Raw materials for organic compounds, Petroleum or Crude oil, Classification of petroleum, Origin of petroleum, Mining of petroleum, Refining of Crude oil, Cracking, Types of Cracking, Synthetic Petrol, Refining of Gasoline, Reforming, Thermal Reforming, Catalytic Reforming, Knocking, Diesel engine fuels, Kerosene as a fuel, Liquefied petroleum gas (LPG), Natural gas.	**25%**
2.	Adsorption: Introduction, Mechanism of adsorption, Types of adsorption, Adsorption of gases by Solids, Comparison of physical Adsorption and Chemisorption, Adsorption isotherms, Freundlich adsorption isotherm, Langmuir adsorption isotherm, Derivation of Langmuir Isotherm, Adsorption of solutes from solutions, Applications of adsorption, Ion-exchange adsorption: Cationic exchange and Anionic exchange, Applications of Ion-exchange adsorption: Water softening, Deionization of water and Medical uses.	**25%**
3.	Catalysis: Introduction, Types of catalysis, Homogeneous catalysis, Heterogeneous catalysis, Characteristics of catalytic reactions, Promoters, Catalytic poisoning, Autocatalysis, Negative catalysis, Activation energy and Catalysis, Theories of catalysis: The Intermediate Compound Formation theory and the adsorption theory, Acid–base catalysis, Mechanism of acid catalysis, Enzyme catalysis, Mechanism of enzyme Catalysis, Characteristics of enzyme.	**25%**
4.	Data Analysis: Introduction of Errors & Statistics, Classification of Errors: Determinate errors and Indeterminate errors, Methods for minimization of Errors, Absolute errors, Relative errors, Relative mean deviation, Standard deviation, Co-efficient of variance, Accuracy and Precision, Significant figures, Law of addition, subtraction, multiplication and division; Gaussian curve, The Q-Test, Student T-Test, Examples.	**25%**

Teaching-Learning Methodology	Courses for B.Sc. Industrial Chemistry programs are delivered through conventional blackboard teaching and supported by ICT tools such as PowerPoint presentations, audio-visual content, e-resources, seminars, workshops, and demonstration models. These methods aim to provide an inclusive and engaging learning environment in alignment with NEP-2020.

Evaluation Pattern

Sr. No.	Details of the Evaluation	Weightage
1.	**Internal Theory Examination** [Continuous Evaluation System (CES) (Attendance, Quizzes, Active Participation) (As per NEP-2020)]	**50%**
2.	**External Theory Examination** [University Theory Examination] (as per NEP-2020)	**50%**

Course Outcomes

Upon successful completion of the course, students will be able to:
1. To acquire basic knowledge of Petrochemicals, Adsorption and Catalysis chemistry.
2. To understand the basic fundamental concepts of Statistics and data analysis.

Suggested References:

Sr. No.	References
1.	**"Engineering Chemistry"** by Jain & Jain; Dhanpat Rai Publishing.
2.	**"Introduction to Petroleum Chemicals"** by H. Steiner; Pergamon Press.
3.	**"Industrial Chemistry"** by B.K. Sharma; Goel Publishing House.
4.	**"Essentials of Physical Chemistry"** by Arun Bahl & B.S. Bahl; S. Chand Publishing.
5.	**"A Student's Guide to Data and Error Analysis"** by Herman J.C. Berendsen; Cambridge University Press.
6.	**"Vogel's Textbook of Quantitative Chemical Analysis"** by J. Mendham et al.; Pearson Education.

Online Resources:
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A Charutar Vidya Mandal's Institution
V.P. & R.P.T.P. SCIENCE COLLEGE
(AUTONOMOUS – GRANT – IN – AID)
Affiliated to Sardar Patel University
VALLABH VIDYANAGAR-388120

Bachelor of Science (B.Sc.) **Industrial Chemistry** **Undergraduate**

B. Sc. (UG) Semester – II (**Revised -** Effective from JUNE 2025)

Course Code (Minor)	US02MAICH02	**Title of the Course**	Industrial Chemistry - Practical
Total Credits of the Course	4	**Hours per Week**	8

Course Objectives:	This course aims to: 1. Provide foundational skills in chemical and water analysis relevant to industrial applications. 2. Introduce inorganic qualitative analysis for detection of cations and anions. 3. Identify and analyze functional groups in simple organic compounds.

Course Content
Part: I (02 Credit; 04 Hours per week) 1. Testing of petroleum and petroleum products as per ASTM
Part: II (02 Credit; 04 Hours per week) 1. Inorganic Qualitative Analysis (Two Radicals) 2. Identification of organic compounds (solid and liquid)

Teaching-Learning Methodology	Hands-on laboratory work guided by demonstrative sessions, Use of ICT tools: PowerPoint presentations, visual simulations, and e-resources, Engagement through lab manuals, model-based learning, and peer discussion, Compliance with inclusive education and NEP-2020 guidelines for laboratory pedagogy.

Evaluation Pattern

Sr. No.	**Details of the Evaluation**	**Weightage**
1.	**Internal Practical Examination:** [Continuous Evaluation System (CES) (Attendance, Journals, Quizzes, Practical Records, Active Participation) (As per NEP-2020)]	**50%**
2.	**External Examination** [University Practical Examination] (as per NEP-2020)	**50%**

Note: Assessment will be maintained through observation of performance, attendance, viva voce, and record submission.

Course Outcomes

Upon successful completion of the course, students will be able to:
1. Perform ASTM standard tests on petroleum products and interpret the results.
2. Analyse unknown inorganic salts through systematic semi-micro qualitative methods.
3. Identify basic functional groups in organic compounds.

Suggested References:	
Sr. No.	**References**
1.	**"Chemistry for Degree Students – First Year"** by R. L. Madan, S. Chand & Company Pvt. Ltd.
2.	**"Inorganic Chemistry"** by Peter Atkins, Tina Overton, Jonathan Rourke, Mark Weller & Fraser Armstrong, Oxford University Press.
3.	**"Recommendations on Graphical Symbols for Process Flow Diagram, IS 3232 – 1965"**, Bureau of Indian Standards.
4.	**"Vogel's Textbook of Practical Organic Chemistry"** by Brian S. Furniss, John Wiley & Sons.

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Bachelor of Science (B.Sc.) **Industrial Chemistry** **Undergraduate**

B. Sc. (UG) Semester – II (**Revised -** Effective from JUNE 2025)

Course Code (Minor)	US02MIICH01	**Title of the Course**	Petroleum Processing and Industrial Adsorption Techniques
Total Credits of the Course	2	**Hours per Week**	2

Course Objectives:	This course aims to: 1. Introduce students to the fundamentals of petroleum origin, refining, and processing in the chemical industry. 2. Provide a thorough understanding of adsorption principles and their industrial applications, especially in water treatment and purification processes.

Course Content		
Unit	**Description**	**Weightage**
1.	Petroleum Technology: Overview of petroleum and crude oil, classification, origin, mining, and refining techniques. Topics include cracking (thermal and catalytic), synthetic petrol production, gasoline refining, reforming processes, knocking, and characteristics of fuels such as diesel, kerosene, LPG, and natural gas.	**50%**
2.	Adsorption and Ion-Exchange Applications: Fundamentals of adsorption, mechanism, types (physical and chemical), adsorption isotherms (Freundlich and Langmuir), derivation of Langmuir isotherm, adsorption from solutions, and ion-exchange processes. Emphasis on industrial uses such as water softening, deionization, and medical applications.	**50%**

Teaching-Learning Methodology	Courses for B.Sc. Industrial Chemistry programs are delivered through conventional blackboard teaching and supported by ICT tools such as PowerPoint presentations, audio-visual content, e-resources, seminars, workshops, and demonstration models. These methods aim to provide an inclusive and engaging learning environment in alignment with NEP-2020.

Evaluation Pattern		
Sr. No.	**Details of the Evaluation**	**Weightage**
1.	**Internal Theory Examination** [Continuous Evaluation System (CES) (Attendance, Quizzes, Active Participation) (As per NEP-2020)]	**50%**
2.	**External Theory Examination** [University Theory Examination] (as per NEP-2020)	**50%**

Course Outcomes
Upon successful completion of the course, students will be able to: 1. Understand the fundamental concepts of petroleum origin, mining, and processing for industrial fuel generation. 2. Apply the principles of adsorption and ion exchange in water purification and chemical separation processes. 3. Demonstrate theoretical and practical knowledge relevant to petroleum refining and adsorption in industrial operations.

Suggested References:	
Sr. No.	**References**
1.	**"Petroleum Refining Technology"** by Ram Prasad; Khanna Publishers.
2.	**"Elements of Petroleum Refining"** by B.K. Bhaskara Rao; Oxford & IBH Publishing.
3.	**"Unit Operations of Chemical Engineering"** by Warren L. McCabe, Julian C. Smith, and Peter Harriott; McGraw-Hill Education.
4.	**"Introduction to Chemical Engineering"** by W.L. Badger and J.T. Banchero; McGraw-Hill Education.
5.	**"Chemical Engineering – Volume 6: Chemical Engineering Design"** by R.K. Sinnott; Elsevier.
6.	**"Adsorption and Ion Exchange"** by Hemant J. Patil; CBS Publishers & Distributors.
7.	**"Water Technology: Industrial and Environmental Aspects"** by M.N. Rao and A.K. Datta; Oxford & IBH Publishing.

Online Resources:

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Bachelor of Science (B.Sc.) Industrial Chemistry Undergraduate

B. Sc. (UG) Semester – II (**Revised -** Effective from JUNE 2025)

Course Code (Minor)	US02MIICH02	**Title of the Course**	Industrial Chemistry - Practical
Total Credits of the Course	2	**Hours per Week**	4

Course Objectives:	This course aims to: 1. Provide foundational skills in chemical and water analysis relevant to industrial applications. 2. Introduce inorganic qualitative analysis for detection of cations and anions. 3. Identify and analyze functional groups in simple organic compounds.

Course Content
(02 Credit; 04 Hours per week) Testing of petroleum and petroleum products as per ASTM

Teaching-Learning Methodology	Hands-on laboratory work guided by demonstrative sessions, Use of ICT tools: PowerPoint presentations, visual simulations, and e-resources, Engagement through lab manuals, model-based learning, and peer discussion, Compliance with inclusive education and NEP-2020 guidelines for laboratory pedagogy.

Evaluation Pattern

Sr. No.	**Details of the Evaluation**	**Weightage**
1.	**Internal Practical Examination** [Continuous Evaluation System (CES) (Attendance, Journals, Quizzes, Practical Records, Active Participation) (As per NEP-2020)]	**50%**
2.	**External Examination** [University Practical Examination] (as per NEP-2020)	**50%**

Note: Assessment will be maintained through observation of performance, attendance, viva voce, and record submission.

Course Outcomes

Upon successful completion of the course, students will be able to:
1. Perform ASTM standard tests on petroleum products and interpret the results.
2. Analyse unknown inorganic salts through systematic semi-micro qualitative methods.
3. Identify basic functional groups in organic compounds.

Suggested References:	
Sr. No.	**References**
1.	**"Chemistry for Degree Students – First Year"** by R. L. Madan, S. Chand & Company Pvt. Ltd.
2.	**"Inorganic Chemistry"** by Peter Atkins, Tina Overton, Jonathan Rourke, Mark Weller & Fraser Armstrong, Oxford University Press.
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Bachelor of Science (B.Sc.) Industrial Chemistry Undergraduate

B. Sc. (UG) Semester – II (**Revised -** Effective from JUNE 2025)

Course Code (Inter-Disciplinary)	US02IDICH01	**Title of the Course**	Petroleum and Catalysis in Industrial Chemistry
Total Credits of the Course	2	**Hours per Week**	2

Course Objectives:	This course aims to: 1. Provide foundational knowledge of petroleum and catalytic processes relevant to industrial chemistry. 2. Introduce key principles of industrial chemical reactions and their applications.

Course Content

Unit	Description	Weightage
1.	Petroleum: Introduction, Raw materials for organic compounds, Petroleum or Crude oil, Classification of petroleum, Origin of petroleum, Mining of petroleum, Refining of Crude oil, Cracking, Types of Cracking, Synthetic Petrol, Refining of Gasoline, Reforming, Thermal Reforming, Catalytic Reforming, Knocking, Diesel engine fuels, Kerosene as a fuel, Liquefied petroleum gas (LPG), Natural gas.	**50%**
2.	Catalysis: Introduction, Types of catalysis, Homogeneous catalysis, Heterogeneous catalysis, Characteristics of catalytic reactions, Promoters, Catalytic poisoning, Autocatalysis, Negative catalysis, Activation energy and Catalysis, Theories of catalysis: The Intermediate Compound Formation theory and the adsorption theory, Acid–base catalysis, Mechanism of acid catalysis, Enzyme catalysis, Mechanism of enzyme Catalysis, Characteristics of enzyme.	**50%**

Teaching-Learning Methodology	Courses for B.Sc. Industrial Chemistry programs are delivered through conventional blackboard teaching and supported by ICT tools such as PowerPoint presentations, audio-visual content, e-resources, seminars, workshops, and demonstration models. These methods aim to provide an inclusive and engaging learning environment in alignment with NEP-2020.

Evaluation Pattern

Sr. No.	Details of the Evaluation	Weightage
1.	**Internal Theory Examination** [Continuous Evaluation System (CES) (Attendance, Quizzes, Active Participation) (As per NEP-2020)]	**50%**
2.	**External Theory Examination** [University Theory Examination] (as per NEP-2020)	**50%**

Course Outcomes
Upon successful completion of the course, students will be able to: 1. Understand the origin, processing, and refining of petroleum and evaluate its industrial applications. 2. Demonstrate knowledge of catalytic processes including enzyme and acid-base catalysis and their mechanisms.

Suggested References:	
Sr. No.	**References**
1.	**"Engineering Chemistry"** by P.C. Jain & Monika Jain; Dhanpat Rai Publishing.
2.	**"Petroleum Refining Technology and Economics"** by James H. Gary, Glenn E. Handwerk; CRC Press.
3.	**"Industrial Chemistry"** by B.K. Sharma; Goel Publishing House.
4.	**"Catalysis: Concepts and Green Applications"** by Gadi Rothenberg; Wiley-VCH.
5.	**"Introduction to Catalysis and Industrial Catalytic Processes"** by Robert J. Farrauto et al.; Wiley.
6.	**"Vogel's Textbook of Quantitative Chemical Analysis"** by J. Mendham et al.; Pearson Education.

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Bachelor of Science (B.Sc.) Industrial Chemistry Undergraduate

B. Sc. (UG) Semester – II (**Revised -** Effective from JUNE 2025)

Course Code (Skill Enhancement Course)	US02SEICH01	**Title of the Course**	Industrial Safety & Hygiene – II
Total Credits of the Course	2	**Hours per Week**	2

Course Objectives:	This course aims to: 1. To help students understand the basic concepts of safety in chemical industries. 2. To increase knowledge of various safety procedures and measures taken at the plant site while working with hazardous chemicals.

Course Content

Unit	Description	Weightage
1.	Safety in Chemical Industries: Place of Chemical Industries in Society, Statutory Provisions, Types of Chemical Hazards & Their Control, General Safety Precautions.	**50%**
2.	Process Hazard & Its Control: Utility Hazard & Its Control, Safety Transportation of Chemicals, Checklist of Routine Inspections in Chemical Factories, Types of Tests, Certificates & Records, Permits for Vessel Entry.	**50%**

Teaching-Learning Methodology	Courses for B.Sc. Industrial Chemistry programs are delivered through conventional blackboard teaching and supported by ICT tools such as PowerPoint presentations, audio-visual content, e-resources, seminars, workshops, and demonstration models. These methods aim to provide an inclusive and engaging learning environment in alignment with NEP-2020.

Evaluation Pattern

Sr. No.	Details of the Evaluation	Weightage
1.	**Internal Theory Examination** [Continuous Evaluation System (CES) (Attendance, Quizzes, Active Participation) (As per NEP-2020)]	**50%**
2.	**External Theory Examination** [University Theory Examination] (as per NEP-2020)	**50%**

Course Outcomes

Upon successful completion of the course, students will be able to:
1. Understand the basic concepts of fire and safety in the industry.
2. Increase knowledge of various safety procedures and measures taken at the plant site during working with hazardous chemicals.

Suggested References:	
Sr. No.	**References**
1.	**"Fundamentals of Industrial Safety & Health – Volume 1"** by Dr. K.U. Mistry, Atul Prakashan.
2.	**"Fundamentals of Industrial Safety & Health – Volume 2"** by Dr. K.U. Mistry, Atul Prakashan.
3.	**"Occupational Safety and Health"** by David H. Goetsch, Pearson Education.

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