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

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

Course Code (Major)	US01MAICH01	**Title of the Course**	Fundamentals of Process Calculations, Diagrams, and Instrumentation
Total Credits of the Course	4	**Hours per Week**	4

Course Objectives:	This course aims to: 1. Introduce the fundamental principles of process calculations in chemical engineering. 2. Develop the ability to represent and interpret equipment and processes using standard chemical engineering diagrams. 3. Familiarize students with basic instrumentation techniques, especially for temperature and viscosity measurement, applicable to process industries.

Course Content		
Unit	**Description**	**Weightage**
1.	Chemical Engineering Equipment Drawing and Process Diagrams: Standard Symbols & Codes: Interpretation of IS/ISO/ANSI equipment and instrumentation symbols used in chemical industries. Drawing of Equipment Parts: Sketching valves, pipe fittings, joints, and mounting parts used in chemical process systems. Freehand Sketching: Practice in manually sketching equipment used in unit operations, Types of Diagrams, Block Flow Diagrams (BFD): Simplified diagrams representing main process units and material flow.	**25%**
2.	Units and Dimensions: Introduction to Process Calculation, Dimension and system of units, Fundamental and Derived quantities of units, Definition and units of force, volume, pressure, power, work, energy, heat; Examples based on unit conversion. Basic Chemical Calculations & Ideal Gas Law: Definition and calculations of mole, atomic weight, molecular weight, equivalent weight, specific gravity and API gravity; Concept and derivation of ideal gas law, STP and NTP conditions, Dalton's law, Amagat's law, Raoult's law, Henry's law, Relation between mole%, volume% and pressure% of ideal gases, Calculation of average molecular weight, density, mole%, weight% in gas mixture.	**25%**
3.	Material Balance without Chemical Reactions: Law of conservation of mass, Material balance calculations of distillation, evaporation, mixing, drying, crystallization, absorption; Brief idea regarding recycling, bypassing and purging operation Material Balance with Chemical Reactions: Introduction to stoichiometric equation, stoichiometric coefficient, stoichiometric ratio, limiting reactant, excess reactant, percent excess, Conversion, Yield and Selectivity, Examples based on Material balance with Chemical Reaction.	**25%**

4.	Process Instrumentation: Introduction, Types of Measurement, Temperature Measurement Instruments Principles and classification of temperature measurement methods, Detailed study of temperature measuring instruments, Construction, working, selection criteria, and industrial applications. Viscosity Measurement: Introduction to viscosity and its significance in process industries, Principle and working of viscosity measurement techniques, Overview of viscosity measuring instruments, Selection of instruments based on process requirements.	**25%**

Teaching-Learning Methodology	The teaching will be delivered through conventional blackboard-based classroom instruction supported by ICT tools including PowerPoint presentations, audio-visual content, e-resources, and practical demonstrations. Learning will be enhanced through interactive seminars, workshops, and hands-on model-based learning, ensuring inclusivity and engagement as per NEP-2020 guidelines.

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. Interpret and construct chemical engineering diagrams using standard conventions.
2. Apply dimensional analysis and perform accurate process calculations involving units and gases.
3. Solve material balance problems in systems with and without chemical reactions.
4. Understand the principles and selection criteria of basic temperature and viscosity measuring instruments used in the industry.

Suggested References:

Sr. No.	References
1.	**"Stoichiometry and Process Calculations"** by K. V. Narayanan & B. Lakshmikutty, Prentice Hall of India.
2.	**"Elementary Principles of Chemical Processes"** by Richard M. Felder & Ronald W. Rousseau, Wiley India.
3.	**"Chemical Process Principles Part I – Material and Energy Balance"** by O. A. Hougen, K. M. Watson & R. A. Ragatz, CBS Publishers.
4.	**"Introduction to Chemical Engineering"** by Walter L. Badger & Julius T. Banchero, McGraw-Hill Education.

5.	**"Chemical Engineering Volume 6 – Process Design and Simulation"** by R. K. Sinnott, Butterworth-Heinemann.
6.	**"Chemical Engineering Drawing Symbols"** by G. K. Patel, Standard Book House.
7.	**"Industrial Instrumentation"** by D. Patranabis, Tata McGraw-Hill Publishing.
8.	**"Mechanical Measurements"** by Thomas G. Beckwith & Roy D. Marangoni, Pearson Education.
9.	**"Fundamentals of Process Control Engineering"** by P. Harriott, Tata McGraw-Hill Publishing.
10.	**"Process Systems Analysis and Control"** by Donald R. Coughanowr, McGraw-Hill 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 – I (**Revised -** Effective from JUNE 2025)

Course Code (Minor)	US01MAICH02	**Title of the Course**	Industrial Chemistry Practical
Total Credits of the Course	4	**Hours per Week**	8

Course Objectives:	This course aims to: 1. Introduce students to industrial engineering symbols, process diagrams, and technical sketching. Strengthen foundational skills in unit conversions, gas laws, and stoichiometric calculations. 2. Develop practical competency in material balance and thermophysical measurements. 3. Familiarize students with standard instrumentation used in chemical industries for physical property measurements.

Course Content

Part I: Process Calculations (2 Credit, 4 Hour per Week)

- To perform unit conversions using standard laboratory techniques.
- To perform stoichiometric calculations and material balance calculation.
- To develop accuracy in laboratory measurements through the calibration and correct handling of Glassware.

Part II: Engineering Drawing, Diagrams & Instrumentation (2 Credit, 4 Hour per Week)

- To develop skills in freehand sketching, interpret standard engineering symbols, and construct Block Flow Diagrams (BFD) representing industrial chemical processes and equipment.
- To understand the working principles of temperature and viscosity measuring instruments.
- To perform acid-base titrations, determine specific gravity and viscosity using standard analytical and physical measurement techniques.

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. Accurately draw and interpret industrial process diagrams and equipment symbols. 2. Apply gas laws and unit conversions in practical laboratory setups. 3. Perform stoichiometric and material balance calculations using experimental data. 4. Measure fluid and temperature properties using industry-standard instruments. 5. Bridge theoretical engineering concepts with practical chemical industry applications.

Suggested References:	
Sr. No.	**References**
1.	**"Elementary Principles of Chemical Processes" –** Richard M. Felder, Ronald W. Rousseau**,** Wiley India.
2.	**"Stoichiometry" –** B.I. Bhatt, S.M. Vora**,** McGraw Hill Education
3.	**"Chemical Process Principles Part-I: Material and Energy Balance" –** O.A. Hougen, K.M. Watson, R.A. Ragatz**,** CBS Publishers & Distributors
4.	**"Process Systems Analysis and Control" –** Donald R. Coughanowr, Steven E. LeBlanc**,** McGraw Hill Education.
5.	**"Industrial Instrumentation" –** D. Patranabis**,** Tata McGraw Hill
6.	**"Chemical Engineering Drawing Symbols" –** Gavin Towler, Ray Sinnott**,** Elsevier (In: Chemical Engineering Design, Volume 6 of Coulson & Richardson's series).
7.	**"Introduction to Chemical Engineering" –** Walter L. Badger, Julius T. Banchero**,** McGraw Hill Education.
8.	**"Engineering Drawing" –** N.D. Bhatt**,** Charotar Publishing House.
9.	**"Instrumental Methods of Analysis" –** H.H. Willard, L.L. Merritt, J.A. Dean, F.A. Settle**,** CBS Publishers & Distributors.

Online Resources:

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

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

Course Code (Minor)	US01MIICH01	**Title of the Course**	Introduction to Industrial Chemistry - I
Total Credits of the Course	2	**Hours per Week**	2

Course Objectives:	This course aims to: 1. Introduce students to foundational principles in chemical engineering. 2. Provide a comprehensive understanding of key concepts in measurements, inorganic chemistry, and analytical techniques relevant to industrial processes.

Course Content		
Unit	**Description**	**Weightage**
1.	Process Instrumentation: Introduction, Types of Measurement, Temperature Measurement Instruments Principles and classification of temperature measurement methods, Detailed study of temperature measuring instruments, Construction, working, selection criteria, and industrial applications. Viscosity Measurement: Introduction to viscosity and its significance in process industries, Principle and working of viscosity measurement techniques, Overview of viscosity measuring instruments, Selection of instruments based on process requirements.	**50%**
2.	Analytical Methods in Chemical Engineering: Introduction to titrimetric methods of chemical analysis, Different types of reactions involved in titrimetry, Preparation and standardization of solutions, Determination of equivalence point and endpoint in titration, Application of acid-base titrations in chemical analysis.	**50%**

Teaching-Learning Methodology	The teaching will be delivered through conventional blackboard-based classroom instruction supported by ICT tools including PowerPoint presentations, audio-visual content, e-resources, and practical demonstrations. Learning will be enhanced through interactive seminars, workshops, and hands-on model-based learning, ensuring inclusivity and engagement per NEP-2020 guidelines.

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. Demonstrate a solid understanding of foundational concepts in chemical engineering. 2. Utilize various measurement techniques and analytical methods in industrial settings. 3. Utilize theoretical analytical methods and apply them in industrial settings.

Suggested References:	
Sr. No.	**References**
1.	**"Unit Operations: Volume I & II"** by K. A. Gavhane, Nirali Prakashan.
2.	**"Principles of Chemical Engineering"** by Richard M. Felder and Ronald W. Rousseau, Wiley.
3.	**"Industrial Instrumentation & Process Control"** by A. P. Kulkarni, Nirali Prakashan.
4.	**"Essentials of Chemical Reaction Engineering"** by H. Scott Fogler, Prentice Hall.
5.	**"Vogel's Textbook of Quantitative Chemical Analysis"** by G. H. Jeffery, J. Mendham, R. C. Denney, Longman Scientific & Technical.
6.	**"Analytical Chemistry"** by G. D. Christian, John Wiley & Sons, 3rd Edition.
7.	**"Analytical Chemistry: Principles"** by J. H. Kennedy, Saunders College Publishers, 2nd Edition, 1990.

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

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

Course Code (Minor)	US01MIICH02	**Title of the Course**	Industrial Chemistry Practical
Total Credits of the Course	2	**Hours per Week**	4

Course Objectives:	This course aims to: 1. Equip students with hands-on experience in handling laboratory glassware and instruments with precision. Build competencies in calibration techniques and laboratory standard operating procedures. 2. Develop foundational skills in the preparation, standardization, and application of analytical solutions. 3. Impart practical knowledge of titrimetric analysis, physical property measurements, and industrial laboratory practices.

Course Content

(2 Credit, 4 Hours Per Week)

1. Calibration and Handling of Laboratory Glassware
2. Titrimetric Analysis: Acid-base titrations involving strong and weak acids/bases, Calculation of normality, molarity, and equivalent weights.
3. Preparation and Standardization of Analytical Solutions (sodium carbonate, oxalic acid, hydrochloric acid, sodium thiosulfate, etc.)
4. Determination and Measurement of specific gravity and viscosity using standard laboratory techniques.

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. Demonstrate competency in laboratory measurements and calibration techniques. 2. Prepare and standardize chemical solutions using titrimetric and analytical methods. 3. Accurately determine physical properties such as viscosity and specific gravity. 4. Understand the application of basic industrial instruments in chemical analysis.

Suggested References:	
Sr. No.	**References**
1.	**"Vogel's Textbook of Quantitative Chemical Analysis"** by J. Mendham, R.C. Denney, J.D. Barnes, M.J.K. Thomas, Pearson Education.
2.	**"Practical Chemistry"** by O.P. Pandey, D.N. Bajpai, S. Giri, S. Chand Publishing.
3.	**"Instrumental Methods of Chemical Analysis"** by B.K. Sharma, Goel Publishing House.
4.	**"Laboratory Manual on Engineering Chemistry"** by Sudha Rani, Dhanpat Rai Publishing.
5.	**"Analytical Chemistry: Principles and Techniques"** by Larry H. Hargis, Pearson Education.

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

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

Course Code (Inter-Disciplinary)	US01IDICH01	**Title of the Course**	Introduction to Instrumentation and Process Control - I
Total Credits of the Course	2	**Hours per Week**	2

Course Objectives	This course aims to: 1. To provide students with foundational knowledge of measurement principles and instrumentation systems used in process industries. 2. This course aims to familiarize students with instrument classifications, standardization, calibration, and basic control instrumentation.

Course Content		
Unit	**Description**	**Weightage**
1.	Classification of instruments, Metrological terms, definitions, units, and standards, Performance characteristics of instruments and calibration methods, Hierarchy of standards and traceability, Measurement of uncertainty, codes, and standard symbols used in instrumentation.	**50%**
2.	Introduction to instruments used for indicating, recording, and controlling process variables including: Pressure (including mud pressure), Flow, Temperature, Viscosity, Level, pH, Density, Weight, Penetration, Torque, RPM, Magnetic flux.	**50%**

Teaching-Learning Methodology	The teaching will be delivered through conventional blackboard-based classroom instruction supported by ICT tools including PowerPoint presentations, audio-visual content, e-resources, and practical demonstrations. Learning will be enhanced through interactive seminars, workshops, and hands-on model-based learning, ensuring inclusivity and engagement per NEP-2020 guidelines.

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 basic terminology and standards used in industrial instrumentation. 2. Identify different categories of instruments used for various measurements in process industries. 3. Analyze performance parameters and calibration requirements of instruments. 4. Comprehend the hierarchy of measurement standards and traceability systems. 5. Apply concepts of instrumentation in laboratory and industrial contexts.

Suggested References:	
Sr. No.	**References**
1.	**"Process Instrumentation and Control"** by A.P. Kulkarni, Nirali Prakashan.
2.	**"Principles of Industrial Instrumentation"** by D. Patranabis, Tata McGraw Hill.
3.	**"Instrumentation Reference Book"** by B.E. Noltingk, Butterworth-Heinemann.
4.	**"Mechanical and Industrial Measurements"** by R.K. Jain, Khanna Publishers.
5.	**"Unit Operations: Vol. I & II"** by K.A. Gavhane, Nirali Prakashan.

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

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

Course Code (Skill Enhancement Course)	US01SEICH01	**Title of the Course**	Industrial Safety & Hygiene – I
Total Credits of the Course	2	**Hours per Week**	2

Course Objectives:	This course aims to: 1. Students will understand the basic concepts of fire and safety in industry. 2. It will increase the know-how of various safety procedures and measures taken at the plant site during working with hazardous chemicals.

Course Content

Unit	Description	Weightage
1.	Introduction of Safety & Hazards Safety in chemical industries, Introduction of hot & cold processes, Types of furnaces & use of safety measures, Need for safety in industries, Indian standards, and safety terminology.	**50%**
2.	Fire & Explosion Hazard in Chemical Industries: Fire phenomena, Nature of fire, Need for fire, triangle of fire, Factors contributing to fire, Classification of fire & extinguishers, Fire prevention & protection systems, General control measures for fire detection and alarm systems, Portable fire extinguishers, automatic water sprinklers, and water spray systems.	**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. Demonstrate knowledge of various safety procedures and measures taken at plant sites while 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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