



**B.Sc. (Industrial Chemistry) Semester – IV**

Course Code (Major)	US04MAICH01	Title of the Course	Chemical Plant Utilities & Unit Operations
Total Credits of the Course	04	Hours per Week	04
Course Objectives:	To make students familiar with: 1. Calculation of Process & Chemical Engineering as a subject. 2. Basic concepts related to Chemical Engineering and engineering drawing.		

Course Content		
Unit	Description	Weightage*(%)
1.	Energy Balance: Forms of energy, Law of conservation of Energy, General Energy Balance Procedure, Energy balance for batch and continuous processes, Heat capacity, Specific heat, Combustion and Calorific value of fuels, Combustion calculations. Adsorption: Adsorbent and adsorbate, Chemisorption and physical adsorption, Adsorption isotherms, Application of adsorption.	25%
2.	Compression equipment: reciprocating compressor, Work of single-stage reciprocating compressor, Effect of clearance, Volumetric efficiency, Multistage compression, Refrigeration: COP & refrigerating effect, Industrial refrigerants, Carnot, and other refrigeration cycles.	25%
3.	Heat Transfer: Modes of heat transfer, Fourier's law, Thermal conductivity, Thermal insulators, Steady state one-dimensional heat conduction equation through the planar wall, cylindrical wall, spherical wall, and composite structure. Heat transfer equipment, Types of heat exchangers, Shell and tube heat exchangers, Double pipe heat exchangers, Extended surface, and Plate type heat exchangers.	25%
4.	Drying: Introduction, General Definitions, Equilibrium, Humidity, Dry and Wet Bulb Temperature, Equilibrium, Constant Rate Period, Falling Rate Period, Drying Equipment: Tray Dryer, Rotary Dryer, Drum Dryer, Spray Dryer, Fluidized Bed Dryer, Tunnel Dryer, Pneumatic (flash) Dryer.	25%

Teaching-Learning Methodology	Conventional method (classroom blackboard teaching), ICT. Courses for B. Sc. Industrial Chemistry programs are delivered through classroom, and laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (PowerPoint presentations, audio-visual resources, e-resources, seminars, workshops, models).
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per NEP 2020)	25%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per NEP 2020)	25%
3.	University Examination (As per NEP 2020)	50%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn about Energy Balance, Adsorption and utility instrumentation.
2.	To learn about handling and working of Heat exchange and Drying Equipment

Suggested References:	
Sr. No.	References
1.	Unit operation Volume I. K.A.Gavhane (NiraliPrakashan).
2.	Introduction to Chemical Engineering. W.L. Badger & J.I. Banchemo (McGraw Hill).
3.	Unit operation, Volume II.Coulson& Richardson
4.	Industrial Chemistry of B K Sharma.
5.	Chemical Process Principles: (Part I), Haugen, Watson, and Regatz (Asia Pub. House).
6.	Fuels and combustion, S. P. Sharma and Chandra Mohan Tata Mc Graw.
7.	Fuels and Combustion, Samir Sarkar, Orient Longmuir Ltd.
8.	Chemistry of engineering materials by C.V. Agrawal, Tara Publications.

On-line resources to be used if available as reference material
Online Resources: Google Books, INFLIBNET, Google Web

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**B. Sc. (Industrial Chemistry) Semester – IV**

Course Code (Major)	US04MAICH02	Title of the Course	Analytical Chemistry
Total Credits of the Course	04	Hours per Week	04
Course Objectives:	To make students familiar with: 1. Basic knowledge, concepts, techniques, and principles of analytical chemistry. 2. The principles of the most important liquid and gas chromatographic.		

Course Content		
Unit	Description	Weightage*(%)
1.	Redox Titrations: Introduction, Redoxsystems, Redoxpotential, Nernstequation, Equilibriumconstant, Titration curve & Feasibility, Redox indicators, Iodometricandiodimetictitrations.,ComplexometricTitrations:Introduction, Stability constant,Ways of detectingendpoint, Titration curves, Equilibrium involved in EDTA titration, Types of EDTA titrations, Titration of mixture; Selectivity, Masking and demasking, Metallochromicindicators, Applications.	25%
2.	Precipitation Titrations - Introduction, Feasibility and end point detection, Indicators, Volhard, Fajan and Mohr's methods,Factors affecting solubility of precipitates.Gravimetric Methods of Analysis - Principle of gravimetry, Requirements of precipitates, Formation and properties of precipitates, Coagulation & peptization, Co-precipitation and occlusion, Washing, drying and ignition of precipitate.	25%
3.	pH metry – Introduction, determination of pH & applications.Potentiometric titrations - Introduction, Types of titrations & Advantages of potentiometric titrations. Conductometric measurements - Introduction, Some important laws, Definition and relations, Effect of dilution, Applications of conductance measurements, Types of titrations, Advantages and disadvantages.	25%
4.	Chromatography - Introduction, Classification and applications.Paper chromatography - Introduction, Experimental details for qualitative analysis. Thin layer chromatography - Introduction, Superiority of TLC over the other techniques, Experimental techniques, Scope & limitations. Column chromatography - Introduction, Experimental details, Theory of development, factors affecting column efficiency.GC & HPLC - Introduction, Instrumentation, Sampling methods, Experimental details and applications.	25%



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Teaching-Learning Methodology	Conventional method (classroom blackboard teaching), ICT. Courses for B. Sc. Industrial Chemistry program are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (PowerPoint presentations, audio visual resources, e-resources, seminars, workshops, models).
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per NEP 2020)	25%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per NEP 2020)	25%
3.	University Examination (As per NEP 2020)	50%

Course Outcomes: Having completed this course, the learner will be able	
1.	To acquire knowledge on basic concepts of redox and complexometric titrations.
2.	To acquire knowledge on the basic principles of precipitation titrations and gravimetric analysis.
3.	To acquire skills in the operation of pH meter and conductometric titrimetry.
4.	To understand various chromatography methods in the separation and identification of organic compounds.



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Suggested References:	
Sr. No.	References
1.	Instrumental methods of chemical analysis by Chatwal – Anand, Himalaya Publishing House.
2.	Instrumental methods of chemical analysis by B.K. Sharma, Krishna Publication Media (P) Ltd., Meerut.,
3.	Analytical chemistry by Gray D. Christian, 4 <sup>th</sup> edition, Wiley & Sons, Inc.,
4.	Instrumental methods of analysis by Willard Merritt, Dean Settle, CBS Publishers & Distributors, New Delhi.,
5.	Principles of instrumental analysis by Skoog, Holler, Nieman, Thomson Asia Pvt. Ltd., Singapore.,
6.	Instrumental methods of chemical analysis by Galen W. Ewing, McGraw – Hill Book Company.
7.	Fundamental of Analytical Chemistry-By Douglas A. Skoog, West, Holler, Crouch (2004, 8 <sup>th</sup> edition) Mexico: Thomson-Brooks/Cole (ISBN: 81-315-0051-9).

On-line resources to be used if available as reference material

On-line Resources: Google books, INFLIBNET, Google Web



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**B. Sc. (Industrial Chemistry) Semester – III**

Course Code (Major Practical)	US04MAICH03	Title of the Course	Practical
Total Credits of the Course	04	Hours per Week	08

Course Objectives:	Develop the skill to analyze and identify the materials, its testing chemicals, Develop skills in the scientific method of calibrating the glassware. Enhance the skill of preparation and standardization of analytical solutions. Develop skills in understanding, planning and performing experiments for titrimetric analysis.
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Course Content
Part: I (02 Credit ; 04 Hours per week) <ul style="list-style-type: none"><li>➤ Experiments base on Heat Transfer and Drying unit operations.</li></ul> Part:II (02 Credit ; 04 Hours per week) <ul style="list-style-type: none"><li>➤ Calibration of Volumetric Glassware. And preparation of solutions</li><li>➤ Experiments based on estimation of raw materials and semi micro analysis of inorganic compounds.</li><li>➤ Chromatography based experiments</li></ul>

Teaching-Learning Methodology	Courses for B. Sc. Industrial Chemistry program are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (PowerPoint presentations, audio visual resources, e-resources, seminars, workshops, models).
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	University Examination (As per NEP 2020)	100%

Course Outcomes: Having completed this course, the learner will be able to Acquire practical knowledge of basic chemical laboratory tools and analytical concept for the subject of industrial chemistry.
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Suggested References:

1. Brian S. Furniss (1989, 5<sup>th</sup> edition) *Vogel's Textbook of Practical Organic Chemistry*. Hoboken: John Wiley & Sons (ISBN: 0-582-462363).
2. Hassner, A. (2012, 3<sup>rd</sup> edition) *Organic Syntheses Based on Name Reactions*. Philadelphia: Elsevier Publishing company (ISBN: 978-0-08-096630-4).
3. Jeffery, G. H.; Bassett, J.; Mendham, J.; Denny, R. C. (1989, 5<sup>th</sup> edition) *Vogel's Textbook of Quantitative Chemical Analysis*. Hoboken: John Wiley & Sons (ISBN: 0-582-44693-7).

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**B.Sc. (Industrial Chemistry) Semester – IV**

Course Code (Minor)	US04MIICH01	Title of the Course	Unit Operations
Total Credits of the Course	02	Hours per Week	02
Course Objectives:	To make students familiar with: 1. Calculation of Process & Chemical Engineering as a subject. 2. Basic concepts related to Chemical Engineering and engineering drawing.		

Course Content		
Unit	Description	Weightage*(%)
1.	Heat Transfer: Modes of heat transfer, Fourier's law, Thermal conductivity, Thermal insulators, Steady state one-dimensional heat conduction equation through the plane wall, cylindrical wall, spherical wall, and composite structure. Heat transfer equipment, Types of heat exchangers, Shell and tube heat exchangers, Double pipe heat exchangers, Extended surface, and Plate type heat exchangers.	25%
2.	Drying: Introduction, General Definitions, Equilibrium, Humidity, Dry and Wet Bulb Temperature, Equilibrium, Constant Rate Period, Falling Rate Period, Drying Equipment: Tray Dryer, Rotary Dryer, Drum Dryer, Spray Dryer, Fluidized Bed Dryer, Tunnel Dryer, Pneumatic (flash) Dryer.	25%

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Evaluation Pattern		
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3.	University Examination (As per NEP 2020)	50%





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Course Outcomes: Having completed this course, the learner will be able to

1.	Learn about Energy Balance, Adsorption and utility instrumentation.
2.	To learn about handling and working of Heat exchange and Drying Equipment

Suggested References:

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1.	Unit operation Volume I. K.A.Gavhane (NiraliPrakashan).
2.	Introduction to Chemical Engineering. W.L. Badger & J.I. Banchero (McGraw Hill).
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B.Sc. (Industrial Chemistry) Semester – III

Course Code (Minor Practical)	US04MIICH02	Title of the Course	Practical
Total Credits of the Course	02	Hours per Week	04

Course Objectives:	Develop the skill to analyze the concept of unit operations like Heat transfer and Drying
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Course Content
(02 Credit ; 04 Hours per week) ➤ Experiments base on Heat Transfer and Drying unit operations.

Teaching-Learning Methodology	Courses for B. Sc. Industrial Chemistry program are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (PowerPoint presentations, audio visual resources, e-resources, seminars, workshops, models).
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	University Examination (As per NEP 2020)	100%

Course Outcomes: Having completed this course, the learner will be able to concept of Unit Operations
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Suggested References:
1. Brian S. Furniss (1989, 5 <sup>th</sup> edition) <i>Vogel's Textbook of Practical Organic Chemistry</i> . Hoboken: John Wiley & Sons (ISBN: 0-582-462363). 2. Hassner, A. (2012, 3 <sup>rd</sup> edition) <i>Organic Syntheses Based on Name Reactions</i> . Philadelphia: Elsevier Publishing company (ISBN: 978-0-08-096630-4).