Re-Accredited 'B++' 2.86 CGPA by NAAC
VEER NARMAD SOUTH GUJARAT UNIVERSITY
University Campus, Udhna-Magdalla Road, SURAT - 395 007, Gujarat, India.
વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી
યુનિવર્સિટી કેમ્પસ, ઉધના-મગદલ્લા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.
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–: પરિપત્ર :–

યુનિવર્સિટી સંલગ્ન વિજ્ઞાન વિદ્યાશાખા હેઠળની તમામ કોલેજોનાં આચાર્યશ્રીઓને જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૫–૨૬ થી અમલમાં આવનાર T.Y.B.Sc. Chemistry Sem.-5 & 6 Major, Minor અને SEC નો પેટાસમિતિ દ્વારા તૈયાર કરવામાં આવેલ અભ્યાસક્રમ સંદર્ભે રસાયણશાસ્ત્ર વિષયની અભ્યાસ સમિતિની તા.૨૮/૦૩/૨૦૨૫ ની સભાના ઠરાવ ક્રમાંકઃ૦૨ થી કરેલ ભલામણ સ્વીકારી વિજ્ઞાન વિદ્યાશાખાની તા.૩૦/૦૪/૨૦૨૫ની સભાનાં ઠરાવ ક્રમાંકઃ૧૭ થી કરેલ ભલામણ સ્વીકારી એકેડેમિક કાઉન્સિલની તા.૫/૫/૨૦૨૫ ની સભાનાં ઠરાવ ક્રમાંકઃ ૮૪ થી મંજુર કરેલ છે. જેનો અમલ કરવા આથી જાણ કરવામાં આવે છે.

બિડાણઃ ઉપર મુજબ

ક્રમાંકઃઓથો./પરિપત્ર/સિલેબસ/૧૧૯૯૨/૨૦૨૫
તા.૨૬–૦૫–૨૦૨૫

કુલસચિવ

પ્રતિ,
૧) યુનિવર્સિટી સંલગ્ન વિજ્ઞાન વિદ્યાશાખા હેઠળની તમામ કોલેજોનાં આચાર્યશ્રીઓ.
.....આપશ્રીની કોલેજના સંબંધિત શિક્ષકોને જાણ કરી અમલ કરવા સારૂ.
૨) ડીનશ્રી, વિજ્ઞાન વિદ્યાશાખા.
૩) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.
.....તરફ જાણ તેમજ અમલ સારૂ.

VEER NARMAD SOUTH GUJARAT UNIVERSITY

UNDER GRADUATE PROGRAMME
IN
CHEMISTRY
UNDER FACULTY OF SCIENCE
3 (YEARS DEGREE) AND 4 (YEARS HONOURS)

T. Y. B. Sc. Sem. – V and Sem. – VI

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

UNDER GRADUATE PROGRAMME IN CHEMISTRY MAJOR/MINOR/SEC

3 (YEARS DEGREE) AND 4 (YEARS HONOURS)

B. Sc. – Sem. – V and VI CHEMISTRY

Programme Outcomes	**PO-01:** Scientific Knowledge & Conceptual Understanding: Develop a strong foundation in scientific principles, theories, and concepts across disciplines, fostering interdisciplinary learning, advance knowledge, and problem-solving abilities. **PO-02:** Analytical & Critical Thinking: Apply critical thinking and analytical reasoning to evaluate scientific data, hypotheses, and real-world problems, leading to evidence-based conclusions. **PO-03:** Research & Inquiry-based Learning: Develop investigative skills through experimentation, data analysis and scientific inquiry to contribute to research and innovation. **PO-04:** Laboratory & Technical Skills: Gain hands-on experience with laboratory techniques, instrumentation, and computational tools relevant to scientific research and industry applications. **PO-05:** Digital & Computational Literacy: Utilize digital tools, computational techniques, and emerging technologies such as AI, bioinformatics, and statistical modelling to enhance scientific learning and problem-solving. **PO-06:** Environmental & Societal Responsibility: Understand the role of science in addressing environmental, health and societal challenges, promoting sustainability and ethical responsibility. **PO-07:** Effective Communication & Collaboration: Develop proficiency in scientific communication, both written and oral, for effective dissemination of knowledge while collaborating in multidisciplinary teams. **PO-08:** Innovation & Entrepreneurship: Foster an entrepreneurial mind-set by applying scientific knowledge for innovation, technology development, and industry-oriented applications. Develop sustainable solutions to address real-world challenges in research and environmental management. **PO-09:** Lifelong Learning & Professional Growth: Cultivate curiosity and adaptability for continuous learning, equipping students for higher education, research, and professional careers. **PO-10:** Ethical Leadership & Value-based Education: Develop leadership qualities, ethical values, and a sense of responsibility in applying science for societal progress, aligning with Indian knowledge systems and global perspectives.

Programme Specific Outcomes

PSO1: Develop a strong conceptual understanding of organic, inorganic, physical, and analytical chemistry, integrating interdisciplinary scientific principles for advanced problem-solving and research.

PSO2: Demonstrate hands-on laboratory and computational skills, performing experiments independently and in teams, applying digital tools, and effectively communicating scientific findings.

PSO3: Apply key chemical concepts, analytical reasoning, and computational techniques to solve real-world challenges, emphasizing research, innovation, and technology-driven learning.

PSO4: Utilize chemical methodologies and problem-solving strategies to address unfamiliar scientific challenges, fostering critical thinking, adaptability, and lifelong learning.

PSO5: Develop industry-relevant skills, enhancing employability through innovation, entrepreneurship, sustainable applications, and professional ethics in chemistry and allied sciences.

PSO6: Engage in research-driven learning, applying experimental techniques, computational methods, and scientific inquiry to contribute to cutting-edge advancements in chemistry.

PSO7: Attain the level of proficiency required for higher education, research, and interdisciplinary scientific careers, integrating lifelong learning, ethical practices, and leadership.

PSO8: Design innovative and sustainable solutions using chemical principles to tackle local and global scientific, societal, and environmental challenges responsibly.

Mapping of PO and PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
PO1	✓		✓				✓	
PO2	✓		✓	✓		✓		✓
PO3	✓	✓	✓	✓		✓	✓	
PO4		✓		✓	✓	✓		✓
PO5		✓	✓	✓	✓	✓	✓	
PO6	✓	✓	✓		✓	✓	✓	✓
PO7	✓	✓		✓	✓		✓	✓
PO8			✓		✓			✓
PO9	✓	✓		✓	✓		✓	✓
PO10						✓		✓

VEER NARMAD SOUTH GUJARAT UNIVERSITY

Programme Name: Bachelor of Science Sem. - V

About Programme:

Teaching and Evaluation Scheme:

Structure

Course Category	Course code	Course title	Marksheet title in English	Level of Course	Teaching hours per week		Exam duration		Credit		Internal marks		External Marks		Total	
					TH	PR	TH	PR	TH	PR	TH	PR	TH	PR	TH	PR
Major	CH-MJ-501	Inorganic Chemistry	Inorganic Chemistry	300	02	04	01	04	02	02	25	25	25	25	50	50
Major	CH-MJ-502	Organic Chemistry	Organic Chemistry	300	02	04	01	04	02	02	25	25	25	25	50	50
Major	CH-MJ-503	Physical Chemistry	Physical Chemistry	300	02	04	01	04	02	02	25	25	25	25	50	50
Minor	CH-ME-501	Chemical Analysis	Chemical Analysis	200	02	04	01	04	02	02	25	25	25	25	50	50
Minor	CH-ME-502	Applied Industrial Chemistry	Applied Industrial Chemistry	200	02	04	01	04	02	02	25	25	25	25	50	50
SEC	CH-SEC-501	Spectral and Industrial Chemistry	Spectral and Industrial Chemistry	-	01	02	0.5	02	01	01	12	12	13	13	25	25

VEER NARMAD SOUTH GUJARAT UNIVERSITY

Programme Name: Bachelor of Science Sem. - VI

About Programme:

Teaching and Evaluation Scheme:

Structure

Course Category	Course code	Course title	Marksheet title in English	Level of Course	Teaching hours per week		Exam duration		Credit		Internal marks		External Marks		Total	
					TH	PR	TH	PR	TH	PR	TH	PR	TH	PR	TH	PR
Major	CH-MJ-601	Inorganic Chemistry	Inorganic Chemistry	300	02	04	01	04	02	02	25	25	25	25	50	50
Major	CH-MJ-602	Organic Chemistry	Organic Chemistry	300	02	04	01	04	02	02	25	25	25	25	50	50
Major	CH-MJ-603	Analytical Chemistry	Analytical Chemistry	300	02	04	01	04	02	02	25	25	25	25	50	50
Minor	CH-ME-601	General Chemistry	General Chemistry	200	02	04	01	04	02	02	25	25	25	25	50	50

[Subject Code-2503000505012001]

VEER NARMAD SOUTH GUJARAT UNIVERSITY

T. Y. B. Sc. – SEM – V CHEMISTRY (MAJOR)

PAPER - CH-MJ-501

Inorganic Chemistry (Major) (2 Credits Theory + 2 Credits Practical)

As per NEP 2020

To be implemented from the Academic year 2025-26

Course Subject Code	CH-MJ-501
Subject Title	Inorganic Chemistry (Theory)
Credits	02
Teaching per week	02 Hours
Effective from	2025-2026
Purpose of Course	This course aims to provide an in-depth understanding of the historical and modern aspects of inorganic chemistry, focusing on the contributions of Prof. P.C. Ray to Indian metallurgy and chemistry, as well as advanced concepts in metal carbonyls and transition metal complexes.
Objective of Course	The course will equip students with knowledge of ancient Indian metallurgical techniques, metal extraction processes, and their relevance to modern chemistry while also developing a strong foundation in the bonding, structure, and properties of metal carbonyls and transition metal complexes.
Course Outcomes	**CO1-Remembering:** Students will recall fundamental chemical concepts, historical metallurgical processes, and bonding theories. They will retain principles like ligand field theory and Jahn-Teller effects, preparing for advanced studies and research. **CO2-Understanding**: Students will comprehend Prof. P.C. Ray's contributions and their relevance to modern chemistry. They will understand transition metal bonding and the role of historical metallurgy in scientific advancements. **CO3-Application**: Students will apply ancient metallurgical knowledge to modern material science and extractive metallurgy. They will use ligand field theory and computational techniques to predict metal complex properties. **CO4-Analysis**: Students will analyse Indian metallurgical advancements, bonding theories, and their implications for chemical reactivity. They will evaluate experimental techniques in metal extraction and transition metal chemistry. **CO5-Evaluation**: Students will assess India's metallurgical heritage, Prof. P.C. Ray's impact, and the reactivity of transition metal complexes. They will critically evaluate experimental data and methodologies in chemical synthesis. **CO6-Creation**: Students will integrate ancient and modern techniques for sustainable metal extraction and material design. They will innovate in transition metal complex synthesis and develop environmentally responsible chemical processes.
Mapping Between COs and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓		✓	✓	
CO2	✓	✓	✓			✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	
CO5	✓		✓	✓	✓	✓	✓	✓
CO6	✓	✓	✓		✓	✓	✓	✓

CH-MJ-501 (Inorganic Chemistry)

Program Name: T. Y. B. Sc. Sem. – V

Syllabus effective from June 2025

Unit – 1		
	Prof. P. C. Ray: A Pioneer in Reviving Ancient Indian Metallurgy and Chemistry **Contribution:** Prof. Prafulla Chandra Ray, the "Father of Indian Chemistry," highlighted India's advanced metallurgical practices and linked ancient mining and metalworking techniques showcasing India's scientific achievements and inspiring modern research. • Wootz steel: The rise and fall of a great Indian technology. • Mining and ore extraction. • Metal and metal working technology. • Gold extraction process. • Zinc production. • Copper mining and extraction process. • Extraction of copper for Ayurvedic purposes. • Copper alloys, Mercury, Lead and silver. • Iron and steel in India.	**15 h**
Unit – 2		
	[A] Metal carbonyls • Definition. • Classification of metal carbonyl. • Nature of Bonding in metal carbonyls. • Structure and bonding in $Ni(CO)_4$, $Fe(CO)_5$, $Cr(CO)_6$, $Fe_2(CO)_9$, $Mn_2(CO)_{10}$, $Co_2(CO)_8$. **[B] Bonding in transition Metal Complexes** • Jahn Teller Theorem. • Distortion in octahedral complexes. • Ligand Field Theory. • Molecular energy level diagram and magnetic properties for $[CoF_6]^{3-}$, $[Co(NH_3)_6]^{3+}$, $^{-}[FeF_6]^{3-}$, $[Fe(CN)_6]^{3-}$.	**07 h** **08 h**

Reference books:

1) A History of Hindu Chemistry from the Earliest Times to the Middle of the Sixteenth Century A.D. by Prof. P. C. Ray, (1902) published by The Bengal Chemical and Pharmaceutical Works.
2) History of Science and Technology in Ancient India: Volume II – Metal Technology by Debiprasad Chattopadhyaya (1986) published by Firma KLM, Calcutta.
3) The Rustless Wonder: A Study of the Iron Pillar at Delhi
4) Introduction to Indian knowledge system concepts and Applications by B. Mahadevan, Vinayak Rajat Bhatt, Nagendra Pavana R. N.
5) Advanced Inorganic Chemistry by Cotton and Wilkinson, John Wiley.
6) Inorganic Chemistry by J. D. Lee.
7) Theoretical Inorganic Chemistry by Day & Selbin, Affiliated East West Publ. Pvt. Ltd.

8) Uni. Chemistry by B. H. Mohan.
9) Structural Inorganic chemistry by A. F. Wells.
10) Chemical Bonding – an introduction by Rawal, Patel & Patel.
11) Basic Inorganic Chemistry by Cotton and Wilkinson.
12) A Text book of Inorganic Chemistry by P. L. Soni.
13) Introduction to Inorganic Chemistry by Durrant and Durrant.
14) Modern Co – ordination Chemistry by R, Lewis and R. G. Wilkinson.
15) Inorganic Chemistry-Principles of structure and reactivity by J. E. Huhhey, E. A. keiter.

[Subject Code-2503000505012002]

VEER NARMAD SOUTH GUJARAT UNIVERSITY

T. Y. B. Sc. – SEM – V CHEMISTRY Practical (MAJOR)

PAPER - CHP-MJ-501

Inorganic Chemistry (Major) (2 Credits Theory + 2 Credits Practical)

As per NEP 2020

To be implemented from the Academic year 2025-26

Course Subject Code	CHP-MJ-501
Subject Title	Inorganic Chemistry (Practical)
Credits	02
Teaching per week	04 Hours
Effective from	2025-2026
Purpose of Course	This course aims to develop students' practical skills in inorganic qualitative analysis by systematically identifying cations and anions using classical and modern analytical techniques.
Objective of Course	Students will learn to handle and analyse inorganic chemicals, apply qualitative tests for the detection of various cations and anions, and interpret results to develop a strong foundation in practical inorganic chemistry.
Course Outcomes	**CO1-Remembering:** Recall and list the ions used in inorganic qualitative analysis, such as chloride, bromide, nitrate, and others, and understand their properties and behavior in qualitative tests. **CO2-Understanding:** Understand and explain the fundamental principles behind the identification of inorganic ions, focusing on their chemical reactions, solubility rules, and behavior in qualitative analysis. **CO3-Application:** Apply qualitative analysis techniques to identify unknown inorganic ions in laboratory experiments, ensuring precise application of principles and techniques. **CO4-Analysis:** Analyse and interpret the results of qualitative tests, assessing the reliability and accuracy of the data obtained from various inorganic ion reactions. **CO5-Evaluation:** Evaluate the various methods used in qualitative analysis, comparing their effectiveness in identifying different inorganic ions, and propose improvements or alternatives. **CO6-Creation:** Design a comprehensive experimental procedure for the qualitative analysis of an unknown inorganic sample, integrating scientific inquiry, creativity, and sustainable practices.
Mapping Between COs and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓		✓	
CO2	✓		✓		✓	✓	✓	✓
CO3		✓	✓		✓	✓	✓	✓
CO4	✓		✓	✓	✓	✓	✓	
CO5	✓			✓	✓	✓	✓	✓
CO6		✓		✓	✓	✓	✓	✓

CHP-MJ-501 (Inorganic Chemistry)

Third Year B. Sc. Semester - V

Syllabus effective from June 2025

Total Credit: 02 (04 hours)

Inorganic Qualitative Analysis:

List of inorganic chemicals used for inorganic qualitative analysis

Chloride	:	Cu^{+2}, Cd^{+2}, Fe^{+3}, Mn^{+2}, Co^{+2}, Ni^{+2}, Ca^{+2}, Ba^{+2}, Sr^{+2}, Na^{+1}, K^{+1}, NH_4^{+1}
Bromide	:	Sr^{+2}, Na^{+1}, K^{+1}, NH_4^{+1}
Iodide	:	K^{+1}
Nitrite	:	Na^{+1}, K^{+1}
Nitrate	:	Co^{+2}, Ni^{+2}, Ba^{+2}, Sr^{+2}, Na^{+1}, K^{+1}, NH_4^{+1}
Sulphite	:	Na^{+1}
Sulphide	:	Zn^{+2}, Sb^{+3},
Sulphate	:	Cu^{+2}, Cd^{+2}, Al^{+3}, Fe^{+2}, Zn^{+2}, Mn^{+2}, Co^{+2}, Ni^{+2}, Mg^{+2}, Na^{+1}, K^{+1}, NH_4^{+1}
Carbonate	:	Cu^{+2}, Cd^{+2}, Zn^{+2}, Mn^{+2}, Co^{+2}, Ni^{+2}, Ca^{+2}, Ba^{+2}, Sr^{+2}, Mg^{+2}, Na^{+1}, K^{+1}, NH_4^{+1}
Phosphate	:	Cu^{+2}, Al^{+3}, Fe^{+3}, Zn^{+2}, Mn^{+2}, Co^{+2}, Ni^{+2}, Ca^{+2}, Ba^{+2}, Sr^{+2}, Mg^{+2}, Na^{+1}, K^{+1}, NH_4^{+1}
Borate	:	H_3BO_3

Inorganic qualitative analysis of a mixture containing six radicals. The mixture may be soluble in water or dilute HCl or Concentrated HCl including chromate and borate.

Note: Candidate should perform the analysis of at least eight mixtures.

[Subject Code-2503000505022001]

VEER NARMAD SOUTH GUJARAT UNIVERSITY

T. Y. B. Sc. – SEM – V CHEMISTRY (MAJOR)

PAPER - CH-MJ-502

Organic Chemistry (Major) (2 Credits Theory + 2 Credits Practical)

As per NEP 2020

To be implemented from the Academic year 2025-26

<table>
<tr><td>Course Subject Code</td><td>CH-MJ-502</td></tr>
<tr><td>Subject Title</td><td>Organic Chemistry (Theory)</td></tr>
<tr><td>Credits</td><td>02</td></tr>
<tr><td>Teaching per week</td><td>02 Hours</td></tr>
<tr><td>Effective from</td><td>2025-2026</td></tr>
<tr><td>Purpose of Course</td><td>This course aims to provide students with a comprehensive understanding of reaction mechanisms, aromaticity, alkaloids, and synthetic drugs, emphasizing both theoretical concepts and their practical applications in organic chemistry.</td></tr>
<tr><td>Objective of Course</td><td>Students will learn the fundamental mechanisms of esterification, hydrolysis, and elimination reactions, analyse aromaticity using Huckel’s rule, explore the structure and synthesis of alkaloids, and understand the classification, synthesis, and applications of important synthetic drugs.</td></tr>
<tr><td>Course Outcomes</td><td>CO1-Remembering: Students will recall fundamental reaction mechanisms such as esterification, hydrolysis, pyrolytic elimination, and their specific pathways ($B_{AC}2$, $A_{AC}2$, $A_{AC}1$, $A_{AL}1$, Cope, and Chugaev).
CO2-Understanding: Students will explain the concept of aromaticity, including Hückel’s rule, and differentiate between aromatic, non-aromatic, and anti-aromatic compounds (benzenoids and non-benzenoids).
CO3-Application: Students will apply knowledge of alkaloid structures, their classification, and structural determination methods to interpret the chemistry of nicotine and papaverine.
CO4-Analysis: Students will analyse the structure-activity relationships (SAR) of synthetic drugs, their classification based on pharmacological action, and their synthesis.
CO5-Evaluation: Students will evaluate different organic reaction mechanisms, comparing their efficiencies and selecting the most suitable synthetic pathways for specific drug molecules.
CO6-Creation: Students will design and propose synthetic strategies for pharmaceutical compounds, incorporating sustainable, innovative, and ethical practices in drug development.</td></tr>
<tr><td>Mapping Between COs and PSOs</td><td>
<table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th><th>PSO7</th><th>PSO8</th></tr>
<tr><td>CO1</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>CO2</td><td>✓</td><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>CO3</td><td>✓</td><td>✓</td><td>✓</td><td></td><td>✓</td><td>✓</td><td></td><td>✓</td></tr>
<tr><td>CO4</td><td>✓</td><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>CO5</td><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td><td>✓</td></tr>
<tr><td>CO6</td><td></td><td>✓</td><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
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CH-MJ-502 (Organic Chemistry)

Program Name: T. Y. B. Sc. Sem. – V

Syllabus effective from June 2025

Unit – 1		
	(A) Reaction Mechanism: (a) Different types of mechanism for Esterification and Hydrolysis: B_{AC}^2, A_{AC}^2, A_{AC}^1, A_{AL}^1, (b) Mechanism of formation and hydrolysis of amides. (c) Pyrolytic elimination: Cope and Chugaev reaction.	**10 h**
	(B) Aromaticity: Introduction to Aromaticity, Huckel's Rule, Aromatic Character of Arenes, Definition & Examples of Aromatic, Non-Aromatic, Anti-Aromatic Compounds (Benzenoids and Non-Benzenoids	**05 h**
Unit – 2		
	(A) Alkaloids: The occurrence, Classification, General methods to determine their structure, Analytical and Synthetic evidence to prove the structure of Nicotine and Papavarine.	**08 h**
	(B) Synthetic Drugs: Classification, based on pharmacological action, synthesis and uses of Amylnitrate, Chloroquine, Pyrimethamine, Sulphadiazine, Diazepam, Lidocaine, Chlorpropamide, Dapsone, Isoniazide, 5-Fluoro Uracil.	**07 h**

Reference Books:

- Natural Products: Chemistry and Applications by Sujata V. Bhat
- Organic Chemistry of Natural Products by O.P. Agarwal
- The Alkaloids: Chemistry and Biology by Geoffrey A. Cordell
- Advanced Organic Chemistry: Reactions, Mechanisms, and Structure by Jerry March
- A Guidebook to Mechanism in Organic Chemistry by Peter Sykes
- Foye's Principles of Medicinal Chemistry by David A. Williams, Thomas L. Lemke
- Essentials of Medicinal Chemistry by Korolkovas and Burckhalter
- Mechanism and Structure in organic chemistry-Goulde. S.
- Reaction mechanism in organic chemistry by Mukhargy & Singh
- Principles of reaction mechanism in organic chemistry by Dharmaraha & Chawla
- Organic reaction mechanism by Bansal Tata Mac. Hill
- Organic Chemistry (Vol I & II) 6 th E^{dn}, I. L. Finar.
- Organic Chemistry by Hendrickson, Cram & Hammond
- Organic Chemistry by Brown R. F.
- Organic Chemistry by Solomon W. Graham
- Principles of Organic Synthesis- R. O. C. Norman
- Basic Principles of Organic chemistry, by R. Y. Caserio, W. A. Benjamin
- May's Chemistry of synthetic Drugs by Dyson.
- Chemistry of drugs, Ener and Caldwell
- Synthetic drugs by Tyagi and Yadav.

- Synthetic Organic Chemistry by O. P. Agarwal
- Organic Chemistry by Morrison and Boyd.
- Chemistry of organic Natural Product Vol. I & II by O. P. Agarwal.
- Chemistry of synthetic drugs by Trivedi
- Principles of Medicinal Chemistry Vol. I & II by S. S. Kadam, K. R. Mahadik, K. G. Bothara (Nirali Prakashan)
- Medicinal Chemsitry by Asuthosh kar 4/e
- Organic reactions & their mechanism by P. S. Kalsi, New age international publishers

[Subject Code-2503000505022002]

VEER NARMAD SOUTH GUJARAT UNIVERSITY

T. Y. B. Sc. – SEM – V CHEMISTRY Practical (MAJOR)

PAPER - CHP-MJ-502

Organic Chemistry (Major) (2 Credits Theory + 2 Credits Practical)

As per NEP 2020

To be implemented from the Academic year 2025-26

Course Subject Code	CHP-MJ-502
Subject Title	Organic Chemistry (Practical)
Credits	02
Teaching per week	04 Hours
Effective from	2025-2026
Purpose of Course	This course aims to develop students' practical skills in organic chemistry by providing hands-on experience in quantitative estimation techniques and chromatographic separation methods.
Objective of Course	Students will learn to determine the concentration and purity of organic compounds using estimation techniques and apply chromatography to separate amino acids, enhancing their analytical and laboratory skills in organic chemistry.
Course Outcomes	**CO1-Remembering:** Students will recall the principles and procedures involved in organic estimation techniques such as the determination of ketones, formaldehyde, aspirin purity, and saponification value. **CO2-Understanding:** Students will explain the theoretical concepts behind organic estimation methods and chromatography techniques, emphasizing accuracy and reproducibility in chemical analysis. **CO3-Application:** Students will perform organic estimation experiments and apply chromatographic techniques to separate amino acid mixtures, demonstrating laboratory precision and problem-solving skills. **CO4-Analysis:** Students will analyse experimental data from organic estimations and chromatography, interpreting results to assess the purity, concentration, and composition of organic compounds. **CO5-Evaluation:** Students will evaluate the efficiency of different estimation techniques and chromatographic methods, comparing their advantages, limitations, and industrial relevance. **CO6-Creation:** Students will design and propose innovative experimental strategies for organic estimations and chromatographic separations, incorporating sustainable practices and modern analytical tools.
Mapping Between COs and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓		✓	✓	
CO2	✓		✓	✓	✓	✓	✓	
CO3		✓	✓	✓	✓	✓		✓
CO4	✓		✓	✓	✓	✓	✓	
CO5		✓	✓	✓	✓	✓		✓
CO6		✓		✓	✓	✓	✓	✓

CHP-MJ-502 (Organic Chemistry)

Third Year B. Sc. Semester - V

Syllabus effective from June 2025

ORGANIC ESIMATION (Any Four)

1. Determination of amount of Ketone (Acetone)
2. Determination of saponification value of an oil.
3. Determination of percentage purity of Aspirin.
4. Determination of amount of Formaldehyde in given solution
5. Determination of amount of Ethyl acetate in the given solution
6. Determination of amount of glucose in the given solution

(Instead of Sample weighing, solution to be given)

CHROMATOGRAPHY

Chromatography separation of amino acid mixture by ascending paper chromatography**.**
(Any two)

1. Glycine + Methionine
2. Alanine + Methionine
3. Alanine + Valine

[Subject Code-2503000505032001]

VEER NARMAD SOUTH GUJARAT UNIVERSITY

T. Y. B. Sc. – SEM – V CHEMISTRY (MAJOR)

PAPER - CH-MJ-503

Physical Chemistry (Major) (2 Credits Theory + 2 Credits Practical)

As per NEP 2020

To be implemented from the Academic year 2025-26

Course Subject Code	CH-MJ-503
Subject Title	Physical Chemistry (Theory)
Credits	02
Teaching per week	02 Hours
Effective from	2025-2026
Purpose of Course	This course aims to provide students with a deep understanding of thermodynamics, electrochemistry, and their applications, highlighting the contributions of Indian and global scientists in advancing these fields.
Objective of Course	Students will explore fundamental thermodynamic principles, chemical potential, fugacity, and the third law of thermodynamics while learning about electrochemical cells, electrode potentials, and the thermodynamics of electrochemical reactions. The course integrates theoretical concepts with real-world applications, emphasizing their significance in energy conversion, materials science, and industrial processes.
Course Outcomes	**CO1-Remembering:** Students will recall fundamental thermodynamic and electrochemical concepts, including the third law, chemical potential, fugacity, electrode potential, and electrochemical cells. **CO2-Understanding:** Students will explain the contributions of Indian scientists like Jnan Chandra Ghosh, A.K. Mukherjee, and K.S. Venkateswarlu in thermodynamics and electrochemistry, highlighting their impact on modern scientific advancements. **CO3-Application:** Students will explain the contributions of Indian scientists like Jnan Chandra Ghosh, A.K. Mukherjee, and K.S. Venkateswarlu in thermodynamics and electrochemistry, highlighting their impact on modern scientific advancements. **CO4-Analysis:** Students will analyse the thermodynamics of electrochemical cells, entropy changes, and energy relationships to predict reaction spontaneity and equilibrium conditions. **CO5-Evaluation:** Students will evaluate different electrochemical cell classifications, electrode potentials, and thermodynamic parameters, comparing their efficiencies and industrial applications. **CO6-Creation:** Students will design and propose innovative approaches to thermodynamic and electrochemical applications, such as battery technology and sustainable energy solutions.

Mapping Between COs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓		✓	✓	
CO2	✓		✓	✓	✓	✓	✓	
CO3		✓	✓	✓	✓	✓		✓
CO4	✓		✓	✓	✓	✓	✓	
CO5		✓	✓	✓	✓	✓		✓
CO6		✓		✓	✓	✓	✓	✓

CH-MJ-503 (Physical Chemistry)

Program Name: T. Y. B. Sc. Sem. – V

Syllabus effective from June 2025

Unit – 1		
	1. Ramnathan, Subrahmanyam Chandrashekhar • **Contribution in thermodynamics and energy**: Chandrashekhar's work on stellar structure and evolution of stars also has tried to thermodynamics, as it involves the application of thermodynamic principles to stellar dynamics, including energy generation, radiation pressure, and gravitational collapse. **2. L. N. (Ludwig) Boltzmann and the Indian influence** • **Contribution in third law of thermodynamics:** Though not Indian, Ludwing Boltzmann's work on statistical mechanics and the molecular kinetic theory had a significant influence on Indian physicists. The application of statistical mechanics, which explains macroscopic thermodynamic behaviour in terms of microscopic particle motion, became a key area of study for many Indian scientists, especially in quantum thermodynamics and low-temperature physics. **3. Jnan Chandra Ghosh** • **Contribution in change in entropy and free energy:** Studied colloid thermodynamics and phase transitions. Conducted research on entropy changes and free energy in chemical reactions. Worked on thermodynamic stability in solution. **Thermodynamics and its Indian Relevance** Thermodynamics is integral to many fields of physics, chemistry, engineering, and even biological systems. The contribution of these Indian scientists helps illustrate how the laws of thermodynamics apply across different areas of science and how innovations in the theoretical frameworks of thermodynamics can lead to groundbreaking advances in technology, cosmology, and material science. **Chemical Potential and Fugacity in Thermodynamics** • System – Open, Closed, and Isolated. • Chemical potential (μ) or Partial molal free energy • Derivation of Gibb's – Duhem equation • Derivation of chemical potential (μ) equation for an ideal gas • Lewis fugacity concept, fugacity function and its physical significance • Concept of Activity and activity coefficient • Name of methods to determine fugacity • Determination of fugacity by graphical method. • Concept of activity and activity coefficient • Standard state of solid, liquid and gas • Numerical problems	**15 h**

	The Third Law of Thermodynamics • The Nernst Heat Theorem (NHT) and its limitation • Statement of third law by Plank, Lewis – Randall • Consequences of third law of thermodynamics • Relation between Residual entropy and Boltzmann constant • Determination of absolute entropy of gas, liquid and solid • Application, importance and exception of third law of thermodynamics • Numerical problems.	
Unit – 2 Electrochemistry		**15 h**
	A. K. Mukherjee • **Contribution in electrochemical cell:** He contributed significantly to the understanding of electrochemical cells, electrochemical equillibrium, and related processes. His work laid the foundation for many studies in electrochemical energy conversion and storage system in India. **K. S. Venkateswarlu** • **Contribution in applied electro chemistry:** He conducted research on electrode potential, and ionic mobility. His work helped to improve understanding of ion transport in solutions. He contributed to applied electrochemistry in battery and fuel cell development. **Electrodics:** • Concept of oxidation and reduction, electrochemical series • Definition of electrode, standard electrode, half-cell, single electrode potential • Sign convention of electrode potential • Galvanic cell with example of Daniel cell • emf of a cell and its measurements by voltmeter and potentiometer • Standard cell (Western cell) • Primary and secondary electrode, Standard hydrogen electrode [SHE] and Calomel electrode. **Thermodynamics of electrochemical cell:** • Flow diagram of electrochemical cell • Reaction in reversible cell and concept of thermodynamics reversibility • Reversible and irreversible electrochemical cell • Relation between free energy change and electrical energy • Prediction of spontaneity of cell reaction • Determination of standard free energy change and equilibrium constant • Temperature coefficient of emf of a cell • Entropy change and enthalpy change of cell reaction **Classification of electrochemical cell:** • Chemical and concentration cell • Liquid Junction Potential (LJP), Methods for elimination of LJP (salt bridge) • Derivation of emf of concentration cell with and without transference. • **Application of electrochemistry in battery**: Li ion cell and Ni-Cd cell. • Numerical problems.	

Reference Books:

1. Thermodynamics and chemical equilibria by Jnan Chandra Ghosh.
2. Physical chemistry by B.K. Sharma
3. Elemental physical chemistry by Glasston & Lewis
4. Advance physical chemistry by D.N. Bajpai
5. Essential of physical chemistry by Bahl, Tuli & Bahl
6. Physical chemistry by Gurdeep Raj
7. Physical chemistry by K.L. Kapoor
8. Physical chemistry by Puri, Sharma, and Pathania
9. Principles of stellar dynamics, New York: Dover A textbook of physical chemistry by A. S. Negi & Anand
10. Atmospheric Brown clouds by Veerbhadharan Ramanathan
11. Physical chemistry by P.L. Soni & O.P. Dharmraj
12. Physical chemistry by K.K. Sharma & L.K. Sharma
13. Industrial chemistry by B.K. Sharma
14. Electro chemistry by B.K. Sharma
15. Electrochemistry: Principles and applications by K. S. Venkateshwarlu
16. Modern Electrochemistry by J'om Bockris and Reddy
17. Physical chemistry by G.M. Barrow
18. Numerical problems by D.V.S Jain

[Subject Code-2503000505032002]

VEER NARMAD SOUTH GUJARAT UNIVERSITY

T. Y. B. Sc. – SEM – V CHEMISTRY Practical (MAJOR)

PAPER - CHP-MJ-503

Physical Chemistry (Major) (2 Credits Theory + 2 Credits Practical)

As per NEP 2020

To be implemented from the Academic year 2025-26

Course Subject Code	CHP-MJ-503
Subject Title	Physical Chemistry (Practical)
Credits	02
Teaching per week	04 Hours
Effective from	2025-2026
Purpose of Course	This course aims to equip students with practical skills in physical chemistry by conducting experiments related to reaction kinetics, electrochemical analysis, and thermodynamic measurements using instrumental techniques.
Objective of Course	Students will investigate reaction rates, measure optical activity using polarimetry, determine pH and buffer capacity, and analyse solutions using conductometry and potentiometry. These experiments will enhance their understanding of chemical kinetics, acid-base equilibria, and electrochemical principles through hands-on experience.
Course Outcomes	**CO1-Remembering:** Students will recall fundamental concepts of reaction kinetics, electrochemistry, conductance, potentiometry, pH metry, and polarimetry. **CO2-Understanding:** Students will explain the principles of reaction rate studies, conductometry, potentiometry, and polarimetry, along with their applications in chemical analysis. **CO3-Application:** Students will apply experimental techniques to determine reaction rates, dissociation constants, solubility products, buffer capacities, and optical activity of substances. **CO4-Analysis:** Students will analyse the kinetic parameters of chemical reactions and evaluate the properties of electrolytes using pH metry, conductometry, and potentiometry. **CO5-Evaluation:** Students will evaluate experimental data for reaction kinetics, conductivity, and potentiometric titrations to determine unknown concentrations and dissociation constants. **CO6-Creation:** Students will design and propose innovative experimental approaches to optimize reaction conditions, develop precise analytical techniques, and apply electrochemical methods to real-world problems.

Mapping Between COs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓		✓	✓	
CO2	✓		✓	✓	✓	✓	✓	
CO3		✓	✓	✓	✓	✓		✓
CO4	✓		✓	✓	✓	✓	✓	
CO5		✓	✓	✓	✓	✓		✓
CO6		✓		✓	✓	✓	✓	✓

CHP-MJ-503 (Physical Chemistry)

Third Year B. Sc. Semester - V

Syllabus effective from June 2025

Total Credit: 02 (04 hours)

1. To investigate the rate of reaction between $K_2S_2O_8$ and KI, [a=b]
2. To investigate the rate of reaction between $K_2S_2O_8$ and KI, [a≠b]
3. To investigate the rate of reaction between H_2O_2 and KI. [a=b]
4. **Polarimetry:** Determination of angle of rotation of given substance using three different dilutions and determination of concentration of unknown solution. Sugar, Glucose, Tartaric acid.
5. **pH metry:** To measure pH of different buffer solution and to study the buffer capacity.
6. **pH metry:** To determine the dissociation constant of weak acid [CH_3COOH] and weak base [NH_4OH] by different dilution.
7. **Conductometry:** To determine the amount of $BaCl_2$ in the given solution using K_2CrO_4 solution.
8. **Conductometry:** To determine the amount of NaCl in the given solution using $AgNO_3$ solution.
9. **Conductometry:** To determine the amount of CH_3COOH in the given solution using NH_4OH solution.
10. **Potentiometry:** To determine the normality of HCl solution using 0.5 N NaOH. solution.
11. **Potentiometry:** To determine the solubility and solubility product of sparingly soluble salt AgCl by the titration of $AgNO_3$ and NaCl.

Note: Any seven practicals including TWO chemical kinetics should be performed by the students.

[Subject Code-2503000505042001]

VEER NARMAD SOUTH GUJARAT UNIVERSITY

T. Y. B. Sc. – SEM – V CHEMISTRY (MINOR)

PAPER - CH-ME-501

Chemical Analysis (Minor) (2 Credits Theory + 2 Credits Practical)

As per NEP 2020

To be implemented from the Academic year 2025-26

Course Subject Code	CH-ME-501
Subject Title	Chemical Analysis (Theory)
Credits	02
Teaching per week	02 Hours
Effective from	2025-2026
Purpose of Course	This course aims to introduce students to the fundamental principles of analytical chemistry, focusing on quantitative analysis, error minimization, and instrumental techniques such as conductometric titration.
Objective of Course	Students will learn various analytical methods, data treatment techniques, and statistical approaches to ensure accuracy and precision in chemical analysis. Additionally, they will gain hands-on experience in conductometric titrations, understanding their principles, applications, and advantages over traditional indicator-based methods.
Course Outcomes	**CO1-Remembering**: Students will recall fundamental concepts of analytical chemistry, including classical and instrumental methods, types of errors, and principles of conductometric titrations. **CO2-Understanding:** Students will explain the advantages, limitations, and applications of different analytical techniques, statistical data treatment, and error minimization in chemical analysis. **CO3-Application:** Students will apply quantitative and computational techniques to analyse experimental data, perform conductometric titrations, and determine accuracy and precision in results. **CO4-Analysis:** Students will critically analyse experimental outcomes, assess statistical significance, interpret conductivity data, and optimize analytical methodologies for enhanced accuracy. **CO5-Evaluation:** Students will evaluate the reliability of analytical methods, compare conductometric titrations with classical techniques, and assess systematic errors' impact on chemical data interpretation. **CO6-Creation:** Students will design and develop innovative analytical procedures, integrate digital tools for chemical data processing, and propose new applications of conductometric titrations.

Mapping Between COs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓		
CO2	✓	✓	✓	✓	✓	✓		✓
CO3	✓	✓	✓	✓	✓		✓	
CO4	✓	✓	✓	✓	✓	✓		✓
CO5	✓	✓	✓	✓		✓	✓	
CO6	✓	✓	✓	✓	✓	✓		✓

Third Year B. Sc. Sem. – V

CH-ME-501 (Chemical Analysis)

Syllabus effective from June 2025

Unit – 1		
	Introduction to analytical chemistry Chemical and Instrumental Analysis (advantages and disadvantages) Overview of methods used in Quantitative analysis (classification of classical and instrumental analysis), Factors affecting the choice of analytical methods (in brief), Step in quantitative analysis (Flow diagram), Analytical methods on the basis of Sample size (in brief), Sampling methods. Sampling in different physical states. **Treatment of analytical data** **Significant figures and rules of computation.** Error Definition, Types of errors: Determinates errors, indeterminate errors, constant and proportional errors. Define and explain the following terms – Accuracy and Precision, mean, median, deviation, average deviation, standard deviation, variance, coefficient of variation, relative mean deviation, range, absolute errors, relative errors. Minimization of determinates errors, Normal error curve. Rejection of result from a set of results, 2.5 d rule, 4.0 d rule and Q-test. (Problems based on above topics).	**15 h**
Unit – 2		
	Conductometric titration Principle and types of conductometric titrations a) Strong acid vs strong base b) Strong acid vs weak base c) Weak acid vs strong base d) Weak acid vs weak base e) Strong acid + weak acid vs strong base f) Strong acid + weak acid vs weak base g) Precipitation titration (i) $BaCl_2$ vs K_2CrO_4 (ii) $AgNO_3$ vs NaCl Advantage of conductometric titration over indicator method.	**15 h**

Reference Books:

- Quantitative Analysis by R. A. Day & A. L. Underwood, 6th ed. Pub. Prentice Hall of India ltd.
- Vogel's Text Book Inorganic Quantitative Analysis, 6 th ed.
- Analytical Chemistry (Principles & Technique) by Lary G. Hargis.
- Fundamental of Analytical Chemistry by Skoog D. A. & West D. M.
- Holler F. J. Instrumental Methods of Analysis by B. K. Sharma
- Instrumental analysis by R. D. Braun Mc Graw Hill.
- Analytical Chemistry by Gary Christian Instrumental methods of chemical analysis
- Dr. H. Kaur. Pragati prakashan Meerut.
- College Analytical Chemistry by Mangaonkar, Teckchandani, Sathe, Ghalsasi, Jain (Himalaya Publication House)

[Subject Code-2503000505042002]

VEER NARMAD SOUTH GUJARAT UNIVERSITY

T. Y. B. Sc. – SEM – V CHEMISTRY Practical (MINOR)

PAPER - CHP-ME-501

Chemical Analysis (Minor) (2 Credits Theory + 2 Credits Practical)

As per NEP 2020

To be implemented from the Academic year 2025-26

Course Subject Code	CHP-ME-501
Subject Title	Chemical Analysis (Practical)
Credits	02
Teaching per week	04 Hours
Effective from	2025-2026
Purpose of Course	This course aims to develop students' practical skills in analytical chemistry by applying conductometric titration techniques for precise determination of acid and salt concentrations.
Objective of Course	Students will learn to perform conductometric titrations for strong and weak acids, acid mixtures, and precipitation reactions, enhancing their understanding of conductivity changes during titration and the advantages of instrumental analysis over traditional methods.
Course Outcomes	**CO1-Remembering:** Students will recall the fundamental principles of conductometric titrations, normality calculations, and conductivity changes during acid-base and precipitation reactions. **CO2-Understanding:** Students will explain the theoretical concepts behind conductometric titrations, including ion conductivity, endpoint determination, and differences between strong and weak acids. **CO3-Application:** Students will apply conductometric methods to determine the normality of strong and weak acids, analyse acid mixtures, and perform precipitation titrations. **CO4-Analysis:** Students will critically interpret conductometric titration curves, assess conductivity variations, and compare experimental results with theoretical expectations. **CO5-Evaluation:** Students will evaluate the accuracy, precision, and reliability of conductometric titrations, comparing them with conventional volumetric titrations. **CO6-Creation:** Students will design and optimize conductometric experiments for complex acid-base and precipitation reactions, integrating digital tools for data analysis.

Mapping Between COs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓		
CO2	✓	✓	✓	✓	✓	✓		✓
CO3	✓	✓	✓	✓	✓		✓	
CO4	✓	✓	✓	✓	✓	✓		✓
CO5	✓	✓	✓	✓		✓	✓	
CO6	✓	✓	✓	✓	✓	✓		✓

Third Year B. Sc. Semester – V

Minor Course (Practical)

CHP-ME-501

Syllabus effective from June 2025

1. Determine the normality of HCl by conductometric titration with strong base.
2. Determine the normality of CH_3COOH by conductometric titration with strong base.
3. Conductometric titration of mixture of acids (HCl + CH_3COOH) using strong base.
4. Conductometric titration of $BaCl_2$ vs K_2CrO_4.
5. Conductometric titration of $AgNO_3$ vs NaCl.

(Note: Perform minimum four practical)

[Subject Code-2503000505052001]

VEER NARMAD SOUTH GUJARAT UNIVERSITY

T. Y. B. Sc. – SEM – V CHEMISTRY (MINOR)

PAPER - CH-ME-502

Applied Industrial Chemistry (Minor) (2 Credits Theory + 2 Credits Practical)

As per NEP 2020

To be implemented from the Academic year 2025-26

Course Subject Code	CH-ME-502
Subject Title	Applied Industrial Chemistry (Theory)
Credits	02
Teaching per week	02 Hours
Effective from	2025-2026
Purpose of Course	This course aims to provide students with an understanding of the chemical processes involved in the fermentation industry, water pollution analysis, cosmetic chemistry, and small-scale chemical manufacturing.
Objective of Course	Students will learn about fermentation processes for industrially important chemicals, water quality assessment techniques, the chemistry behind cosmetics and perfumes, and the formulation of everyday chemical products through small-scale preparations.
Course Outcomes	**CO1-Remembering:** Students will recall the fundamental concepts of fermentation, water pollution, cosmetics chemistry, and small-scale chemical preparations. **CO2-Understanding:** Students will explain fermentation conditions, pollutant effects, chemical formulations in cosmetics, and principles behind small-scale manufacturing. **CO3-Application:** Students will apply chemical knowledge to industrial processes, wastewater treatment, and formulation of commercial products like cosmetics and household items. **CO4-Analysis:** Students will critically analyse industrial processes, assess environmental impact, and evaluate ingredient roles in cosmetic formulations. **CO5-Evaluation:** Students will evaluate industrial methods, compare chemical processes, and assess product effectiveness and sustainability. **CO6-Creation:** Students will design and develop eco-friendly products and optimize industrial processes to improve efficiency and sustainability.

Mapping Between COs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓	✓	✓	✓		✓
CO2	✓	✓	✓	✓	✓	✓		
CO3	✓	✓	✓	✓	✓	✓		✓
CO4	✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓		✓		✓
CO6	✓	✓	✓	✓	✓	✓		

Third Year B. Sc. Sem. – V

CH-ME-502 (Applied Industrial Chemistry)

Syllabus effective from June 2025

Unit – 1		
	Fermentation Industry Definition, condition favorable for fermentation process (pH, temperature, presence of other substances, absence of preservatives, concentration), manufacture of ethanol, citric acid, acetone and butanol, acetic acid, lactic acid from molasses, manufacture of penicillin-G	**08 h**
	Water Pollution Types of water pollutants, Trace elements in water and their effects; Determination of BOD, COD, DO, Total hardness, Total dissolved solids, Ozone treatment process for wastewater.	**07 h**
Unit – 2		
	Chemistry of cosmetics and perfumes A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours. Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone.	**08 h**
	Some small scale preparation of (1) Safety matches (2) Naphthalene balls (3) Wax candles (4) Shoe polish (5) Writing/ fountain pen ink (6) Chalk crayons (7) Plaster of Paris	**07 h**

Reference Books:

1) Shreve Chemical Process Industries 5 ed. George. T. Austin. Mag. Hill. Book Agency
2) Reigel's Industrial Chemistry Ed. By James A. Kent.
3) Unit Process in Organic Synthesis by D. H. Groggins.
4) The Chemical Process Industries by R. Norris Shreve; McGraw-Hill Book Company, Ltd.
5) An Introduction to Industrial Chemistry by Peter Wiseman, Applied Science Pub. Ltd. London.
6) Industrial Chemistry by Clerk Ranken; Andesite Press.
7) Industrial Chemistry by B. K. Sharma Goel Pub.
8) Quantitative Analysis by R.A.Day & A L Underwood, 6th ed. Pub. Prentice Hall of India ltd.
9) Vogel's Text Book Inorganic Quantitative Analysis, 6^{th} ed.
10) Industrial safety management, by L.M. Desmukh, Tata Mc Graw Hill, New Delhi, 2006.
11) Industrial safety, Health & Environment management, Sunil S. Rao, R.K. Jain. Khanna Publishers, New Delhi, 2006.
12) E. Stocchi: Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK.
13) P.C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
14) Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996).

[Subject Code-2503000505052002]

VEER NARMAD SOUTH GUJARAT UNIVERSITY

T. Y. B. Sc. – SEM – V CHEMISTRY Practical (MINOR)

PAPER - CHP-ME-502

Applied Industrial Chemistry (Minor) (2 Credits Theory + 2 Credits Practical)

As per NEP 2020

To be implemented from the Academic year 2025-26

Course Subject Code	CHP-ME-502
Subject Title	Applied Industrial Chemistry (Practical)
Credits	02
Teaching per week	04 Hours
Effective from	2025-2026
Purpose of Course	This course aims to develop students' practical skills in organic estimation and chromatographic separation techniques, essential for quantitative and qualitative analysis in organic chemistry.
Objective of Course	Students will learn to determine the concentration and purity of organic compounds such as ketones, esters, and amino acids using titration and estimation techniques. Additionally, they will gain hands-on experience in separating amino acids using ascending paper chromatography, enhancing their analytical and laboratory skills.
Course Outcomes	**CO1-Remembering:** Students will recall fundamental principles of organic estimation and chromatography, including separation techniques and quantitative analysis. **CO2-Understanding:** Students will explain the principles behind organic estimation methods and the working of chromatographic techniques for amino acid separation. **CO3-Application:** Students will apply various titrimetric and chromatographic techniques to determine the composition and purity of organic compounds. **CO4-Analysis:** Students will analyse experimental data, interpret chromatographic results, and assess the accuracy and precision of organic estimations. **CO5-Evaluation:** Students will evaluate the reliability of different organic estimation techniques and compare chromatographic separation efficiencies. **CO6-Creation:** Students will design optimized protocols for organic compound estimation and chromatography, considering accuracy and efficiency.

Mapping Between COs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓		✓	✓	✓	✓	✓	✓
CO2		✓	✓	✓	✓	✓	✓	
CO3	✓	✓		✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓		✓	✓	✓	✓
CO6	✓	✓	✓	✓	✓	✓	✓	✓

Third Year B. Sc. Semester – V

Minor Course (Practical)

CHP-ME-502

Syllabus effective from June 2025

ORGANIC ESIMATION (Any Four)

1. Determination of amount of Ketone (Acetone)
2. Determination of saponification value of an oil
3. Determination of percentage purity of Aspirin.
4. Determination of amount of Formaldehyde in given solution.
5. Determination of amount of Ethyl acetate in the given solution.
6. Determination of amount of Glycine in the given solution.

(Instead of Sample weighing, solution to be given)

CHROMATOGRAPHY

Chromatography separation of amino acid mixture by ascending paper chromatography**. (Any two)**

1. Glycine + Methionine
2. Alanine + Methionine
3. Alanine + Valine

[Subject Code-2503000505062001]

VEER NARMAD SOUTH GUJARAT UNIVERSITY

T. Y. B. Sc. – SEM – V CHEMISTRY (SEC)

PAPER - CH-SEC-501

Spectral and Industrial Chemistry (SEC) (1 Credits Theory + 1 Credits Practical)

As per NEP 2020

To be implemented from the Academic year 2025-26

Course Subject Code	CH-SEC-501
Subject Title	Spectral and Industrial Chemistry (Theory)
Credits	01
Teaching per week	02 Hours
Effective from	2025-2026
Purpose of Course	This course aims to provide students with fundamental knowledge of molecular spectroscopy and the chemistry of soaps and detergents, emphasizing their principles, applications, and environmental impact.
Objective of Course	Students will learn the principles and applications of molecular spectroscopy, including NMR, ESR, and Raman spectroscopy, along with the chemistry, types, and cleansing mechanisms of soaps and detergents.
Course Outcomes	**CO1-Remembering**: Students will recall fundamental principles of molecular spectroscopy, including different types of spectra and electromagnetic radiation. **CO2-Understanding:** Students will explain the principles and applications of NMR, ESR, rotational, vibrational, and Raman spectroscopy, along with the mechanism of light scattering. **CO3-Application**: Students will apply spectroscopic techniques to analyze molecular structures, calculate bond lengths, and interpret spectral data. **CO4-Analysis:** Students will analyse the differences between various types of molecular spectra and evaluate the principles of single-beam spectrophotometers. **CO5-Evaluation**: Students will compare the properties, environmental impacts, and cleansing actions of soaps and detergents based on their chemical composition. **CO6-Creation:** Students will design and propose improved formulations for soaps and detergents, considering efficiency, environmental sustainability, and industrial applications.

Mapping Between COs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓		✓	✓	✓	✓
CO2	✓		✓	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓	✓		✓
CO4	✓	✓	✓	✓	✓		✓	
CO5	✓	✓	✓		✓	✓	✓	✓
CO6	✓		✓	✓	✓	✓	✓	

Third Year B. Sc. Sem. – V

CH-SEC-501 (Spectral and Industrial Chemistry)

Syllabus effective from June 2025

	[A] Molecular spectroscopy • Brief introduction to spectroscopy. • Various type of spectra given by molecular species. • NMR, ESR or EPR, pure rotational spectra, vibrational and vibrational-rotational spectra, Raman spectra. • Electromagnetic radiation with wavelength and energy. • Radiofrequency, microwave, IR, UV/visible, X-ray region. • Rotational spectra, calculation of bond length. • Vibrational-rotational spectra, Hook's law, vibrational energy level, Light scattering and Raman Spectroscopy with applications. • Principle and working of single beam spectrophotometer. • Numerical based on reduced mass and moment of inertia.	**10 h**
	[B] Soap and detergents Introduction, Definition of soaps and detergents, Types of soap (hard soap, soft soap, medicated soap, transparent soap), Types of detergents, Cleansing action of soap and detergents, Environmental impact of soap and detergents, Comparison of soap and detergents.	**5 h**

Reference Books:

- Quantitative analysis by R.A. Day and A.L. Underwood.
- Instrumental analysis, 5th Edition, by Skoog, Holler, Nieman
- Advanced Practical Organic Chemistry by Leonard F. Morrison, 2nd Edition, 2015, CRC Press.
- Modern Technology of Soaps, Detergents and Toiletries by P.K. Chattopadhyay, Revised Edition, 2013, NIIR Project Consultancy Services.
- The Science of Soaps and Detergents: Comprehensive Guide by David E. Shaw, 3rd Edition, 2017, McGraw Hill.
- Handbook on Soaps, Detergents & Acid Slurry by S.K. Singh, 2nd Revised Edition, NIIR Project Consultancy Services.
- Handbook of Detergents: Properties by Uri Zoller, 1st Edition, 2008, CRC Press.
- Industrial Applications of Surfactants IV, by D.R. Karsa, 4th Edition, 1999, Royal Society of Chemistry.

VEER NARMAD SOUTH GUJARAT UNIVERSITY

T. Y. B. Sc. – SEM – V CHEMISTRY Practical (SEC)

PAPER - CHP-SEC-501

Spectral and Industrial Chemistry (SEC) (1 Credits Theory + 1 Credits Practical)

As per NEP 2020

To be implemented from the Academic year 2025-26

Course Subject Code	CHP-SEC-501
Subject Title	Spectral and Industrial Chemistry (Practical)
Credits	01
Teaching per week	02 Hours
Effective from	2025-2026
Purpose of Course	This course aims to equip students with practical skills in spectrophotometric analysis, surfactant behavior studies, and soap formulation.
Objective of Course	Students will learn to analyse chemical compounds using spectrophotometry, study the effects of electrolytes on surfactants, determine critical micelle concentration, and assess soap quality through TFM measurement and liquid soap preparation.
Course Outcomes	**CO1-Remembering:** Students will recall the principles of spectrophotometry and surfactant chemistry, including key concepts such as cloud point, critical micelle concentration (CMC), and total fatty matter (TFM). **CO2-Understanding:** Students will explain the interactions of electrolytes with surfactants, the chemistry of soap preparation, and the role of metal complexes in spectrophotometric analysis. **CO3-Application**: Students will apply spectrophotometric methods to determine NO_2^- and metal-ligand complexes, and analyse the impact of electrolytes on non-ionic surfactants. **CO4-Analysis:** Students will analyse experimental data to determine CMC values, assess soap quality based on TFM, and evaluate the cloud point behavior of surfactants. **CO5-Evaluation:** Students will compare the effectiveness of different spectrophotometric techniques, assess the influence of salts on surfactant properties, and evaluate soap formulations. **CO6-Creation**: Students will design and formulate liquid glycerine soap, optimizing composition for improved cleansing efficiency and environmental sustainability.
Mapping Between COs and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	✓	✓	✓		✓	✓	✓	✓
CO2	✓		✓	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓	✓		✓
CO4	✓	✓	✓	✓	✓		✓	
CO5	✓	✓	✓		✓	✓	✓	✓
CO6	✓		✓	✓	✓	✓	✓	

Third Year B. Sc. Sem. – V

CHP-SEC-501

Syllabus effective from June 2025

1. Spectrophotometric determination of NO_2^{-1}.
2. Spectrophotometric determination of copper-ammonium complex.
3. Effect of electrolyte on cloud point of non-ionic surfactant.
4. CMC determination of ionic surfactant in the presence of salt.
5. Preparation of liquid glycerine soap.
6. Measurement of TFM (Total fatty matter) in soaps.
7. To investigate the corrosion rate of Copper/Brass/Iron/Aluminium in different acid concentrations.

(Note: Perform any four experiments)

Reference Books:

- Handbook of Food Analysis: Physical Characterization and Nutrient Analysis by Leo M.L. Nollet, 3rd Edition, 2015, CRC Press.
- Food Adulteration and Safety by H.G. Ramachandran 1st Edition, 2016, Tata McGraw-Hill Education
- Advanced Practical Physical Chemistry by J. B. Yadav, 31st Edition, 2020, Goel Publishing House.
- Food Chemistry, by H.-D. Belitz, Werner Grosch, Peter Schieberle, 4th Revised and Extended Edition, 2009, Springer.
- Handbook of Food Adulteration and Safety, by B.K. Ghosh, 1st Edition, 2020, Random Publications.
- Modern Technology of Soaps, Detergents and Toiletries by P.K. Chattopadhyay, Revised Edition, 2013, NIIR Project Consultancy Services.
- Surfactants and Interfacial Phenomena by M. J. Rosen, and Joy T. Kunjappu, 4th Edition, 2012, Wiley-Interscience.
- Vogel's Quantitative Chemical Analysis by J. Mendham, R.C. Denney, J.D. Barnes, and M. Thomas, 6th Edition, 2000, Pearson Education.