પરિપત્ર:

ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટીની સાયન્સ વિદ્યાશાખાનાં અભ્યાસક્રમ ચલાવતી તમામ સંલગ્ન કોલેજોનાં આચાર્યશ્રીઓને સવિનય જણાવવાનું કે સાયન્સ વિદ્યાશાખા હેઠળનો NEP-૨૦૨૦ અંતર્ગત કેમેસ્ટ્રી વિષય સેમેસ્ટર-૫નો અભ્યાસક્રમ આ સાથે સામેલ છે.

માનનીય કુલપતિશ્રીની મંજુરી અનુસાર સદર અભ્યાસક્રમ શૈક્ષણિક વર્ષ જુન,૨૦૨૫ થી અમલવારી કરવાની રહે છે. સાયન્સ વિદ્યાશાખાનાં અભ્યાસક્રમ ચલાવતી તમામ સંલગ્ન કોલેજો ધ્વારા તેની અમલવારી કરવા જણાવવામાં આવે છે.

નોંધ: બીકેએનએમયુ/ એકેડેમિક/૨૦૪/૨૦૨૫નાં પરિપત્રમાં કેમેસ્ટ્રી અભ્યાસ સમિતિનાં ચેરપર્સન દ્વારા મળેલ ઈ-મેઈલ મુજબ અભ્યાસક્રમમાં ફેરફાર કરવામાં આવેલ છે.

Bhakta Kavi Narsinh Mehta University Junagadh.

24/7/2025

ખાસ ફરજ પરના અધિકારી
(એકેડેમિક)

ક્રમાંક/બીકેએનએમયુ/ એકેડેમિક/૩૯૯/૨૦૨૫
ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી,
સરકારી પોલીટેકનિક કેમ્પસ,
ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી રોડ,
ખડીયા, જૂનાગઢ-૩૬૨૨૬૩
તા.૨૪/૦૭/૨૦૨૫

પ્રતિ,

- ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી સંલગ્ન સાયન્સ વિદ્યાશાખાનાં અભ્યાસક્રમો ચલાવતી તમામ કોલેજોના આચાર્યશ્રીઓ તરફ....

નકલ સાદર રવાનાઃ-

- માન.કુલપતિશ્રી/ કુલસચિવશ્રીનાં અંગત સચિવશ્રી.
- પરીક્ષા નિયામકશ્રી, ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી, જુનાગઢ

નકલ રવાના જાણ તથા યોગ્ય કાર્યવાહી અર્થેઃ

- સીસ્ટમ મેનેજરશ્રી, આઇ.ટી.સેલ વિભાગ (વેબસાઇટ ઉપર પ્રસિદ્ધ થવા અર્થે.)

BHAKTA KAVI NARSINH MEHTA UNIVERSITY

Major/Minor

Syllabus of Chemistry (Honors) as per NEP-2020

Faculty of Science

Effective from June 2025

Subject: CHEMISTRY

SEMESTER- V

SUMMARY OF THE SYLLABUS

Sem No.	Sr. No.	Category of Course	Course Code	Title of the Paper	Course Level	Credit	Teaching Hrs.	SEE Marks	CCE Marks	Total Marks	Exam Duration
Sem-5	1	Major-11	CHM301-3C	Higher Chemistry-301	5.5	4	4T	50	50	100	2 hrs
	2	Major-12	CHM302-3C	Higher Chemistry-302	5.5	4	4T	50	50	100	2 hrs
	3	Major-13	CHM303-3C	Higher Chemistry Practical-303	5.5	4	8P	50	50	100	8 (P) hrs
	4	Minor-4	CHE301-3C	Minor Chemistry-301	5.5	4	4T	50	50	100	2 hrs
	5	Minor-5	CHE302-3C	Minor Chemistry Practical-302	5.5	4	8P	50	50	100	8(P) hrs

BHAKTA KAVI NARSINH MEHTA UNIVERSITY

JUNAGADH

BOARD OF STUDIES

FACULTY OF SCIENCE

SYLLABUS FOR CHEMISTRY (HONOURS)

PROGRAMME (SEMESTER- V)

EFFECTIVE FROM JUNE, 2025

BHAKTA KAVI NARSINH MEHTA UNIVERSITY

Major/Minor

Syllabus of Chemistry (Honors) as per NEP-2020

Faculty of Science

Effective from June 2025

Subject: CHEMISTRY

SEMESTER- V

Major Chemistry-11(IKS) (CHM301-3C/Higher Chemistry-301)

Course Level	5.5		**Internal Marks**	50
Programme	B. Sc. Chemistry		**External Marks**	50
Semester	V		**Practical Internal**	-
Category of Course	Major-11		**Practical External**	-
Course Credit	4		**Practical Exam Duration**	-
Teaching Hours	4T		**Total**	-
Course Code	**CHM301-3C**		**External Theory Exam Duration**	2 hrs
Course Title	**Higher Chemistry-301**			

Course Objectives:

- Introduction and correlation of IKS to modern concepts of Natural product chemistry and separation techniques.
- Amino Acids, Peptides, and Proteins: Study the structure, properties, and biochemical significance of amino acids, peptides, and proteins.
- Nucleosides and Nucleotides: Understand the Structure and Function of Nucleotides and Nucleosides.
- Chromatography: Introduce chromatography techniques (Column, Paper, TLC, Gas, and Ion-exchange) and their applications in the separation and analysis of compounds.
- Carbohydrates: Study the classification, structure of monosaccharide and disaccharide (glucose and sucrose) and biochemical importance of carbohydrates
- Volumetric Analysis: Understand various volumetric analytical methods
- Error and statistics: Introduce students to the concept of error and statistics in scientific calculations.

Course Learning Outcomes: Upon successful completion of this course, students will:

- Students will become aware about the versatility of Indian Knowledge system, its wisdom and realize the enormous scope for its further applications. They will also be able to holistically apply the modern concept of natural product and some separation techniques.
- Amino Acids, Peptides, and Proteins: Analyze the chemical structure and properties of biomolecules and their role in biological processes.
- Nucleosides, Nucleotides: Apply knowledge of nucleotides to understand their roles in cellular metabolism and health.
- Carbohydrates: Analyze the structure and biological functions of various carbohydrates and their roles in living organisms.
- Chromatography: Perform chromatographic techniques to separate, identify and purify chemical compounds.
- Volumetric analysis: Perform accurate titrations to determine concentrations and apply volumetric principles to various analytical tasks.

- Error and statistics: Determinate (Instrumental, Operative and Errors of method) and indeterminate errors, calibrate instruments using Blank measurement, independent method, Parallel method and Standard addition method, use Significant figure and its laws

Course Contents

Sem	Unit No	Syllabi	Teaching Hours
5	1	**Chapter-1: Amino acids, Peptides and Proteins** Introduction and Relevance to IKS Classification of amino acids name and formula. Synthesis of amino acids by: (i) Strecker amino acid synthesis (ii) Gabriel pthalimide synthesis (ii) Erlenmeyer azlactone synthesis (iii) Hydantoin method Physical properties of amino acids, Chemical properties of amino acids, Isoelectric point with examples Introduction to Polypeptides, Synthesis of Polypeptides by: (i) Bergmann Method (ii) Sheehan's Method (use of Phthaloyl group) (iii) Fischer's Method (use of p-toluenesulphonylchloride) Introduction and classification of proteins, Constitution of Thyroxine, Synthesis of Thyroxine	**15**
	2	**Chapter-2: Nucleosides and Nucleotides** Introduction, Importance of nutrition, vitality, and holistic health, which indirectly align with modern concepts of nucleotides, nucleosides in IKS, Definition and Difference between nucleosides and nucleotides Structure of its components; Base: Purine and Pyrimidine, Sugar: Ribose and 2-Deoxyribose Structure of common nucleosides; Adenosine, Guanosine, Cytidine, Uridine and Thymidine Structure of common nucleotides: AMP, GMP, CMP, UMP and TMP Chemical Properties; i). Hydrolysis, ii). Acid and base stability, iii). UV absorption and tautomerism	**05**

		Importance and Applications (only structure and basic function): Role in energy transfer: ATP & GTP Role in cofactors NAD+ and FAD	
		Chapter-3: Chromatography Ancient Indian separation and purification techniques and applications. Introduction, Principle & Classification of chromatography Column chromatography: Principle, Adsorbents, Preparation of column, Method, Separation of green leaf pigment, Paper chromatography: Introduction, Principle, Types of Paper Chromatography (Ascending and Descending, Two dimensional; Circular), Migration parameters (Rf value and Rx value), Spotting and Visualization. Separation of amino acids and metal ions (Fe+ , Co+2, Ni+2) mixture using spray reagent ninhydrine and aniline phthalate TLC: Introduction, Principle, Method of preparation of chromplate, Experimental techniques, Superiority of TCL over other chromatographic Techniques, Application of TLC. Gas chromatography; Introduction, Types, Principle of GLC and GSC, Instrumentation, Carrier gas and Solvent, Advantages of gas chromatography.	**10**
	3	**Chapter-4: Carbohydrates** Introduction, Concepts of 'guns' of food and importance and applications of jaggery in IKS, Classification and nomenclature, general reaction of monosaccharaides (with reference to Glucose and Fructose) Inter-conversions: Conversion of Aldose to the corresponding ketose Conversion of Aldose to the next higher Ketose (wolform method) Conversion of Aldose to the Ketose having two more carbon atoms (Sowden Conversion of Ketose to the corresponding Aldose) method) Step-up reaction (Ascending in Aldose series) Kiliani reaction Sowden nitromethane reaction Step-down reaction (Descending in Aldose series – Aldohexose to Aldopentose) by Ruff's method Configuration of monosaccharides Ring structure of Aldoses Determination of ring size of Glucose by Methylation method	**15**

		and Periodic oxidation method Mutarotation of D (+) glucose Introduction of disaccharides & configuration of sucrose**.**	
	4	**Chapter-5 Volumetric Analysis** Volumetric analysis in ancient Indian knowledge system, Units of liquid volume in classical and later periods. Modern concepts in volumetric analysis. Primary and secondary standard solution. Ostwald theory of indicator Neutralization Titration with Graphs: Strong acid - Strong base titration, Weak acid -Strong base titration, Strong acid – Weak base titration Redox Titration: Types of Redox indicator, Iodometry and Iodimetry titration Precipitation Titration: Argentometric Titration, Determination of end point by (I) Mohr's method (II) Fajan's method (III) Volhard's method	**10**
		Chapter-6: Error and statistics Introduction to error and statistical thinking manifested in ancient India. Types of errors, Determinate (Instrumental, Operative and Errors of method) and indeterminate errors; Additive and Proportional errors Gaussian (Normal Distribution) curve and its explanation Minimization of errors (Calibration of instruments, Blank measurement, independent method, Parallel method and Standard addition method) Accuracy and precision, Absolute error and Relative error, Mean and Median Deviation, Relative mean deviation, Width (Range), Standard deviation, Variance and Coefficient of variance Explanation of Significant figure and its laws. Q – Test and Student T- Test	**05**

BHAKTA KAVI NARSINH MEHTA UNIVERSITY

Major/Minor

Syllabus of Chemistry (Honors) as per NEP-2020

Faculty of Science

Effective from June 2025

Subject: CHEMISTRY

SEMESTER- V

Major Chemistry-12 (CHM302-3C/Higher Chemistry-302)

Course Level	5.5		**Internal Marks**	50
Programme	B. Sc. Chemistry		**External Marks**	50
Semester	V		**Practical Internal**	-
Category of Course	Major-12		**Practical External**	-
Course Credit	4		**Practical Exam Duration**	-
Teaching Hours	4T		**Total**	-
Course Code	**CHM302-3C**		**External Theory Exam Duration**	2 hrs
Course Title	**Higher Chemistry-302**			

Course Objectives:

- Metal π-Complexes: Explore the bonding, synthesis, and reactivity of metal-π complexes, with an emphasis on industrial and catalytic applications.
- Infrared Spectroscopy: Understand the principles of IR spectroscopy to identify molecular vibrations and functional groups.
- Ultraviolet and Visible Spectra: Learn UV-Visible spectroscopy techniques to analyse electronic transitions in molecules and determine chromophores.
- Nuclear Magnetic Resonance (NMR) Spectroscopy: Provide a comprehensive understanding of NMR principles to elucidate the structure and dynamics of molecules.
- Electrochemistry-I: Develop insights into redox processes, electrode potentials, and electrochemical cells for various applications.
- Problem solving using mixed spectroscopic data: Understand the spectral data and reach a conclusion based on the spectral data provided.
- This course aims to equip students with both theoretical knowledge and analytical skills required to interpret data from these chemical techniques and apply them to real-world research and industry challenges.

Course Learning Outcomes: Upon successful completion of this course, students will:

- Metal π-Complexes: Demonstrate an understanding of the structure and bonding in metal-π complexes and predict their reactivity.
- Infrared Spectroscopy: Accurately interpret IR spectra to identify functional groups and use it effectively to characterize molecules.
- UV-Vis Spectra: Apply UV-Visible spectroscopy to determine electronic transitions and molecular absorption properties.
- NMR Spectroscopy: Analyze NMR spectra to determine molecular structure, identify chemical environments, and detect isomerism in compounds.
- Electrochemistry-I: Solve problems involving electrochemical cells and predict electrode reactions.
- Problem solving using mixed spectroscopic data: Analyze the spectral data and identify

significant structural properties and constitution.

- These outcomes ensure students are proficient in applying spectroscopic and electrochemical techniques for research, analytical tasks, and problem-solving in professional environments.

Course Contents

Sem	Unit No	Syllabi	Teaching Hours
5	1	**Chapter-1: Metal π- complexes** **Metal carbonyls:** Definition, preparation, physical and chemical properties, Classification of metal carbonyls, Nature of M-CO bond based on Molecular orbital model (with spectral support), Types of CO groups, (Terminal, doubly bridge, triply bridge and semi-bridge), Application of IR spectroscopy for determination of geometry of complex and determination of bond order, detection of terminal and bridging CO groups, Structures of (i) $Ni(CO)_4$, (ii) $Fe(CO)_5$, (iii) $Fe_2(CO)_9$, (iv)$Fe_3(CO)_{12}$, (v) $Mn_2(CO)_{10}$, (vi) $Co_2(CO)_8$, 18-electron rule and Effective atomic number (EAN), calculation of metal-metal bond, number of metal and number of ligand if the complex follow 18 electrons rule, Only structure, number of bridge and non-bridge carbonyl in $Co_2(CO)_8$, Ru2$(CO)_9$, $Os_2(CO)_9$, $Ru_3(CO)_{12}$, $Os_3(CO)_{12}$, $Co_4(CO)_{12}$, $Rh_4(CO)_{12}$ $Ir_4(CO)_{12}$, $Rh_6(CO)_{16}$, **Metal nitrosyls**: Definition, preparation, physical and chemical properties, Complexcompounds having simple NO ligand (neutral), Linear (NO^+) and Bent (NO^-), terminal M-NO bonding, bridging NO groups, IR study of metal nitrosyls.	**15**
	2	**Chapter-2 Infrared Spectroscopy** Introduction, Principle, theory of IR, selection rules, Normal modes of vibrations, intensity, Factors influencing IR vibrations: Coupled vibrations, Fermi resonance, electronic effects, Bond angles, H-bond, Stretching frequency calculation equation (only for interpretation of Mass and bond dependency of frequency), Instrumentation, interpretation of IR, Finger print region, Group frequencies and its applications to Aliphatic and aromatic Hydrocarbons, alcohols phenols, carbonyl compounds, carboxylic acids and its derivatives, ethers, halogen compounds and compounds containing C-N, C-S, C-X linkages, Application of IR in chemical analysis, chemical reactions, H-bonding, tautomerism, and stereochemistry, General Applications to inorganic complexes,	**09**

		pharmaceutical analysis and other industrial applications. Logical examples on relative absorption frequencies, positions in aromatic ring, functional group identification or structural elucidation of organic compounds (Spectral Data to be provided and values not to be remembered by the students).	
		Chapter-3: Ultraviolet and Visible Spectra Instrumentation, Types of transition in organic molecules, Auxochrome, chromophore, Explanation of bathochromic shift, hypsochromic shift, hyperchromic and hypochromic effects, Factor affecting UV spectral bands, Application of UV. Calculation of λmax of (i) dienes and conjugated dienes (ii) enones and dienones (iii) aromatic carbonyl system. Problems solving based on UV absorption data. (Spectral Data to be provided and values not to be remembered by the students)	**06**
	3	**Chapter-4: Proton Magnetic Resonance Spectroscopy [PMR/ ^{1}H-NMR]** Introduction: Principle; Magnetic properties-nuclear quantum number and orientation of magnetic moments of nuclei. Number of signals: Equivalent and non-equivalent protons with illustrations; enantiotopic and diastereotopic protons; Position of the signal: Shielding and deshielding of protons; Internal standard, Characteristic chemical shift and factors affecting on it; Paramagnetic and diamagnetic anisotropic effect with examples; Intensity of signals: Peak area and number of protons Splitting of the signals: Spin- spin coupling, Theory of splitting (formation of doublet, triplet, quartet) Coupling constant; Geminal and Vicinal coupling, Calculation of Coupling constant(J). Low temp NMR, Deuterium labeling; General Applications of NMR in identification of constitutional isomers, geometrical isomers, keto enol tautomers, partial double bond characters and H-bonding. Complications and limitations of PMR Problems related to determination of structure of organic molecules like aliphatic organic molecules, mono and di substituted aromatic compounds. [except: heterocyclic compound, Fused aromatic compounds] from PMR spectral data. (Spectral Data to be provided and values not to be remembered by the students)	**15**
	4	**Chapter-5: Problem solving using mixed spectroscopic data** Problem solving based on logical correlation of data and structural	**05**

		property or constitutional establishment/structural elucidation of simple aliphatic or mono and disubstituted aromatic organic compound (except heterocyclic compounds, fused aromatic compounds) from the spectral data provided like UV and or IR and or NMR. (Spectral Data to be provided and values not to be remembered by the students)	
		Chapter-6: Electrochemistry – I Introduction, Conventional sign and representation of cell, Reversible cell and Irreversible cell, Types of reversible electrodes, Half-cell, standard half-cell, Measurement of emf, Standard cell, Standard electrode potential, Single electrode potential, Reference electrodes: (1) Primary reference electrode (2) Secondary reference electrodes (Calomel, Ag/AgCl/Cl-1 and Hg/HgSO4 / SO4-2electrodes), Applications of emf series, Calculation of single electrode potential, Determination of equilibrium constant, Determination of ΔG, ΔS and ΔH from emf of cell, Determination of solubility sparingly soluble salt, Numerical based on theory.	**10**

BHAKTA KAVI NARSINH MEHTA UNIVERSITY

Major/Minor

Syllabus of Chemistry (Honors) as per NEP-2020

Faculty of Science

Effective from June 2025

Subject: CHEMISTRY

SEMESTER- V

Major Chemistry-13 (CHM303-3C/Higher Chemistry Practical-303)

Course Level	5.5		**Internal Marks**	50
Programme	B. Sc. Chemistry		**External Marks**	50
Semester	V		**Practical Internal**	50
Category of Course	Major-13		**Practical External**	50
Course Credit	4		**Practical Exam Duration**	8 (P) Hrs
Teaching Hours	8P		**Total**	-
Course Code	**CHM303-3C**		**External Theory Exam Duration**	-
Course Title	**Higher Chemistry Practical-303**			

Course Objectives:

- Organic Separation: Develop practical skills to separate and identify components from a binary organic mixture using chemical and physical methods.
- Physicochemical Exercises: Provide hands-on experience with various instruments (Viscometer, Refractometer, Polarimeter) and techniques to study the physical and chemical properties of substances.
- Thermodynamics: Understand enthalpy and free energy changes.
- Refractometer & Viscosity: Measure refractive indices and viscosity to study molecular interactions.
- Polarimeter: To analyses optical activity.
- Surface Tension: Study intermolecular forces by measuring surface tension of liquids.
- Chromatography (Paper & TLC): Use chromatography to separate, identify, and analyses components of mixtures.
- The course aims to enhance laboratory proficiency by teaching students both separation techniques and physicochemical analysis for a variety of chemical systems.

Course Learning Outcomes: Upon successful completion of this course, students will:

Organic Separation:

- Effectively separate, purify, and identify components of a binary organic mixture using extraction, crystallization, and other techniques.

Physicochemical Exercises:

- Thermodynamics: Perform conductometric titrations and calculate thermodynamic parameters like enthalpy and entropy.
- Refractometer & Viscosity: Measure refractive index and viscosity, and interpret molecular properties influencing them.
- Polarimeter: To measure optical rotation.
- Surface Tension: Measure surface tension to explore molecular interactions in liquids.
- Paper & TLC Chromatography: Perform chromatographic techniques to separate and analyse chemical components.

- These outcomes ensure students gain competence in laboratory techniques and instrumentation essential for chemical analysis and research.

Course Contents

Sem	Unit No	Syllabi	Teaching Hours
5	1	**Organic Separation (Mixture of two compounds)** ***[15 binary mixtures may be provided for separation and identification of the compound]*** Separation & Analysis of an organic mixture containing (a) Two solid components using water, $NaHCO_3$, NaOH and HCl for separation (b) Liquid + liquid component - separation by physical method. (c) Liquid + solid component - separation by physical method. **Note: Students may be trained to be able to carry out separation of binary mixture in exam without use of laboratory manual.**	**60**
	2	**Physicochemical Exercise** ***[Minimum 10 exercises should be done]*** **i. Refractometer** 1. To determine specific refractivity and molecular refractivity of given pure liquid A, B, C, D. 2. To determine specific refractivity and molecular refractivity of glycerine (10%, 5%, 2.5%) and unknown glycerine solution. **ii. Viscosity** 1. To determine relative and absolute viscosity of pure liquid A, B, C, D by Ostwald's viscometer. 2. Preparation three different 10%, 5%, 2.5% aqueous solution of glycerine, find viscosity of these three solutions as well as unknown concentration solution with the help Ostwald's viscometer. **iii. Polarimeter** 1. To determine specific rotation of three different concentration (10%, 5%, 2.5%) of dextrose solution. From graph find out the unknown. 2. Study the inversion rate of sugar in presence of 1N HCl and	**60**

		determine the rate of reaction. **iv. Surface tension:** 1. Find the surface tension of the liquids A, B and C by using drop weight method. Find the value of parachor of liquid and CH_2 group. 2. Comparison of cleansing power of various detergent powders. **v. Thermodynamics:** 1. Calculate entropy of vaporization (ΔS_v) of a given liquid by plotting a graph of log (1/time) vs (1/temperature) **vi. Chromatography** 1. To determine Rf value of individual and mixture of amino acid by ascending paper chromatography. 2. To determine Rf value of individual and mixture of amino acid by circular paper chromatography. 3. To determine Rf value of individual and mixture of amino acid by thin layer chromatography (TLC). 4. To determine Rf value of individual and mixture of metal ions by ascending paper chromatography. To determine Rf value of individual and mixture of metal ions by circular paper chromatography.	

BHAKTA KAVI NARSINH MEHTA UNIVERSITY

Major/Minor

Syllabus of Chemistry (Honors) as per NEP-2020

Faculty of Science

Effective from June 2025

Subject: CHEMISTRY

SEMESTER- V

Minor Chemistry-4 (CHE301-3C/ Minor Chemistry-301)

Course Level	5.5		**Internal Marks**	50
Programme	B. Sc. Chemistry		**External Marks**	50
Semester	V		**Practical Internal**	-
Category of Course	Minor-4		**Practical External**	-
Course Credit	4		**Practical Exam Duration**	-
Teaching Hours	4T		**Total**	-
Course Code	**CHE301-3C**		**External Theory Exam Duration**	2 hrs
Course Title	**Minor Chemistry-301**			

Course Objectives:

- Polymers: To introduce students to the classification, synthesis, properties, and applications of polymers in daily life and industry.
- Polynuclear Aromatic Hydrocarbons (PAHs): To develop an understanding of the synthesis and reactions of key PAHs.
- Sweetening Agents: To explore the chemistry of natural and artificial sweeteners, including their synthesis and use in food and pharmaceuticals.
- Petrochemicals: To examine the origin, extraction, refining processes, and chemical conversions of petroleum into valuable chemicals.
- Pollution: To create awareness about chemical pollutants, their sources, types, and the impact on environment and health, including remediation methods.
- Volumetric Analysis: Develop skills in quantitative chemical analysis using titration methods to determine the concentration of unknown solutions.

Course Learning Outcomes: Upon successful completion of this course, students will:

- Polymers: Classify polymers based on origin, structure, and polymerization process. Describe the mechanisms of polymer formation (addition and condensation). Explain the physical and chemical properties of various polymers. Identify and evaluate the industrial and biomedical applications of polymers.
- Polynuclear Aromatic Hydrocarbons: Understand the synthesis of key PAHs. Explain chemical reactions involving PAHs.
- Sweetening Agents: Explain the synthesis of key sweetening agents.
- Petrochemicals: Trace the steps from crude oil refining to petrochemical product synthesis. Understand the chemical conversions of hydrocarbons into key petrochemicals. Recognize the role of petrochemicals in the production of plastics, detergents, and fuels.
- Pollution: Identify major types of chemical pollution: air, water, and soil. Understand the sources and effects of pollutants, heavy metals and organic compounds. Evaluate pollution control measures and environmental management practices.
- Volumetric Analysis: Perform accurate titrations to determine concentrations and apply volumetric principles to various analytical tasks.

BHAKTA KAVI NARSINH MEHTA UNIVERSITY

Major/Minor

Syllabus of Chemistry (Honors) as per NEP-2020

Faculty of Science

Effective from June 2025

Subject: CHEMISTRY

SEMESTER- V

Course Contents

Sem	Unit No.	Syllabi	Teaching Hours
5	1	**Chapter-1 Polymers** Introduction, Classification of Polymers based on Source, Structure, Molecular forces, Modes of polymerization, Growth of polymerization, Crystallinity and Tacticity. Types of Polymerizations, Addition (Homo and Co-polymerization) and Condensation Polymerization, Free Radical Polymerization Reaction with mechanism, Rubber: Natural rubber, Vulcanized rubber, Bio-degradable and non-bio degradable polymer, Number average molecular weight, weight average molecular weight and PDI, Only the name of methods uses for determination of molecular mass of polymers, Synthesis, Properties and Use of: Nylon-6, Nylon-66, Terylene, Teflon, Buna-S, PHBV, Nylon-2-nylon-6, Neoprene, Buna-N.	**15**
	2	**Chapter-2 Polynuclear Aromatic Hydrocarbons** Introduction, Classification of Polynuclear hydrocarbon, Synthesis and chemical properties: Biphenyl, Diphenyl methane, Naphthalene, Anthracene	**10**
		Chapter-3 Sweeting Agents Introduction, Synthesis and applications of Saccharin p-Anisylurea Dulcin	**05**
		Chapter-4 Petrochemicals Introduction Petrochemicals from Methane (C_1), Ethylene (C_2) and Propylene (C_3) **Methane** Manufacture of Chloromethanes (Chlorinated hydrocarbons) Manufacture of Synthetic gas	**08**

	3	**Ethylene** Manufacture of ethylene glycol from (i)Ethylene chlorohydrins (ii)Ethylene oxide Manufacture of ethyl alcohol by (i)Sulphuric acid process and (ii)Catalytic hydration process **Propylene** Manufacture of glycerol (i)Via allyl chloride and (ii)Via acrolein Manufacture of acrylonitrile	
		Chapter-5 Environment and Pollution Introduction of Environment and Pollution, State only the names of different types of pollution, Details discuss about Water pollution, **Water pollution:** Classification of water pollution (i) Physical pollution (ii) Chemical pollution (iii) Biological pollution (iv) Physiological pollution **Sources of water pollution**: (i) Sewage and domestic waste (ii) Industrial effluents (iii) Agricultural discharges (iv) Fertilizers (v) Toxic metals (vi) Siltation (vii) Thermal pollutions (viii) Radioactive materials **Control of Water Pollution**, Dissolved Oxygen (D.O.) determination Chemical Oxygen Demand (C.O.D.) determination Biological Oxygen Demand (B.O.D.) determination	**07**
	4	**Chapter-6 Volumetric Analysis** Primary and secondary standard solution **Neutralization Titration with Graphs:** Ostwald theory of indicator, Strong acid - Strong base titration, Weak acid - Strong base titration, Strong acid – Weak base titration, Poly protic acid - Strong base titration, **Redox Titration:** Principle of internal indicator, External indicator K3[Fe(CN)6] and reagent itself as indicator. Redox Titration with graph and calculation,	**15**

		Iodometry and Iodimetry titration and starch as indicator, **Precipitation Titration:** Argentometric Titration, Determination of end point by (I) Mohr's method (II) Fajan's method (III) Volhard's method. **Complexometry Titration** EDTA and Velcher's law explanation of pM EDTA Vol. graph with stability constant value, **Types of EDTA titration** (i) Direct, (ii) Back titration, (iii) Substitution titration (iv) Alklimetry titration mixture with the help of masking and de-masking agent. Principle of metal ion indicator, Use of EBT, calcon, muroxide as indicator with structure and characteristics. Numerical based on the theory.	

BHAKTA KAVI NARSINH MEHTA UNIVERSITY

Major/Minor

Syllabus of Chemistry (Honors) as per NEP-2020

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Subject: CHEMISTRY

SEMESTER- V

Minor Chemistry-5 (CHE302-3C/ Minor Chemistry-302)

Course Level	5.5		**Total Internal Marks**	50
Programme	B. Sc. Chemistry		**Total External Marks**	50
Semester	V		**Total Practical Internal**	50
Category of Course	Minor-5		**Total Practical External**	50
Course Credit	4		**Practical Exam Duration**	8 (P) hrs
Teaching Hours	8P		**Total marks**	100
Course Code	**CHE302-3C**		**External Theory Exam Duration**	-
Course Title	Minor Chemistry Practical-302			

Course Objectives:

- Organic Separation: Develop practical skills to separate and identify components from a binary organic mixture using chemical and physical methods.
- Physicochemical Exercises: Provide hands-on experience with various instruments (Viscometer, Refractometer, Polarimeter) and techniques to study the physical and chemical properties of substances.
- Thermodynamics: Understand enthalpy and free energy changes.
- Refractometer & Viscosity: Measure refractive indices and viscosity to study molecular interactions.
- Polarimeter: To analyses optical activity.
- Surface Tension: Study intermolecular forces by measuring surface tension of liquids.
- The course aims to enhance laboratory proficiency by teaching students both separation techniques and physicochemical analysis for a variety of chemical systems.

Course Learning Outcomes:

Upon successful completion of this course, students will:

- Organic Separation:
- Effectively separate, purify, and identify components of a binary organic mixture using extraction, crystallization, and other techniques.

Physicochemical Exercises:

- Thermodynamics: Perform conductometric titrations and calculate thermodynamic parameters like enthalpy and entropy.
- Refractometer & Viscosity: Measure refractive index and viscosity, and interpret molecular properties influencing them.
- Polarimeter: To measure optical rotation.
- Surface Tension: Measure surface tension to explore molecular interactions in liquids.
- These outcomes ensure students gain competence in laboratory techniques and instrumentation essential for chemical analysis and research.

Course Contents

Sem	Unit No	Syllabi	Teaching Hours
5	1	**Organic Separation (Mixture of two compounds)** ***[15 binary mixtures may be provided for separation and identification of the compound]*** Separation & Analysis of an organic mixture containing 1. Two solid components using water, $NaHCO_3$, NaOH and HCl for separation 2. Liquid + liquid component - separation by physical method. 3. Liquid + solid component - separation by physical method. **Note: Students may be trained to be able to carry out separation of binary mixture in exam without use of laboratory manual.**	**60**
	2	**Physicochemical Exercise** ***[Minimum 10 exercises should be done]*** **I. Refractometer** • To determine specific refractivity and molecular refractivity of given pure liquid A, B, C, D. • To determine specific refractivity and molecular refractivity of glycerine (10%, 5%, 2.5%) and unknown glycerine solution. **II. Viscosity** • To determine relative and absolute viscosity of pure liquid A, B, C, D by Ostwald's viscometer. • Preparation three different 10%, 5%, 2.5% aqueous solution of glycerine, find viscosity of these three solutions as well as unknown concentration solution with the help Ostwald's viscometer. **III. Polarimeter** • To determine specific rotation of three different concentration (10%, 5%, 2.5%) of dextrose solution. From graph find out the unknown. • Study the inversion rate of sugar in presence of 1N HCl and determine the rate of reaction. **IV. Surface tension:** • Find the surface tension of the liquids A, B and C by using drop weight method. Find the value of parachor of liquid and CH_2 group. • Comparison of cleansing power of various detergent	**60**

		powders. **V. Thermodynamics:** • Calculate entropy of vaporization (ΔS_v) of a given liquid by plotting a graph of log (1/time) vs (1/temperature)	

Suggested Reading:

1. Principles of Inorganic chemistry – Puri, Sharma & Kalia
2. Concise Inorganic Chemistry - J. D. Lee
3. Advanced Inorganic Chemistry- Cotton and Wilkinson
4. Basic Inorganic Chemistry - Gurdeep & Chatwal
5. Organic Chemistry (Volume I, II & III) by S.M. Mukherji, S.P. Singh and R.P. Kapoor
6. A Text Book of Organic Chemistry (II Edition) by Raj K. Bansal
7. Name Reactions in Organic Synthesis by Dr. A. R. Parikh et. Al
8. Reactions and Rearrangements by Gurdeep Chatwal
9. Essentials of Physical Chemistry, B. S. Bahl, G. D. Tli and Arun Bahl, S. Chand & Co.. New Delhi
10. Elements of Physical Chemistry, Late B.R. Puri, L. R. Sharma and Madan Pathania, Vishal Publishing Co. Jalandhar
11. Principles of Physical Chemistry, Samule H. Maron and Carl F. Prutton, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi
12. Physical Chemistry, B. K. Sharma, Goel Publication House. Meerut.
13. Quantum chemistry by A. K. Chandra
14. Basic Concept of Quantum Chemistry by R. K. Das.
15. Molecular Physical Chemistry by McQuarrie
16. Elements of Physical Chemistry, Samuel Glasstone and David Lewis, Macmillan & Co.
17. Industrial Chemistry by B.K. Sharma
18. Thermodynamics by Gurudeeep Raj
19. Thin Layer Chromatography by Egal Stall
20. Thermodynamics for Chemists by Samuel Glasstone
21. A Textbook of Quantitative Inorganic Analysis by A. I. Vogel
22. Inorganic inflictive analysis by Vogel and Gehani Parekh
23. Reigel's Handbook of Industrial Chemistry by James A. Kent
24. Fundamental of Analytical Chemistry by Skoog and West
25. Instrumental Methods of Chemical Analysis by B. K. Sharma
26. Instrumental Method of Chemical Analysis by Chatwal Anand
27. Analytical Chemistry by Dick
28. Electrometric Methods of Analysis by Browning
29. Principle of Instrumental Methods of Analysis by Skoog
30. Jack T. Ballinger; Gersshon J. Shugar. Chemical Technicians' Ready Reference Hand book, 5th Edition, 2011, ISBN:9780071745925, The McGraw-Hill com, Inc
31. Organic structures from spectra, fourth edition, by L. D. Field, S. Sternhell, J. R. Kalman (John Willey and sons),
32. Heterocyclic Chemistry, third edition, J. A. Joule, K. Mills, G.F. Smith
33. An introduction to the Chemistry of Heterocyclic Compounds, Third edition, R. Morrin Acheson (John Willey & sons).

34. Organic Synthesis based on name reactions, third edition, A practical guide to 750 transformations, A. Hassner and I. Namboothiri (Elsevier).
35. Name reactions in Heterocyclic Chemistry by Jie Jack Li (Wiley India Edition).
36. Heterocyclic Chemistry, Seventh Edition by Raj K. Bansal (New Age International Publishers).
37. Organic structures from spectra, fourth edition, by L. D. Field, S. Sternhell, J. R. Kalman (John Willey and sons)
38. Structure Determination of Organic Compounds: Tables of Spectral Data" by Ernö Pretsc h, Philippe Bühler, and Martin Badertscher
39. Spectroscopic Methods in Organic Chemistry" by Ian Fleming and Dudley Williams
40. Organic Chemistry" by Jonathan Clayden, Nick Greeves, and Stuart Warren.
41. Handbook of solvent extraction by TehC. Lo, Malcolm H. I. Baird, and Carl Hanson
42. 'Extraction Techniques in Analytical Sciences' , by John R. Dean
43. Joshi H. S; Comprehensive practical Analytical Chemistry.
44. Practical Analytical Chemistry by Atul H. Bapodra; LAP LAMBERT Academic publishing, ISBN 978-613-8-32440-9

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SEMESTER- V

Evaluation scheme for various courses

Scheme-1 **Internal Evaluation Scheme (50 marks) for 4 credit 100 marks course**		
Sr. No.	**Particulars**	**Marks**
1	**Mid Semester Exam (T/P-Mandatory)**	**25**
2	Class Test	05
3	Open book exam/test	05
4	Practical skills	05
5	Self-test/ Online test	05
6	Quizzes/Objective test	05
7	Class assignment	05
8	Home assignment	05
9	Research/Dissertation	05
10	Viva/Oral exam	05
11	Group Discussion	05
12	Paper presentation/Seminar	05
13	Co-curricular work	05
14	Field Assignment	05
15	Poster Presentation	05
16	Attendance	05
17	Project Work/Journal	05
	Total	**50**

Note: Sr.No.1 is mandatory. Select **any five** from **Sr.No.2 to 17**. Each contains five marks. Student should secure **18/50 Marks** for **passing** in **internal Exam.**

For **Major paper 11, 12 and Minor-4:** 25 Mid-term + 25 CCE + 50 External Theory = 100

For **Major paper-13(Practical) and Minor paper-5(Practical):** 25 Mid-term (practical) + 25 CCE + 50 External Practical; Exam = 100

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SEMESTER- V

Paper Style External Theory Exam

Ques. No.	Particulars	From which Unit	Marks
1	Any two out of three questions	**1**	**10**
2	Any two out of three questions	**2**	**10**
3	Any two out of three questions	**3**	**10**
4	Any two out of three questions	**4**	**10**
5	Any two out of four questions	**One from each Unit**	**10**
		Total Marks	**50**

Paper Style External Practical Exam

Exercise	Particulars	Time	Marks
1	Session-1	4 hrs	**25**
2	Session-2	4 hrs	**25**
	Total	**8 hrs**	**50**