પરિપત્ર:

ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટીની સાયન્સ વિદ્યાશાખાનાં અભ્યાસક્રમ ચલાવતી તમામ સંલગ્ન કોલેજોનાં આચાર્યશ્રીઓને સવિનય જણાવવાનું કે સાયન્સ વિદ્યાશાખા હેઠળનો NEP-૨૦૨૦ અંતર્ગતનો કેમેસ્ટ્રી વિષયનો (બી.એસસી (કેમેસ્ટ્રી) વિથ ઓનર્સ) નો સેમેસ્ટર-૩ અને સેમેસ્ટર-૪ નો અભ્યાસક્રમ આ સાથે સામેલ છે.

માનનીય કુલપતિશ્રીની મંજુરી અનુસાર સદર અભ્યાસક્રમ શૈક્ષણિક વર્ષ જુન,૨૦૨૪ થી અમલવારી કરવાની રહે છે. સાયન્સ વિદ્યાશાખાનાં અભ્યાસક્રમ ચલાવતી તમામ સંલગ્ન કોલેજો ધ્વારા તેની અમલવારી કરવા જણાવવામાં આવે છે.

Bhakta Kavi Narsinh Mehta University Junagadh.

27/06/2024

ખાસ ફરજ પરના અધિકારી
(એકેડેમિક)

ક્રમાંક/બીકેએનએમયુ/ એકેડેમિક/૭૫૯/૨૦૨૪
ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી,
સરકારી પોલીટેકનિક કેમ્પસ,
ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી રોડ,
ખડીયા, જૂનાગઢ-૩૬૨૨૬૩
તા.૨૭/૦૬/૨૦૨૪

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
# JUNAGADH

## BOARD OF CHEMISTRY STUDIES

## FACULTY OF SCIENCE

## SYLLABUS FOR

## B.Sc (HONOURS) PROGRAMME

## (SEMESTER- III & IV)

## MAJOR/MINOR/MULTIDISCIPLINARY

## EFFECTIVE FROM JUNE, 2024

**BHAKTA KAVI NARSINH MEHTA UNIVERSITY**

**Major/Minor/Multidisciplinary**

**Syllabus of B.Sc. (Honors) as per NEP-2020**

**Faculty of Science**

**Effective from June 2024**

**Subject: Chemistry**

**SEMESTER-III & IV**

## Summary of the Major, Minor and MDC syllabus
## B.Sc Chemistry
## SEMESTER- 3

| Sem | Category of Course | Course Code | Course Title | Course Level | Credit | Teaching Hrs. | SEE Marks | CCE Marks | Total Marks | SEE Evaluation Exam Duration | Page |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | Major-5 | CHM205-2C | Intermediate Chemistry-205 | 5.0 | 4 | 4T | 50 | 50 | 100 | 2.hrs. | 1 |
| | Major-6 | CHM206-2C | Intermediate Chemistry-206 | 5.0 | 4 | 4T | 50 | 50 | 100 | 2.hrs. | 5 |
| | Major-7 | CHM207-2C | Intermediate Chemistry Practical-207 | 5.0 | 4 | 8P | 50 | 50 | 100 | 4 (P) hrs | 10 |
| | MDC-3 | MDC203-2C | Multidisciplinary Chemistry-203 | 5.0 | 4 | 3T+2P | 50 | 50 | 100 | 2 hrs | 13 |

**BHAKTA KAVI NARSINH MEHTA UNIVERSITY**

**Major/Minor/Multidisciplinary**

**Syllabus of B.Sc. (Honors) as per NEP-2020**

**Faculty of Science**

**Effective from June 2024**

**Subject: Chemistry**

**SEMESTER-III & IV**

## Summary of the Major, Minor and MDC syllabus
## B.Sc Chemistry
## SEMESTER- 4

| Sem | Category of Course | Course Code | Course Title | Course Level | Credit | Teaching Hrs. | SEE Marks | CCE Marks | Total Marks | SEE Evaluation Exam Duration | Page |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | Major-8 | CHM208-2C | Intermediate Chemistry-208 | 5.0 | 4 | 4T | 50 | 50 | 100 | 2.hrs. | **21** |
| | Major-9 | CHM209-2C | Intermediate Chemistry-209 | 5.0 | 4 | 4T | 50 | 50 | 100 | 2.hrs. | **25** |
| | Major-10 | CHM210-2C | Intermediate Chemistry Practical-210 | 5.0 | 4 | 8P | 50 | 50 | 100 | 4 (P) hrs | **29** |
| | Minor-3 | CHE203-2C | Minor Chemistry-203 | 5.0 | 4 | 3T+2P | 50 | 50 | 100 | 2 hrs | **32** |

**BHAKTA KAVI NARSINH MEHTA UNIVERSITY**

**Major/Minor/Multidisciplinary**

**Syllabus of B.Sc. (Honors) as per NEP-2020**

**Faculty of Science**

**Effective from June 2024**

**Subject: Chemistry**

**SEMESTER-III & IV**

| | | | | |
|---|---|---|---|---|
| **Course Level** | 5.0 | | **Internal Marks** | 50 |
| **Programme** | B.Sc Chemistry | | **External Marks** | 50 |
| **Semester** | III | | **Practical Internal** | - |
| **Category of Course** | Major-5 | | **Practical External** | - |
| **Course Credit** | 4 | | **Prac. External Exam Duration** | - |
| **Teaching Hours** | 4T | | **Total** | - |
| **Course Code** | **CHM205-2C** | | **External Theory Exam Duration** | 2 hrs |
| **Course Title** | **Intermediate Chemistry-205** | | | |

**Course Objectives:**

- This course will provide an Intermediate level introduction to understand the important aspects of all the three main branches of Chemistry, viz, Inorgaic, organic and physical chemistry.
- It is designed to understand the physical and chemical properties of various inorganic transition elements. Also understand properties of some organic functional groups and the solutions.

**Course Learning Outcomes**: After completion of the course:

On completion of the course, the students will be able to understand:

1. Chemistry of the elements of first and inner transition series which includes their physical, chemical, magnetic and spectral properties. These elements have wide applications as super conducting materials.
2. The chemistry of the most abundant organic chemicals containing oxygen or nitrogen containing functional groups. These functional groups containing molecules are the starting material for various industrial synthesis and are used as solvents. These groups act as conjunctions or are the fundamental building blocks in synthesis.
3. Phases of liquid and equilibrium distribution of components. This portion is an important part to undersand the industrial process protocols and chemistry.

   The physical properties of various miscible and immiscible liquid pairs
4. About the chemistry of some special compounds of p block elements like P,S and X and also understand the shape of compounds formed by inert gases.

5. Some name reactions associated with some oxygen and nitrogen containing functional groups. The solute solvent association and dissociation and Nerst distribution laws with limitations.

| Sem | Unit No. | Syllabi | Teaching Hours |
|---|---|---|---|
| 3 | 1 | **Chapter-1 Chemistry of the element of First Transition Series**<br>Introduction, Position in the periodic table, Electronic configuration, Reversal of energies of 3d and 4s orbitals, Physical properties such as atomic properties (atomic radii, Ionic radii, Ionization potential), Oxidation states, Metallic conductivity, Melting point & Boiling point, Density, Reducing properties, Tendency of formation of alloys, Catalytic properties, Magnetic and spectral properties, Oxides and oxo anions of transition metals, Calculation of magnetic moment of ion of 3d series metal. | **10** |
| | | **Chapter-2 Chemistry of the element of First Inner Transition Series**<br>Introduction, Position in the periodic table, Occurrence & Important ores, Individual isolation by (A) Ion Exchange Method (B) Solvent extraction method, Electronics configuration with necessary explanation, Oxidation state & their stability, Magnetic properties, Color, Isotopes, Spectral properties, Lanthanide contraction, Misch metal, Uses of Lanthanides & their compounds. | **05** |
| | 2 | **Chapter-3 Alcohols, Phenols, Ethers and Epoxides**<br>Basic IUPAC nomenclature of alcohol, phenol and ether,<br>**Alcohols:**<br>Preparation (by the reduction of aldehyde, ketone, carboxylic acid, ester and Grignard reaction), Chemical properties (Reaction with sodium metal, Relative reactivity of 1°, 2°, 3° alcohols (Lucas test), Esterification and Oxidation by periodic acid and lead tetraacetate)<br>**Phenols:**<br>Preparation (Dow process and Cumene process), Chemical Properties; Electrophilic substitution reaction (nitration, sulphonation and bromination) Relative acidity of phenol, | **05** |

| | | | |
|---|---|---|---|
| | | alcohol and carboxylic acid, Factors affecting on acidity of phenol.<br>**Ethers:**<br>Preparation (Williamson synthesis) and Chemical reactions (with $Cl_2$ in light and dark, with conc. $H_2SO_4$, with hot and cold HI, hydrolysis)<br>**Epoxides**:<br>Reactions of epoxides with alcohols, ammonia derivatives and $LiAlH_4$. | |
| | | **Chapter-4 Nitrogen Containing Functional Groups**<br>Basic IUPAC nomenclature of amine, nitro compounds, nitriles and isonitriles.<br>**Amines:**<br>Effect of substituent and solvent on basicity; Distinction between 1°, 2° and 3° amines with Hinsberg reagent, Preparation (from nitro compound, alkyl halide and Hoffmann degradation of amides) Chemical properties: Reaction with acid chloride, alkyl halide and nitrous acid. Chemical reaction of aniline (nitration, sulphonation and bromination) Diazonium Salts: Preparation and their synthetic applications.<br>Preparation and important reactions of nitro compounds, nitriles and isonitriles. | **05** |
| | | **Chapter-5 Aryl halides**<br>Basic IUPAC nomenclature of aryl halide, Preparation (including preparation from diazonium salts), Nucleophilic aromatic substitution (SNAr), Benzyne mechanism, Relative reactivity of alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilicsubstitution reactions. | **05** |
| | **3** | **Chapter-6 Phase Equilibrium-I**<br>Introduction, Criteria of phase equilibrium, Explanation of terms: Phases, Components and Degrees of freedom of a system, Gibbs Phase Rule, Limitations of Phase Rule, Phase diagrams of one-component systems (Water, Sulphur, $CO_2$) Two component systems: Condensed Phase Rule, Eutectics system (Lead-Silver) and Park method of desilverization, Congruent melting point system (Mg – Zn) and Incongruent melting point system (Na - K). | **10** |
| | | **Chapter-7 Solutions**<br>Introduction, Factors affecting on solubility, Types of solutions, Types of liquid –liquid solutions | **05** |

| | | | |
|---|---|---|---|
| | | **Miscible Liquid Pair:**<br>Ideal solutions and Raoult's law, Deviations from Raoult's law (non-ideal solutions), Vapor pressure - composition curves of ideal and non-ideal solutions, Temperature - composition curves of ideal and non-ideal solutions, Distillation of ideal and non-ideal solutions, Lever rule, Fractional column and Bubble cap tower, Azeotropes.<br>**Immiscible Liquid Pair:**<br>Introduction, Principle of steam distillation and its applications, Numericals, | |
| | **4** | **Chapter-8 Chemistry of some special compounds of p-block elements**<br>Oxo acids of Phosphorus ($H_3PO_2$, $H_3PO_3$, $H_3PO_4$, $H_3PO_5$, $H_4P_2O_7$, $H_4P_2O_8$, $H_4P_2O_5$, $H_4P_2O_6$, $HPO_3$, $(HPO_3)_3$ and $(HPO_3)n$,<br>Oxo acids of Sulphur (Sulphurous acid series, Sulphuric acid series, Thionic acid series, Peroxy acid series,<br>Oxo acids of halogen, Oxides of chlorine ($Cl_2O$, $ClO_2$, $Cl_2O_6$, $Cl_2O_7$) and oxide of iodine ($I_2O_5$),<br>Inter-halogen compounds<br>Valence bond and VSEPR approach of following xenon compounds; Oxides of xenon ($XeO_3$, $XeO_4$), Fluorides of xenon ($XeF_2$, $XeF_4$, $XeF_6$), Oxy-fluorides of xenon ($XeOF_4$, $XeO_2F_2$, $XeOF_2$) | **05** |
| | | **Chapter-9 Name Reactions and Rearrangement-I**<br>**Name Reaction:**<br>Reimer-Tiemann, Kolbe's Schmidt, Carbylamine reaction, Hoffmann's exhaustive methylation<br>**Rearrangement:**<br>Pinacol-Pinacolone Rearrangement, Fries Rearrangement, Claisen Rearrangement, | **05** |
| | | **Chapter-10 Nernst Distribution Law**<br>Introduction, Nernst Distribution Law and its limitations, Modified Nernst Distribution Law [Solute associate in the solvent, Solute dissociate in the solvent, Solute enters into chemical reaction with solvent] Applications, Solvent extraction, Numericals | **05** |

**BHAKTA KAVI NARSINH MEHTA UNIVERSITY**

**Major/Minor/Multidisciplinary**

**Syllabus of B.Sc. (Honors) as per NEP-2020**

**Faculty of Science**

**Effective from June 2024**

**Subject: Chemistry**

**SEMESTER-III & IV**

| | | | | |
|---|---|---|---|---|
| **Course Level** | 5.0 | | **Internal Marks** | 50 |
| **Programme** | B.Sc Chemistry | | **External Marks** | 50 |
| **Semester** | III | | **Practical Internal** | - |
| **Category of Course** | Major-6 | | **Practical External** | - |
| **Course Credit** | 4 | | **Prac. External Exam Duration** | - |
| **Teaching Hours** | 4T | | **Total** | - |
| **Course Code** | **CHM206-2C** | | **External Exam Duration** | 2 hrs |
| **Course Title** | **Intermediate Chemistry-206** | | | |

**Course Objectives:**

- Develop a vision of wave characteristics of electron in an atom and molecular formation. Introduce to the industrial applications of inorganic chemicals like cement and fertilizer. Provide extensive coverage of structure and properties of carbonyl group containing functional groups in organic chemistry.
- Elaborate first law of thermodynamics and its applications. Introduce to the physical properties associated with the molecular structure. Also introduce to the partially miscible liquid and their phase equilibrium.

**Course Learning Outcomes**: On completion of the course, the students will be able to understand:

1. The postulates of wave mechanics, structure of atom, understand the concept of molecular formation using concept of hybridization and draw the shape of molecules. The types of fertilizers Containing various primary nutrients like N,P,K their manufacture and composition and uses at various levels.
2. The common chemistry of Carbonyl containing functional group like aldehydes , ketones, carboxylic acid their derivatives and active methylene compounds. Their physical properties, synthesis uses and interconversions into varied other useful compounds.

3. The first law of Thermodynamics, various types of processes and heat exchanges. Behaviours of ideal gas, various enthalpy changes during process and solve problems associated with the enthalpy change.

   Also understand physical properties like surface tension, viscosity, dipole moment and molecular structure.

4. The Chemistry of cement production. Starting from its raw material source and analysis, process chemistry, production, types of cement and end uses in various construction and industrial processes.

   Also learn about the various named reactions and rearrangements associated with functional groups mainly containing carbonyl group and its synthetic applications.

   The phase equilibria of partially miscible liquid pairs with different critical solution temperature. Formation of two and three pairs of partially miscible liquids and application of ternary liquid diagram.

| Sem | Unit No. | Syllabi | Teaching Hours |
|---|---|---|---|
| 3 | **1** | **Chapter-1 Wave mechanics-I**<br>Introduction of wave Mechanics, Postulates of wave Mechanics, Interpretation of $\psi$, $\psi^2$, $\psi\psi^*$, Derivation of Schrodinger's equation in three dimensions (Cartesian Coordinates), Eigen function & Eigen value, Orthogonal & Normalized wave function, Concept of Molecular Orbital Theory, Characteristic of Molecular Orbital, Wave function of $H_2^+$ & $H_2$, Potential energy and Schrodinger's equation for $H_2^+$ & $H_2$, Derivation of normalized wave function of $H_2^+$ based on M.O.T., Derivation co efficient of wave function of sp, $sp^2$ & $sp^3$ Hybridization with bond angle. | **10** |
| | | **Chapter-2 Fertilizer**<br>Introduction, Plant nutrients and its role, Classification and Properties of fertilizers,<br>Nitrogenous fertilizers:<br>**Ammonium nitrate:** Manufacture by Prilling method and Stengel method<br>**Ammonium sulphate:** Manufacture from gypsum (Sindri Process) & Action as fertilizer | **05** |

| | | | |
|---|---|---|---|
| | | **Urea:** Manufacture from Ammonium carbide and Sindri process & Action as fertilizer<br>**Phosphate fertilizer:** Manufacture of Normal super phosphate and Triple super phosphate<br>**Ammonium Phosphate:** Manufacture of Mono ammonium phosphate and Diammonium phosphate | |
| | **2** | **Chapter-3 Aldehydes and ketones**<br>Introduction, Constitution of carbonyl group and reactivity, Preparation of aldehydes and ketones; Nucleophilic addition reactions (HCN, Grignard, Alcohol, $NaHSO_3$ with mech) Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Oxidations and reductions (Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$,with mech); | **05** |
| | | **Chapter-4 Carboxylic Acids and their Derivatives**<br>Preparation, Physical properties and reactions of monocarboxylic acids: Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic substitution at acyl group Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann reaction. | **05** |
| | | **Chapter-5 Active methylene compounds**<br>Keto-enol tautomerism, Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate. | **05** |
| | **3** | **Chapter-6 First Law of Thermodynamics**<br>Introduction, Limitations and advantages of Thermodynamics, Types of systems, Properties of system: Intensive and extensive properties, Types of processes, State and path functions, Exact and inexact differential concept of heat, Work and internal energy, First law of Thermodynamics: Statements, Mathematical derivation, Heat absorbed at constant volume, Perpetual machine of first kind, Enthalpy, Heat Capacity: Its types and derivation of relation ($C_p - C_v = R$), Isothermal reversible and irreversible work of ideal gas, Proof of: $W_{rev} > W_{irr}$ Relations between P – V, V – T and T – P for Adibatic process, Adiabatic reversible and irreversible work of ideal gas, Joule Thomson effect, Joule Thomson co-efficient of ideal gas, Zeroth Law (Only Statement and Explanation), Variation of enthalpy with temperature (Kirchhoff Equation), Numericals | **10** |
| | | **Chapter-7 Physical Properties and Molecular Structure** | **05** |

| | | | |
|---|---|---|---|
| | | **Introduction**<br>**Types of Physical Properties:** Additive and constitutive properties<br>**Surface Tension:** Explanation of Surface Tension, Name of methods to determine surface tension, The Drop Weight method<br>**Parachor:** Macleod Equation and $P_1/P_2 = V_1/V_2$, Atomic Parachor, To determine structure of (i) Quinine (ii) Benzene (iii) Isocyanides group (iv) Nitro group<br>**Viscosity:** Explanation (Briefly), unit and factors affecting the viscosity, Measurementof viscosity (derivation of $\eta_1 / \eta_2 = d_1t_1 / d_2t_2$), Ostwald's Viscometer<br>**Refractive Index and Refractivity:** Introduction, Specific and Molecular Refractivity, Abbe Refractometer, Molecular refractivity and chemical constitution<br>**Optical Activity:** Polarization of light, Optical activity, Factors affecting angle of rotation, Specific rotation, Polarimeter<br>**Dipole Moment:** Polar and non-polar molecule, Electric polarization (Polarizability of molecules), The Mosotti Clausious Equation, Kinds of molar polarization [Electron & nuclear polarization, orientation polarization (permanent dipole moment)]; Application of Dipole Moment: Identification of polar and non-polar molecules,<br>Molecular Structure:<br>Mono atomic molecules, (ii) Diatomic molecules (iii) Triatomic molecules ($CO_2$, $H_2O$, $SO_2$) (iv) Tetratomic molecules ($NH_3$, $BCl_3$)<br>**Numericals** | |
| | **4** | **Chapter-8 Cement**<br>Introduction, Type of cement, Raw material for manufacture, Cement rock beneficiation, Manufacturing processes of Portland cement, setting and hardening of Portland cement, Properties and uses of cement, Mortar and concrete, curing and decay of concrete, RCC and its advantage | **05** |
| | | **Chapter-9 Name Reactions and Rearrangement-II**<br>**Name Reaction:**<br>Aldol condensation, Cannizzaro reaction, Knoevenagel condensation, Perkin reaction, Wittig reaction, Haloform | **05** |

| | | | |
|---|---|---|---|
| | | reaction, Baeyer Villiger oxidation.<br>**Rearrangement:**<br>Beckmann rearrangement, Benzil-Benzilic acid rearrangement, Hofmann bromamide degradation. | |
| | | **Chapter-10 Phase Equilibrium-II**<br>Two components partially miscible liquid pairs: (1) Maximum critical solution temperature (2) Minimum critical solution temperature (3) Maximum and Minimum critical solution temperature, Influence of impurity on critical solution temperature, Three component partially miscible liquid system, Method of graphical presentation, Types of partially miscible three liquid systems: One partially miscible pair: Effect of adding third component, Nature of tie line, Plait point, Binodal curve, Characteristics of diagram, A is added to binary system, A is constant and B and C varied, Formation of two pairs of partially miscible liquid, Formation of three pairs of partially miscible liquid, Application of ternary liquid diagram. | **05** |

**BHAKTA KAVI NARSINH MEHTA UNIVERSITY**

**Major/Minor/Multidisciplinary**

**Syllabus of B.Sc. (Honors) as per NEP-2020**

**Faculty of Science**

**Effective from June 2024**

**Subject: Chemistry**

**SEMESTER-III & IV**

| | | | | |
|---|---|---|---|---|
| **Course Level** | 5.0 | | **Internal Marks** | 50 |
| **Programme** | B.Sc Chemistry | | **External Marks** | 50 |
| **Semester** | III | | **Practical Internal** | 50 |
| **Category of Course** | Major-7 | | **Practical External** | 50 |
| **Course Credit** | 4 | | **Prac. External Exam Duration** | 4 Hrs |
| **Teaching Hours** | 8P | | **Total** | - |
| **Course Code** | **CHM207-2C** | | **External Practical Exam Duration** | 4 hrs |
| **Course Title** | **Intermediate Chemistry Practical – 207** | | | |

**Course Objectives:**

- Enable the students to carryout qualitative analysis of pure organic compounds using chemical and physical properties.
- Familiarize them with the volumetric methods of estimating the quantity of organic compound present and also acquaint them with the handful methods of common organic synthesis.

**Course Learning Outcomes**: After completion of the course:

1. The learners will be able to individually carry out identification of unknown organic compound using various Tests like Preliminary tests, solubilities, elements present, functional groups present, their melting points/boiling points and derivatizations possible.
2. Practically carryout quantitative estimation of some known organic compound or functional groups like amide, ester, phenols, amines, carboxylic acid or compounds like glucose in a solution using simple chemical methods which can produce observable and measurable volume change during the process involved.
3. Practically carry out and handle various types of organic synthetic reactions like Nucleophilic substitution reaction, Electrophilic aromatic substitution reaction, diazotization, and coupling reactions, oxidation reactions etc of simple compounds.

| Sem | Unit No. | Syllabi | Teaching Hours |
|---|---|---|---|
| 3 | 1 | **Organic Qualitative Analysis [Minimum 15 Practical] [Minimum six bifunctional Organic Compounds should be given]**<br>Identification of an organic compound through the functional group analysis and<br>determination of melting point or boiling point<br>(Bifunctional organic compounds) | **60** |
| | 2 | **Organic Volumetric Estimation**:<br>[Standard solution may be prepared by the students/given. Six-Estimations may be given]<br>1. To determine the amount of –CONH2 in the given Acetamide solution<br>2. To determine the amount of Phenol / m-cresol in the given solution<br>3. To determine the amount of Aniline / p-toludine in the given solution<br>4. To determine the amount of Ester in the given solution<br>5. To determine the amount of Glucose in the given solution<br>6. To determine the amount of –COOH in the given carboxylic acid | **24** |
| | 3 | **Organic Synthesis: [Minimum 9 syntheses should be done]**<br>(Percentage of yield, crystallization, melting point)<br>**i. Acetylation / Benzoylation**<br>1. Acetylation of salicylic acid<br>2. Acelytation of aniline<br>3. Acelytation of phenol<br>4. Benzoylation of aniline<br>5. Benzoylation of phenol<br>**ii. Aliphatic Electrophilic substitution**<br>1. Preparation of iodoform from ethanol<br>2. Preparation of iodoform from acetone<br>**iii. Aromatic Electrophilic Substitution**<br>**Nitration:**<br>1. Preparation of m-dinitrobenzene,<br>2. Preparation of nitro acetanilide. | **36** |

| | | | |
|---|---|---|---|
| | | **Halogenation:**<br>1. Preparation of p-bromo acetanilide,<br>2. Preparation 2:4:6 -tribromo phenol<br>**iv. Diazotization / Coupling**<br>1. Preparation of methyl orange<br>2. Preparation of methyl red<br>**v. Oxidation**<br>1. Preparation of benzoic acid from benzaldehyde | |

**BHAKTA KAVI NARSINH MEHTA UNIVERSITY**

**Major/Minor/Multidisciplinary**

**Syllabus of B.Sc. (Honors) as per NEP-2020**

**Faculty of Science**

**Effective from June 2024**

**Subject: Chemistry**

**SEMESTER-III & IV**

| | | | | |
|---|---|---|---|---|
| **Course Level** | 5.0 | | **Internal Marks** | 50 |
| **Programme** | B.Sc Chemistry | | **External Marks** | 50 |
| **Semester** | III | | **Internal (T)** | 25 |
| **Category of Course** | MDC-3 | | **Internal (P)** | 25 |
| **Course Credit** | 4 | | **Internal Practical Exam Duration** | 2 Hrs |
| **Teaching Hours** | 3T+2P | | | |
| **Course Code** | **MDC203-2C** | | **External Theory Exam Duration** | 2 hrs |
| **Course Title** | **Multidisciplinary Chemistry-203** | | | |

**Course Objectives:**

- Develop a vision of some industrial applications of chemistry. Enable brief outline of the environmental chemistry and pollution and its types.
- Also enable understand Qualitative and quantitative analytical methods of inorganic materials.

**Course Learning Outcomes**: On completion of the course, the students will be able to:

- Understand chemistry of fertilizers and apply their knowledge in identification, synthesis and end use of it.
- Work as a lab chemist or plant operator in cement industry with equipped knowledge of cement raw material, its analysis, processes and different types of end use.
- Know about the segments of environment, different types of environment pollution including air pollution and its main sources.
- Independently carry out inorganic qualitative analysis of salts and mixtures. Estimate amount of metal in a mixture of metal using the most accurate quantitative analytical method like gravimetric analysis.

**BHAKTA KAVI NARSINH MEHTA UNIVERSITY**

**Major/Minor/Multidisciplinary**

**Syllabus of B.Sc. (Honors) as per NEP-2020**

**Faculty of Science**

**Effective from June 2024**

**Subject: Chemistry**

**SEMESTER-III & IV**

| Sem | Unit No. | Syllabi | Teaching Hours |
|---|---|---|---|
| 3 | 1 | **Chapter-1**<br>**Fertilizer**<br>Introduction, Plant nutrients and its role, Classification and Properties of fertilizers,<br>Nitrogenous fertilizers<br>**Ammonium nitrate:** Manufacture by Prilling method and Stengel method<br>**Ammonium sulphate:** Manufacture from gypsum (Sindri Process) & Action as fertilizer<br>**Urea:** Manufacture from Ammonium carbide and Sindri process & Action as fertilizer<br>**Phosphate fertilizer:** Manufacture of Normal super phosphate and Triple super phosphate<br>**Ammonium Phosphate:** Manufacture of Mono ammonium phosphate and Diammonium phosphate | **11** |
| | 2 | **Chapter-2**<br>**Cement**<br>Introduction, Type of cement, Raw material for manufacture, Cement rock beneficiation. Manufacturing Processes of Portland cement, Setting and Hardening of Portland cement, Properties and uses of cement, Indian Standard Institute (ISI) specification of cement, Mortar and concrete, curing and Decay of concrete, RCC and its advantage, Uses of cement\ | **11** |
| | 3 | **Chapter-3**<br>**Environmental Chemistry**<br>Environment – definition and introduction, Segments of environment (i) Atmosphere (ii) Hydrosphere (iii) Lithosphere (iv) Biosphere, Environmental pollution and its types. Air Pollution: Major sources of air pollution, Control of Air pollution, Green House Effect, Photochemical smog, CFC and ozone depletion, Acid rain, Sources and effects of NOX and SOX, | **11** |
| | **4** | **Chapter-4**<br>**Principle of Inorganic Qualitative Analysis and Gravimetric Analysis**<br>Introduction, Preparation of Original Solution (OS), Concept of classification of cations (IP and Ksp) and role of Group reagents<br>Explanation with chemical equations for the following | **12** |

| | | | |
|---|---|---|---|
| | | A. Dry test for positive radicals<br>(1) Charcoal test, (2) Cobalt nitrate test& (3) Flame test.<br>B. Dry test for negative radicals (including use of various reagent papers)<br>Principle of Gravimetric analysis: Factors affecting gravimetric analysis, Co-Precipitation and Post precipitation, Completeness of precipitation, Effect of acid and Temperature on solubility, Purity of ppt, Super saturation, Coagulation. Operation in gravimetric analysis like Solution formation, Precipitation, Filtration, Washing, Drying, Incineration, Weighing. | |

**BHAKTA KAVI NARSINH MEHTA UNIVERSITY**

**Major/Minor/Multidisciplinary**

**Syllabus of B.Sc. (Honors) as per NEP-2020**

**Faculty of Science**

**Effective from June 2024**

**Subject: Chemistry**

**SEMESTER-III & IV**

Course: **Multidisciplinary Chemistry Paper-3 [1-Credit Practical]**

## Gravimetric analysis

| Sem | Unit No. | Syllabi | Teaching Hours |
|---|---|---|---|
| **3** | | **Gravimetric Analysis:**<br>**Minimum six Gravimetric analysis exercises with three containing impurities of Cu or Fe and three pure solutions may be given.**<br><br>1. Estimation of nickel (II) in a mixture of solution containing $NiSO_4$, $CuSO_4$ and free $H_2SO_4$ as $Ni(DMG)_2$ complex using Dimethylglyoxime (DMG).<br>~~2.~~ Estimation of copper as CuSCN<br>3. Estimation of $Fe^{+2}$ as $Fe_2O_3$ in a solution containing a (mixture of $CuSO_4$ and) $FeSO_4$ $NH_4SO_4$ by precipitating iron as $Fe(OH)_3$.<br>4. Estimation of Al (III) from the solution mixture containing $CuSO_4$ $AlSO_4$ and $H_2SO_4$ as $Al_2O_3$ or by precipitating with oxine and weighing as $Al(oxine)_3$ (aluminium oxinate)<br>5. Estimation of Ba as $BaSO_4$ in a mixture of solution containing $BaCl_2$ $FeCl_3$ and HCl.<br>6. Estimation of Mn in a mixture of solution containing $MnCl_2$, $CuCl_2$ and HCl as $Mn_2P_2O_7$.<br>7. Estimation of Zn in a mixture of solution containing $ZnSO_4$, $CuSO_4$ and $H_2SO_4$ as $Zn_2P_2O_7$. | **30P** |

**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. Engineering Chemistry by Jain and Jain
18. Industrial Chemistry by B.K. Sharma
19. Thermodynamics by Gurudeeep Raj
20. Thin Layer Chromatography by Egal Stall
21. Thermodynamics for Chemists by Samuel Glasstone
22. A Textbook of Quantitative Inorganic Analysis by A. I. Vogel
23. Inorganic inflictive analysis by Vogel and Gehani Parekh
24. Reigel's Handbook of Industrial Chemistry by James A. Kent
25. Fundamental of Analytical Chemistry by Skoog and West
26. Instrumental Methods of Chemical Analysis by B. K. Sharma
27. Instrumental Method of Chemical Analysis by Chatwal Anand
28. Analytical Chemistry by Dick
29. Electrometric Methods of Analysis by Browning
30. Principle of Instrumental Methods of Analysis by Skoog
31. Jack T. Ballinger; Gersshon J. Shugar. Chemical Technicians' Ready Reference Handbook, 5th Edition, 2011, ISBN:9780071745925, The McGraw-Hill com, Inc

**BHAKTA KAVI NARSINH MEHTA UNIVERSITY**

**Major/Minor/Multidisciplinary**

**Syllabus of B.Sc. (Honors) as per NEP-2020**

**Faculty of Science**

**Effective from June 2024**

**Subject: Chemistry**

**SEMESTER-III & IV**

| INTERNAL EVALUATION SCHEME | | |
|---|---|---|
| **NO** | **Particulars** | **Marks** |
| 1 | **Mid Semester Exam (Mandatory)** | **25** |
| 2 | Class Test | 05 |
| 3 | Open book exam/test | 05 |
| 4 | Open note exam/test | 05 |
| 5 | Self-test/ Online test | 05 |
| 6 | Essay/Article writing | 05 |
| 7 | Quizzes/Objective test | 05 |
| 8 | Class assignment | 05 |
| 9 | Home assignment | 05 |
| 10 | Reports Writing | 05 |
| 11 | Research/Dissertation | 05 |
| 12 | Case Studies | 05 |
| 13 | Viva/Oral exam | 05 |
| 14 | Group Discussion | 05 |
| 15 | Role Play | 05 |
| 16 | Paper presentation/Seminar | 05 |
| 17 | Language Lab work | 05 |
| 18 | Interview | 05 |
| 19 | Craft work | 05 |
| 20 | Co-curricular work | 05 |
| 21 | Field Assignment | 05 |
| 22 | Poster Presentation | 05 |
| 23 | Attendance | 05 |
| 24 | Project Work | 05 |
| | **Total** | **50** |

**Note: Sr.No.1 is mandatory. Select any five from Sr.No.2 to 24. Each Contains five marks. Student should secure 18 Marks for passing in internal Exam.**

**BHAKTA KAVI NARSINH MEHTA UNIVERSITY**

**Major/Minor/Multidisciplinary**

**Syllabus of B.Sc. (Honors) as per NEP-2020**

**Faculty of Science**

**Effective from June 2024**

**Subject: Chemistry**

**SEMESTER-III & IV**

**For Major paper 5, 6, 8, and 9: 25 Mid-term + 25 CCE + 50 External Theory = 100**

**For Major paper-7 and 10 (Practical): 25 Mid-term (Practical) + 25 CCE + 50 External Practical; Exam = 100**

**Paper Style (For B.Sc. Chemistry SEM- 3, 4)**

| Ques. No. | Particulars | From which Unit | Marks |
|---|---|---|---|
| **1** | Any two out of 3 questions (5 marks each) | **1** | **10** |
| **2** | Any two out of 3 questions (5 marks each) | **2** | **10** |
| **3** | Any two out of 3 questions (5 marks each) | **3** | **10** |
| **4** | Any two out of 3 questions (5 marks each) | **4** | **10** |
| **5** | Any two out of 4 questions (5 marks each) | **One question From Each Unit** | **10** |
| | | **Total Marks** | **50** |

**********

# SEMESTER- IV

**BHAKTA KAVI NARSINH MEHTA UNIVERSITY**

**Major/Minor/Multidisciplinary**

**Syllabus of B.Sc. (Honors) as per NEP-2020**

**Faculty of Science**

**Effective from June 2024**

**Subject: Chemistry**

**SEMESTER-III & IV**

| | | | | |
|---|---|---|---|---|
| **Course Level** | 5.0 | | **Internal Marks** | 50 |
| **Programme** | B.Sc Chemistry | | **External Marks** | 50 |
| **Semester** | IV | | **Practical Internal** | - |
| **Category of Course** | Major-8 | | **Practical External** | - |
| **Course Credit** | 4 | | **Prac. External Exam Duration** | - |
| **Teaching Hours** | 4T | | **Total** | - |
| **Course Code** | **CHM208-2C** | | **External Exam Duration** | 2 hrs |
| **Course Title** | **Intermediate Chemistry-208** | | | |

**Course Objectives:**

- Enable learners to be aware about the coordination and organometallic compounds, their structure and special chemistry.
- Emphasize on the study of the property of molecular symmetry and stereochemistry of inorganic and organic molecules. Understand the second law of thermodynamics and free energy change with chemical equilibrium.

**Course Learning Outcomes**: After completion of the course the learner will be able to:

1. Understand types of ligands, coordination compounds and their isomerism including geometrical and optical. Understand the uses of coordination compounds in bilogcal systems and other applications.
2. Know about various types of organ metallic compounds and their classification based on heptacity. They will also understand nonclassical bonded organometallic compounds and their bonding.
3. Understand property of symmetry in molecules. Their classification based on symmetry elements present. They will also be able to construct the group multiplication table for molecules based on the possible symmetry operations.
4. Understand the limitations of first law of thermodynamics, about spontaneous processes and energy changes. Also the concept of entropy and solve problems based on the second law of thermodynamics.

5. Calculate free energy changes with various parameters and predict the direction of chemical equilibrium of various spontaneous processes.
6. Classify oils and fats and identify the properties which can be exhibiged by various types of oils. Carry out various types of hydrogenations of oils. Carryout analysis of oil and fats like saponification value, iodine value etc.
7. Understand stereochemical terms, classifications of stereoisomers their nomenclature based on various methods. Concept of conformations in cyclic systems to explain their stability. Draw various projection formulae of types of conformations of cyclohexane, deduce their symmetry point group, write and compare the factors affecting their relative stability, calculate relative energy and draw energy level diagram. Also calculate relative stability of conformations of monosubstituted cyclohexane.
8. Understand law of active mass, Vant Hoff isotherm, clausis Clapeyron equation and solve numerical problems.

| Sem | Unit No. | Syllabi | Teaching Hours |
|---|---|---|---|
| **4** | **1** | **Chapter-1 Basics of Co-ordination chemistry**<br>Introduction of co-ordination compounds, Double salt, mixed salt and complex compounds, Types of complex compounds, Classification of ligands (Based on charge and denticity), π-acid ligands, Ambidentate ligands, Chelating ligands, Bridge ligands and Flexi dentate ligands, co-ordination number, co-ordination polyhedron, Oxidation number of central metal atom, IUPAC nomenclature of co-ordination compounds, Warner co-ordination theory and its failure, Co-ordination number and geometry related to co-ordination number,<br>Isomerism in co-ordination compounds; 1) Structural isomerism 2) Stereo isomerism<br>**In structural isomerism-**<br>1) ionization 2) hydration 3) co-ordination 4) co-ordination positions 5) polymerization 6) linkage isomerism 7) Ligand isomerism,<br>**In stereo isomerism-**<br>1) Geometrical; Cis-trans isomerism in $ML_4$ and $ML_6$ types of complexes | **10** |

| | | | |
|---|---|---|---|
| | | 2) Optical isomerism<br>Application of co-ordination compounds in biological systems, analytical chemistry, extraction of gold and silver, purification of metals, industry, medical field. | |
| | | **Chapter-2 Organometallic compounds**<br>Introduction, Classification based on nature of M-C Bond and hapticity. Preparation, Properties and uses of Organo lithium compounds and Organo magnesium compounds, Preparation, bonding & structure of (1) Zeise's Salts (dπ-pπ)bonding, (2) Tri Methyl Aluminium (3c-2e) bonding and (3) Ferrocene (Sandwich structure-Moffit -without orgal diagram). | **05** |
| | **2** | **Chapter-3 Molecular Symmetry**<br>Introduction, Symmetry elements and symmetry operations with illustrations, Concept and properties of group, Products of symmetry operation, Symmetry point group classification flow chart [Cαv, Dαh, $C_s$, $C_i$, $C_1$, Td, Oh, Ih, $D_{nh}$, $D_{nd}$ $D_n$, $C_{nh}$ $C_{nv}$ $S_{2n}$, $C_n$], Construction of group multiplication tables for $C_{2v}$, $C_{3v}$ and $C_{2h}$ point groups, Definition & calculation of Order (h) of point groups. | **15** |
| | **3** | **Chapter-4 Second Law of Thermodynamics**<br>Limitations of first law of thermodynamics, Spontaneous process, Carnot cycle and theorem, Statements of second law of thermodynamics, Perpetual machine of second kind (briefly), Concept of entropy and definition of entropy, ΔS in reversible & irreversible (spontaneous) process, ΔS in ideal gases, ΔS of mixture of ideal gas, ΔS in physical transformations and heating of the substance, Entropy and second law of thermodynamics, Physical significance of entropy, Numerical based on theory. | **10** |
| | | **Chapter-5 Free Energy and Chemical Equilibrium-I** Free Energy: its significance and variation with P and T, Work function: Its physical significance and variation with V and T, ΔG for ideal gases, Gibbs Helmholtz equation and its applications, Criteria for chemical equilibrium (According to ΔG = ΔH - TΔS), Numerical based on theory. | **05** |
| | **4** | **Chapter-6 Oils and Fats**<br>Introduction, Properties of oil and fats, Classification,<br>Hydrogenation of oil: (i) Optimum condition for the hydrogenation process and (ii) Preparation of Nickel catalyst, | **05** |

| | | | |
|---|---|---|---|
| | | Process for hydrogenation of oil: (i) Dry process and (ii) Wet process,<br>Analysis of oil and fats: (i) Saponification value (ii) Acid value (iii) Iodine value (WIJS method) and (iv) Reichert – Meisel value. | |
| | | **Chapter-7 Stereochemistry**<br>Difference between Asymmetric-Dissymmetric, Enantiomers-Diastereomers, Methods of Resolution, Racemic modification and its types, Anomers and epimers.<br>Stereochemistry of compounds with 1 and 2 asymmetric carbon atoms (similar and dissimilar) threo, erythro and meso forms and R, S Nomenclature.<br>Conformations of cyclohexane: Explanations of α/β and axial/equitorial bonds, Newmann and conformational projections, comparison of various conformations of cyclohexane w.r.t Shape, Symmetry, intramolecular interactions and relative energy level diagram.<br>Conformations of Methyl cyclohexane: Comparison of relative stability. | **05** |
| | | **Chapter-8 Free Energy and Chemical Equilibrium-II**<br>Law of active mass, Vant Hoff isotherm (By equilibrium box and chemical potential method), Vant Hoff isochore, Clausius - Clapeyron equation, Numerical based on theory. | **05** |

**BHAKTA KAVI NARSINH MEHTA UNIVERSITY**

**Major/Minor/Multidisciplinary**

**Syllabus of B.Sc. (Honors) as per NEP-2020**

**Faculty of Science**

**Effective from June 2024**

**Subject: Chemistry**

**SEMESTER-III & IV**

| | | | | |
|---|---|---|---|---|
| **Course Level** | 5.0 | | **Internal Marks** | 50 |
| **Programme** | B.Sc Chemistry | | **External Marks** | 50 |
| **Semester** | IV | | **Practical Internal** | - |
| **Category of Course** | Major-9 | | **Practical External** | - |
| **Course Credit** | 4 | | **Prac. External Exam Duration** | - |
| **Teaching Hours** | 4T | | **Total** | - |
| **Course Code** | **CHM209-2C** | | **External Exam Duration** | 2 hrs |
| **Course Title** | **Intermediate Chemistry-209** | | | |

**Course Objectives:**

- Expose in detail about the applications of wave mechanisms to atomic structure and property. Introduce to some daily applications of chemistry like soaps and detergents and bioinorganic chemistry.
- Introduce to the Heterocyclic compounds, natural product molecules like alkaloids, terpenoids and named reactions, rearrangement and reagents closed associated with it. Provide depth of third law of thermodynamics, chemical kinetics and partial molar properties.

**Course Learning Outcomes**: After completion of the course the following learning outcomes are expected:

1. The students would be well convergent to the terminologies used in wave mechanics and understand approach of wave mechanics to interpret energy levels and behaviour of electron in an atom. Calculate energy of electron in various energy levels.

   The students will be well aware about the chemistry of soap and detergent. Starting from preparation of these chemicals to their mechanism of action.
2. Students will understand chemistry of the most important class of naturally occurring organic compound like alkaloids and terpenoids. Starting from their isolation, structural elucidation, synthesis and applications. They will also be able to write and carryout some known organic named reactions, rearrangements and reagents.

3. Learners will study the third law of thermodynamics and its applications. Leaner will be able to calculate absolute entropies and solve problems related to the processes undergoing free energy and entropy change. They will have thorough understanding of the rate of various types of reactions and factors affecting it. Molecularity and order of the reaction and various methods used to determine the order of the reaction. Theories of reaction rate and solve numerical based on those theories.
4. The students would have understood the importance and applications of various metals and their complexes in biological systems. Also studied reasons of their toxicity.

   They would be well convergent with the most important class of organic compounds. Learners will know five and six membered (Pyridine) monocyclic heterocyclic compounds, their structure, stability, relative basicity, preparations and chemical properties including substitution reactions of mono heterocyclic compounds.

   They would have understood the partial molar properties and their determination using various methods. Understand physical significance of chemical potential and its variation with temp and pressure. They would be able to solve problems using Henry's law, Raoult's law and Nernst Distribution Law.

| Sem | Unit No. | Syllabi | Teaching Hours |
|---|---|---|---|
| **4** | **1** | **Chapter-1 Wave Mechanics-II**<br>Basic concepts, Operators algebra (addition, subtraction, multiplication), commutative property, linear operator, commutation operator, the operator DEL & DEL SQUERED, momentum operator, Hamiltonian operator, Particle in one dimensional box; Wave equation and energy related to a particle moving in one dimensional box, Energy levels and interpretation of energy equation, Normalization and orthogonally of wave function, Particle in three-dimensional box; Derivation of normalized wave equation, Energy related with it, Degeneracy, Example based on energy of 1s orbital, normalization, orthogonally, particle in one and three dimensional box and degeneracy. | **10** |

| | | | |
|---|---|---|---|
| | | **Chapter-2 Soap and Detergent**<br>Introduction, Raw materials for manufacture, Methods for manufacture of soap (i) Batch process (ii) Continuous process<br>Types of soap: Toilet soap, transparent soap, shaving soap, Neem soap,<br>Introduction to detergents, Principal group of synthetic detergents, Bio-degradability of surfactants, Classification of surface-active agents, Anionic detergents,<br>Manufacture of anionic detergents; (i) Oxo Process (ii) Alfol Process, (iii) Welsh Process<br>Cationic detergents, Non – Ionic detergents, amphoteric detergents | **05** |
| | **2** | **Chapter-3 Alkaloids**<br>Introduction, Occurrence, Classification and Isolation, General method of proving structure of alkaloids, Constitution, Properties and synthesis of<br>(i) Coniine<br>(ii) Nicotine and<br>(iii) Papaverine | **05** |
| | | **Chapter-4 Terpenoids**<br>Introduction, Occurrence, Classification, General characteristics of Terpenoids, Isoprene & special Isoprene Rule,<br>Constitution and Synthesis of Citral and α-Terpineol | **05** |
| | | **Chapter-5 Name reactions, Rearrangements and Reagent**<br>Reactions: Arndt Eistert reaction and Bischler Napieralski reaction<br>Rearrangements: Curtius rearrangement and Benzoin Condensation<br>Reagent: Lithium Aluminium hydride $LiAlH_4$ and Sodamide | **05** |
| | **3** | **Chapter-6 Chemical Kinetics**<br>Concept of Chemical Kinetics, Rate of chemical reaction, Dependence of rate of reaction on concentration, Factors affecting on rate of chemical reaction, Rate law and rate constant, Order of the chemical reaction, Molecularity of elementary & complex reactions, Molecularity versus order of reaction, Zero order reaction, Integrated rate equation of first order reaction, Second order reaction, Methods for determination of order of reaction, Arrhenius equation (Without Derivation), Concept of activation energy. | **10** |

| | | | |
|---|---|---|---|
| | | Theories of reaction rate: Collision theory of reaction rate, Absolute rate or activated complex theory, Numericals based on theory. | |
| | | **Chapter-7 Third law of Thermodynamics**<br>Introduction, Nernst heat theorem, Third law of thermodynamics, Determination of absolute entropies of solids, liquids and gases, Applications of third law of thermodynamics ($\Delta S^0$, $\Delta G^0$ and equilibrium constant of chemical reaction), Tests of third law of thermodynamics, Residual entropy, Numerical based on theory. | **05** |
| | **4** | **Chapter-8 Bio-Inorganic Chemistry**<br>Metalloporphyrin, Structure and roll of Haemoglobin in biological system, Myoglobin, Structure of chlorophyll and its importance, Toxicity of arsenic, mercury, lead and cadmium, Reason for toxicity. | **05** |
| | | **Chapter-9 Heterocyclic Compounds-I**<br>Classification and nomenclature of mono heterocyclic compound based on size of ring, Aromaticity in 5 membered (Furan, Thiophene and Pyrrole), Preparation of Furan, Thiophene, and Pyrrole, Chemical Properties (Electrophilic Substitution Reaction) of Furan, Thiophene andPyrrole<br>Nitration, Sulphonation, Acetylation, Chlorination, Reaction with Organometallic Compounds,<br>Aromaticity of Pyridine, Basicity of Pyridine, Relative basicity of Pyridine, Pyrrole and Aliphatic amines Preparation of Pyridine from acetylene, Hantzsch's synthesis, Chemical Properties of Pyridine: Electrophilic and Nucleophilic Substitution Reaction. | **05** |
| | | **Chapter-10 Partial Molar Properties**<br>Introduction, Definition of partial molar property, Concept of chemical potential, Physical significance (properties) of chemical potential, Derivation of Gibbs-Duhem equation, Variation of chemical potential with temperature and pressure, Determination of partial molar properties by method of intercept, Applications of chemical potential (Henry's law, Rault's law and Nernst's distribution law), Numerical based on theory. | **05** |

**BHAKTA KAVI NARSINH MEHTA UNIVERSITY**

**Major/Minor/Multidisciplinary**

**Syllabus of B.Sc. (Honors) as per NEP-2020**

**Faculty of Science**

**Effective from June 2024**

**Subject: Chemistry**

**SEMESTER-III & IV**

| | | | | |
|---|---|---|---|---|
| **Course Level** | 5.0 | | **Internal Marks** | 50 |
| **Programme** | B.Sc Chemistry | | **External Marks** | 50 |
| **Semester** | IV | | **Practical Internal** | 50 |
| **Category of Course** | Major-10 | | **Practical External** | 50 |
| **Course Credit** | 4 | | **Prac. External Exam Duration** | 4 Hrs |
| **Teaching Hours** | 8P | | **Total** | - |
| **Course Code** | **CHM210-2C** | | **External Practical Exam Duration** | 4 hrs |
| **Course Title** | **Intermediate Chemistry Practical – 210** | | | |

**Course Objectives:**

- To enable student to be able to carry out quantitative and qualitative analysis of some chemicals independently.

**Course Learning Outcomes**: After completion of the course:

1. The students would be able to carry out analysis of a mixture containing positive and negative radicals which collectively made a soluble solution.
2. Carry out physicochemical exercises to study the rate of reaction of various reactions like hydrolysis of ester, reaction between potassium persulphate and KI, KBrO3 ad KI, determine the energy of activation of some reactions, partition coefficient of an acid between two a polar and non-polar liquid etc
3. The learner would be able to determine concentration of various ions using iodo/iodimetrically. They will also be able to estimate some metal ions quantitatively using complexometric titrations. They will be able to carry out water analysis and some analysis using redox titrations.

| Sem | Unit No. | Syllabi | Teaching Hours |
|---|---|---|---|
| 4 | | **Inorganic Qualitative Analysis**:<br>**[Minimum fifteen inorganic mixtures should be given]**<br>Qualitative Analysis of an inorganic mixture containing four radicals<br>(Including soluble $PO_4^{-3}$),<br>[Excluding $PO_4^{-3}$ (insoluble), $CrO_4^{-2}$, $Cr_2O_7^{-2}$, $AsO_3^{-3}$, $AsO_4^{-3}$, $BO_3^{-3}$ and $S^{-2}$] | **60** |
| | | **Physicochemical Exercise (Seven exercises may be given)**<br>1. To determine the specific reaction rate of the hydrolysis of methyl acetate / Ethyl acetate catalyzed by H+ ion at room temperature.<br>2. To study the rate of reaction between K2S2O8 and KI.<br>3. To study the rate of reaction between KBrO3 and KI.<br>4. To determine the temperature coefficient and Energy of activation for the hydrolysis of ester at two different temperatures.<br>5. To determine the temperature coefficient and Energy of activation for the reaction between K2S2O8 and KI at two different temperatures<br>6. To determine the rate of adsorption of the given organic acid using animal charcoal.<br>7. Distribution Law: To study the partition co-efficient of benzoic acid between water and benzene / kerosene and hence study the molecular condition of benzoic acid in the solution.<br>8. To study the partition co-efficient of acetic acid between water and chloroform and hence study the molecular condition of acetic acid in the solution. | **28** |
| | | **Inorganic Volumetric Analysis [Eight estimations should be given]**<br>**i. Iodometry and Iodimetry**<br>(a) Estimation of Cu+2 and CuSO4.5H2O in the given CuSO4.5H2O using 0.05N Na2S2O3.5H2O solution.<br>(b) Estimation of As+3 and As2O3 in the given As2O3 using 0.05N Na2S2O3.5H2O solution. | **32** |

| | | | |
|---|---|---|---|
| | | **ii. Complexometric titration:**<br>1. Estimation of the amount of $Ni^{+2}$ in the given $NiSO_4.7H_2O$ solution using 0.02 N EDTA solutions.<br>2. Estimation of the amount of $Mg^{+2}$ and $Pb^{+2}$ in the given solution containing a mixture of $Mg^{+2}$ and $Pb^{+2}$ using 0.02 N EDTA solution<br>3. Estimation of the amount of $Ca^{+2}$ and $Zn^{+2}$ in the given solution containing a mixture of $Ca^{+2}$ and $Zn^{+2}$ using 0.02 N EDTA solution<br>4. Estimation of the amount of $Fe^{+3}$ and $Cr^{+3}$ in the given solution containing a mixture of $Fe^{+3}$ and $Cr^{+3}$ using 0.02 N/ 0.01 M $Pb(NO_3)_2$ and 0.02 N/ 0.01 M EDTA solution.<br>**iii. Redox titration**<br>1. Determination of the amount of $NO_2^{-1}$ in the given $NaNO_2$ or $KNO_2$ solution by reduction method using 0.1 N $KMnO_4$ solutions.<br>**iv. Water Analysis**<br>1. To determine the amount of chloride in the given sample of water using 0.02 N $AgNO_3$.<br>**v.** To determine the purity of NaHCO3 in the given sample. | |

**BHAKTA KAVI NARSINH MEHTA UNIVERSITY**

**Major/Minor/Multidisciplinary**

**Syllabus of B.Sc. (Honors) as per NEP-2020**

**Faculty of Science**

**Effective from June 2024**

**Subject: Chemistry**

**SEMESTER-III & IV**

| | | | | |
|---|---|---|---|---|
| **Course Level** | 5.0 | | **Internal Marks** | 50 |
| **Programme** | B.Sc Chemistry | | **External Marks** | 50 |
| **Semester** | IV | | **Internal(T)** | 25 |
| **Category of Course** | Minor-3 | | **Internal (P)** | 25 |
| **Course Credit** | 4 | | **Internal Practical Exam Duration** | 2 Hrs |
| **Teaching Hours** | 3T+2P | | | |
| **Course Code** | **CHE203-2C** | | **External Theory Exam Duration** | 2 hrs |
| **Course Title** | **Minor Chemistry-203** | | | |

**Course Objectives:**

- To acknowledge the students with oils and fats and some applications of chemistry like soaps and detergents.
- Also, enable them to be able to understand environment and sources of various types pollutions. Also, familiarize them with the most versatile analytical technique like chromatography.

**Course Learning Outcomes**: After completion of the course:

1. The students will be able to classification and properties of oil and fats. Hydrogenation of oil and analysis of oil and fats.
2. They will also be familiar with the types of soaps and detergents, classification of soaps and detergents, their raw materials, manufacturing processes and some estimating parameters and chemicals methods used to determine it.
3. Learners will be well educated with the environmental aspects in chemistry. The types of pollutions and aware about the chemicals and other sources creating it.
4. The students will be well convergent with the principle of various chromatographic technique of separation of materials and its applications in various fields.

| Sem | Unit No. | Syllabi | Teaching Hours |
|---|---|---|---|
| | 1 | **Chapter-1 Oils and Fats**<br>Introduction, Properties of oil and fats, Classification,<br>Hydrogenation of oil: i) Optimum condition for the hydrogenation process and ii) Preparation of Nickel catalyst,<br>Process for hydrogenation of oil: i) Dry process and ii) Wet process,<br>Analysis of oil and fats: i) Saponification value ii) Acid value<br>iii) Iodine value (WIJS method) and iv) Reichert – Meisel value. | **11** |
| | **2** | **Chapter-2 Soap and Detergent**<br>Introduction, Raw materials for manufacture, Methods for manufacture of soap (i) Batch process (ii) Continuous process<br>Types of soap: Toilet soap, transparent soap, shaving soap, Neem soap,<br>Introduction to detergents, Principal group of synthetic detergents, Bio-degradability of surfactants, Classification of surface-active agents, Anionic detergents,<br>Manufacture of anionic detergents; (i) Oxo Process (ii) Alfol Process, (iii) Welsh Process<br>Cationic detergents, Non – Ionic detergents, amphoteric detergents | **11** |
| | **3** | **Chapter-3**<br>**Environmental Chemistry**<br>Environment – definition and introduction, Segments of environment (i) Atmosphere (ii) Hydrosphere (iii) Lithosphere (iv) Biosphere, Air Pollution: Major sources of air pollution, Control of Air pollution, Green House Effect, Photochemical smog, CFC and ozone depletion, Acid rain, Sources and effects of NOX and SOX, Environmental pollution and its type. | **11** |
| | **4** | **Chapter-4 Chromatography**<br>Introduction, Classification of chromatography - types of chromatography, Principle of Chromatography<br>**Column chromatography:** Principle, Adsorbents, Preparation of column, Method, Separation of green leaf pigment, | **12** |

| | | | |
|---|---|---|---|
| | | **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<br>**TLC:** Introduction, Principle, Method of preparation of chromplate, Experimental techniques, Superiority of TCL over other chromatographic Techniques, Application of TLC.<br>**Gas chromatography;** Introduction, Types, **P**rinciple of GLC and GSC, Instrumentation, Carrier gas and Solvent, Column and Detectors (Briefly), Advantages of gas chromatography<br>**Ion Exchange chromatography:** Introduction, Definition and Principle, Type of resins, Properties of ion exchange resins, Factors affecting separation of ions, Ion exchange capacity, Applications (Removal of interfering ion, Softening of water, Demineralization of water, Separation of lanthanides) | |

Course: **Minor Chemistry Paper-3 [1-Credit Practical]**

| Sem | Unit No. | Syllabi | Teaching Hours |
|---|---|---|---|
| **4** | 2 | **Chromatography**<br>Atleast six practicals may be given.<br>1. To determine Rf value of individual amino acids in a mixture of amino acid by ascending paper chromatography.<br>2. To determine Rf value of individual and mixture of amino acid by circular paper chromatography.<br>3. To determine Rf value of individual and mixture of amino acid by thin layer chromatography (TLC).<br>4. To determine Rf value of individual and mixture of metal ions by ascending paper chromatography.<br>5. To determine Rf value of individual and mixture of metal ions by circular paper chromatography.<br>6. To determine Rf value of individual and mixture of two sugars by ascending paper chromatography.<br>7. Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC)<br>8. Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the Rf values. | **30P** |

**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
11. Pathania, Vishal Publishing Co. Jalandhar
12. Principles of Physical Chemistry, Samule H. Maron and Carl F. Prutton, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi
13. Physical Chemistry, B. K. Sharma, Goel Publication House. Meerut.
14. Quantum chemistry by A. K. Chandra
15. Basic Concept of Quantum Chemistry by R. K. Das.
16. Molecular Physical Chemistry by McQuarrie
17. Elements of Physical Chemistry, Samuel Glasstone and David Lewis, Macmillan & Co.
18. Engineering Chemistry by Jain and Jain
19. Industrial Chemistry by B.K. Sharma
20. Thermodynamics by Gurudeeep Raj
21. Thin Layer Chromatography by Egal Stall
22. Thermodynamics for Chemists by Samuel Glasstone
23. A Textbook of Quantitative Inorganic Analysis by A. I. Vogel
24. Inorganic inflictive analysis by Vogel and Gehani Parekh
25. Reigel's Handbook of Industrial Chemistry by James A. Kent
26. Fundamental of Analytical Chemistry by Skoog and West
27. Instrumental Methods of Chemical Analysis by B. K. Sharma
28. Instrumental Method of Chemical Analysis by Chatwal Anand
29. Analytical Chemistry by Dick
30. Electrometric Methods of Analysis by Browning
31. Principle of Instrumental Methods of Analysis by Skoog.
32. Mikes, O. & Chalmes, R.A. Laboratory Hand Book of Chromatographic & Allied
33. Methods, Elles Harwood Ltd. London.
34. □□□□Ditts, R.V. Analytical Chemistry – Methods of separation.
35. Jack T. Ballinger; Gersshon J. Shugar. Chemical Technicians' Ready Reference Hand book, 5th Edition, 2011, ISBN:9780071745925, The McGraw-Hill com, Incpanies

| INTERNAL EVALUATION SCHEME | | |
|---|---|---|
| **NO** | **Particulars** | **Marks** |
| 1 | **Mid Semester Exam (Mandatory)** | **25** |
| 2 | Class Test | 05 |
| 3 | Open book exam/test | 05 |
| 4 | Open note exam/test | 05 |
| 5 | Self-test/ Online test | 05 |
| 6 | Essay/Article writing | 05 |
| 7 | Quizzes/Objective test | 05 |
| 8 | Class assignment | 05 |
| 9 | Home assignment | 05 |
| 10 | Reports Writing | 05 |
| 11 | Research/Dissertation | 05 |
| 12 | Case Studies | 05 |
| 13 | Viva/Oral exam | 05 |
| 14 | Group Discussion | 05 |
| 15 | Role Play | 05 |
| 16 | Paper presentation/Seminar | 05 |
| 17 | Language Lab work | 05 |
| 18 | Interview | 05 |
| 19 | Craft work | 05 |
| 20 | Co-curricular work | 05 |
| 21 | Field Assignment | 05 |
| 22 | Poster Presentation | 05 |
| 23 | Attendance | 05 |
| 24 | Project Work | 05 |
| | **Total** | **50** |

**Note: Sr.No.1 is mandatory. Select any five from Sr.No.2 to 24. Each Contains five marks. Student should secure 18 Marks for passing in internal Exam.**

**For Major paper 5, 6, 8, and 9: 25 Mid-term + 25 CCE + 50 External Theory = 100**

**For Major paper-7 and 10 (Practical): 25 Mid-term (Practical) + 25 CCE + 50 External Practical; Exam = 100**

**Paper Style (For B.Sc. Chemistry SEM- 3, 4)**

| Ques. No. | Particulars | From which Unit | Marks |
|---|---|---|---|
| **1** | Any two out of 3 questions (5 marks each) | **1** | **10** |
| **2** | Any two out of 3 questions (5 marks each) | **2** | **10** |
| **3** | Any two out of 3 questions (5 marks each) | **3** | **10** |
| **4** | Any two out of 3 questions (5 marks each) | **4** | **10** |
| **5** | Any two out of 4 questions (5 marks each) | **One question From Each Unit** | **10** |
| | | **Total Marks** | **50** |

**********