

JAI NARAIN VYAS UNIVERSITY, JODHPUR
Department of Chemistry

Nomenclature of Minor Papers
B.Sc. (Four year undergraduate program)

SEMESTER-I		
S.No.	Course Code	Title
1.	08/CHE/MNR/101T	Fundamentals of Chemistry-I
2.	08/CHE/MNR/101P	Practical Chemistry
SEMESTER-II		
1.	08/CHE/MNR/151T	Fundamentals of Chemistry-II
2.	08/CHE/MNR/151P	Practical Chemistry
SEMESTER-III		
1.	08/CHE/MNR/201T	Fundamentals of Chemistry-III
2.	08/CHE/MNR/201P	Practical Chemistry
SEMESTER-IV		
1.	08/CHE/MNR/251T	Advanced Chemistry-II
2.	08/CHE/MNR/251P	Practical Chemistry
SEMESTER-V		
1.	08/CHE/MNR/301T	Molecular Spectroscopy
2.	08/CHE/MNR/301P	Practical Chemistry
SEMESTER-VI		
1.	08/CHE/MNR/351T	Biomolecules and Industrial Organic Material
2.	08/CHE/MNR/351P	Practical Chemistry

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SYLLABUS OF B.Sc. I year (Chemistry) I semester as per NEP-2022

Syllabus for I semester Minor

Title: Fundamentals of Chemistry-I

Course Code: 08/CHE/MNR/101T:

UNIT-I: Chemical Bonding and Molecular Structure

Ionic Bonding: General characteristics of ionic bonding, Energy considerations in ionic bonding, lattice energy, solvation energy and their importance in the context of stability and solubility of ionic compounds, Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability, Fajan's rules

Covalent bonding: VB approach, shapes of some inorganic molecules and ions on the basis of VSEPR theory and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

UNIT-II: Molecular Orbital Approach

Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+ , Banana Bonding (3C-2e Bond) in diboranes.

Hydrogen Bonding: Types and impact of inter and intra molecular hydrogen bonding.

UNIT-III: Fundamentals of Organic Chemistry

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation, Cleavage of Bonds: Homolysis and Heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles, Reactive Intermediates: Carbocations, Carbanions and free radicals.

Stereochemistry

Conformations with respect to ethane, butane and cyclohexane, Newmann, Sawhorse and Fischer representations, Concept of chirality (upto two carbon atoms), Configuration: Geometrical and Optical isomerism, Enantiomerism, Diastereomerism and Meso compounds, Threo and erythro, D and L, cis-trans nomenclature, R/S (for upto 2 chiral carbon atoms) and E/Z Nomenclature (for upto two C-C systems).

UNIT-IV: Aliphatic Hydrocarbons

Alkenes: Preparation- Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. **Reactions:** Free radical Substitution: Halogenation.

Alkenes: Preparation- Elimination reactions: Dehydration of alcohols and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). **Reactions:** cis-addition (alk. KMnO_4) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation.

UNIT-V: Gaseous State

Deviation from ideal behavior, Vander Waals equation of state and its discussion.

Critical Phenomena: PV isotherms of real gases, critical phenomenon continuity of states, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state.

Molecular velocities: Root mean square, average and most probable velocities (No derivation). Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquification of gases (based on Joule-Thomson effect). Numerical.

Books Suggested:

1. Inorganic Chemistry by B.R. Puri and L.R. Sharma
 2. Inorganic Chemistry by G.C. Shrivare and V.P. Lavania
 3. A Text Book of Organic Chemistry by R.K. Bansal
 4. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentice-Hall
 5. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma and M.S. Pathania, Shobhan Lal Naginchand & Co.
- Chemistry-Semester-I by R.L. Madan (S. Chand & Co.)

Practical Chemistry- 08/CHE/MNR/101P
(Minor Course)

SYLLABUS OF B.Sc. I year (Chemistry) II semester as per NEP-2022

Syllabus for II semester Minor

Title: Fundamentals of Chemistry-II

Course Code:08/CHE/MNR/151T

Exercise1.

Qualitative analysis of inorganic mixture containing 5-radicals (anions and cations), separation and identification of cations (group 0, I, II, III, IV, V and VI) and anions which may have special combination of acidic radicals (CO_3^{2-} , SO_3^{2-} , NO_3^- , NO_2^- , NO_2^+ , Br^- , Cl^- , Br^- , I^- , S^{2-} , SO_3^{2-} , SO_4^{2-} -Excluding interfering radicals and insoluble)

Exercise2:

- Determination of density of given liquid by RD bottle.
- Sol Preparation: $\text{Fe}(\text{OH})_3$, $\text{Al}(\text{OH})_3$, As_2S_3

UNIT-I: s-Block elements

Periodicity in properties of alkali and alkaline earth metals. Complexation tendency, Solvation tendency, stability and solubilities of carbonates, bicarbonates and sulphates of Magnesium and Calcium, Synthesis and applications of important hydrides: NaBH_4 , LiBH_4 , and LiAlH_4 .

p-Block elements

Periodicity in properties of III A, IV A, V A, VI A and VII A group elements.

Silicates, oxides of nitrogen, phosphorous and sulphur- their structure and preparations.

UNIT-II: Dienes and Alkynes

Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes. Structure of allenes and butadiene, methods of formation, polymerization. Chemical reactions – 1, 2- and 1, 4- additions, Diels-Alder reaction.

Nomenclature, structure and bonding in alkynes. Methods of formation. Chemical reactions of alkynes, acidic nature of 1-alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, oxidation and polymerization.

UNIT III: Aromaticity and Arenes:

Structure of benzene: Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Huckel's rule, aromatic ions. Nomenclature of benzene derivatives. Aryl group. Methods of formation and chemical reactions of alkylbenzenes,

Aromatic electrophilic substitution – general pattern of the mechanism, role of σ^- and π^- complexes. Mechanism of nitration, halogenation, sulphonation, and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives. Birch reduction.

Structure, preparation and properties of naphthalene.

UNIT IV: Solutions

Types of liquid mixtures, Raoult's law, Ideal and Non-ideal mixtures, Vapour pressure of liquid mixtures, vapour pressure-Composition and Boiling point-composition curves of completely miscible binary solutions, Fractional distillation of binary liquid solutions, Azeotropic mixtures and Distillation of immiscible liquid mixtures.

Partially miscible liquids mixtures-phenol-water, triethylamine-water, nicotine-water-systems, consolute temperature-lower and upper, Numerical.

UNIT V: Chemical Thermodynamics & Chemical Equilibrium

Laws of thermodynamics. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature - Kirchhoff's equation.

Statement of third law of thermodynamics and calculation of absolute entropies of substances.

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG° , Le Chatelier's principle. Relationships between K_p , K_c and K_x for reactions involving ideal gases.

Books Suggested

1. Inorganic Chemistry by B.R. Puri and L.R. Sharma
2. Inorganic Chemistry by G.C. Shivhare and V.P. Lavanla
3. Inorganic Chemistry by Satya Prakash
4. A Text Book of Organic Chemistry by M.K. Jain
5. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentice-Hall
6. Advanced Organic Chemistry by Mukherji & Kapoor Vol I & II
7. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma and M.S. Pathania, Shobhan Lal Naginchand & Co.
8. Physical Chemistry by Bahl & Tuli (S. Chand & Co.)
9. Chemistry-Semester-II by R.L. Madan (S. Chand & Co.)

Practical Chemistry-08/CHE/MNR/151P (Minor Course)

Exercise 1:

Acidimetry-Alkalimetry titration:

- (a) Weak acid vs Strong base (Oxalic acid/NaOH)
- (b) Strong acid vs Strong base (HCl and H_2SO_4 /NaOH)

Redox Titrations:

To determine the strength of given oxalic acid solution by titrating it against $KMnO_4$ solution

Exercise 2:

(a) Viscosity:

(i) To determine the viscosity of the given organic liquid by Ostwald Viscometer

(b) Surface Tension:

(i) To determine the surface tension of a given organic liquid by Stalagmometer.

Checked

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SYLLABUS OF B.Sc. II year (Chemistry) III semester as per NEP-2022

Minor

Title: Fundamentals of Chemistry-III

Course Code: 08/CHE/MNR/201T

UNIT-I: Basics of Electrochemistry

Conductance, Specific conductance, Molar and equivalent conductance and their variations with dilution for weak and strong electrolytes. Kohlrausch Law of independent migration of ions. Activity, activity coefficient and ionic strength. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only).

UNIT-II: Chemical Kinetics

Rate, order, molecularity and stoichiometry of a reaction, Derivation of integrated rate law and characteristics of zero, first and second order reactions, Pseudo-first order reaction, Determination of the order of reaction-differential method, method of integration (hit and trial method), half-life method and isolation method.

Theories of Reaction Rate: Simple collision theory and its limitations, transition state theory (equilibrium hypothesis) and derivation of the rate constant, Thermodynamical formulation of rate constant, Comparison of collision theory and transition state theory. Numericals.

UNIT-III: Hydroxyl and Carbonyl Compounds:

Monohydric alcohols: methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding. Acidic nature. Reactions of alcohols.

Dihydric alcohols – nomenclature, methods of formation, chemical reactions of vicinal glycols,

Preparation of phenols, physical properties and acidic character. Comparative acidic strengths of alcohol and phenol, resonance stabilization of phenoxide ion. Reactions of phenols: Electrophilic aromatic substitution, acylation and carboxylation. Mechanism of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben- Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction.

Nomenclature and structure of the carbonyl group. Physical properties and Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid

chlorides, synthesis of aldehydes and ketones using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids.

UNIT-IV: Chemistry of Transition Elements

General Characteristics and Periodicity in properties with emphasis on their electronic configuration and multiple oxidation states of 3d, 4d and 5d series elements.

Colored ion formation, magnetic, catalytic properties and complex formation tendency in 3d series elements. Frost diagram for manganese.

UNIT-V: f-Block elements

Chemistry of Lanthanides: Electronic structure, oxidation state, ionic radii, colors, spectral and magnetic properties. Lanthanide contraction and its consequences.

Chemistry of actinides: General characteristics, comparative treatment of actinides and lanthanides with respect to ionic radii, oxidation states, magnetic behavior and spectral properties.

Books Suggested

1. Inorganic Chemistry by B.R. Puri and L.R. Sharma
2. A Text Book of Organic Chemistry by M.K. Jain
3. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentice-Hall
4. Advanced Organic Chemistry by Singh, Mukherji & Kapoor Vol I & II
5. Physical Chemistry by P.W. Atkins
6. Physical Chemistry by Bahl & Tuli (S. Chand & Co.)
7. Chemistry-Semester-III by R.L. Madan (S. Chand & Co.)

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Practical Chemistry-08/CHE/MNR/201P
(Minor Course)

SYLLABUS OF B.Sc. II year (Chemistry) IV semester as per NEP-2022

Minor

Title: Advanced Chemistry-II

Course Code:08/CHE/MNR/251T

Exercise1:

Iodometric Titrations:

(i) To determine the strength of given unknown copper sulphate solution iodometrically using starch as indicator.

(ii) To determine the strength of given unknown potassium dichromate solution iodometrically using starch as indicator.

Exercise2:

Viscosity:

To determine the % composition of a binary solution by Viscosity measurement.

Surface Tension:

To determine the % composition of a binary solution by surface tension measurement

UNIT-I: Coordination compounds

Werner's coordination theory and experimental verification, Effective Atomic Number concept, chelates, nomenclature of coordination compounds, stereoisomerism in complexes of coordination number 4 and 6, Complexometric titrations and theory of metallochrome indicators.

UNIT-II: Concepts of acids and bases:

Arrhenius, Brønsted-Lowry, Lewis and Usanovich concept. Acid base titrations, Theory of indicators, Redox titrations

Non aqueous solvents: Physical properties of solvent, types of solvents and their general characteristics. Reactions in non aqueous solvents with reference to liquid NH_3 and liquid SO_2

UNIT-III: Reactive methylene compounds and Carboxylic Acid

Reactive methylene compounds: malonic ester and acetoacetic ester – preparation and synthetic applications. Mechanism of Claisen condensation

Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids. Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction.

UNIT-IV: (A) Nitrogen Compounds: Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanisms of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline media. Picric acid.

Alkyl amines: Preparation of alkyl amines, reactivity, structure and nomenclature of amines, physical properties. Structural features affecting basic nature of amines. Amine salts as phase-transfer catalysts.

(B)Phase Equilibrium-I

Statement and meaning of the terms – phase, component and degree of freedom, Gibbs phase rule, phase equilibria of one component system – water and sulphur systems. Simple eutectic system – Pb-Ag system, desilverisation of lead.

UNIT-V: Quantum Mechanics

Introduction, black body radiation, Planck radiation law, Photoelectric effect, Compton effect, Bohr's model of Hydrogen atom and its defects, de Broglie's Hypothesis, de Broglie's equation and its experimental verification, Heisenberg's Uncertainty principle, Hamiltonian operator, Schrodinger's wave


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equation (time independent), Physical Interpretation of wave function, Postulates of quantum mechanics, Schrodinger equation for particle in one dimensional box.

Practical Chemistry-08/CHE/MNR/251P

(Minor Course)

Books Suggested

6. Concise Inorganic Chemistry by J.D. Lee (Wiley Pub.)
7. Advanced Inorganic Chemistry by Cotton & Wilkinson (Wiley Pub.)
8. Advanced Organic Chemistry by J. March.
9. Organic Chemistry by I.L. Finar (Pearson Pub.)
10. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentice-Hall
11. Advanced Organic Chemistry by Singh, Mukherji & Kapoor Vol I & II
12. The Elements of Physical Chemistry by P.W. Atkins (Oxford Pub.)
13. Physical Chemistry by Bahl & Tuli (S. Chand & Co.)
14. Chemistry-Semester-IV by R.L. Madan (S. Chand & Co.)

Exercises1:

Qualitative Analysis: - Identification of organic compounds (one liquid and one solid) through the functional group analysis (containing only one functional group).

Exercises2: Preparations: (Inorganic)

- a) Micro cosmic salt,
- b) Ferrous Ammonium Sulphate
- c) Nickel ammonium sulphate,
- d) Sodium thiosulphate,
- e) Ferrous Sulphate,
- f) Tetra ammine copper (II) sulphate,

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SYLLABUS OF B.Sc. III year (Chemistry) V semester as per NEP-2022

Minor

Title: : Molecular Spectroscopy

Course Code:08/CHE/MNR/301T

UNIT I: Spectroscopy:

Introduction of molecular spectrum, electromagnetic radiation, regions of the spectrum, Basic features of different Spectrometers, Born-Oppenheimer approximation, degrees of freedom.

UNIT II: Rotational Spectrum: Diatomic molecules, Energy levels of a rigid rotator (semi-classical principles), selection rules, spectral intensity, distribution using population distribution (Maxwell-Boltzmann distribution) determination of bond length, qualitative description of non-rigid rotator, isotope effect. Numericals.

UNIT III: Vibration Spectroscopy:

Introduction, Energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, determination of force constant and qualitative relation of force constant and bond energies, effect of anharmonic motion and isotope on the spectrum

UNIT IV: Raman Spectroscopy: concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules. Numericals.

UNIT V: Electronic Spectrum: Origin of electronic spectrum, absorption laws (Beer-Lambert law), molar absorptivity, types of electronic transitions, Concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. Franck-Condon principle.

Books Suggested

1. Molecular Spectroscopy by Banwell
2. Fundamentals of Molecular Spectroscopy by P.S. Sindhu (New Age Int.)
3. Molecular Structure and Spectroscopy by G. Aruldas (PHI)

Practical Chemistry-08/CHE/MNR/301P

(Minor Course)

Exercises1:

Chemical Kinetics:

- (i) To study the hydrolysis of an ester catalyzed by an acid and determine the rate constant and order of reaction.
- (ii) To study saponification of ester and determine the rate constant and order of reaction.
- (iii) To study the reaction b/w acetone and iodine with respect to iodine and determine the rate and order of reaction.

Exercises2:

Synthesis of organic compounds: -

- (i) Preparation of iodoform from ethanol and acetone.
- (ii) Diazotization/Coupling of primary aromatic amines (aniline).
- (iii) Preparation of methyl orange.

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SYLLABUS OF B.Sc. III year (Chemistry) VI semester as per NEP-2022

Minor

Title: Bio molecules and Industrial Organic Material

Course Code: 08/CHE/MNR/351T

UNIT-I: Amino Acids

Classification, structure and stereochemistry of amino acids; Acid-base behavior, isoelectric point, electrophoresis and separation of amino acids by chromatography. Preparation and reactions of α -amino acids. Distinctive properties of α -, β -, and γ -amino acids. analysis of amino acid. Glycine- preparation, physical & chemical properties.

UNIT-II: Introduction to Carbohydrates

Classification and nomenclature. Monosaccharides, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides: Erythro and threo diastereomers. Conversion of glucose into mannose, mechanism of osazone formation, Cyclic structure of D (+)-glucose. Mechanism of mutarotation.

UNIT-III:

Introduction, of proteins. Classification of proteins, selective hydrolysis of peptides. Classical peptide synthesis, solid-phase peptide synthesis. Peptide structure determination, end group analysis, Structures of peptides and proteins. Protein denaturation/renaturation. Analytical tests and uses of proteins.

Occurrence of sucrose, manufacture of sucrose, physical and chemical properties of sucrose, configurational structure of sucrose, uses and analytical test of sucrose, constitution of sucrose. Structure of starch and cellulose.

UNIT-IV: Fats, Oils, Detergents

Introduction to oil and fats. Mineral oils, essential oils. Extraction, physical and chemical properties of oil and fats. Natural fats, edible and industrial oils of vegetable origin, common

fatty acids, glycerides, hydrogenation of unsaturated oils. Analysis of oil & fats-Saponification value, iodine value, acid value, R/M value.

Lipids- Introduction to lipids, general physical and chemical properties, classification: simple lipids, compound lipids, lipoproteins, derived lipids, classification based on fatty acids,

Soaps & soap less detergents. Soaps- manufacture of soap, toilet soap & laundry soap, special varieties of soaps, cleansing action of soap. Synthetic detergents, alkyl and aryl sulphonate, micelles, various types of micelles.

UNIT-V: INDUSTRIAL POLYMERS:

Natural rubbers, synthetic rubbers, Buna rubbers. Silicone rubber- introduction, history, curing, properties, production, structure, special grades and forms of silicone rubber, Silicone Rubbers. Comparison of silicon rubbers with organic rubber. Silicone rubber vs thermoplastics vs thermoplastic-elastomers.

Books Suggested:

1. Organic Spectroscopy by Y.R. Sharma (S. Chand)
2. Organic Spectroscopy by Jagdamba Singh (Pragati Prakashan)
3. Organic Chemistry by Bahl & Bahl
4. Polymer Chemistry by P. Bahadur & N.V. Shastri

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Practical Chemistry-08/CHE/MNR/351P
(Minor Course)

Exercise1:

Complexometric Titration:

- (i) To determine the $\text{Ca}^{+2}/\text{Mg}^{+2}$ in given solution by titration with EDTA.
- (ii) To determine the total hardness of given water sample.

Exercise2:

Thin Layer Chromatography

- (i) Separation of dyes
- (ii) Separation of green leaf (Spinach) pigments.



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