# SHRI RAM SINGH DHONI RAJKIYA MAHAVIDYALAYA, JAINTI (ALMORA)

## Academic Session: 2022-23

## Course Outline: NEP Syllabus

## Subject: Chemistry

### Class: B.Sc. 1st Semester

| Theory Paper: Paper I | Units | Practical Paper: Paper II | Units | Total Credits of the Year | Hours per Semester |
|---|---|---|---|---|---|
| Fundamentals of Chemistry- I | 1. Atomic Structure and Periodic Properties<br>2. Chemical Bonding-I<br>3. Mechanism of Organic Reactions<br>4. Stereochemistry of Organic Compounds<br>5. States of Matter-I<br>6. States of Matter-II | Chemical Analysis -I | 1. Laboratory hazards and safety precautions<br>2. Inorganic exercise (Acidic radicals including combinations and interfering radicals)<br>3. Organic exercise<br>4. Physical exercise | 4+2=6 | 60 hour: Theory<br>60 hour:Practical |

### TEACHING PLAN: B.Sc. 1st Semester

**Paper I: Theory: Course Title: Fundamentals of Chemistry-I**

Max. Marks = 100 Marks = 25 (Internal assessment) + 75 (Theory Paper)

| UNITS | TOPICS | NO. OF HOURS = 60 |
|---|---|---|
| 1. Atomic Structure and Periodic Properties | Dual nature of matter; de Broglie concept. Heisenberg uncertainty principle; its significance. Atomic orbitals, Schrödinger wave equation (no derivation); significance of $\psi$ and $\psi^2$. Quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s, p and d orbitals. Aufbau energy diagram, Pauli's exclusion principle. Hund's rule of maximum multiplicity. Electronic configuration of elements (s block, p block and | 12 |

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| | first series of d-block elements). Effective nuclear charge, Slater's rule.<br>The general idea of Modern periodic table, atomic and ionic radii, ionization potential, electron affinity, electronegativity-definition, trends of variation in periodic table and their application in prediction and explaining the chemical behaviour of elements and compounds thereof. | |
| 2. Chemical Bonding-I | Ionic bond, covalent bond-Valence Bond Theory and its limitations; various types of hybridization and shapes of different inorganic and organic molecules. Valence Shell Electron Pair Repulsion Theory (VSEPR) and shapes of $NH_3$, $H_2O$, $H_3O^+$, $SF_4$, $ClF_3$, $ICl_2$, $TeF_5^-$ $NH_4^+$ and other simple molecules/ions ($CO_2$, $SO_2$, $SO_3$, $Cl_2O_7$, $SO^{2-}$, $CO_3^{2-}$, $NO_3^-$, $PO_4^{3-}$) including compounds of xenon.<br>Resonance, hyperconjugation, field effects- inductive, mesomeric, electromeric effect | 08 |
| 3. Mechanism of Organic Reactions | Types of reagents- electrophiles and nucleophiles. Types of organic reactions. Energy considerations. Reactive intermediates- carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples). | 08 |
| 4. Stereochemistry of Organic Compounds | Types of isomerism- optical isomerism- elements of symmetry, molecular chirality, enantiomers, stereogenic centers, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centre, diastereomers, threo and erythro diastereomers, meso compounds, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. Geometrical isomerism: determination of configuration of geometrical isomers, E & Z system of nomenclature. | 12 |
| 5. States of Matter-I | **Gaseous State-**Postulates of kinetic theory of gases, deviation from ideal behavior, van der Waal's equation of states, Critical phenomena – PV isotherms of real gases, relationship between critical constants and van der Waals constants. Molecular velocities: Root mean square, average and most probable velocities, qualitative discussion of the Maxwell's distribution of molecular velocities, Numerical problems.<br>**Liquid State-**Intermolecular forces, Structural differences between solids, liquids and gases. Physical properties of liquids including their methods of determination: surface tension, viscosity, Numerical problems. | 12 |
| 6. States of Matter-II | **Solid State:** Introduction to crystalline materials, Definition of space lattice, unit cell, crystal planes, Miller indices, Laws of crystallography – (i) law of constancy of | 08 |

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| | interfacial angles (ii) law of rationality of indices (iii) law of symmetry. Symmetry elements in crystals, X-ray diffraction by crystals. Bragg's equation, Numerical problems.<br>**Colloidal State:** Definition of colloids, classification of colloids. Solids in liquids (sols): properties – kinetic, optical and electrical; stability of colloids, protective action, Hardy-Schulze law, gold number. | |

**Books Recommended:**


- R. L. Madan, "Chemistry for Degree Students, B. Sc. First Year", S. Chand Publishing, New Delhi, India.
- B. R. Puri, L. R. Sharma, and K. C. Kalia, "Principles of Inorganic Chemistry", Vishal Publishing Co., India.
- R. D. Madan, U. M. Malik and G. D. Tuli, "Selected topics in Inorganic Chemistry", S. Chand Publishing, New Delhi, India.
- S. Prakash, G. D. Tuli, S. K. Basu and R. D. Madan, "Advanced Inorganic Chemistry", S. Chand Publishing, New Delhi, India.
- I. L. Finar, "Organic Chemistry", Pearson Education India.
- Boyd, Morrison and Bhattacharjee, "Organic Chemistry", Pearson Education India.
- A. Bahl and B. S. Bahl, "Advanced Organic Chemistry", S. Chand Publishing, India.
- B. R. Puri, M. S. Pathania, and L.R. Sharma, "Principles of Physical Chemistry", Vishal Publishing, India.
- A. Bahl, B. S. Bahl and G. D. Tuli, "Essential of Physical Chemistry", S. Chand Publishing, India.
- P. W. Atkins, "Atkin's Physical Chemistry: International", Oxford University Press.


## COURSE OUTCOMES: PAPER I: Fundamentals of Chemistry-I

This course will provide a broad foundation in chemistry that stresses scientific reasoning and analytical problem solving with a molecular perspective. Students will gain knowledge regarding molecular geometries, physical and chemical properties of the molecules. Along with this, the course provides a broader theoretical picture in multiple stages in an overall chemical reaction including reactive intermediates, transition states and states of all the bonds broken and formed. It enables to understand the reactants, catalyst, stereochemistry and major and minor products of any organic reaction. . The course will also strengthen the knowledge of students regarding complete picture of states of matter that includes gaseous, liquid, solid and colloidal states.

## TEACHING PLAN: B.Sc. 1st Semester

### Paper II: Practical: Course Title: Chemical Analysis - I

Max. Marks = 100 Marks

| UNITS | TOPICS | NO. OF HOURS = 60 |
|---|---|---|
| 1 | Laboratory hazards and safety precautions | 06 |
| 2 | **Salt mixture analysis:** Identification of acid radicals (three to four) including anions in combination and basic radicals upto II Group in the given salt mixture. | 18 |
| 3 | **Organic exercise:** Determination of absolute configuration of organic molecules using ball and stick models. Students are supposed sketch the structure of simple organic compounds showing their stereochemistry using Fischer Projection. | 18 |
| 4 | **Physical exercise:** Determination of relative surface tension of the given liquid using Stalagmometer. | 18 |

**Books Recommended:**


- O. P. Pandey, D. N. Bajpai and S. Giri, Practical Chemistry for B. Sc. I, II and III Year Students of All Indian Universities, S. Chand Publishing, New Delhi, India.
- S.M. Khopkar, Basic Concepts of Analytical Chemistry. New Age International Publisher.
- J. Mendham, Vogel's Quantitative Chemical Analysis, Pearson.


## COURSE OUTCOMES: PAPER II: Chemical Analysis - I

Upon completion of this course, the students will have the knowledge and skills to understand the laboratory methods and tests related to inorganic mixture analysis along with the estimation of surface tension of commercial products. Also, they can understand the absolute configuration of organic molecules with the help of models. In short we can say that the students will able to estimate anions and cations in samples qualitatively including the determination of relative surface tension of a given liquid and to find out the absolute configuration of organic molecules.

# Academic Session 2022-23
# Course Outline: NEP Syllabus
# Subject: Chemistry

## Class: B.Sc. 2nd Semester

| Theory Paper: Paper I | Units | Practical Paper: Paper II | Units | Total Credits of the Year | Hours per Semester |
|---|---|---|---|---|---|
| Fundamentals of Chemistry- II | 1. Chemical Bonding-II<br>2. Salient Features of *s*- and *p*-Block Elements<br>3. Aliphatic Compounds<br>4. Aromatic Compounds<br>5. Chemical Kinetics and Catalysis<br>6. Thermodynamics I | Chemical Analysis-II | 1. Laboratory hazards and safety precautions<br>2. Inorganic exercise (acid- base titrations)<br>3. Organic exercise<br>4. Physical exercise | 4+2=6 | 60 hour: Theory<br>60 hour:Practical |

## TEACHING PLAN: B.Sc. 2nd Semester

### Paper I: Theory: Course Title: Fundamentals of Chemistry-II

Max. Marks = 100 Marks = 25 (Internal assessment) + 75 (Theory Paper)

| UNITS | TOPICS | NO. OF HOURS = 60 |
|---|---|---|
| 1. Chemical Bonding-II | Molecular Orbital Theory (MOT) as applied to diatomic homonuclear/heteronuclear inorganic molecules. MO diagrams and bond order of $H_2$, $He_2$, $Li_2$, $Be_2$, $B_2$, $C_2$, $N_2$, $O_2$, $F_2$, $Ne_2$, CO, NO, HF difference between VB and MO theories. Multicentre bonding in electron deficient molecules. Polarization of covalent molecules, Percentage ionic character from dipole and electronegativity difference. Polarizing power and polarizability; Fajan's rule. Metallic bond- Electron Pool, valence bond and MO theories. Weak interactions-hydrogen bonding in inorganic and organic | 10 |

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| | molecules and van der Waals interactions. | |
| 2. Salient Features of s- and p-Block Elements | General discussion with respect to all periodic (Occurrence, electronic configuration, atomic & ionic radii, density, ionization potential, metallic behaviour, electropositive nature, electronegativity, electron affinity, hydration energy, flame colouration, photoelectric effect, polarization power, boiling and melting point) and chemical properties (reactivity towards water, oxygen, air and moisture, hydrogen, halogens, ammonia). Diagonal relationship, catenation, inert pair effect, pπ- pπ, dπ-pπ bond, chemistry of hydrides, halides, oxides and oxyacids of p-block elements. Silicates, Boron nitrogen compounds (borazene and boron nitrides), interhalogen compounds, basic property of iodine. | 10 |
| 3. Aliphatic Compounds | Chemical reactions of alkanes. Mechanism of free radical halogenation of alkanes. Cycloalkanes- Baeyer's strain theory and its limitations. Ring strain in small rings (cyclopropane and cyclobutane), theory of strainless rings. The case of cyclopropane ring-bent or banana bonds.<br><br>Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions, Markownikoff's Rule, hydroboration-oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, Polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene.<br><br>Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration- oxidation, metal- ammonia reduction, oxidation and polymerization. | 10 |
| 4. Aromatic Compounds | Aromaticity- the Hückel rule, aromatic ions. Aromatic electrophilic substitution- general pattern of the mechanism, role of σ and π complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel- Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives. | 10 |

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| 5. Chemical Kinetics and Catalysis | Chemical kinetics and its scope, rate of a reaction, factors influencing the rate of a reaction– concentration, temperature, pressure, solvent, light, catalyst; hetero and homocatalysis, significance. Inhibitors, poisons and promoters. Concentration dependence of rates of simple reaction, Molecularity, Order of reaction- zero order, first order, second order, pseudo-order, Radioactive decay a first order phenomenon, half-life period, Methods of determination of the order of reaction- differential method, method of integration, method of half-life period and isolation methods, Numerical problems. | 10 |
| 6.Thermodynamics I | Definition of thermodynamic terms, system, surroundings etc. Types of thermodynamic systems and thermodynamic processes. Intensive and extensive properties. Concept of heat and work, first law of thermodynamics, definition of internal energy and enthalpy. Heat capacity – heat capacities at constant volume and at constant pressure and their relationship, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and reversible conditions. Thermochemistry; standard state, Standard enthalpy of formation – Hess's law of heat summation and its application. Temperature dependence of enthalpy, Kirchoff's equation, Numerical problems. | 10 |

**Books Recommended:**


- R. L. Madan, "Chemistry for Degree Students, B. Sc. First Year", S. Chand Publishing, New Delhi, India.
- B. R. Puri, L. R. Sharma, and K. C. Kalia, "Principles of Inorganic Chemistry", Vishal Publishing Co., India.
- R. D. Madan, U. M. Malik and G. D. Tuli, "Selected topics in Inorganic Chemistry", S. Chand Publishing, New Delhi, India.
- S. Prakash, G. D. Tuli, S. K. Basu and R. D. Madan, "Advanced Inorganic Chemistry", S. Chand Publishing, New Delhi, India.
- I. L. Finar, "Organic Chemistry", Pearson Education India.
- Boyd, Morrison and Bhattacharjee, "Organic Chemistry", Pearson Education India.
- A. Bahl and B. S. Bahl, "Advanced Organic Chemistry", S. Chand Publishing, India.
- Singh, Jagdamba and L. D. S. Yadav, "Undergraduate Organic Chemistry" Pragati Prakashan, India.
- B. R. Puri, M. S. Pathania, and L.R. Sharma, "Principles of Physical Chemistry", Vishal Publishing, India.
- A. Bahl, B. S. Bahl and G. D. Tuli, "Essential of Physical Chemistry", S. Chand Publishing, India.

- P. W. Atkins, "Atkin's Physical Chemistry: International", Oxford University Press.

## COURSE OUTCOMES: PAPER I: Fundamentals of Chemistry-II

Upon successful completion of this course, the students will be able to describe the reactions shown by aliphatic and aromatic compounds. They will also able to understand the bonding in inorganic molecules, salient features of s- and p- block elements, different aspects of chemical kinetics, catalysis and first law of thermodynamics.

## TEACHING PLAN: B.Sc. 2nd Semester

### Paper II: Practical: Course Title: Chemical Analysis - II

Max. Marks = 100 Marks

| UNITS | TOPICS | NO. OF HOURS = 60 |
|---|---|---|
| **1** | Laboratory hazards and safety precautions | 06 |
| **2** | **Inorganic exercise:** Acid-base titrations; preparation of a solution in normal/molar terms, its standardization using a primary standard solution, determination of the strength of unknown solution. For example: preparation of NaOH solution (secondary standard say N/10), preparation of $(COOH)_2$ solution (primary standard say N/10), standardization of NaOH solution titrating it against $(COOH)_2$ solution using phenolphthalein (indicator) and then determination of the strength of given HCl solution. | 18 |
| **3** | **Organic exercise:** Differentiation between alkanes, alkenes and alkynes. Differentiation between aliphatic and aromatic compounds using chemical and physical tests. | 18 |
| **4** | **Physical exercise:** Determination of relative viscosity of the given liquid using Ostwald viscometer. | 18 |

**Books Recommended:**


- O. P. Pandey, D. N. Bajpai and S. Giri, Practical Chemistry for B. Sc. I, II and III Year Students of All Indian Universities, S. Chand Publishing, New Delhi, India.
- S.M. Khopkar, Basic Concepts of Analytical Chemistry. New Age International Publisher.
- J. Mendham, Vogel's Quantitative Chemical Analysis, Pearson.


## COURSE OUTCOMES: PAPER II: Chemical Analysis - II

After completing this course, the students will be able to quantitatively find out the amount of acid or base in the samples, to qualitatively differentiate among different classes of organic compounds and to measure the relative viscosity of a given liquid.