S. S. Jain Subodh P.G. College, Jaipur

(Autonomous)

SYLLABUS

Bachelor of Science (B.Sc.)

(Three Year Under Graduate Programme)

CHEMISTRY

Syllabus & Examination Scheme (NEP 2020)

I - II Semester

2025-26

S. S. Jain Subodh P.G. College, Jaipur

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BACHELOR OF SCIENCE

Chemistry

Semester I

EXAMINATION SCHEME

Paper code	Paper Title	Maximum Marks	Credit	EoSE* in Hrs.	
				Theory	Practical
BCHE101	Structure-bonding, Mathematical concept and States of matter	100	4	3	-
BCHEP 151	Chemistry Lab I	50	2	-	4
Total		150	6		

* **EoSE = End of Semester Examination**

S. No.	PAPER	EoSE	CIA	TOTAL
1.	Theory	70%	30%	100
2.	Practical	60%	40%	100

Note:

- It will be necessary for a candidate to pass in theory part as well as practical part of a subject separately.

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B.Sc. Semester I

1 credit- 25 marks
4 credit- 100 marks
Question paper: 70 marks
Internal Assessment: 30 marks

Objectives:

The aim of this course is to provide students with a theoretical understanding of the basic constituents of matter, atoms, ions and molecules in terms of their electronic structure and chemical bonding of these are to be explained by applying basic quantum chemistry. The objective of this course is to explain the basic concepts of mathematics and to explain the structural differences and transformations between states of matter. In addition, the laboratory course is designed to provide students with practical experience in basic qualitative analytical techniques, the use of laboratory techniques, and the determination of physical properties of matter.

Course Outcomes :

By the end of this course, students will have a clear understanding of various concepts related to atomic and molecular structure, chemical bonding, mathematical concepts, and states of matter. Students will also have practical experience in calibration of glassware, qualitative analysis of radicals, identification of functional groups in organic compounds, determination of various physical properties of substances, crystallization and preparation of standard solutions of different concentrations

Marks distribution in question paper:

The question paper (EoSE – End of Semester Examination) will consist of two parts A and B

Part-A- 14 marks

Part-A will be compulsory having 10 very short answer type questions (with a limit of 20 words) of two marks each and candidate can attempt any 7 questions.

Part-B- 56 marks

Part-B of the question paper shall be divided into 4 units comprising question no 2-5.

There will be one question from each unit with internal choice. Each question will carry 14 marks.

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Structure-bonding, Mathematical concept and States of matter

Unit-I

Ionic Solids: General characteristics of ionic bonding, Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, Lattice enthalpy and Born-Lande equation for calculation of Lattice Enthalpy (no derivation), Born-Haber cycle and its applications, Solvation enthalpy and solubility of ionic solids, polarizing power and polarizability, Fajan's rule, lattice defects, semiconductors.

Metallic bond: Free electron, Valence Bond and Band Theories.

Weak Interactions: Hydrogen bonding, Van der Waals forces.

Unit-II

Covalent Bond: Valence bond theory and its limitations, Directional character, Hybridization. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_30^+, SF_4, ClF_3, $IC1_2$, H_2O.

Molecular Orbital Theory: LCAO method, bonding, nonbonding and anti-bonding MOs and their characteristics for combinations of atomic orbitals, MO treatment of homonuclear and heteronuclear (CO and NO) diatomic molecules. Comparison of VB and MO approaches.

Multicenter bonding in electron deficient molecules, bond strength and bond energy, ionic character in covalent compounds, calculation of percentage ionic character from dipole moment and electronegativity difference.

Unit-III

Mathematical Concepts: Logarithmic relations, curve sketching, linear graphs and calculations of slopes, differentiation of functions like *kx,* ex, *xn,* sin x and log x, maxima and minima, partial differentiation and reciprocity relations, integration of some useful/relevant functions, permutations and combinations, factorials, probability. Matrices and Determinant.

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals, difference between liquid crystal, solid and liquid and application of liquid crystals.

Solid State: Definition of space lattice, unit cell. Laws of crystallography-(i) Law of constancy of interfacial angles (ii) Law of rationality of indices (iii) Law of symmetry. Symmetry elements in crystals. Basic concept of X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl and CsCl (Laue's method and powder method.). Defects in solids.

Unit-IV

Gaseous State: Postulates of kinetic theory of gases, deviation from ideal behavior, Van der Waals equation of state.

Critical Phenomenon: PV isotherms of real gases, continuity of states, the isotherms of van der Waals equation, relationship between critical constants and van der Waals constants, the law of corresponding states, reduced equation of state.

Molecular Velocities: Root mean square, average and most probable velocities. 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.).

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. Liquids in solids (gels): classification, preparation and properties, inhibition, general applications of colloids. Liquids in liquids (emulsions): types of emulsions, preparation. Emulsifier.

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References:

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3. Tuli, G.D. Advanced Inorganic Chemistry, S. Chand, New Delhi.
4. Satya Prakash Advanced Inorganic Chemistry, S. Chand, New Delhi.
5. Adams, D. M. Inorganic Solids - Introduction to Concepts in Solid-state Structural Chemistry, John Wiley, London.
6. Puri, Sharma & Kalia, Principles of Inorganic Chemistry, S. Chand, New Delhi.
7. Puri, B. R., Sharma, L. R. & Pathania, M. S. Principles of Physical Chemistry, Vishal Publishing Co.
8. Gurdeep Raj, Advanced Physical Chemistry, Goel Publishing House.
9. Atkins, W. Physical Chemistry, Oxford University Press.
10. Silby, R. J. & Alberty, R. A. Physical Chemistry, John Wiley & Sons.
11. Barrow, G.M. Physical Chemistry, Tata McGraw-Hill.
12. Kapoor, K. L. A Textbook of Physical Chemistry, (Volume I) Macmillan India Ltd.

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Chemistry Lab I

1 credit- 25 marks
2 credit- 50 marks
External Assessment: 30 marks
Internal Assessment: 20 marks

Inorganic Chemistry **7 marks**

Separation and identification of six radicals (3 cations and 3 anions) in the given inorganic mixture including special combinations.

Organic Chemistry **5 marks**

Laboratory Techniques

Determination of melting point (Naphthalene, Benzoic acid, Urea, etc.), boiling point (Methanol, Ethanol, Cyclohexane, etc.) and mixed melting point (Urea-Cinnamic acid, etc.).

(a) Crystallization of Phthalic acid and Benzoic acid from hot water, Acetanilide from boiling water, Naphthalene from Ethanol etc.; Sublimation of Naphthalene, Camphor, etc.

Qualitative Analysis

Identification of functional groups (unsaturation, phenolic, alcoholic, carboxylic, carbonyl, ester, carbohydrate, amine, amide, nitro and hydrocarbon) in simple organic compounds (solids or liquids) through element detection (N, S and halogens).

Physical Chemistry **8 marks**

Viscosity and Surface Tension:

a) To determine the viscosity/surface tension of a ·pure liquid (alcohol etc.) at room temperature. (Using the Ostwald viscometer/stalagmometer).
b) To determine the percentage composition of a given binary mixture (Acetone and Ethyl Methyl ketone) by surface tension method.
c) To determine the percentage composition of a given mixture (non- interacting systems) by viscosity method.
d) To determine the viscosity of amyl alcohol in water at different concentration and calculate the excess viscosity of these solutions.

Viva voce **5 marks**

Practical Record **5 marks**