



**+3-I-S-NEP-Major-I-P-1-Sc-Chem**

**2024**

Time :As in Programme

Full Marks : 100

*The figures in the right-hand margin indicate marks.*

*Answer all questions.*

**PART-I**

1. Answer all Questions. 1x10
- a. The number of spectral lines obtained in the hydrogen spectrum when an electron jumps from  $n=1$  to  $n=5$  is/are \_\_\_\_\_.
- b. If the quantum numbers of the last electron of an atom are:  $n=3$ ,  $l=0$ ,  $m_l = 0$ ,  $m_s = +1/2$ , then find its atomic number.
- c. Which out of 3p and 4s atomic orbitals has more energy?
- d. In the periodic table the number of groups present in s-Block is/are \_\_\_\_\_.
- e. The most electronegative element in the periodic table is \_\_\_\_\_.
- f. The number of covalent bonds present in  $\text{NH}_4\text{Cl}$  molecule is \_\_\_\_\_.
- g. The shape of  $\text{CO}_2$  is linear because the hybridization of C is \_\_\_\_\_.
- h. The distorted structures are formed if the central atom contains \_\_\_\_\_ electrons along with the shared pair of electrons.

(Turn Over)

- i. Ethanol is soluble in water due the presence of \_\_\_\_\_ bond between water and alcohol.
- j. Greater the bond order in a molecule \_\_\_\_\_ is its stability.

### PART-II

2. Answer all the following questions in maximum 50 words each.

2x9

- a. What was the key conclusion of Rutherford's nuclear model of the atom?
- b. Explain how did Sommerfeld modify Bohr's atomic model?
- c. How is the probability of finding a particle related to  $\psi$  ?
- d. What is the cause of periodicity in the properties of elements?
- e. Discuss the advantage of the long-form periodic table over Mendeleev's table.
- f. How does atomic radius change across a period and group in the periodic table?
- g. What is lattice energy? Discuss how does lattice energy depend on the charges and sizes of ions?
- h. Explain the structure of  $\text{SF}_6$  molecule with the help of VSEPR theory.
- i. Write the molecular orbital electronic structures of  $\text{C}_2$  and  $\text{B}_2$  molecules. Also predict their bond orders and magnetic properties.

### PART-III

3. Answer any eight of the following questions in maximum 250 words each. 5x8
- a. Discuss about the Hund's rule of maximum spin multiplicity.
  - b. Explain the significance of  $\psi$  and  $\psi^2$ .
  - c. Write the postulates of wave mechanics.
  - d. What is modern periodic law? Describe the structure and significance of the long-form periodic table.
  - e. Define electronegativity. How does electronegativity vary across a period and down a group?
  - f. Give a note on the packing of ions in a crystal structure.
  - g. What are equivalent and non-equivalent hybrid orbitals? Discuss the shape  $\text{NH}_3$  molecule.
  - h. Give a brief discussion on polarizing power and polarizability of ions.
  - i. Explain valence bond theory.
  - j. Explain the Free Electron Model of Metallic Bonding. How does the Free Electron Model explains the metallic properties?

### PART-IV

Answer any four of the following questions (maximum 800 words each) 8x4

4. What are quantum numbers? Explain the four types of quantum numbers in details and write their significances.

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5. Write short notes on:
    - a. de-Broglie's concept
    - b. Pauli's exclusion Principle
    - c. Auf-bau principle.
  6. Write short notes on:
    - a. van der Waal's radius
    - b. Electron affinity
    - c. Sanderson's electron density ratio.
  7. State and explain Fajan's rule. Explain the consequences of polarization.
  8. Write the main postulates of the VSEPR theory. Also explain the structure of  $\text{SO}_4^{2-}$ ,  $\text{CH}_4$  and  $\text{PCl}_3$  using VSEPR theory.

