

M.Sc. (Chemistry) (NEP Pattern) Semester-III  
**STPG03CHE03 - Paper-III : Spectroscopy-I**

P. Pages : 3

Time : Three Hours



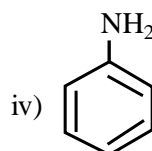
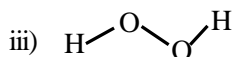
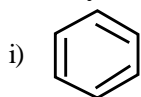
**GUG/S/25/15962**

Max. Marks : 80

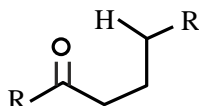
1. A) i) How does reducible and irreducible representation applied in the analysis of molecular vibrations? 8
- ii) Derive the character table for  $\text{NH}_3$  using great orthogonality theorem.
- B) i) Discuss the symmetry operations involves in  $\text{BF}_3$  and  $\text{CH}_2 = \text{CH}_2$  molecules and give its point group. 8
- ii) Describe the steps involved in classify molecules into its appropriate point group.

**OR**

- A) What are the applications of character table. 4
- B) Identify the point group in the following. 4



- C) Explain why  $\text{C}_{2v}$  point group is classified as Abelian group. 4
- D) What are the main components of the Schoenflies symbol. 4
2. A) i) Describe why chemical ionization (CI) differ from electron impact ionization (EI) and explain why CI is preferred over EI. 8
- ii) Discuss the mechanism of following reaction with product formation? Also write name of reaction?



- B) Explain the concept of isomer shift in Mossbauer spectroscopy? How does it provide information about the electronic environment? Explain it with relevant examples? 8

**OR**

- A) Explain the term in mass spectrometry with example. 4  
 i) Base peak ii) Metastable ion peak
- B) Explain how could you differentiate n-pentane and 2-methyl butane by using mass spectrometry. 4
- C) Explain the Quadrupole splitting in Mossbauer spectroscopy. 4
- D) Discuss the applications of Mossbauer spectroscopy in studying magnetic properties of materials. 4
3. A) i) Define moment of inertia? Classify the molecules on the basis of moment of inertia. 8  
 ii) The separation between successive lines in pure rotational spectrum of HBr is  $1.7 \times 10^3 \text{ m}^{-1}$  calculate the equilibrium internuclear distance in the molecule.  
 $[h = 6.626 \times 10^{-34} \text{ Js}, C = 3 \times 10^8 \text{ m/s}, H = 1, Br = 79.9]$
- B) i) How does hyperfine splitting in an ESR. Spectrum provide information about the nuclear environment of unpaired electron. 8  
 ii) Explain the ESR Spectrum of  $\text{CH}_3$ .

**OR**

- A) Derive the expression for the rotational energy of rigid diatomic molecule. 4
- B) Describe the stark effect and its significance. 4
- C) Discuss the ESR spectrum of  $[\text{Cu}(\text{H}_2\text{O})_6]^{+2}$ . 4
- D) Explain the term Karmer's degeneracy. 4
4. A) i) Explain the principle of IR spectroscopy and how it is used to identify functional groups in organic molecules. 8  
 ii) Discuss the role of IR spectroscopy in identifying the geometrical isomers.
- B) i) What are stokes and antistokes lines in Raman spectrum? Which of these are more intense and why? 8  
 ii) Give the applications of Raman spectroscopy.

**OR**

- A) Write a note on Rayleigh Scattering and State its selection rule. 4
- B) Explain why Raman and IR spectroscopy are considered complementary to each other. 4
- C) Discuss the types of bands in IR spectrum. 4

- D) Explain how atomic mass and bond strength influence the vibrational frequencies of bonds in a molecules.

4

5. Attempt **any eight**.

2x8  
=16

- a) What is symmetry elements in group theory?
- b) Give the point group of the  $\text{CH}_4$  and  $\text{SF}_6$ .
- c) How will you obtain molecular ion peak at 64 and 66 in  $\text{CH}_3 - \text{CH}_2 - \text{Cl}$  molecule.
- d) How does Mossbauer spectroscopy helps in determining oxidation state of iron in compound.
- e) What is the difference between the rigid rotor and non rigid rotor in microwave spectroscopy.
- f) Explain why  $\text{CO}_2$  is microwave inactive but IR active molecule.
- g) How many ESR lines obtained by Naphthalene and Anthracene molecules.
- h) How will you distinguish aldehyde and Ketones by using IR spectroscopy.
- i) How is Raman Scattering differ from Rayleigh Scattering.
- j) What is the difference between the stretching and bending vibrations in IR spectroscopy.

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