M.Sc.(Chemistry) CBCS Pattern Semester-III

PSCHT09 - Spectroscopy

P. Pages : 2 **GUG/W/23/11331**

Time : Three Hours * 6 3 4 5 * Max. Marks : 80

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1. a) Derive character table for C_3V point group on the basis of GOT? Identify point group for SF_4 molecule? **8**

b) What is Great Orthogonality Theorem? Explain corollaries of the theorem? **8**

OR

c) Identify point groups of following molecules? **4**

i) BCl_3 ii) NO_2

iii) BF_3 iv) C_2H_4

d) List elements of symmetry in: **4**

i) Pyridine

ii) Cyclopropane

iii) Ketene

iv) 1, 3, 5-tribromobenzene

e) Show all rotation reflection operations are not considered as new operation. **4**

f) Name the symmetry elements and symmetry operations in CH_4 molecule? **4**

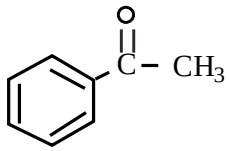
2. a) Explain the following: **8**

i) CI method for ion production. ii) Nitrogen rule.

b) Define “isomer shift” in Mossbauer Spectroscopy. Give its applications. **8**

OR

c) Explain all possible fragmentation for in mass spectrometry. **4**



d) How is Mossbauer used to determine the structure of $Fe(CO)_{12}$? Explain. **4**

e) What is Metastable peak? Calculate position of metastable peak for toluene? **4**

f) Discuss biological applications of Mossbauer Spectroscopy? **4**

3. a) How does relative intensity of lines in rotational spectra depends upon the population of energy states? Discuss. **8**

b) Discuss the following: **8**
i) Intensity of ESR lines. ii) Line width of signal.

OR

c) Calculate rotational constant 'B' for HCl molecule. The H-Cl bond length is 136 pm. The masses of 'H' and "Cl" can be taken as 1 and 35.5 respectively. **4**

d) Explain applications of ESR spectroscopy. **4**

e) Classify poly atomic molecules on the basis of moment of inertia about x, y, and z Axes? **4**

f) Give an account of ESR spectroscopy of methyl radical and naphthalene. **4**

4. a) Discuss the following: **8**
i) Morse potential energy function. ii) Isotopic effect in IR

b) Explain quantum mechanical theory of Raman effect? **8**

OR

c) Explain classical theory for Raman Scattering? **4**

d) Calculate force constant for HCl molecule if fundamental vibrational frequency. **4**
Is $8.667 \times 10^{13} s^{-1}$ (H = 1.008 amu and Cl = 35.5 amu)

e) Discuss how IR and Raman bands are complementary to each other. **4**

f) Discuss Harmonic Oscillator. **4**

5. a) List various symmetry elements in CH_4 molecule. **2**

b) Give example of molecule with $3\sigma v$ and $1\sigma h$. **2**

c) Give principle of mass spectroscopy. **2**

d) What is magnetic hyperfine interaction. **2**

e) How is ESR used to study free radicals. **2**

f) Give examples of symmetric top and asymmetric top molecules. **2**

g) Calculate fundamental modes of vibration in NH_3 molecule. **2**

h) Explain Rayleigh Scattering. **2**

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