

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

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P. Pages : 2

Time : Three Hours



GUG/S/25/11331

Max. Marks : 80

1. a) What are different types of groups? Draw group multiplication table for H_2O molecule. 8
- b) Derive the character table for water molecule using great orthogonality theorem. 8

OR

- | | | |
|-----------|--|---|
| c) | Explain the multiplication table for C_3V point group. | 4 |
| d) | Explain reducible and irreducible representation. | 4 |
| e) | What are symmetry elements and their Schoenflies symbols? | 4 |
| f) | Explain application of character table in selection rule of IR and Raman spectroscopy. | 4 |
| 2. | | |
| a) | Discuss the high resolution mass spectroscopy. Explain the N-Rule in mass spectroscopy. | 8 |
| b) | Discuss the application of Mossbauer spectroscopy in determining the electronic structure and molecular structure. | 8 |

OR

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|-----------|---|---|
| c) | How will you distinguish between - 1 - Butanol, 2 - Butanol, and 2 - methyl 2 - propanol on the basis of mass spectrum? | 4 |
| d) | Explain the terms in mass spectroscopy with example. | 4 |
| | i) Metastable peak | |
| | ii) Molecular ion peak | |
| e) | Discuss the quadrupole splitting in Mossbauer spectrum of $[\text{Fe}(\text{CN})_5(\text{NO})]^{2-}$ ion. | 4 |
| f) | Explain hyperfine magnetic splitting. | 4 |
| 3. | | |
| a) | Derive an expression for moment of inertia and rotational energy for rigid rotors. | 8 |
| b) | Discuss the principle of ESR spectroscopy and it's instrumentation techniques. | 8 |

OR

- c) Discuss the effect of isotopic substitution on transition frequencies. 4
- d) The rotational constant for H_{35}Cl is observed to be 10.5909 cm^{-1} . What are the values of B for H^{37}Cl and for $^2\text{D}^{37}\text{Cl}$? 4

- e) Explain the zero field splitting. 4
- f) Explain Stark effect in brief. 4
- 4. a) Derive the expression for energy level in vibrational rotational spectroscopy. Give selection rule and predict appearance of spectra. 8
- b) Give an account of vibrational Raman spectra and coherent anti-Stokes Raman spectrum. 8

OR

- c) Calculate number of modes of vibration for- 4
 - i) H_2O ii) CO_2
- d) Explain- 4
 - i) Fundamental vibrational frequencies
 - ii) Isotope effect in IR spectroscopy.
- e) Define the term Stokes, Anti-Stokes and Rayleigh scattering. 4
- f) Explain the application of Raman spectroscopy in organic chemistry. 4
- 5. a) Assign the point group for- 2
 - i) H_2 ii) HCl
 - ii) CH_4 iv) BF_3
- b) Write a note on dihedral plane. 2
- c) Write a note on 'Isotopic contribution' in mass spectroscopy. 2
- d) When the Mossbauer effect will occur? 2
- e) Distinguish between spherical top and symmetric top molecules on the basis of moment of inertia. 2
- f) Give the ESR lines for ESR spectrum of methyl free radical. 2
- g) What is the necessary condition for a molecule to absorb infrared radiation? 2
- h) Which type of molecules give rise to pure rotational Raman lines? 2
