WT—317—2024

FACULTY OF SCIENCE

M.Sc. (First Year) (Second Semester) EXAMINATION

NOVEMBER/DECEMBER, 2024

CHEMISTRY

Paper CH-424

(Analytical Chemistry Principles of Spectroscopy)

(Wednesday, 18-12-2024)   **Time : 10.00 a.m. to 1.00 p.m.**

Time—3 Hours   *Maximum Marks—75*

N.B. :— (1) Attempt *all* questions.

   (2) Use of calculator and logarithmic table is allowed.

   (3) Useful constants :

   $c = 3 \times 10^8$ ms^{-1}

   $h = 6.626 \times 10^{-34}$ Js.

1. Attempt any *three* of the following :   15

   (*a*) Give an account of the terms reflection and polarisation of light.

   (*b*) What is effect of isotopic substitution on rotational spectra of diatomic rigid rotator ?

   (*c*) The force constant of HBr molecule is 360 Nm^{-1} and reduced mass is 1.56×10^{-27} kg. Determine the fundamental vibrational frequency of HBr molecule.

   (*d*) State and explain Koopman's theorem.

   (*e*) Explain shielding and deshielding effect with suitable example.

P.T.O.

2. Attempt any *three* of the following : 15

(a) Explain the factors affecting width and intensity of spectral line in spectra.

(b) The pure rotational spectrum of diatomic molecule consists of series of equally spaced lines separated by 560 cm^{-1}. Calculate the internuclear distance if the reduced mass of the molecule is 1.6×10^{-27} kg.

(c) What is zero point energy ? Explain overtone and hot bands in vibrational spectrum.

(d) Give an account on vector representation of momenta and vector coupling.

(e) Explain zero field splitting and Kramer's degeneracy.

3. Answer the following :

(a) Explain the quantum theory of Raman scattering and discuss in brief about the rotational-Raman spectroscopy. 8

Or

Explain the breakdown of Born-Oppenheimer approximation. Show the P, Q and R branches in rotational vibrational spectra of diatomic molecule using suitable diagram.

(b) Explain the principle of nuclear quadrupole resonance spectroscopy and give its applications. 7

Or

State and explain Frank-Condon principle and discuss spectra of transition metal complexes.

4. Answer the following :

   (*a*) (*i*) Explain spin-spin interaction in NMR. 8

   (*ii*) Give an account on A_2B_2 splitting.

   Or

   What do you mean by hyperfine coupling constant and explain isotropic and anisotropic coupling constant ?

   (*b*) Enumerate the principle involved in FT-NMR and give the use of NMR in medical diagnosis. 7

   Or

   (*i*) Explain resonance Raman spectroscopy.

   (*ii*) Discuss the vibrations of polyatomic molecule.

5. Write short notes on any *three* : 15

   (*i*) Stark effect

   (*ii*) Mutual exclusion principle

   (*iii*) Measurement technique in ESR

   (*iv*) Spectrum of hydrogen atom

   (*v*) Factors affecting chemical shift.