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NY—317—2023

FACULTY OF SCIENCE

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

NOVEMBER/DECEMBER, 2023

(New/CBCS Pattern)

CHEMISTRY

(CH-424)

(Analytical Chemistry Principles of Spectroscopy)

(Wednesday, 13-12-2023)

Time : 10.00 a.m. to 1.00 p.m.

Time—3 Hours

Maximum Marks—75

N.B. :— (i) Attempt *all* questions.

(ii) Use of calculator or logarithmic table is allowed.

(iii) Useful constants :

$$c = 3 \times 10^8 \text{ m/s}$$

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

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

(a) Explain dispersion and refraction of light radiation.

(b) Explain factors affecting width and intensity of spectral line in rotational spectra.

(c) The pure rotational spectrum of diatomic molecule consists of equally spaced lines separated by 670 m^{-1} .

Calculate the internuclear distance if the reduced mass of the molecule is $1.82 \times 10^{-27} \text{ kg}$.

(d) Give an account of principle of X-ray photoelectron spectroscopy.

(e) Explain the factors influencing coupling constant 'J'.

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

- (a) Give an account of the time dependent perturbation theory.
- (b) The force constant of HCl molecule is 450 Nm^{-1} and reduced mass is $1.72 \times 10^{-27} \text{ kg}$. Determine the fundamental vibrational frequency of HCl molecule.
- (c) Explain vibrational rotational Raman spectra.
- (d) State and explain Koopman's theorem.
- (e) Explain in brief electron spin resonance spectroscopy.

3. Attempt the following :

- (a) Explain the classical theory of Raman-scattering and discuss Resonance-Raman spectroscopy. 8

Or

Explain the principle of vibrational spectra. Describe vibrational spectra of diatomic molecule as anharmonic oscillator. 8

- (b) Explain the theory of Nuclear Quadrupole resonance spectroscopy and give the splitting in NQR spectra. 7

Or

Describe types of electronic transitions in electronic spectroscopy. Discuss charge transfer spectra. 7

4. Answer the following :

- (a) (i) Explain the use of NMR in Medical diagnosis. 8
- (ii) Give an account of AMX SP

Or

What is chemical shift ? Explain the factors affecting chemical shift.

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- (b) (i) Explain shielding and deshielding effect. 7
- (ii) Give an account of ABC splitting.
- Or*
- (i) Explain mutual exclusion principle. 7
- (ii) Discuss vibrational energy level in diatomic molecule.
5. Write short notes on (any *three*) : 15
- (a) Kramer's degeneracy
- (b) Breakdown of Oppenheimer approximation
- (c) Photoelectric effect
- (d) Franck-Condon principle
- (e) Overtones and Hot bands in IR spectrum.

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