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NEPWT—274—2024

FACULTY OF SCIENCE AND TECHNOLOGY

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

NOVEMBER/DECEMBER, 2024

CHEMISTRY

(SCHEE-1451)

(Principles of Spectroscopy)

(Wednesday, 18-12-2024)

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

Time—3 Hours

Maximum Marks—60

N.B. :— (i) Question No. 1 is compulsory.

(ii) Attempt any *three* questions from Q. No. 2 to Q. No. 6.

(iii) Use of logarithm table and simple non-programmable calculator is allowed.

1. Answer the following questions : 15

(a) Explain the effect of isotopic substitution of rotational spectrum of diatomic molecule.

(b) Find out the fundamental modes of vibrations for molecules :

(i) CO₂

(ii) SO₂.

(c) Explain the energies of atomic orbitals.

P.T.O.

2. Answer the following questions :

- (a) (i) The pure rotational spectrum of gaseous diatomic molecule consists of a series of equally spaced lines separated by 10 cm^{-1} . Calculate the bond length of the molecule. The reduced mass of molecule is $1.70 \times 10^{-27} \text{ kg}$.

$$(h = 6.626 \times 10^{-34} \text{ J.s.}, C = 3 \times 10^8 \text{ m/s})$$

- (ii) Explain the factors affecting width of spectral line. 8

- (b) Discuss the vibrational spectrum of anharmonic oscillator. 7

3. Attempt the following questions :

- (a) State and explain Frank-Condon principle. 8

- (b) Explain rotational vibrational spectra of diatomic molecule. 7

4. Attempt the following questions :

- (a) (i) The force constant for a diatomic molecule is 860 Nm^{-1} . If the reduced mass of molecule is $1.76 \times 10^{-27} \text{ kg}$, then determine the fundamental vibrational frequency. 4

- (ii) Explain principle of IR-spectroscopy. 4

- (b) Derive equation for the energy of diatomic molecule as rigid rotator. 7

5. Answer the following questions :

- (a) Explain the electronic spectra of polyatomic molecule. 8
- (b) What is Raman effect ? Explain pure rotational Raman spectrum. 7

6. Write short notes on the following : 15

- (i) Koopman theorem
- (ii) Mutual exclusion principle
- (iii) Spectra of alkali metal atom.