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AG—283—2018

FACULTY OF SCIENCE

M.Sc. (Second Semester) EXAMINATION

NOVEMBER/DECEMBER, 2018

(CBCS Pattern)

CHEMISTRY

Paper CH-424

(Principles of Spectroscopy)

(Tuesday, 4-12-2018)

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) 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) Give an account of polarization and scattering of light radiation.

(b) The molecule H_2 is microwave inactive while HCl is microwave active. Explain. Write a note on nuclear and electron spin interaction.

(c) The force constant of H-Br molecule is 420 Nm^{-1} . If the reduced mass is $1.65 \times 10^{-27} \text{ kg}$, determine the fundamental vibrational frequency.

(d) Give the applications of ESCA spectroscopy.

(e) Give an account of chemical shifts and factors affecting the chemical shifts.

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

- (a) What are the main factors which determine the intensity of spectral lines ?
- (b) If the internuclear distance of AB molecule is 1.20×10^{-10} m, calculate the rotational constant.
(A = 1.60×10^{-27} kg and B = 5.80×10^{-27} kg)
- (c) What are the conditions for vibrational spectra ? Give an account of force constant and bond energy.
- (d) Explain the energies of atomic orbitals.
- (e) Enumerate basic principles involved in Electron Spin Resonance Spectroscopy.

3. (a) What is Raman effect ? Explain pure rotational Raman spectrum. 8

Or

Explain the break-down of Oppenheimer approximation. Show the P, Q and R branches in rotational vibrational spectra of diatomic molecule using suitable diagram. 8

(b) Explain the theory of NQR. Give the applications of NQRS. 7

Or

Describe electronic transitions in electronic spectroscopy. Explain charge transfer spectra. 7

4. Answer the following :

- (a) (i) Explain spin-spin interaction. 8
- (ii) Give an account of AMX splitting.

Or

(i) Explain Spin Hamiltonian. 8

(ii) Give an account of spin densities and McConnell relationship.

- (b) Explain the coupling constant 'J'. Write down the advantages of FT NMR. 7

Or

- (i) Explain mutual exclusion principle. 7
(ii) Explain the vibration in polyatomic molecules.

5. (A) Select the *correct* alternative for the following multiple choice questions : 5

- (i) Symmetric top molecules have :
(a) All three moment of inertia are equal
(b) Two moment of inertia are equal
(c) All moment of inertia are different
(d) All moment of inertia are zero
- (ii) The vibrational degree of freedom for O₂ molecule is :
(a) 0
(b) 1
(c) 3
(d) 2
- (iii) ¹³C and ¹⁹F have nuclear spin equal to :
(a) 1/2
(b) 1
(c) 0
(d) 3/2
- (iv) The electric field gradient arises from in the electron distribution about the nucleus.
(a) Symmetry
(b) Asymmetry
(c) Spin in electron distribution
(d) None of the above

P.T.O.

- (v) C^{12} and O^{16} do not interact with electron because they have :
- (a) Zero Spin
 - (b) No Nuclear Spin
 - (c) Both (a) and (b)
 - (d) None of the above
- (B) Write notes on any *two* of the following : 10
- (a) Franck-Condon Principle
 - (b) Stark Effect
 - (c) Zero field splitting and Kramer's degeneracy.