

This question paper contains 3 printed pages]

L—283—2019

FACULTY OF SCIENCE

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

MARCH/APRIL, 2019

(CBCS Pattern)

CHEMISTRY

Paper CH-424

(Principles of Spectroscopy)

(Tuesday, 30-4-2019)

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 and logarithmic table is allowed.

(iii) Useful constants :

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

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

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

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

(b) What is the principle of microwave spectroscopy ? Classify the molecules on the basis of moment of inertia.

(c) Determine the fundamental vibrational frequency of HCl molecule if the force constant is 483 Nm^{-1} and reduced mass for HCl is $1.626 \times 10^{-27} \text{ kg}$.

(d) Explain the principle of X-ray photoelectron spectroscopy.

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

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

(a) Define bandwidth of a spectral line. Explain Doppler broadening.

P.T.O.

- (b) The pure rotational spectrum of a diatomic molecule consists of a series of equally spaced lines separated by 208 m^{-1} . Calculate the internuclear distance if the reduced mass of the molecule is $1.65 \times 10^{-27} \text{ kg}$.
- (c) Explain the vibrations of a polyatomic molecule. How many vibrational degrees of freedom for CO_2 and C_6H_6 molecules ?
- (d) Give an account of orbital angular momentum and spin angular momentum of an electron.
- (e) Explain zero field splitting and Kramer's degeneracy.
3. Attempt the following :
- (a) Explain the classical theory of Raman effect. Enumerate the role of mutual exclusion. 8
- Or*
- Explain the factors affecting vibrational frequencies. Describe vibrational spectra of a diatomic molecule as a anharmonic oscillator. 8
- (b) Explain the applications of NQR technique. Give the splitting in NQR spectra. 7
- Or*
- Give an account of radiative and non-radiative transitions. Explain the spectra of transition metal complexes. 7
4. Attempt the following :
- (a) (i) Explain the use of NMR in medical diagnostics. 8
- (ii) Give an account of A_2B_2 splitting.
- Or*
- What do you mean by hyperfine coupling ? Explain its types. 8
- (b) (i) Explain shielding and deshielding effect. 7
- (ii) Explain the factors affecting the chemical shift.
- Or*
- (i) Explain the rotational-vibrational spectra. 7
- (ii) Derive an expression of an energy of SHO.

5. (A) Select the *correct* alternative for the following MCQs : 5

- (i) Degeneracy of a diatomic molecule is :
- (a) $2J$
 - (b) $2J + 1$
 - (c) $-2J$
 - (d) $2J^2$
- (ii) The value of the force constant in the increasing order is :
- (a) $C-C > C = C > C \equiv C$
 - (b) $C-C < C = C < C \equiv C$
 - (c) $C \equiv C < C = C > C-C$
 - (d) $C = C < C-C > C \equiv C$
- (iii) The value of nuclear spin depends on :
- (a) Mass number
 - (b) Atomic number
 - (c) Both (a) and (b)
 - (d) None of the above
- (iv) ' η ' is NQR is measure of :
- (a) Symmetry of EFG
 - (b) Non-symmetry of EFG
 - (c) Spins
 - (d) Couplings
- (v) The intensity of esr signal is directly proportional to on which is inversely proportional to :
- (a) Energy
 - (b) Temperature
 - (c) Pressure
 - (d) All of the above

(B) Write notes on any *two* :

10

- (i) Effect of isotopic substitution on rotational spectra
- (ii) Frank-Codon principle
- (iii) Measurement technique in esr.