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AI—354—2017
FACULTY OF SCIENCE
M.Sc. (Second Semester) EXAMINATION
MARCH/APRIL, 2017
(CBCS Pattern)
ORGANIC CHEMISTRY
Paper CH-424

(Principles of Spectroscopy)

(Friday, 28-4-2017)   **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. Answer any *three* of the following :   3×5=15

   (a) Explain width and intensity of spectral line.

   (b) The pure rotational spectrum of the gaseous molecule CN consists of a series of equally spaced lines separated by 3.7978 cm^{-1}. Calculate the internuclear distance of the molecule.
   (^{12}C = 12.011 and ^{14}N = 14.007 gmol^{-1}).

   (c) Derive the expression for vibrational energy in terms of wave number and explain vibrational spectra of diatomic molecule.

   (d) State and explain Koopman's theorem.

   (e) Give an account of Shielding and deshielding with suitable examples.

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

   (a) Explain reflection and dispersion of electromagnetic radiation.

   (b) The frequency of fundamental absorption peak due to the stretching vibration of carbonyl group is 1710 cm^{-1}. Calculate the force constant. The masses are ^{12}C = 2 × 10^{-23} gm per atom and ^{16}O = 2.6 × 10^{-23} gm per atom.

P.T.O.

(c) Give an account of spectra of hydrogen atom and alkali metal atoms.

(d) Explain the basic principle involved in electron spin resonance spectroscopy.

(e) Explain vibrational-rotational Raman spectra.

3. Answer the following :

(a) What is internal conversion ? Give an account of spectra of transition metal complexes. 8

Or

Give an account of quadrupole nuclei and coupling constant. Give the applications of nuclear quadrupole resonance spectroscopy. 8

(b) Explain quantum theory of Raman effect and resonance Raman spectroscopy. 7

Or

Explain the principle of vibrational spectra. Derive an expression for vibrational-rotational spectra. 7

4. Answer the following :

(a) What is chemical shift ? Explain the factors affecting chemical shift. 8

Or

Give an account of hyperfine cinteractions. 8

(b) Discuss the principle of NMR spectra. How chemical shift can be measured ? 7

Or

Explain mutual exclusion rule. Discuss the applications of Raman spectroscopy. 7

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

(i) The spacing between two rotational spectral lines is equal to :

(a) B (b) 2B

(c) $\dfrac{B}{2}$ (d) B^2

(ii) The lowest energy of a quantum mechanical harmonic oscillator is :

(a) zero

(b) $h\nu$

(c) $\dfrac{1}{2} h\nu$

(d) $2\ h\nu$

(iii) ^{13}C spectra can be simplified by the process of :

(a) Noise decoupling

(b) Off-resonance decoupling

(c) Broad band decoupling

(d) All of the above

(iv) Nuclei having $I = \dfrac{3}{2}$ is :

(a) $_7N^{14}$

(b) $_{17}Cl^{35}$

(c) $_5B^{11}$

(d) $_{13}Al^{27}$

(v) Which of the following will show esr spectra ?

(a) H_2

(b) Na^+

(c) Cu^+

(d) H

(B) Write short notes on any *two* of the following : 10

(a) Spin-spin coupling

(b) Charge transfer spectra

(c) Application of esr spectroscopy.