

(Pages : 3)

M – 7126

Reg. No. :

Name :

Third Semester M.Sc. Degree Examination, March 2022

Physics

PH 232 : ATOMIC AND MOLECULAR SPECTROSCOPY

(2018-2019 Admission)

Time : 3 Hours

Max. Marks : 75

SECTION – A

Answer any **five** questions. **Each** question carries **3** marks.

- I. (a) With the help of vector diagrams explain LS coupling scheme.
- (b) What is hyperfine splitting of spectral lines?
- (c) Explain the effect of isotopic substitution on the rotational spectrum of a rigid body.
- (d) In the vibrational spectrum of N_2 molecule the alternate lines of P and R branches are less intense. Comment and explain.
- (e) What are reducible and irreducible representations?
- (f) Explain spin-spin coupling and what is its effect in NMR?
- (g) Explain the term isomer effect.
- (h) What is hyper Raman effect?

(5 × 3 = 15 Marks)

P.T.O.



SECTION – B

Answer **all** questions. Each question carries **15** marks.

- II. A. (a) Discuss with necessary theory, the anomalous Zeeman effect.
(b) Explain the Anomalous Zeeman splitting pattern for D_1 and D_2 transitions of sodium atom.

OR

- B. (a) Discuss symmetry operations and symmetry elements.
(b) Explain the matrix representation of symmetry operators.
- III. A. (a) Discuss the diatomic vibrating rotator taking CO molecule as an example.
(b) Describe using a suitable diagram the instrumentation and techniques for infrared spectroscopy.

OR

- B. (a) With necessary theory, discuss the rotational fine structure of electronic-vibration transitions.
(b) What is Fortrat diagram? Explain.
- IV. A. (a) Describe in detail a simple NMR spectrometer.
(b) Explain the term chemical shift. Predict the pattern of high resolution NMR spectrum of methyl alcohol containing a trace of water.

OR

- B. (a) Explain the principle of ESR spectroscopy. How do you account for hyperfine structures in ESR spectrum?
(b) What is g factor? How does ESR help in determining this factor?

(3 × 15 = 45 Marks)



SECTION – C

Answer any **three** questions. **Each** question carries **5** marks.

- V. (a) Work out the term symbols for the pd configuration in LS coupling scheme.
- (b) Obtain the ground state of oxygen with electronic configuration $1s^2 2s^2 2p^4$
- (c) How many revolutions per second approximately does a CO molecule make when $J = 3$. The CO bond length is 0.1131 nm.
- (d) What is vibrational frequency corresponding to a thermal energy of kT at 298K. What is the wavelength of this radiation?
- (e) In the rotational Raman spectrum of HCl the shifts from the exciting line are separated by $\overline{\Delta\nu} = (62.4 + 41.6 J) \text{ cm}^{-1}$. Evaluate the rotational constant.
- (f) Consider the ESR spectrum of the free radical CH_3 in a magnetic field of 0.34 T. If $g = 2.0023$ for free electron, find the resonance frequency.

(3 × 5 = 15 Marks)

