(6 pages) **Reg. No. :** .....

Code No. : 9387 **Sub. Code : HPHM 42**

M.Sc. (CBCS) DEGREE EXAMINATION, APRIL 2015.

Fourth Semester

Physics

MOLECULAR SPECTROSCOPY

(For those who joined in July 2012 onwards)

Time : Three hours Maximum : 75 marks

SECTION A — (10 × 1 = 10 marks)

Answer ALL the questions.

Choose the correct answer :

1. For linear molecules

   (a) $I_B = I_C; I_A = 0$ (b) $I_A = I_B; I_C = 0$

   (c) $I_A = I_C, I_B = 0$ (d) $I_A = I_B = I_C = 0$

2. For a rigid diatomic molecule, the absorption spectrum lines are with a line spacing of

   (a) 4B (b) B

   (c) 2B (d) 5B

3. Zero-point energy of a simple harmonic vibrator is

   (a) $E_0 = \frac{1}{2} tw$ (b) $E_0 = \frac{w}{t}$

   (c) $E_0 = \frac{t}{w}$ (d) $E_0 = t^2 w$

4. The selection rule for a rotating-vibrating linear molecule is

   (a) $\Delta v = 0$

   (b) $\Delta v = \pm 1$

   (c) $\Delta v = \pm 1$ and $\Delta J = 0, \pm 1$

   (d) $\Delta J = 0, \pm 1$

5. Stoke's radiation is generally

   (a) More intense than antistoke's lines

   (b) Less intense

   (c) Less intense than antistoke's lines

   (d) More intense

6. The selection rule for pure rotational Raman spectra of linear molecules

   (a) $\Delta J = 0$

   (b) $\Delta J = \pm 1$

   (c) $\Delta J = \pm 2$

   (d) $\Delta J = 0$ or $\Delta J = \pm 2$ only

7. Multiplicity of a system is given by

(a) $2S + 1$ (b) $2S$

(c) $2S - 1$ (d) $S - 1$

8. Franck-Condon principle explains the intensity of

(a) Rotation spectra

(b) Vibrational spectra

(c) Electronic spectra

(d) Vibrational-electronic spectra

9. Nuclear magneton β_N is equal to

(a) $\frac{eh}{4m_p\pi}$ (b) $\frac{h}{4m_p\pi}$

(c) $\frac{e}{4m_p\pi}$ (d) $\frac{eh}{m_p}$

10. The coupling constant refers to

(a) Spin-lattice interaction

(b) Spin-spin interaction

(c) Lattice-lattice interaction

(d) Molecular interaction

SECTION B — ($5 \times 5 = 25$ marks)

Answer ALL the questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Deduce the rotational constant for a rigid diatomic molecule.

Or

(b) Explain briefly the rotational spectrum of asymmetric molecule.

12. (a) Discuss the vibrational energy of a diatomic molecule.

Or

(b) Explain briefly the asymmetry of vibration.

13. (a) Give the quantum theory of Raman scattering.

Or

(b) Give the classical treatment of hyper Raman effect.

14. (a) Explain the vibrational coarse structure.

Or

(b) Explain the predissociation of spectral lines.

15. (a) Derive the resonance condition for NMR.

Or

(b) Explain the quadrupole nucleus.

SECTION C — (5 × 8 = 40 marks)

Answer ALL the questions, choosing either (a) or (b).

Each answer should not exceed 600 words.

16. (a) Obtain the energies of a non-rigid rotator.

Or

(b) Describe the information derived from rotational spectra.

17. (a) Obtain the energies of a diatomic vibrating rotator.

Or

(b) Describe the rotational vibrational spectra of polyatomic molecules.

18. (a) Obtain the frequencies of Raman spectra of symmetric top molecules.

Or

(b) Illustrate the vibrational Raman spectra with suitable example.

19. (a) Discuss the rotational fine structure of electronic vibrational spectra.

Or

(b) Give an account of photoelectron spectroscopy.

20. (a) Explain the ESR spectrum of hydrogen atom.

Or

(b) Give an account of NQR instrumentation.

———————