K18P 0129

Reg. No. : .....

Name : .....

Second Semester M.Sc. Degree (Regular/Supplementary/Improvement) Examination, March 2018

Physics

(2014 Admn. Onwards)

PHY 2C09 – SPECTROSCOPY

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer **both** questions **either a** or **b.**

1. a) Explain Born-Oppenheimer approximation. Discuss the vibrational coarse structure of a diatomic molecule.

OR

b) What are PQR branches in the electronic spectrum of molecules ? Explain the formation of band head, band origin and shading of bands.

2. a) Give the basic principle of ESR spectroscopy. Explain the hyperfire structure. Describe a simple setup for the study of ESR.

OR

b) Explain the classical theory and quantum theory of Raman effect. Show how the complementary nature of Raman and IR spectra help us to distinguish the structure of H_2O and CO_2 molecules. **(2×12=24)**

SECTION – B

Answer **any four.** 1 mark for part **a**, 3 marks for part **b** and 5 for part **c**.

3. a) Define anomalous Zeeman effect.

b) Explain stark effect.

c) Calculate the Zeeman shift observed in the normal Zeeman effect when a spectral line of wavelength 5000 Å is subjected to the magnetic field of 1.4 Wb/m^2 taking $e/m = 1.76 \times 10^{11}$ $C.kg^{-1}$.

P.T.O.

4. a) Write down the equation for the energy levels of a diatomic molecule.
   b) The spacing between lines in P and R branches of CO_2 is 4B instead of the expected 2B. Why ?
   c) The fundamental and first overtone transition of $^{14}N\ ^{16}O$ are centred at 1876.06 cm^{-1} and 3724.20 cm^{-1} respectively. Evaluate the equilibrium vibration frequency, an harmanicity constant, zero point energy and free constant of the molecule.

5. a) What is centrifugal distortion ?
   b) Explain the effect of isotopic substitution on the rotational spectra of the molecules.
   c) What is the change in the rotational constant B when hydrogen is replaced by deuterium in the hydrogen molecule ?

6. a) Define depolarisation ratio.
   b) State the conditions for a vibration to be Raman active.
   c) The Raman line associated with a vibrational mode which is both Raman and IR active is found at 4600 Å; when excited by a light of wavelength 4358 Å. Calculate the wavelength of the corresponding infrared band.

7. a) What are Fertrat parabolae ?
   b) Explain Franck-tender principle.
   c) The spectroscopic bond dissociation energy of $^{35}Cl\ ^{16}O$ radical is 1.9 eV. Calculate the equilibrium bond dissociation energy of ClO if the fundamental vibrational frequency is 780 cm^{-1}.

8. a) What is a Mössbauer spectrum ?
   b) Explain with a block diagram a Mössbauer spectrometer.
   c) Electron spin resonance is observed for atomic hydrogen with an instrument operating at 9.5 MHz. If the 'g' value for the electron in the hydrogen atom is 2.0026, what is the magnetic field applied ? Bohr magnetic $\mu_B = 9.274 \times 10^{-24}$ J/T. **(4×9=36)**
