M 27251

Reg. No. : .....

Name : .....

II Semester M.A./M.Sc./M.Com. Degree (Reg./Sup./Imp.) Examination, March 2015
(2014 Admn. Onwards)
PHYSICS
PHY2C09 : Spectroscopy

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer both questions (Either **a** or **b**).

1. a) Distinguish between Normal Zeeman effect and Anomalous Zeeman effect. Discuss the theory of Normal Zeeman effect and prove that the frequency shift is the same for all Normal Zeeman effect lines.

OR

b) What is Stark effect ? Describe the importance of the study of quadrapole hyperfine interaction in microwave spectra. Explain the different types of information obtained from rotational spectra.

2. a) Describe the construction and working of a Raman spectrometer. Explain the importance of Raman effect for phase transition studies.

OR

b) Explain Frank-Condon principle. Explain band origin and band head in the rotational fine structure of electronic vibration spectra. **(2×12=24)**

SECTION – B

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

1. a) What is fine structure of spectral lines ?

b) Explain singlet and triplet states with examples.

c) The wavelength of the first line of the Lyman series of hydrogen is 1215A°. Calculate the wavelength of the second line of the series and the series limit.

P.T.O.

2. a) What are linear molecules ? Give example.

   b) Explain how rotational energy transitions take place.

   c) Discuss the rotational spectra of rigid molecules. Draw the rotational energy levels and transitions for a rigid diatomic molecule.

3. a) What is a diatomic vibrating rotator ?

   b) In the vibration rotation spectrum of HBr, why is it that the rotational lines at the high frequency end of the R branch are closely spaced and those at the low frequency end of the P-branch widely spaced.

   c) The fundamental band for HCL is centered at 2886 cm^{-1}. Assuming that the inter nuclear distance is 1276 A°. Calculate the wave number of the first two lines of each of the P and R branches of HCL.

4. a) What is NMR ?

   b) Explain how NMR frequency is related to the external magnetic field applied.

   c) Find the energy difference between the spin up and spin down states of a proton in a magnetic field of B = 1.00 Tesla. Estimate the Larmour frequency of the proton in the field (g = 5.586 and $\mu_N = 5.051 \times 10^{-27}$ J/T .

5. a) Give the principle of ESR.

   b) What are the factors responsible for the hyperfine structure in ESR spectra ? Explain.

   c) Calculate the resonance frequency of a free electron in a magnetic field of 1.69 Tesla.

6. a) What is a symmetric top molecule ?

   b) Derive an expression for the rotational constant of a diatomic molecule.

   c) Calculate the rotational constant and bond length of carbon monoxide if the first line in the rotation spectrum of CO has a frequency of 3.8424 cm. **(4×9=36)**
