K17P 0613

Reg. No. : B6PSPH1609

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Second Semester M.Sc. Degree (Regular/Supplementary/ Improvement) Examination, March 2017

(2014 Admission Onwards)

PHYSICS

PHY 2C09 : Spectroscopy

Time : 3 Hours

Max. Marks : 60

SECTION – A

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

1. a) Discuss the rotational spectra of rigid diatomic molecules. Also estimate the relative intensities of the spectral lines.

OR

b) Explain band origin and band head in relation to the rotational fine structure of electronic vibration spectra.

2. a) Give the classical and quantum theory of Raman effect. Show that the Stokes lines are more intense than that of Antistokes lines.

OR

b) What are hot bands in a vibrating diatomic molecule. Draw a diagram showing the energy levels of vibrating diatomic molecule. **(2×12=24)**

SECTION – B

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

3. a) Name the different series in alkali spectra.

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 $e/m = 1.76 \times 10^{11}\ Ckg^{-1}$.

P.T.O.

4. a) Define spherical top molecules.

   b) Molecules having permanent dipole moment are microwave active and those not having permanent dipole moment are microwave inactive. Comment.

   c) Rotational and centrifugal distortion constants of HCl molecule are 10.593 cm^{-1} and 5.3×10^{-4} cm^{-1} respectively. Estimate the vibrational frequency and force constant of the molecule.

5. a) What is pre-dissociation ?

   b) Explain Fortrat parabola.

   c) The spectroscopic bond dissociation energy of $^{35}ClO^{26}$ radical is 1.6 eV. Calculate the equilibrium bond dissociation energy of ClO, if the fundamental vibrational frequency is 780 cm^{-1}.

6. a) Give the principle of ESR.

   b) What is Fermi contact interaction and hyperfine structure ?

   c) A molecule AB_2 has the following IR and Raman spectra. Discuss the molecular structure and assign the observed lines to molecular vibrations.

Frequency (cm^{-1})	IR	Raman
3750	Very strong	–
3650	Strong	Strong, polarized
1595	Very strong	–

7. a) Give the principle of NMR.

   b) Explain Larmour precession.

   c) A system of protons at a temperature of 25°C is placed in a magnetic field of 2 T. What is the ratio of number of proton spins in the lower state to the number in the upper state.

8. a) What is Mössbauer spectroscopy ?

   b) Explain isomer shift in Mössbauer's experiment.

   c) Calculate the Doppler velocity corresponding to the natural line width of the γ-ray emission from 140.4 keV excited state of ^{57}Fe nucleus having a half life of 9.8×10^{-8} s.

(4×9=36)
