LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – **PHYSICS**

THIRD SEMESTER – **NOVEMBER 2014**

PH 3815 - SPECTROSCOPY

Date : 01/11/2014   Dept. No.   Max. : 100 Marks
Time : 09:00-12:00

PART A

Answer all questions: **(10×2=20 marks)**

1. What are the advantages of Gunn diodes over klystrons as microwave source in microwave spectrometers?

2. The rotational constant of NO is $1.7201 cm^{-1}$. Calculate the moment of inertia of the molecule.

3. Sketch the fundamental vibrational modes of H_2O molecule.

4. Why anti - Stokes lines are less intense than Stokes lines?

5. Comment on the statement 'Homonuclear diatomic molecules give no microwave or infrared spectra whereas they do give a rotational Raman spectrum'.

6. Electron spin resonance is observed for atomic hydrogen with an instrument operating at 9.5 GHz. If the g value for the electron in the hydrogen atom is 2.0026, what is the magnetic field applied? Bohr magnetron = $9.274 \times 10^{-24} JT^{-1}$

7. Distinguish between spin - lattice and spin - spin relaxation time.

8. What is a v' progression?

9. Give any two applications of SEM.

10. Explain briefly the principle of NMR.

PART –B

Answer any FOUR questions: **(4 ×7.5 = 30 marks)**

11 (a) Explain the factors that determine the intensity of a spectral line. Obtain an expression for J at which maximum population occurs.   (4.5)

(b) The average spacing between successive rotational lines of carbon monoxide molecule is $3.8626 \ cm^{-1}$. Determine the transition which gives the most intense spectral line at temperature 300 K.

12. Outline the theory of Raman spectrum on the basis of (a) Classical theory (b) Quantum theory.

13. Outline the principle of photoelectron spectroscopy.

14. Explain the importance of Franck-Condon principle in explaining the intensity of molecular spectrum.

15. What is a Fortrat parabola? Explain how this is used to calculate the position of band head.

16. Outline briefly the principles in EELS spectroscopy.

PART –C

Answer any <u>FOUR</u> questions: **(4×12.5 = 50 marks)**

17. Explain with theory, the spectrum of a linear diatomic molecule of rigid rotor type. Deduce the correction for non – rigid type.

18. (a) Describe with theory the rotation – vibration spectra of a diatomic molecule.

    (b) The fundamental and first overtone transitions of CO are centred at 2143.3 cm^{-1} and 4260.0 cm^{-1}. Calculate the equilibrium oscillation frequency, the anharmonicity constant and force constant of the molecule.

19. Explain Polarizability ellipsoid. On the basis of the polarizability, outline the vibrational Raman effect of CO_2 and H_2O.

20. Explain in detail the principle and working of an ESR spectrometer.

21. Explain the functioning of XPES and UPES.

22. Derive the relation for NMR and explain the working of the spectrometer.

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