SUBJECT CODE : **PH/ME/MS54**

B.Sc. DEGREE EXAMINATION NOVEMBER 2010
BRANCH III - PHYSICS
FIFTH SEMESTER

COURSE : **MAJOR – ELECTIVE**
PAPER : **MOLECULAR SPECTROSCOPY**
TIME : **3 HRS.** MAX. MARKS : 100

SECTION - A

ANSWER ALL QUESTIONS: (10 x 3 = 30)

1. Define Molecular spectroscopy. Mention the factors to be considered in the intensity of spectral lines.

2. State the Beer-Lambert law.

3. Distinguish between symmetric top (prolate and oblate), spherical top and asymmetric top molecules.

4. Diatomic molecules such as CO, HF will show a rotational spectrum whereas N_2, O_2, H_2 will not, why?

5. What is stark effect? Outline its importance in the study of microwave spectroscopy.

6. What is Born – Oppenheimer approximation in Infrared spectroscopy?

7. If the bond length of H_2 is 0.07417 nm, what would be the position of the first three rotational Raman lines in the spectrum? Given $^1H = 1.673 \times 10^{-27}$ Kg.

8. State the rule of Mutual exclusion.

9. Define depolarization ratio. Why is it important in Raman spectroscopy?

10. Distinguish between dissociation energies D_e and D_o in the Electronic spectra of diatomic molecules.

SECTION – B

ANSWER ANY <u>SIX</u> QUESTIONS: (6X5=30)

11. Explain the different parameters that characterize the electromagnetic wave.

12. Discuss the theory of rotational spectra with rigid diatomic molecule.

13. Obtain the energy expression of a diatomic molecule treating it as a harmonic oscillator and discuss its energy levels.

14. Discuss the effect of anharmonicity on the vibrational spectra of diatomic molecules.

15. The fundamental band for HCl is centered at $2886 cm^{-1}$. Assuming that the internuclear distance is $1.276 A^o$. Calculate the first two lines of each of the P and R branches of HCl. Given the reduced mass of HCl is 1.6275×10^{-27} Kg.

16. Draw the functional diagram of double-beam Infra-red spectrometer and explain how it works.

17. Give the quantum theory of Raman effect.

18. State and explain Franck Condon principle.

SECTION – C
ANSWER ANY <u>TWO</u> QUESTIONS: **(2X20=40)**

19. a) Illustrate in pictorial fashion the various regions into which the electromagnetic spectrum is divided with the corresponding wave length.

    b) What is the reason for line broadening of spectral lines?

    c) Explain a grating spectrometer with a schematic diagram.

20. Describe the theory of vibrational – rotational spectra of a diatomic molecule.

21. a) State the conditions for a vibration to be Raman active. Discuss in detail the pure rotational Raman spectra.

    b) Irradiation of carbon tetrachloride by $4358 A^o$ radiation gives Raman lines at 4400, 4419, and $4447 A^o$. Calculate the Raman shift for each of these lines.

22. Explain how the rotational fine structure of electronic vibration spectra allows one to determine the internuclear distance of the electronic state.

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