STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086.
(For candidates admitted during the academic year 2004-05)

SUBJECT CODE : **PH/MO/SP64**

B.Sc. DEGREE EXAMINATION APRIL 2007
BRANCH III - PHYSICS
SIXTH SEMESTER

COURSE   :   **MAJOR – OPTIONAL**
PAPER   :   **SPECTROSCOPY**
TIME   :   **3 HOURS**   MAX. MARKS : 100

SECTION - A

ANSWER ALL QUESTIONS: (10 x 3 = 30)

1.   List the electromagnetic waves in ascending order of their wavelength.

2.   Comment on the statement "Raman effect gives validity to the quantum nature of radiation".

3.   Are all vibrational lines accompanied by rotational lines. If so why?

4.   Calculate the number of vibrational frequencies in Benzene molecule.

5.   Explain Boltzmann distribution law.

6.   What is the advantage of Laser over other conventional sources.

7.   Explain why the infrared region is used as a finger print region?

8.   What happens to the spectra of a molecule such as HCl when hydrogen and chlorine atoms are replaced by their isotopes?

9.   Calculate the reduced mass of a system consisting of an electron and a proton. Assume the mass of the electron to be 1/1840 Mass of the proton.

10.   What is Stark effect?

SECTION - B

ANSWER ANY SIX QUESTIONS: (6 x 5 = 30)

11.   What is Raman effect? Explain with examples how Raman effect is complementary to IR absorption?

12.   The moment of inertia of the CO molecule is 1.46×10^{-46} kg-m^2. Calculate the energy in eV and the angular velocity in the lowest rotational energy level of the CO molecule.   (3 + 2 marks)

13. What is meant by resolving power? Derive an expression relating slit width and resolving power.

14. Distinguish between emission and absorption spectra with examples.

15. Assume the vibrations of H_2 molecule to be simple harmonic in nature calculate the vibrational quantum no: corresponding to dissociation energy of 4.5eV. If the force constant k=550 N/m and the mass of hydrogen atoms 1.67×10^{-27}kg and h=6.68×10^{-34} J sec.

16. Explain the term polarisibility. Discuss the selection rules for Raman and IR transitions to occur.

17. The infrared spectrum of HBr consists of a series of lines spaced 17cm^{-1} apart. Find the interatomic distance of HBr. Assume the values of h=6.6×10^{-34} J sec, C=3×10^8m/sec, Avogardo's No=6×10^{23} MKS units.

18. Explain with examples how molecules are classified as linear, symmetric top, spherical top and asymmetric top molecules.

SECTION - C

ANSWER ANY TWO QUESTIONS: (2 x 20 = 40)

19. Distinguish between single beam and double beam spectrophotometer. (5 marks)
    Draw a neat ray diagram of a double beam spectrophotometer and explain it's working.   (5 + 10 marks)

20. Give the theory of pure rotation and hence derive an expression for the rotational energy. Show that rotational lines are equally spaced.   (17 marks)
    Give examples of molecules which exhibit pure rotational spectra.   (3 marks)

21. Give the Quantum theory of Raman effect. Why is the intensity of the Stoke's lines more intense than the anti - Stoke' lines?   (5 + 5 marks)
    Explain with a diagram the working of a Laser Raman spectrophotometer.
                                                                         (10 marks)

22. State the principle of mutual exclusion.   (3 marks)
     Discuss the normal modes of vibration of a polyatomic molecule.   (7 marks)
    Discuss the two application of Raman and IR spectroscopy respectively. (10 marks)

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