LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

THIRD SEMESTER – **NOVEMBER 2017**

16PPH3MC02/PH 3815 – SPECTROSCOPY

Date: 03-11-2017 Dept. No. Max. : 100 Marks

Time: 09:00-12:00

PART A

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

1. How are molecules classified on the basis of moment of inertia? Give one example each.
2. What are the advantages of Gunn diodes over kryptrons as microwave source in microwave spectrometers?
3. Define dipolarisation ratio. Wh y it is important in Raman spectroscopy?
4. Explain Born – Oppenheimer approximation.
5. What is predissociation?
6. A free electron is placed in a magnetic field of strength 1.4 T. Calculate the resonance frequency if g = 2. 0023 and μB = 9. 274 × 10^{-24} JT^{-1}.
7. Write the advantages of TMS when recording NMR spectra.
8. An excited ^{57}Fe nucleus, recoiling at 10^2 ms^{-1} emits γ- radiation with frequency 10 × 10^{18} Hz. Calculate the Doppler shift of the γ- ray frequency.
9. What is fluorescence spectroscopy?
10. Write the principle of UPS.

PART B

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

11. (a) Outline briefly each section of an IR spectrometer.
    (b) Calculate the frequency of NO molecule whose force constants is 1609 Nm^{-1}.
12. (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 rotational spectrum of BrF shows a series of equivalent spectral lives spaced 0.71433 cm^{-1} apart. Find which transition give raise to the most intense spectral line at 300 K.
13. Discuss the importance of Franck-Condon principle in explaining the intensity of vibrational electronic spectra.
14. Obtain an expression for the dissociation energy of a molecule.
15. Explain the spectral splitting in NMR due to coupling between several nuclei using family tree method.
16. Outline the principle of photoelectron spectroscopy.

PART C

Answer **any four** questions: (4×12.5=50 marks)

17. (a) Explain with theory, the spectrum of symmetric top molecule.
    (b) The three consecutive lines in the rotational spectrum of HBr are 84.544, 101.355 and 118.112 cm^{-1}. Find the values of rotational constant, centrifugal distortion constant and vibrational frequency.
18. (a) Explain the vibration spectrum of a diatomic molecule. Deduce the effect of anharmonicity.
    (b) The fundamental and first overtone transitions of $^{14}N^{16}O$ are centered at 1876.06 cm^{-1} and 3724.20 cm^{-1}. Evaluate the equilibrium vibration frequency, the anharmonicity constant, zero point energy and the force constant of the molecule.
19. a) Outline the theory of Raman effect on the basis of classical and quantum theory.

b) N_2O and NO_2 molecules exhibit three fundamental vibration frequencies in both IR and Raman spectra. The bands of N_2O show simple PR structure and those of NO_2 show complex structure. Comment on their structure.

20. Explain the principle of ESR. Sketch a neat diagram and explain the functioning of ESR spectrometer.
21. Explain the role of Doppler Effect and uncertainty principle in obtaining Mossbauer spectrum. With a block diagram, explain a Mossbauer spectrometer.
22. Explain the principle and application of electron energy loss spectroscopy (EELS).

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