LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

THIRDSEMESTER – APRIL 2018

16PPH3MC02/PH3815–SPECTROSCOPY

Date: 26-04-2018 Dept. No. Max. : 100 Marks

Time: 09:00-12:00

PART A

Answer **ALL** questions (10×2=20)

1. Explain microwave active and microwave inactive molecules with an example for each.
2. The bond length of HF molecule is 0.0927 nm. What is the moment of inertia of the HF molecule?
3. How many normal modes of vibration are possible for (a) H_2O (b) HCl (c) C_6H_6 (d) OCS?
4. State the rule of mutual exclusion.
5. What is pre-dissociation?
6. What is the energy of a wave of wavelength 12,500 Å?
7. State the advantages of TMS when recording NMR spectra.
8. An NMR signal for a compound is found to be 160 Hz downwards from TMS peak operating at 100 MHz. Calculate its chemical shift in ppm.
9. Write any two applications of SEM.
10. What is fluorescence spectroscopy?

PART B

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

11. (a) Illustrate the effect of isotopic substitution on the pure rotational spectra of a diatomic molecule.
    (b) The first rotational line of $^{12}C^{16}O$ is observed at 3.84235 cm^{-1} and that of $^{13}C^{16}O$ at 3.673377 cm^{-1}. Calculate the atomic weight of ^{13}C, assuming the mass of ^{16}O to be 15.9949 amu.
12. (a) Outline briefly each section of an IR spectrometer.
    (b) Calculate the frequency of NO molecule whose force constants is 1609 Nm^{-1}.
13. (a) Explain polarizability ellipsoid. On the basis of polarizability, outline the vibrational Raman effect of H_2O
    (b) The first rotational Raman line of H_2 appears at 346 cm^{-1} from the exciting line. Calculate the bond length of H_2 molecule.
14. State Franck-Condon principle andaccount for intensity of spectral lines.
15. Explain the chemical shift in NMR spectroscopy.
16. Outline the principle of photoelectron spectroscopy.

PART C

Answer any **FOUR** questions (4×12.5=50)

17. Explain with theory, the spectrum of linear diatomic molecules of rigid rotor type. Deduce the correction for non – rigid type.
18. (a) Explain the vibration spectrum of a diatomic molecule. Deduce the effect of anharmonicity.
    (b) The fundamental and first overtone transitions of CO are centered at 2143.3 cm^{-1} and 4260 cm^{-1}. Calculate the equilibrium oscillation frequency, the anharmonicity constant and force constant of the molecule.
19. State the principle of ESR. With necessary diagram, explain how it is used to characterize samples.
20. Using family tree method, explain how spectral splitting is taking place in NMR spectroscopy due to coupling of other nuclei with suitable examples.
21. Outline the principles of Mossbauer spectroscopy. With a block diagram, explain the working of Mossbauer spectrometer.
22. Explain the principle, working and applications of electron energy loss spectroscopy (EELS).

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