M SC DEGREE END SEMESTER EXAMINATION MAY - 2015
SEMESTER -2**M SC CHEMISTRY / APPLIED CHEMISTRY**
COURSE: **P2CHET08, P2CPHT08 - MOLECULAR SPECTROSCOPY**

Time: 3 Hours   Max.Marks:75

SECTION A

(Answer any **Ten** questions. Each question carries **2** marks)

1. What are singlet and triplet states? Give examples
2. Sketch out the ESR spectra of (i) Benzene radical (ii) Methyl radical
3. Explain the term Larmor Precession
4. Arrange the following molecules in the increasing order of chemical shift values of protons, and justify. CH_3Br, CH_3I, CH_3F, CH_3Cl.
5. Explain why anti stokes lines are less intense than stokes lines.
6. Comment on the significance of Finger print region in IR spectra
7. Calculate the NMR frequency of a bare proton in magnetic field of 14092 Gauss.
   Given: g_N= 5.585 and β_N =5.05 x 10^{-12} JT^{-1} [1 Tesla = 10,000 Gauss]
8. Discuss the selection rules in microwave, IR, Raman and EPR spectroscopy.
9. Sketch the fundamental mode of vibration of water and carbon dioxide molecule. Give the IR absorption region correspond to each vibrational mode.
10. Why vibrations involving relatively neutral bonds such as C-C,C-H,C=C are strong Raman scatterers while they are weak in IR absorption.
11. What is mutual exclusion principle?
12. Briefly describe COSY and HETCOR.
13. Why microwave source and techniques have to be applied for the application of ESR ?

(2 x 10 = 20)

SECTION B

(Answer any **Five** questions, by attempting not more than 3 questions from each bunch. Each question carries 5 marks)

Bunch I

14. Explain P, Q , and R branches in Vibrational spectroscopy
15. State and explain Born Oppenheimer approximation
16. Write a note on Auger electron spectroscopy.
17. What is indirect spin-spin interaction? Why the NMR spectrum of the CHO group in acetaldehyde splits into four lines?

(PTO)

Bunch II

18. Calculate the degeneracies of the rotational levels of a diatomic molecule with energies $h/8\pi Ic$ and $6 h/8\pi Ic$; where I is the moment of inertia

19. A substance shows Raman line at 4570 Å when the exciting line is 4358 Å. Find the positions of stokes and anti stoke lines for the same substance if the wavelength of the exciting line is 4047 Å.

20. The chemical shift is 2.1 for one group of protons and 2.5 for another group of protons. What is the separation between them in Hertz when the signals are recorded with a spectrometer operating at the following frequencies? (a) 60 MHz   (b) 220 MHz   (c) 600 MHz

21. Explain the significance of term symbols. Determine the term symbols of the following molecules: O_2, B_2, Be_2 and N_2.

$(5 \times 5 = 25)$

SECTION C
(Answer any **Two** questions. Each question carries **15** marks)

22. (a) Explain Chemical isomer shift in the structural elucidation of molecules
    (b) Give a brief outline of the principles behind XPS spectroscopy

23. (a) Give a detailed account of the pure rotational Raman spectra in Linear ,Symmetric top and Spherical top molecules
    (b) Explain the application of Mossabauer spectroscopy in the study of high and low spin complexes of iron (II) and iron (III)

24. (a) Derive the expression for the rotational energy levels in a diatomic molecule
    (b) Write a note on NQR spectroscopy.

25. (a) Explain the principle and working of lasers.
    (b) Write note on different types of lasers and their applications.

$(15 \times 2 = 30)$

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