QP CODE: 25022457

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Reg No : .....

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M.Sc DEGREE (CSS) SPECIAL REAPPEARANCE EXAMINATION, APRIL 2025

Third Semester

CORE - CH500303 - SPECTROSCOPIC METHODS IN CHEMISTRY

M.Sc CHEMISTRY, M.Sc ANALYTICAL CHEMISTRY, M.Sc POLYMER CHEMISTRY,M.Sc APPLIED CHEMISTRY, M.Sc PHARMACEUTICAL CHEMISTRY

2019 ADMISSION ONWARDS

4769FD68

Time: 3 Hours Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

*Weight **1** each.*

1. What is Cotton effect?
2. How will you distinguish between the inter molecular and intra molecular hydrogen bonding?
3. Arrange in the decreasing order of olefinic stretching frequencies of the following compounds: cyclohexene, cyclopentene, cyclobutene, cyclopropene.
4. Why C-13 nuclei has Nuclear Magnetic Resonance while C-12 does not?
5. Explain the spin-spin coupling in AX_3 and A_2X_3 type molecule.
6. Explain long range coupling.
7. What is the importance of off diagonal peaks in COSY experiment? Illustrate with an example.
8. An ether molecule with formula $C_5H_{12}O$ shows two singlets at 4.09 ppm and 3.97 ppm. Predict the structure.
9. Explain the fragmentation pattern in alcohols and phenols.
10. What is Benzil-Benzilic acid rearrangement? How will you nanalyse the products using IR and proton NMR spectroscopy?

(8×1=8 weightage)

Part B (Short Essay/Problems)

*Answer any **six** questions.*

*Weight **2** each.*

11. Explain why a polar solvent shifts π-π* transition to a longer wavelength and n-π* transitions to shorter wavelength.
12. Explain the effect of vibrational coupling in the IR spectrum of organic compounds.

13. Discuss the effect of inductive effect and resonance on the chemical shift values of protons with suitable examples.

14. (a) Write a note on spin splitting.
(b) Which spectroscopy is most useful for distinguishing the following pairs: (a) 1-chloropropane and 2-chloropropane, (b) 1-butene and 2-butene

15. Explain the principle and working of MRI technique.

16. Ethyl butanoate in its mass spectrum shows two characteristic peaks due to odd electron ions at m/z = 88 and 60 and an abundant ion at m/z = 71. Explain the fragmentation.

17. Discuss the various fragmentation products of the following compounds: (i) 2- pentene, (ii) 1- butanol and (iii) 3-pentanone.

18. An organic compound with molecular weight 60 on heating with Sodium hypo bromite gives out nitrogen with effervescence. In NMR, it shows a band 2.5 τ. In UV it absorbs at 222 nm ε_{max} 62. The bands observed in the IR spectrum are 3490 cm^{-1} (b), 1675 cm^{-1}(s). Determine the structure.

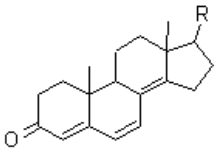
(6×2=12 weightage)

Part C (Essay Type Questions)

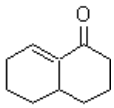
*Answer any **two** questions.*

*Weight **5** each.*

19. *(a) Give in detail about Chiro optical properties. (b) Find out the sign of cotton effect for the following molecules.*



(a)



(b)

20. Distinguish between first order and non-first order spectra in NMR and discuss different methods to simplify the non first order NMR spectra.

21. Discuss the various ionisation methods used in mass spectrometry.

22. (a) A compound with molecular formula $C_4H_8O_3$ gave the following spectral data. Deduce the structure.
IR: 1120, 1745 cm^{-1}
^1H NMR: δ 4.05 (2H, s), 3.8 (3H, s) and 3.5 (3H, s) ppm
(b) Acetone reacts with two molar equivalents of benzaldehyde in presence of KOH and ethanol. Propose a structure for the product. The spectral data of the product are:
^{13}C NMR : δ 125, 128, 129, 130.5, 134.5, 144 and 185 ppm
DEPT 135 –NIL
DEPT 90 - δ 125, 128, 129, 130.5 and 144 ppm
DEPT 45- δ 125, 128, 129, 130.5 and 144 ppm

(2×5=10 weightage)