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Sl. No.

M.Sc. III Semester Degree Examination, April/May - 2024

CHEMISTRY

Spectroscopy

(NEP)

Time : 3 Hours Maximum Marks : 70

Note : *Answer* ***any five*** *of the following questions with question No.* ***1 (Q.1)*** *is* ***Compulsory****. Each question carries* ***equal*** *marks.*

1. (a) Explain the applications of rotational spectra in the determination of bond length and moment of inertia. **5+5+4=14**

(b) Discuss the vibration and rotational spectra of carbon monoxide.

(c) Account on the vibration spectra of anharmonic oscillator with a suitable example.

2. (a) Why the vibration frequency of C=C is higher compared to C-C ? Assign the different peak positions and corresponding bands for different peaks observed in the FT-IR spectra of propanenitrile and acetonitrile. **5+5+4=14**

(b) Describe the factors affecting group frequencies in FT-IR spectroscopy.

(c) Calculate the vibrational frequency of C-H bond provided velocity of light = 3×10^8 m/s and force constant for the C-H bond is 5×10^5 dynes/cm.

3. (a) Illustrate the theory of NMR spectroscopy briefly. **5+5+4=14**

(b) What is double resonance technique ? Explain its principle and applications with a suitable example.

(c) An organic compound with molecular formula $C_5H_{11}Cl$ showed the following ^1H NMR data (δ, ppm) : 1.1 (t, 3H), 1.6 (s, 6H) and 1.9 (q, 3H). Deduce the structure of the compound.

4. (a) Explain the principle and applications of MRI. **5+5+4=14**

(b) Discuss the application of ^{13}C NMR spectroscopy in the study of keto-enol tautomerism.

(c) Why ^{13}C NMR spectroscopy is less sensitive compared to ^1H NMR spectroscopy ? Give the ^{13}C chemical shifts of alkenes, alcohols and ethers.

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5. (a) With a neat schematics, explain the production of X-rays using Coolidge tube. Also explain the characteristics of X-rays. **5+4+5=14**

(b) Explain the principle and applications of TEM.

(c) Distinguish between electron diffraction and X-ray diffraction.

6. (a) A compound with a molecular weight of 102 shows the following spectral data : **5+5+4=14**

FT-IR (cm^{-1}) : 3070, 2970-2880, 1950-1870, 1610-1490, 1458, 743 and 692.

^{1}H NMR (δ, ppm) : 1.2 (t, 3H), 2.61 (q, 2H), 7.12 (s, 5H)

Find the structure of the compound.

(b) Discuss the principle and applications of pulse techniques in NMR spectroscopy.

(c) Predict the FT-IR spectral peak position and corresponding functional groups of acetic acid, ethanol and diethyl ester.

7. (a) With neat schematics, explain the principle and working of Raman spectrometer. **5+5+4=14**

(b) Discuss the rotational Raman spectra of a diatomic molecule with a suitable example.

(c) What is photoelectric effect ? Discuss the principle and ionization process involved in X-ray photoelectron spectroscopy.

8. (a) Explain the applications of IR spectroscopy in the study of inorganic anions.

(b) Explain the principle and applications of ^{19}F NMR spectroscopy. **5+5+4=14**

(c) What are Miller indices ? How it can be calculated ? Explain.

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