Roll No. | | | | | | | | | | | | | Total No. of Pages : 02

Total No. of Questions : 09

M.Sc.(Chemistry) (2015 to 2017) (Sem.–3)

SPECTROSCOPY – II

Subject Code : MSCH-302

Paper ID : [72620]

Time : 3 Hrs. Max. Marks : 100

INSTRUCTIONS TO CANDIDATES :

1. **Attempt FIVE questions in ALL including the Question No. 1 which is COMPULSORY and selecting ONE EACH from each UNIT.**

Q1 Answer briefly :

a) After ionization and fragmentation occur, what does the mass spectrometer do to provide a mass spectrum?

b) How will you identify a particular signal in PMR arise due to NH or OH proton?

c) Why greater sensitivity is required to record ^{13}C NMR spectrum compared to that PMR spectrum?

d) Why Mossbauer Spectroscopy is well suited for biological applications?

e) What is NQR? In which region of electromagnetic spectrum, NQR spectra are observed?

f) What is nuclear quadrupole coupling constant?

g) Predict different peaks in the mass spectrum of ethyl chloride.

h) What is a *metastable* ion?

i) Of the two molecules N_2 and O_2, which will show an ESR spectrum and why?

j) Predict the ESR spectrum of methyl radical. (2×10=20)

UNIT-I

Q2 a) Discuss the principle of NMR spectroscopy and explain how this technique is being used in elucidating the structure of the molecules. (10)

b) What is chemical shift? In the 300 MHz spectrum of a certain compound there are two triplets separated by 3 ppm. The observed coupling constant is 7 Hz. What is this separation in Hz? In a 500 MHz spectrum, what is the separation between these signals in Hz and in ppm? (5)

c) Explain magnetic anisotropy effect in NMR by taking suitable examples. (5)

Q3 a) What is coupling constant? Describe various types of proton couplings in PMR spectroscopy. (8)

b) Write short notes on : (12)

i) Correlation spectroscopy ii) MRI

iii) NOE iv) Chemical shift reagents.

UNIT-II

Q4 a) Explain the principle of NQR. (8)

b) Explain how NQR spectroscopy helps in studying hydrogen bonding in crystals? (6)

c) From the drawing of energy level diagram calculate transition frequencies for a nucleus having / = 5/2 and assuming (a) $\eta = 0$ (b) $\eta \neq 0$. (6)

Q5 a) Discuss the applications of *ESR* spectra. (10)

b) Which valence state of copper *i.e.* Cu^{+} ion or Cu^{+2} ion, will show ESR and why? (5)

c) Outline some of the differences between *NMR* and *NQR*. (5)

UNIT-III

Q6 a) Explain the principle and applications of Mossbauer Spectroscopy. (15)

b) Calculate the recoil velocity of free Mossbauer nucleus of mass 9.4684×10^{-26} kg, when emitting a γ-ray of wavelength 8.57×10^{-11} m. What is the Doppler shift of the γ-ray frequency to an outside observer? (5)

Q7 a) What is isomer shift? Explain with examples. (5)

b) Outline briefly : (10)

i) Quadrupole interaction.

ii) Magnetic hyperfine interaction in *Mossbauer* spectroscopy.

c) Draw the energy level schemes and transitions for a *Mossbauer* nucleus having $I_g = {}^1/_2$ and $I_e = 3/2$. (5)

UNIT-IV

Q8 a) Explain the following by taking suitable examples : (6)

i) Nitrogen rule.

ii) McLafferty rearrangement.

b) Describe various ionization techniques in mass spectrometry. (8)

c) Describe the fragmentation pattern of alcohols and esters. (6)

Q9 a) Explain the appearance of m/z 44 in the mass spectrum of $CH_3CH_2CH_2CHO$. (6)

b) Give the applications of mass spectrometry. (6)

c) Account for the major peaks of each of the following compounds. Write equations for their formation :

i) $CH_3OCH_2CH_2CH_3$: m/z = 31, 45, 59, and 74.

ii) $CH_3CH_2COOCH_3$: m/z 57, 59 and 88. (8)