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PG CBCS

M.SC. Semester-III Examination, 2021

CHEMISTRY

PAPER: CEM 301

(ADVANCED SPECTROSCOPY-I)

Full Marks: 40 **Time: 2 Hours**

Answer any <u>FOUR</u> questions from the following: 4x10 =40

1. Discuss each step involved for unimolecular processes and bimolecular processes in a photophysical process. 5+5
2. Deduce the Stern-Volmer equation. How do you obtain the quenching rate constant using the Stern-Volmer equation? 5+5
3. Discuss the working principle of photoelectron spectroscopy? What do you mean by adiabatic ionization energy, vertical ionization energy, and work function in photoelectron spectroscopy? 5+2+2+1
4. Discuss the working principle of Nuclear Quadrupole Resonance (NQR) spectroscopy. What is the main advantage of NQR spectroscopy? What structural information does an NQR spectrum give of a sample? 5+2+3
5. (a) The benzene radical anion $C_6H_6^-$ has a g-value 2.0025. At what field would you search for resonance in a spectrometer operating at 9.302 GHz.

   (b) A radical containing two non-equivalent protons with splitting constant 2.0 mT and 2.6 mT gives a spectrum centered on 332.5 mT. At what field do the hyperfine lines lie and what are their relative intensity? 5+5
6. (a) What is ESR spectroscopy used for?

   (b) What compounds can you analyse by epr spectroscopy?

   (c) What is fine and hyperfine structure?

   (d) Draw hyperfine esr spectra of hydrogen radical ($H^{\cdot}$). 2.5×4
7. (a) How many ESR lines can be expected for $^{33}S^{19}F_6$ radical anion and radical cation? I=3/2 for ^{33}S, and I=1/2 for ^{19}F.

   (b) $[Mo(CN)8]^{3-}$ complex shows single line of ESR spectra, but when carbon(C) is replaced by ^{13}C isotope we get nine lines.- Explain.

   (c) The esr spectrum of $[(NH_3)_5Co\text{-}O_2\text{-}Co(NH_3)_5]^{5+}$ shows fifteen lines. Derive structural information for this complex ion from this data. 3+3+4

(P.T.O.)

8. (a) Predict the intensity distribution in the hyperfine lines in the esr spectrum of the $\cdot CD_3$ (I=1for D) radical.

   (b) What frequency of radiation is used for EPR spectroscopy?

   (c) Draw the hyperfine splitting pattern in the ESR spectrum of $\dot{C}H_3$ radical. 3+2+5

9. (a) What is laser and its uses?

   (b) Explain the coherence nature of LASER.

   (c) What is population Inversion?

   (d) Explain florescence and phosphorescence with energy diagram.

   (e) Write photo electric effect. 5×2

10. (a) Why DPPH is used in ESR?

    (b) Draw the esr spectrum of DPPH radical and explain it.

    (c) What is the number of peaks for $\cdot CH_2(OCH_3)$, a methoxymethyl radical in EPR due to hyperfine coupling?

    (d) What will be intensity of lines in the esr spectrum of di-tertiary butyl nitroxide (DTBN). 2+3+3+2

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