



THE AMERICAN COLLEGE, MADURAI

(An Autonomous Institution Affiliated to Madurai Kamaraj University)
Re-accredited (2nd Cycle) by NAAC with Grade "A", CGPA – 3.46 on a 4-point scale

Backlog Arrear Examination, March 2021

PGC 4407 / 4427

Spectral methods in chemistry

Marks 75

Time: 3 Hrs

Answer any five questions

5 x 15 = 75 marks

- In detail explain the principle and conditions for Mossbauer spectroscopy and illustrate how Mossbauer spectroscopy assists in arriving at the structure and geometry of inorganic compounds. (10)
 - In what way PES is different from other spectroscopic techniques? Elaborate the principle involved in PES. (5)
- Discuss the factors that influence the IR vibrational frequencies. (6)
 - Sketch the expected UV-Vis spectrum for transition metal ions. Explain the same. (4)
 - How will you use a UV-Vis spectra to follow a first order kinetics? (5)
- Discuss the principle, instrumentation and working of simple ESR spectrometer. (8)
 - In detail explain hyperfine splitting and Cramers degeneracy. (7)
- An organic compound with molecular formula $C_7H_{13}Br$ gives three signals in 1H -NMR spectrum. A 2H multiplet at 3.22 ppm, a 5H multiplet at 1.2 ppm and 6H multiplet at 1.8 ppm are observed. The off resonance ^{13}C - NMR spectrum consists of a doublet at 40.0 ppm and four triplets at 40.8, 31.7, 26.1 and 25.8 ppm. The IR spectrum has no bands between $1445-2849\text{ cm}^{-1}$. The base peak appears at m/e 97 in the mass spectrum. Predict the structure of the compound? What is the intensity ratio of the lines at m/e 176 and 178 in the mass spectrum of this compound? (10)
 - Electron spin resonance is observed for atomic hydrogen with an instrument operating at 9.5 GHz. If the g value for the electron in the hydrogen atom is 2.0026, what is the magnetic field applied? [$\mu_B = 9.274 \times 10^{-24}\text{ JT}^{-1}$] (5)
- Discuss the principle of mass spectrometry. Explain how this technique can be used to identify the molecular weight and molecular formula of an organic compound? (10)
 - Explain how metastable ions are generated. How can you identify the position of metastable ion and what information regarding structure can be obtained from metastable ion. (5)
- There is a three spin AMX system with the following coupling relation: $J_{AX} = 2 J_{AM} = 4 J_{MX}$. Depict the coupling patterns on A, M and X signals. (8)
 - Write short notes on (i) Nuclear Overhauser effect; (ii) Isotopic pattern due to halogens (7)
- Elaborate the influence of dihedral angle and electronegativity on the germinal and vicinal couplings in 1H -NMR. (5)
 - Explain the significance of Koopmans theorem. (5)
 - Give the fragmentation pattern of phenylacetone. (5)