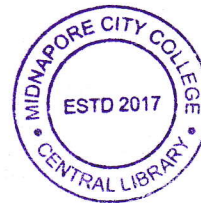


PG CBCS
M.Sc. Semester-III Examination, 2022
CHEMISTRY
PAPER: CEM 301
ADVANCED SPECTROSCOPY-I (COMMON PAPER:
PHYSICAL/INORGANIC/ORGANIC)



Full Marks: 40

Time: 2 Hours

GROUP – A

1. Answer any **four** questions from the following questions: **2×4 = 8**
- What is the main advantage of NQR spectroscopy?
 - What compounds can you analyze by EPR spectroscopy?
 - What is a fine and hyperfine structure?
 - What frequency of radiation is used for EPR spectroscopy?
 - What are lasers and their uses?
 - Why DPPH is used in ESR?
 - What structural information does an NQR spectrum give of a sample?
 - What do you mean by adiabatic ionization energy, and vertical ionization energy in photoelectron spectroscopy?

GROUP - B

2. Answer any **four** questions from the following questions: **4×4 = 16**
- Discuss the working principle of Nuclear Quadrupole Resonance (NQR) spectroscopy.
 - Discuss the working principle of photoelectron spectroscopy.
 - Discuss about the Ruby laser.
 - Write general feature and properties of LASER.
 - The ESR spectrum of $[(\text{NH}_3)_5\text{Co}-\text{O}_2-\text{Co}(\text{NH}_3)_5]^{5+}$ shows fifteen lines. Derive structural information for this complex ion from this data.
 - How many ESR lines can be expected for $^{33}\text{S}^{19}\text{F}_6$ radical anion and radical cation? $I=3/2$ for ^{33}S , and $I=1/2$ for ^{19}F .
 - $[\text{Mo}(\text{CN})_8]^{3-}$ complex shows a single line of ESR spectra, but when carbon(C) is replaced by ^{13}C isotope we get nine lines.- Explain.

(P.T.O.)

- h) A radical containing two non-equivalent protons with splitting constants 2.0 mT and 2.6 mT gives a spectrum centered on 332.5 mT. In what field do the hyperfine lines lie and what are their relative intensity?

GROUP - C

3. Answer any two questions from the following questions: 8×2 = 16

- a) Discuss each step involved for unimolecular processes and bimolecular processes in a photophysical process. (4+4)
- b) Deduce the Stern-Volmer equation. How do you obtain the quenching rate constant using the Stern-Volmer equation? (4+4)
- c) (i) Draw the ESR spectrum of DPPH radical and explain it.
(ii) What is the number of peaks for $\cdot\text{CH}_2(\text{OCH}_3)$, a methoxymethyl radical in EPR due to hyperfine coupling?
(iii) What will be the intensity of lines in the ESR spectrum of di-tertiary butyl nitroxide (DTBN)? (3+3+2)
- d) (i) Predict the intensity distribution in the hyperfine lines in the ESR spectrum of the $\cdot\text{CD}_3$ (I=1 for D) radical.
(ii) Draw the hyperfine splitting pattern in the ESR spectrum of $\cdot\text{CH}_3$ radical. (4+4)

