

M. Sc. 3rd Semester Examination, 2024

CHEMISTRY

(Phy./Org./Inorg. Spl.)

PAPER — CEM-301

Full Marks : 50

Time : 2 hours

Answer **all** questions

The figures in the right hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

GROUP—A

Answer any **four** questions of the following :

1. What is the maximum depth of XPS ? 2×4
2. Why is NQR synonymous to “zero field NMR” ?

(Turn Over)

(2)

3. The ESR frequency for a free electron is 9347 MHz. Calculate the magnetic field strength at which the ESR spectrometer is working.
4. Predict the number of lines in the ESR spectrum of following radical $[^{13}\text{CF}_2\text{D}]$:
[$I(^{19}\text{F}) = 1/2$; $I(\text{D}) = 1$]
5. What is P-type delayed emission ? Give example.
6. Draw the schematic diagram of Time Correlated Single Photon Counting instrument.

GROUP - B

Answer any **four** questions of the following :

7. What is a Fabry-Perot resonator ? Explain it with proper diagram. 4 × 4
8. Briefly describe the construction of a Ruby LASER. 1 + 3
8. Briefly describe the construction of a Ruby LASER. 4

(3)

9. Besides the beam electrons, how many electrons are involved in AES ? Can x-rays eject non-core electrons ? 2 + 2
10. Predict the intensity distribution in the hyperfine lines of the ESR spectrum of p-benzosemiquinone radical anion. 4
11. Explain the appearance of two lines in the ESR spectrum of hydrogen atom. 4
12. What is E-type delayed emission ? How do you obtain singlet-triplet energy gap of a molecule showing E-type delayed emission ? 1 + 3

GROUP--C

Answer any **two** questions of the following : 8×2

13. Which method, AES or XPS, is better for resolving chemical shifts and why ? Which direction would a peak in a given spectrum move if an atom loses a valence charge ? What if the atom gains a valence charge ? 2 + 3 + 3

(4)

14. Compare and contrast active and passive mode locking. Explain as how one can detect the explosives by NQR spectroscopy. 4 + 4
15. (a) 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.
- (b) Considering weak “zero-field splitting” predict the expected EPR spectrum of a high spin octahedral Mn(II) complex. 4 + 4
16. What is meant by exciplex emission? Write down the characteristics of exciplex emission. Draw the potential energy diagram of donor (D) and acceptor (A) as a function of intermolecular distance for both the ground and excited state to explain the exciplex formation. Use the potential energy diagram to explain that the exciplex emission is red shifted, broad and structureless. 1 + 2 + 3 + 2

[Internal Assessment – 10 Marks]
