

November 2025
M.Sc.
Third Semester
CORE – 09
CHEMISTRY
Course Code: MCHC 3.11
(Inorganic Chemistry - III)

Total Mark: 70
Time: 3 hours

Pass Mark: 28

Answer five questions, taking one from each unit.

UNIT-I

1. (a) The NH_3 stretching frequencies of complexes are lower than those of the free NH_3 molecule. Give reasons. 5
- (b) Explain with examples showing that complexes involving bridging sulphato group exhibit more bands. 6
- (c) What is lattice water? 3
2. (a) Show with examples that CN stretching frequencies get shifted to a higher value on coordination. 6
- (b) Discuss the infrared structural studies of the following: $3 \times 2 = 6$
 - (i) Aquo complexes
 - (ii) Hydroxo complexes
- (c) What is IR spectroscopy? 2

UNIT-II

3. (a) State and explain Drago's rule by taking an example. 4
- (b) How many ESR lines are present in $3 \times 2 = 6$
 - (i) $[\text{Ti}(\text{H}_2\text{O})_6]^{+3}$ (Given, $I_{\text{Ti}} = 3/2$, $I_{\text{H}} = 1/2$)
 - (ii) $[\text{Cu}(\text{H}_2\text{O})_6]^{+2}$ (Given, $I_{\text{Cu}} = 3/2$, $I_{\text{H}} = 1/2$)
- (c) Explain the principle of NMR spectroscopy. 4
4. (a) Explain why BrF_5 show one quartet and one doublet ^{19}F NMR signals. 4

- (b) Calculate the number of ^{31}P NMR signals and mention the intensity ratio in the following: $2 \times 2 = 4$
- (i) H_3PO_3 (ii) P_4S_3
- (c) Calculate the ESR lines of the following radicals: $1 \times 6 = 6$
- (i) $\dot{\text{C}}\text{D}_3$ (ii) $\dot{\text{C}}\text{H}_3$
 (iii) $\dot{\text{N}}\text{H}_3$ (iv) $\dot{\text{N}}\text{H}_2$
 (v) $\dot{\text{C}}\text{H}_2\text{D}$ (vi) $\dot{\text{C}}_6\text{H}_6$
- (Given, $I_{\text{H}} = \frac{1}{2}$, $I_{\text{D}} = 1$, $I_{\text{N}} = 1$)

UNIT-III

5. (a) What is meant by base peak? Explain the type of ions produced in mass spectrometer with suitable examples. $1 + 4 = 5$
- (b) Draw the bar graph representation and discuss the fragmentation of butyl ethyl ketone. 6
- (c) Write any three applications of ESI. 3
6. (a) Discuss how would you determine the molecular formula and isotope peaks by using mass spectroscopy. 6
- (b) What is MALDI-MS? Discuss its working principle. $1 + 4 = 5$
- (c) Write a short note on negative ion chemical ionisation. 3

UNIT-IV

7. (a) Write short notes on each of the following: $3 \times 2 = 6$
- (i) Recoil energy
 (ii) Isomer shift
- (b) How would you obtain the Mossbauer spectrum? Explain. 4
- (c) Explain the Mossbauer spectroscopy applications in $2 \times 2 = 4$
- (i) oxidation state and electronic configuration
 (ii) presence of π -bonding
8. (a) Write short notes on each of the following: $3 \times 2 = 6$
- (i) Doppler shift
 (ii) Quadrupole interaction
- (b) Discuss the principle of Mossbauer spectroscopy. 4
- (c) Explain the Mossbauer spectroscopy applications in $2 \times 2 = 4$
- (i) chemical shift and bond nature
 (ii) biological systems

UNIT-V

9. (a) Discuss the d-spacing formulae and systematically absent reflection from the X-ray diffraction of crystals. 2+2=4
- (b) Explain the screw axes and the different types of glide planes that occur in the crystals. 3+4=7
- (c) Draw the stereographic projection of the point group 422, 32 and mm2. 3
10. (a) Discuss the stereographic projections of the crystals. 5
- (b) Write short notes on the X-ray diffractions by crystals. 3
- (c) Explain the symmetry elements present in the space group tetragonal $I4_1$ by showing the equivalent positions and coordinates present in it. 6
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