

**2022**  
**M.Sc.**  
**Third Semester**  
 CORE – 09  
**CHEMISTRY**  
*Course Code: MCHC 3.11*  
 (Inorganic Chemistry - III)

Total Mark: 70

Pass Mark: 28

Time: 3 hours

Answer five questions, taking one from each unit.

**UNIT-I**

1. (a) Discuss the IR stretching frequencies of ammine complexes. 5  
 (b) Write short notes on the IR spectras of the complexes with:  
     (i) Sulphato as ligand                      (ii) Hydroxo as ligand       $2\frac{1}{2} \times 2 = 5$   
 (c) Give the applications of IR spectroscopy. 4
2. (a) What is the distinguishing factor between hydroxo complexes and aquo complexes in the IR spectrum? 4  
 (b) Explain with examples some unidentate and bidentate sulphato complexes. 5  
 (c) Write notes on the following:  $2\frac{1}{2} \times 2 = 5$   
     (i) Aquo complexes  
     (ii) Thiocyanato complexes

**UNIT-II**

3. (a) What are hyperfine line? 2  
 (b) Give the difference between NMR and ESR spectroscopy? 3  
 (c) How many ESR hyperfine lines are present in the following complexes?  $3 \times 3 = 9$   
     (i)  $[\text{Cu}(\text{NH}_3)_4]^{2+}$                       (ii)  $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$   
     (iii)  $[\text{Cu}(\text{en})_2]^{2+}$   
 Given, Cu ( $I = 3/2$ ), Ti ( $I = 3/2$ ), N ( $I = 1$ ), H ( $I = 1/2$ )

4. (a) Calculate the hyperfine lines present in ESR spectra of  $\dot{\text{N}}\text{H}_2$ .  
 Given, N(I = 1), H (I =  $\frac{1}{2}$ ) 3
- (b) How many NMR signals are present in the following? Mention the intensity ratio. 2×2=4
- (i)  $\text{H}_3\text{PO}_2$  (ii)  $\text{H}_3\text{PO}_3$
- (c) Which nuclear spin (I) value will follow Pascal's triangle of intensity ratio? 1
- (d) Calculate  $^{19}\text{F}$  NMR total signals found in the following. 3×2=6
- (i)  $\text{BrF}_5$  (ii)  $\text{PCl}_2\text{F}_3$   
 Given, P (I =  $\frac{1}{2}$ ) and F (I =  $\frac{1}{2}$ )

### UNIT-III

5. (a) Briefly discuss the instrumentation of ESI-MS. Give its applications in biomolecules. 4+2 =6
- (b) Explain one type of ionisation technique in mass spectroscopy. 4
- (c) Write the fragmentation and bar graph of n-pentane. 4
6. (a) Discuss the instrumentation of MALDIMS. 4
- (b) Write notes on the following: 3×2 = 6
- (i) Molecular ion technique
- (ii) Organometallic representative compound
- (c) With diagrammatic representation, give the instrumentation of mass spectroscopy. 4

### UNIT-IV

7. (a) Discuss the spectral parameter of magnetic interaction. 4
- (b) Discuss the Mossbauer spectroscopy application of structure elucidation. 4
- (c) Write short notes on the following: 3×2=6
- (i) Recoil energy
- (ii) Doppler shift
8. (a) Write short note on Mossbauer spectrum. 4
- (b) Discuss the instrumentation of Mossbauer spectrometer. 4
- (c) Explain the Mossbauer spectroscopy applications of: 3×2=6

- (i) Presence of  $\pi$ -bonding
- (ii) Oxidation state and electronic configuration

### UNIT-V

9. (a) Discuss the four Bravais lattices present in the crystals. 4
- (b) Draw the stereographic projection of the point group 4, 3, 32 and  $mm2$ . 4
- (c) Explain the symmetry elements present in the tetragonal space group  $I4_1$  by showing the equivalent positions and coordinates present in it. 6
10. (a) Write brief notes on the X-ray diffraction by crystals and give the derivation of Bragg's equation. 3+3=6
- (b) Illustrate (100), (110), (111) and (112) planes in cubic lattice and direction indices of [010], [111], [100] and [120]. 6
- (c) Draw the diagrams of the monoclinic space groups P2 and A2. 2
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