

**M. SC. IN CHEMISTRY/
M. SC. IN ANALYTICAL
CHEMISTRY
(MSCCHEM/MSCANCHEM)
Term-End Examination
June, 2026**

MCH-011 : INORGANIC CHEMISTRY—I

Time : 2 Hours

Maximum Marks : 50

Note : Attempt any *five* questions. Question No. 1 is compulsory. All questions carry equal marks.

1. Answer any *five* of the following :
 - (a) Explain variation in oxidation states of Fe and Cu in terms of electronic configuration. 2

- (b) How ethylene interacts with transition metals to form complexes. Illustrate diagrammatically. 2
- (c) Draw the structure of diameric trialkyl-aluminium explaining bond angles. 2
- (d) Illustrate crystal field splitting of *d*-orbitals in tetragonally distorted field. 2
- (e) What are actinoids ? Name all the actinoids and write their general electronic configuration. 2
- (f) Explain Nephelauxetic effect and write the series in terms of ionic and covalently bonded ligands. 2
2. (a) What factors affect atomic radii ? Explain briefly. Arrange the following isoelectronic species in order of decreasing ionic radius : 2+1+2
- $\text{Na}^+, \text{Mg}^{2+}, \text{Al}^{3+}, \text{Si}^{4+}$

- (b) State Bent's rule and explain with a suitable example. Why F-C-F bond angle in CH_2F_2 is less than 109.5° ? Also explain S-character difference for C-H and C-F bonds. 2+1+2
3. (a) Write down chemical equation for the preparation of S_4N_4 and draw its ring structure. Also draw structures of $\text{N}_4\text{S}_4\text{F}_4$, S_4N_2 and $\text{S}_3\text{N}_3\text{F}_3$. 5
- (b) Explain the different modes of coordination of NO ligand in metal complexes. Draw molecular orbital scheme of NO and compare it with CO. 2+3
4. (a) Explain the concept of hapticity with suitable ligands with mono, di, tri and penta hapticity. What is the hapticity in $[\text{Cr}(\eta^6\text{-C}_6\text{H}_6)_2]$? 5

- (b) What is borazine ? How is it prepared by using B_2H_6 and BCl_3 ? Draw valence bond structures of borazine. 5
5. (a) How does metal-metal bonding occur in metal clusters ? Explain any *two* major types of bondings in metal clusters with a suitable example for each. 5
- (b) Define crystal field stabilization energy (CFSE) with illustration. Explain weak and strong field complexes for d^1 to d^{10} configuration and calculate CFSE for each in both types of complexes. 5
6. (a) Write down chemical equations with reaction conditions for the preparation of $Ni(CO)_4$, $Fe(CO)_5$ and $Fe_2(CO)_9$. Also draw their structures. 5

- (b) Discuss three limitations of crystal field theory. Explain why MO theory has to be considered. 5
7. (a) Define and explain the terms μ_s , μ_L and μ_{eff} with mathematical expressions. Out of d^1 to d^9 , in which one of these, orbital contribution is not expected in octahedral complexes. 3+2
- (b) Explain spin crossover with graphical presentation. Which d -electron configurations are likely to have spin crossover and under what conditions ? 3+2
8. (a) What is Russell-Saunders coupling ? Explain coupling of L and S vectors to produce J. Show splitting of terms in carbon ground state by J-J coupling. 1+2+2

- (b) What is the origin of charge transfer spectra ? Explain ligand to metal charge transfer (LMCT) bands considering a π -donor ligand. Give suitable illustration. 2+3

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