

Ref. No.: Ex/Met/BS/B/Chem/T/212/2025

B.E. METALLURGICAL ENGINEERING
SECOND YEAR FIRST SEMESTER EXAM 2025

CHEMISTRY - II

Time : Three hours

Full Marks 100

Use separate answer scripts for each group

Group A

1. (a) What are the differences between qualitative and quantitative analysis? Write any three major application of analytical chemistry.

 $2+3$

- (b) What is oxidation-reduction reaction? What is the role of such reaction in redox titration? Explain with relevant example.

- (c) What do you mean by dichrometometry? What are the advantages of dichrometometry over permanganometry? 1+3

2. (a) What are the reasons behind the fact that EDTA is used as the most acceptable titrant to estimate metal ions by complexometric method? What is the role of pH in complexometric titration? 2+2

- (b) What is metal ion indicator? What are the major criteria for a good metal ion indicator? 1+3

- (c) When the back titration method in complexometric titration is adopted, for the estimation of the amount of metal ion concentration; in a solution? 2

3. (a) What do you mean by digestion in gravimetric analysis? What are the different types of filtration methods are used in this method? How do you estimate the proper drying temperature of the precipitate, after the quantitative separation in gravimetric analysis? 2+2+1

- (b) What is the major difference between Thermogravimetry and Differential thermal analysis? 2

[Turn over

(c) Explain the Thermogravimetric analysis of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ mentioning all the relevant chemical transformations. 3

Group B

4. (a) Write IUPAC name and write the formula of the following complexes 1×3

(i) $[\text{Cr}(\text{H}_2\text{O})_5\text{Br}_2]\text{Cl}$ (ii) $[\text{Pt}(\text{NH}_3)_4\text{Br}_2]^{2+}$ (iii) $\text{Au}(\text{CN})_2^-$

(b) Discuss Werner's coordination theory. Draw the structure of $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$ following the Werner's theory? 3+1

5. Show the hybridization of the central atom in $[\text{Co}(\text{NH}_3)_6]^{3+}$ and $[\text{CoF}_6]^{3-}$ using VBT considering the fact that $[\text{Co}(\text{NH}_3)_6]^{3+}$ and $[\text{CoF}_6]^{3-}$ are diamagnetic and paramagnetic, respectively, in nature. 2+2

6. (a) Which complex of the following pairs has larger value of Δ_o ? Give explanation in support of your answer. 2+2

(i) $[\text{Co}(\text{CN})_6]^{3-}$ and $[\text{CoF}_6]^{3-}$

(ii) $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ and $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$

(b) Calculate CFSE of the following 3+3

(i) $[\text{Co}(\text{NH}_3)_6]^{3+}$ and (ii) $[\text{CoCl}_4]^{2-}$

7. (a) Predict the structure of $[\text{MnCl}_4]^{2-}$ using CFT with the splitting of d -orbital of the metal ion in the complex. Comment on its magnetic properties. 3+1

(b) $[\text{Ni}(\text{NH}_3)_6]^{2+}$ and $[\text{Ni}(\text{CN})_4]^{2-}$ have octahedral and square planar geometry around the metal center. Show the splitting of d -orbital of the metal ion in both the complexes and mention the number of unpaired electron(s) in each complex. 3+3

(c) Determine the spin only magnetic moment of an octahedral $\text{Fe}(\text{II})$ complex in its low spin state using CFT. 2

Group C

Q8 is compulsory and any three from rest of the questions.

8. Mention the commercial name of CCl_3F and CCl_2F_2 2+2

9. (a) Mention main parameters for measuring water quality. 5

(b) Define hardness. How we estimate it? 3

(c) Define the term 'Dissolved Oxygen'? Why it is important? 2

10. What do you mean by 'Chemical Oxygen Demand'? Discuss method of analysis of 'Chemical Oxygen Demand'. Mention interferences of such analysis. 3+4+3

11. (a) Write the reactions involved in the dissociation of O_3 by CF_2Cl_2 . What is 'Null Cycle'?

What is the most adverse effect of ozone depletion on human health? 4+1+1

(b) What is smog? Mention the primary and secondary pollutants produced in sulfurous smog. 2+2

12. (a) What do you mean by fuel rich and fuel lean condition of automobile exhaust? How we can control the pollution under such conditions? 4+1

(b) What is Green House Effect? What do you mean by global warming potential? 3+2