

M.E. Metallurgical Engineering - First Year -1st Sem**Subject: Physicochemical Principles of Metallurgical Processes****Time: Three Hours****Full marks: 100****(Answer any five from the following questions)**

1. (a) What is an Ellingham diagram? What is the basis on which Ellingham diagram is drawn? State the salient features of this diagram. 4+3+3 = 10

(b) What is the need for studying this diagram in connection with extraction of nonferrous metals? 5

(c) (b) What difference do we observe when the relevant data is plotted in the Ellingham diagram for the reactions and justify the difference: (i) $C + O_2 = CO_2$, and (ii) $2C + O_2 = 2CO$ 5

2. (a) What is the difference between roasting and calcination? Name different types of roasting? What is the purpose of roasting in case of hydrometallurgical processes? 4+4+3 = 11

(b) Name the ores used for aluminium extraction. Would you recommend for carbothermic reduction of aluminium ore for extraction of aluminium? Give justification in support of your answer. 2+2+5 = 7

3. (a) Define different heat capacities of a gaseous system? How are these heat capacities mathematically expressed? Derive the relationships for these heat capacities. How are these heat capacities related? 4+2+6+2 = 14

(b) What is known as activity of a component in a solution? What will be the activity of component for a very dilute binary solution? What will be the activity of the component when the solution is not so dilute? 2+2+2 = 6

4. (a) List the advantages and disadvantages of hydrometallurgical processes for metal extraction. 6

(b) Give a general flow sheet showing various steps for hydrometallurgical extraction of metals. 8

(c) How would you know the rate controlling step for leaching reactions? Discuss. 6

5. (a) What is "predominance area diagram?" How this diagram is obtained? Discuss the usefulness of this diagram with an example? 3+6+6 = 15

(b) Find the oxygen partial pressure in equilibrium with a metal and its oxide at a given temperature and make comment about this metal to metal oxide reaction. 5

6. (a) What is cementation reaction? With an example discuss the cementation process and the kinetics involved in this process. 5 + 10 = 15

(b) How is the leaching of gold done? Give all the necessary reactions. 5

7. (a) Discuss the complete process for extraction of aluminium from its ore. 15

(b) Highlight the difficulty associated in the extraction of aluminium and the reason behind such difficulty. 5