M.TECH MATERIAL ENGG AND M.E. METALLURGICAL AND MATERIAL ENGINEERING

FIRST YEAR FIRST SEMESTER EXAM 2018

PHYSICO CHEMICAL PRINCIPLES OF METALLURGICAL PROCESSES

Time Three hours Full Marks 100

Answer any five questions

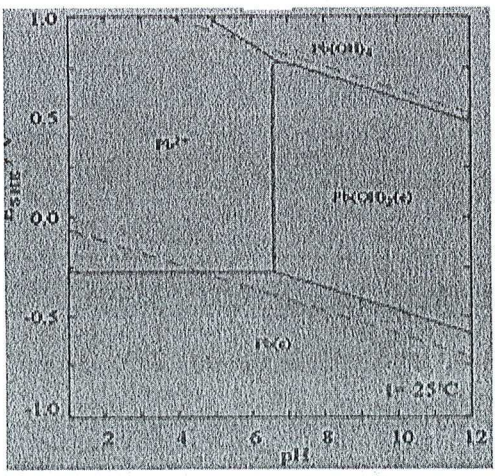
1. You have found a meteorite , having valuable NiO, FeO , Cu_2O. Find out whether Ni and Cu can be pyrometallurgical extraction., using C or CO as reducing agent. Do a thermodynamic study using the following thermodynamic data to find which temperature Ni will be produced and which temperature Cu will be produced. Find out relationship between equilibrium constant and gas pressure assuming all other activities of al solid equal to 1 20

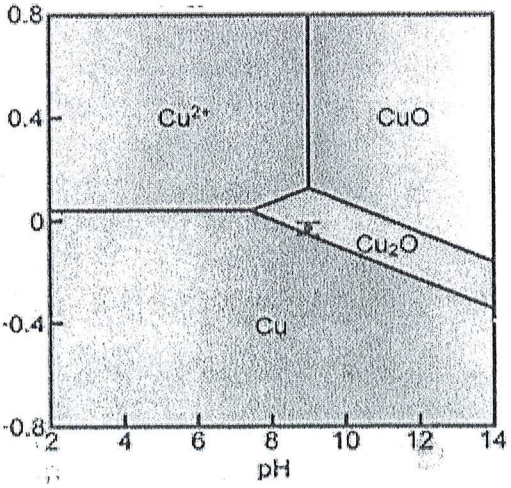
Reaction	G= H –TS , joules
$Ni + 1/2O_2 = NiO$	-235600 +86T
$Fe + 1/2O_2 = FeO$	-263700 + 64.35T
$C + 1/2O_2 = CO$	-111700-87.65T
$C+O_2=CO_2$	-394100-0.84T

2. Explain with diagram the following kinetic reaction mechanism s for metallurgical reactions , take any example. Explain also how will you increase the production rate of the following types of reactions. What will be the effect of particle size, porosity and temperature. 5X4=20

i. Topo Chemical Reaction
ii. Chemical controlled reaction
iii. Diffusion Controlled reaction
iv Mass Transfer controlled reaction

3. You want to produce valuable metals from electronic waste such as mother boards and processors of old computer. The valuables metals are Cu (300/kg), Pb(50gm/kg), Au(0.5mg/kg), Ag(25mg/kg). Use the following E-pH diagram. Consider Au and Ag will only leach in cyanide solution 20





Sketch an hydrometallurgical and electro metallurgical route to produce the metal sparely. Discuss the steps will follow and write down all reactions. State also how will you find deposition potential of the metal at cathode.

4. a. Explain how to draw isomorphous and Eutectic phase diagrams from the concept of Free energy composition diagram at different temperature for solid solution. Apply Gibbs phase rule at eutectic point 12

b. What is Predominance area diagram for metal sulphide. Draw and explain the utility of the diagram 8

5. Explain the following with examples 4X5

a. Roasting b. Matte Smelting c. Leaching e.E-pH diagram e. Electrowining and Electrorefining

6. Distinguish the following in tabular form 5X4

a. Aquous solution electrolysis Fused salt electrolysis
b . Solvent Extraction and Ion exchange
c. Physical adsorption and chemisorption
d. Raoult's Law , Ideal solutrion and Henry's Law Non Ideal solution

7. Write short notes on the following 5X4

a. Elligham diagram b. Adsorption Isotherm c. Alternative standard state and Regular Solution d. Equilibrium and effect of pressure and temperature Gas solid reactions