

**B.E. Metallurgical and Material Engineering - Third Year - Second Semester 2019**  
**SUBJECT : Extraction of Non Ferrous Metals**

Time Three hours

Full Marks 100

Answer any five questions , all questions are of equal marks

1. Explain the following of pyrometallurgical extraction process with reactions and state when and Why it is done. (a) Oxidizing Roasting (b) Chloride Roasting (c) Matte Smelting (d) Reduction Smelting

5X4

2. Discuss the following process

a. Extraction and Refining of Pb

b. Extraction of Mg hydro and electro metallurgical process

c. Explain with a flow chart how will recover, Cu, Zn, Ni from a waste of sulphide of them

8+6+6

3. Draw a flowchart to produce pure  $Al_2O_3$  from the bauxite ore. Explain the following on Bayer process.

(i). How will you decide temperature, pressure and concentration of leaching solution for the ore with different percentage of Boehmite and Gibbsite in the ore. (ii) Why bauxite ore with high % of Silica is not considered as economically viable (iii) Why a critical cooling temperature is required during precipitation stage. (iv) the various factors which control the kinetics of precipitation and agglomeration and how to get very fine precipitate.

5+4+2+4+5

4. Describe with example how E-pH diagrams of the wanted metal and gangue help in selecting proper leachant. State the other factors in choosing a leachant. Explain how cyanide leaching of Au is an electrochemical process with anodic and cathodic areas and reactions. Derive the equation of the rate of this leaching involving leachant concentration. Is cyanide leaching activation or concentration polarization controlled? explain and show how to enhance the rate.

3+ 4+ 3+ 3 +4+3

5. Distinguish between following

6+6+5+3

- i. Electro refining of Cu and Electrowining of Cu
- ii. Solvent Extraction and Ion Exchange
- iii. Aqueous solution Electrolysis and Fused Salt Electrolysis
- iv. Furnace and Converter

[ Turn over

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- 6.. a Draw a modified E-pH diagram Metal potential  $E_M$  and Hydrogen potential  $E_H$  on Y axis and Metal conc  $M^{+n}$  and pH on x axis for a few common metals. Show which metals can be deposited by passing  $H_2$  gas at what pH and metals which cannot be deposited at all by  $H_2$  gas. State reactions and thermodynamics 10
- b.. Explain the thermodynamics and kinetics conditions for cementation of a metal M, from its aqueous solution by another metal M2. How these conditions are achieved ? How will control the process parameters to produce fine cemented metal powder. 4+3+ 3
8. Write short notes on the followings 5+ 5+5 +5
- Extraction of Titanium from Rutile
  - Merit and Demerit of Pyro and Hydrometallurgical extraction
  - Electrolytic Production of Al from molten Cryolite bath
  - Cell Potential from aqueous solution and fused salt electrolysis