

B.E.(MET) Part III 6th Semester Examination, 2010

Subject: NON-FERROUS METALLURGY [MT 603]

Group A

Answer Q. 1 and any three from the rest

1. (Compulsory) Answer any **Five** questions: [5]
- Give an example of metallothermic reduction.
 - Explain why carbothermic reduction of Al_2O_3 to Al is not feasible.
 - Define matte grade,
 - What is Periodic Current Reversal in electrorefining ?
 - Where in India are copper extraction units located'?
 - Name two locations for aluminium extraction plants in India.
 - AG for decomposition of Al_2O_3 in cryolite has a large positive value. Even then how is aluminium obtained from Hall cell ?
 - State the effect of pressure in Mond process.
2. a) Give a labelled flow sheet of the process to obtain cathode copper. Write the reactions involved in converting and fire refining.
- b) 1000 kg chalcopyrite concentrate, containing 66% $CuFeS_2$, is charged in a matte smelter. Assuming 100% recovery of Cu, calculate the quantity of Matte produced and the Matte Grade. Assume that (i) the reaction is : $2CuFeS_2 + O_2 = Cu_2S + 2 FeS + SO_2$, (ii) the matte is $[Cu_2S .FeS]$.
- c) Why is there a change of slope in the line for ZnO formation in Ellingham diagram? [4+4+2]
3. a) Discuss the special design features of Hall cell for Fused Salt electrolysis and the factors that influence overall power consumption . How does the anode reaction influences the cell voltage ?
- b) Compare the fused halide electrolysis methods as applied to Al and Mg, with respect to choice of electrodes, the bath composition and the anodic reactions. 1/+41
4. a) Explain briefly the reason for the following facts regarding Imperial Smelting Process:
i) Agglomerated feed is charged ii) the top is sealed from atmosphere iii) the temperatures of outgoing gases from the reactor, including Zn vapour, is kept high
- b) Explain the basic principle of Pidgeon's process to obtain magnesium. Why is vacuum applied in the retorts? [5+5]
5. a) Discuss the principle of solvent Extraction process, giving a flow sheet, indicating the reagents involved in a commercial application.
- b) Give a flow sheet for hydrometallurgy of zinc. Explain why (i)-w±sp elaborate purification of the electrolyte is required (ii) special care is required in selection of the cathode and the bath composition. [4 1- 6]

6. Answer any two :
- Distinguish between the sintering methods of galena and of hematite
 - How do you obtain pure TiCl_4 from TiO_2 ? What is the utility of converting the oxide to chloride ?
 - How is molten lead refined for removal of precious metals ? Justify- the use of Cl_2 gas in the lead bath after this step.
 - Describe briefly Kroll reduction process for titanium, highlighting the conditions required in the reactor.

Group B

Attempt any three. All questions carry equal marks. Two marks are reserved for neatness.

- Discuss the role of alloying elements in phase stability of Titanium and its alloys. Suggest a possible alloy modification to prevent burning in an aeroengine environment. State the salient features of p to co transformation in these alloys. [5+2+4]
- Why Ni alloys are used as excellent filler materials during dissimilar metal welding? Differentiate between the precipitation hardened and dispersion strengthened Ni alloys. Explain why these alloys suffer from solidification or liquation cracking. Estimate the performance of Ni alloys as superalloys. What is Monel Metal? [2+3+2+3+1]
- State the advantages of non-ferrous alloys over ferrous alloys. Enlist the properties and applications of different refractory materials. What are the limitations of refractory materials? Comment on the performance of Tungsten as filament and its non- sag characteristic. ^3+3+2+3]
- Discuss the possible heat treatments of Magnesium and its alloys. State the factors on which the corrosion resistances of Mg alloys are dependent. Comment on the safety concern of Mg and its alloys. The higher the Zn content (over 1%) the higher will be hot shortness-justify. 1³⁺⁴⁺²⁺²1
- Discuss the composition and use of the following: Muntz Metal, Free Cutting Brass, Tobin Bronze, Manganese Bronze. Comment on the applicability of AA5xxx and AA6xxx alloys in automobile applications. State the mechanism of strengthening in AA7050 alloy. [6+3+2]