

Principles of Extractive Metallurgy (MT 402)

Time: 3 hours

Full Marks :100

Answer all questions

Marks in the margin indicate full marks

All parts of a question must be written at one place

Give neat sketches wherever necessary

1. What are the dimensions of the following terms and why? (i) Thermal conductivity, (ii) View factor, (iii) Heat transfer coefficient, (iv) Specific gravity, (v) Energy efficiency in electro winning, (vi) Reynold's number, (vii) Stephan Boltzman Const. (viii) Faraday constant.

8×2.5=20

2. Ask any good question on any topic related to this course and answer it.

1×10=10

3. Answer any five

(i) Write the heat flux equation for one dimensional steady state heat flow from the interior of a furnace to the outside through a 2 layer composite insulation.

(ii) Explain how in a CaO-SiO₂ melt the anionic structure changes with the CaO content.

(iii) In an electrolytic cell the actual metal produced is only 90% of that expected from theory and the actual voltage is four times the theoretical decomposition voltage. What is the energy efficiency?

(iv) There is an equimolar mixture of NaCl, SnCl₄ and AlCl₃. How will the activity of AlCl₃ change if SnCl₄ is replaced by KBr ?

(v) A sulphide particle is floating with a gas bubble in an aqueous media. Draw, schematically, the surface tension forces operating that is : S-L, L-G, and G-L.

(vi) Explain why solvent extraction process is more effective when there is multiple contacting.

(vii) Explain why an aluminium electrowinning plant needs hundreds of cells i.e 'pots'

5×5=25

4. Say if the following statements are True (T) or False (F)

- (i) In the Ni-O-S phase stability diagram Ni and NiO are separated by a vertical line.
- (ii) For reduction of a metal oxide by carbon the equilibrium ratio of partial pressures of CO and CO₂ decreases with increase in temperature.
- (iii) Zinc, being more electropositive than hydrogen, cannot be electrolyzed in acid solutions.
- (iv) When acid solutions are electrolyzed then acid is consumed but when alkalies are electrolyzed more alkali is produced.
- (v) In Ellingham diagrams the ΔG°_f versus T plots are straight lines unless there is a phase change.
- (vi) Under certain conditions silicate and phosphate slags can contain Si⁴⁺ and P⁵⁺ ions.
- (vii) A hot wall is radiating heat to a colder wall. The view factor will be changed if there are insulating walls enclosing the source and the sink.
- (viii) The main function of a chimney is to release furnace gases at a high level.
- (ix) Limiting current density of an electrolytic cell arises out of the Faraday's laws.
- (x) During communiton most of the energy consumed is required for creating new surfaces.

10×2=20

5. Explain the reasons for your answers for any five of the questions in Q.4.

5×5=25