

BACHELOR OF ENGINEERING IN CHEMICAL ENGINEERING EXAMINATION, 2019

(2nd Year, 2nd Semester)

MATERIAL SCIENCE AND ENGINEERING

Time : Three hours

Full Marks : 100

(Answer Question No. 1 and any four from the rest)

1. Answer any eight from the following questions: 8 x 5 = 20
- According to Fe-C system classify the whole group of plain carbon steel.
 - Schematically draw the phase diagram of a binary system of two metals A and B having no solid solubility of B in A and consider that A and B have complete solubility in each other in the liquid state.
 - Find the amount of proeutectoid phase in annealed 0.45 pct carbon steel and 1.1 pct carbon steel.
 - Why pure gold is not used for making ornaments and what we do to overcome the difficulties.
 - Find the relationship between true stress and engineering stress.
 - What is the purpose of tempering of steel? What would be expected microstructure in case hardened and tempered 1.1 pct carbon steel?
 - Write down the peritectic reaction in case of Fe-C system and comment about this reaction.
 - Justify the selection of hardening temperature of 1.1 wt.pct plain carbon steel.
 - Why aluminium is not extracted from its ore by carbothermic reduction?
 - Write a short note on "Anode Effect".
2. Describe the procedure for obtaining the T-T-T curve of a plain carbon eutectoid steel and comment on the nature of the curve. 10+5 = 15
3. What is meant by hardenability of steel? Define the parameter by which hardenability of steel is indexed. Describe the Jominy Hardenability test procedure and state the advantages and limitations of this method. 2+3+10 = 15
4. Justify the selection of annealing and hardening temperature of 1.1 wt pct plain carbon steel. What is the reason for higher strength observed in case of an alloy as compared to pure metal? Find the packing fraction of an FCC crystal system. Comment on the microstructure of (i) annealed 1.1 wt pct carbon steel, (ii) quenched eutectoid steel. 5+3+3+4= 15
5. Define phase. What is Gibbs Phase Rule? Find the degree of freedom at the eutectoid point of Fe-C system and comment on your result. State the rules for formation of extensive solid solution. Discuss the factors governing the hardenability of steel. 2+2+2+3+6 = 15
6. What microstructures do you expect in the following cases? 15
- 0.2 wt pct plain carbon steel heated at 950°C for 1 hour and then furnace cooled.
 - 0.8 wt. pct plain carbon steel in the hardened condition
 - 1.1 wt pct plain carbon steel heated above ACm temperature for 1 hour and then furnace cooled.
 - Annealed plain carbon eutectoid steel.
 - 1.1 wt. pct plain carbon steel in the normalised condition.

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7. What microstructures do you expect in the following cases? 3x5= 15
- (i) 0.2 wt pct plain carbon steel heated at 950°C for 1 hour and then furnace cooled.
 - (ii) 0.8 wt. pct plain carbon steel in the hardened condition
 - (iii) 1.1 wt pct plain carbon steel heated above ACm temperature for 1 hour and then furnace cooled.
 - (iv) Annealed plain carbon eutectoid steel.
 - (v) 1.1 wt. pct plain carbon steel in the normalised condition.
8. (a) State the advantages and disadvantages for extraction of metals by hydrometallurgical route.
(b) Give a general flow sheet for extraction of metal values from sulfide ore by hydrometallurgical route.
(c) Write a short note on "Cementation Reaction" 5+5+5 = 15
9. (a) Write a short note about "Ellingham Diagram". What is the purpose of Roasting in metal extraction process?
(b) Describe the aluminium extraction process starting from its ore. 4+2+9