

B.E. CHEMICAL ENGINEERING, THIRD YEAR, SECOND SEMESTER EXAM 2018 (Old)**Subject: MATERIAL SCIENCE & ENGG****Time: Three Hours****Full Marks: 100**

(Answer Question No. 1 and any four from the rest. All parts of a question need to be answered chronologically)

- Q 1.** Comment on the expected microstructure in the following cases (any four): 5 x 4 = 20
- 0.8 wt pct plain carbon steel slowly cooled from a temperature 750°C.
 - A plain carbon steel containing 0.8 wt pct carbon tempered at 700°C for 6 hrs after hardening treatment.
 - 0.4 wt pct plain carbon steel heated at 950°C and cooled down to 50°C at a rate higher than critical cooling rate.
 - 1.1 wt pct plain carbon steel under hardened condition.
 - 0.2 pct plain carbon steel under annealed state
 - A piece of pure iron heated at 950°C and cooled very slowly in the furnace.
 - 0.2 wt pct plain carbon steel heated at 740°C (intercritical region) and cooled down to 50°C at a very high cooling rate.
- Q 2. (a)** What is a grain of a polycrystal? Define Phase. State the Gibbs Phase rule for condensed matter system? Write down the eutectoid reaction of Fe-C system and find the degree of freedom for such reaction. 2+ 2+ 2 + 4 = 10
- (b)** Write down the peritectic reaction in case of Fe-C system. Why this reaction does not go to completion? What is pearlite and what is the characterizing parameter of pearlite? 2+ 4+ 4 = 10
- Q 3. (a)** Justify the selection of hardening (austenising) temperature in case of 1.2 wt pct plain carbon steel.
- (b)** Whether retained austenite in the hardened structure in 1.0 pct and 1.2 pct plain carbon steel would be same or vary? Justify your answer.
- (c)** Why hardening-tempering treatment is known as the most important heat treatment process of steel?
- (d)** Find the relationship for critical size of nucleus in case of homogeneous nucleation. On what factor does this critical size depend and how? 5+4+3+5+3=20
- Q 4. (a)** What are the advantages and disadvantages of hydrometallurgy? Describe the purification processes of bauxite employed for extraction of aluminium. 6+8 = 14
- (b)** What is electro-refining? With an example find the theoretical cell voltage for electro-refining process. 3+ 3 = 6
- Q 5. (a)** State the Hume-Rothery Rule for formation of extensive binary solid solution. What is a binary isomorphous system? Define packing density and find the packing density of FCC unit cell. 4+3+2+3 = 10
- (b)** Describe complete procedure for obtaining the T-T-T curve of a plain carbon eutectoid steel and explain the nature of the curve with reasons. 10
- Q 6. (a)** What is a crystal? How would you find the Miller indices of a plane in cubic crystal system? Draw the (210) and (111) planes in a cubic crystal system. How would you know the crystalline nature of a material? 2+3+4+3 = 12
- (b)** Draw a binary phase diagram which shows complete miscibility of the components both in solid and liquid phases. 8
- Q7. (a)** What is known as hardenability of steel? What is Grossman hardenability? Discuss the factors on which hardenability of steel depend. 3+3+6 = 12
- (b)** After drawing the engineering stress-strain curve of a ductile material discuss the nature of the curve. What are the properties one can obtain from this curve? 6 + 2 = 8