B.E. CHEMICAL ENGINEERING, SECOND YEAR, SECOND SEMESTER EXAM 2017

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 five): 4 x 5 = 20

     a. 1.1 wt pct plain carbon steel in normalized state.
     b. A plain carbon steel containing 0.8 wt pct carbon tempered at $700^\circ C$ for 6 hrs after hardening treatment.
     c. 0.4 wt pct plain carbon steel in the annealed state.
     d. A plain carbon hypereurectoid steel under hardened condition.
     e. An eutectoid steel in the hardened condition.
     f. A piece of pure iron heated at $950^\circ C$ and cooled very slowly in the furnace.
     g. 0.2 wt pct plain carbon steel heated at $735^\circ C$ and cooled down to $50^\circ C$ at a very high cooling rate.

Q 2. (a) 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

     (b) What is martensite? Discuss about the lattice correspondence between the parent and product phase in case of martensitic transformation of steel. What is the significance of Ms Temperature?   2+5+3

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?
     (e) Give the example for peritectic reaction in Fe-C system. Why the reaction is incomplete in nature.
                                                  5+4+3+5+3 = 20

Q 4. (a) What is the basis for Ellingham Diagram? What is the benefit of studying Ellingham Diagram? Explain the nature of the slopes for $C-CO_2$ and C-CO lines.
     (b) Comment with example on the phenomenon for change in slope of certain lines in Ellingham Diagram.
     (c) Describe the gold extraction process by hydrometallurgical route.
     (d) Write a short note on "Anode Effect"   2+2+3+3+6+4 = 20

Q 5. (a) Give the flow sheet for the Bayer's process in extraction of Aluminium.
     (b) After mentioning a suitable example discuss the contact reduction process of metals in aqueous solution.
     (c) Discuss the leaching process of an ore including the kinetics of leaching. How would you determine the rate controlling step during leaching of an ore?   5+7+8 = 20

Q 6. Define packing density of unit cell. Find the packing density for FCC unit cell. Find the Burgers Vector of Ferrite and Austenite? Find the relationship between true strain and engineering strain. Draw and explain the nature of the engineering stress-strain curve of a moderately ductile material. What are the properties can be obtained from this curve what are the measures of these properties.   2+3+2+3+6+4 = 20