Fourth Semester B.E. Degree Examination, Dec.2014/Jan.2015
Material Science and Metallurgy

Time: 3 hrs.   Max. Marks:100

Note: Answer any FIVE full questions, selecting atleast TWO questions from each part.

PART - A

1. a. Determine and compare the atomic packing factor of a B.C.C and F.C.C crystal structure with respect of densities. **(10 Marks)**
   b. The density of Iron is 7.88 gm/cm^3 and the atomic weight is 55.85. Calculate its atomic radius. **(05 Marks)**
   c. The diffusion coefficient of nickel in austenitic steel is 10^{-22} m^2/sec at 500^{0}C and 10^{-15} m^2/sec at 1000^{0}C. Calculate the activation energy for the diffusion of nickel in this alloy over this temperature range. **(05 Marks)**

2. a. Draw the stress – strain diagram for a ductile material and explain the mechanical properties in elastic and plastic region. **(10 Marks)**
   b. A copper wire has a nominal breaking strength of 300 MPa its ductility is 77% reduction of area. Calculate the true stress for fracture. **(04 Marks)**
   c. Derive an equation for critical resolved shear stress in slip. When it is maximum? **(06 Marks)**

3. a. Define creep. With a typical creep curve, explain the different stages of creep. **(06 Marks)**
   b. Difference between Ductile fracture over Brittle fracture. **(04 Marks)**
   c. Explain Griffith's criterion of brittle fracture. **(04 Marks)**
   d. Draw the S – N diagram for mild steel and aluminium and explain. **(06 Marks)**

4. a. Explain the mechanism of solidification in pure metals and derive an expression for the critical size of the nucleus. **(08 Marks)**
   b. What are the factors that affect the cast metal structure? Show schematically, the different cast metal structure. **(06 Marks)**
   c. What is a solid solution? List the Hume Rothery rules for the formation of substitutional solid solution. **(06 Marks)**

PART - B

5. a. Draw a neat sketch of Fe – Fe$_3$C system and show all phase fields, temperature, composition on it. Write down the three reaction involved in Fe – Fe$_3$C system. **(10 Marks)**
   b. Explain the construction of two metals is completely soluble in liquid state and partly soluble in the solid state. Give the typical example. **(06 Marks)**
   c. A binary alloy A – 50% B, contains at particular temperature two solid phases α and β. The compositions of α and β are 5% B and 95% B respectively. Calculate the amount of α and β in the alloy. **(04 Marks)**

6. a. What is T.T.T diagram? Explain with a neat sketch, the martensitic transformation of austenite. **(10 Marks)**
   b. What is heat treatment? Briefly explain the different surface treatments with sketch. **(10 Marks)**

7   a. Compare the micro structure, composition, properties and application of S.G. Iron and gray C.I.   **(08 Marks)**

    b. Explain the effect of different alloying elements on steel.   **(06 Marks)**

    c. Give the composition and application of copper and its alloy.   **(06 Marks)**

8   a. Define a composite material and classify composite materials according to

       i) Matrix materials and   ii) Reinforcement materials used.   **(08 Marks)**

    b. What are the techniques of producing M.M.C's? Explain briefly.   **(06 Marks)**

    c. List the advantages and application of composite materials.   **(06 Marks)**

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