USN | | | | | | | | | | |

10ME32A/AU32A/MT32/TL32

Third 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. Classify in detail the different types of crystal imperfections. Explain with a neat sketch the edge dislocation. **(08 Marks)**

b. Illustrate steady state and non-steady state diffusion. **(06 Marks)**

c. Steel gear, having carbon content of 0.2% is to be gas carburized to achieve carbon content of 0.90% at the surface and 0.4% at 0.5mm depth from the surface. If the process is to be carried out at 927°C, find the time required for carburization. Take diffusion co-efficient of carbon in given steel = 1.28×10^{-11} mt^2/sec. Given data: **(06 Marks)**

Z	erf(z)
0.75	0.7112
z	0.7143
0.8	0.7421

2 a. Derive an expression for critical resolved shear stress for slip in a crystal structure. **(06 Marks)**

b. Establish the relationship between engineering stress and true stress also show the relationship of engineering strain and true strain. **(06 Marks)**

c. Consider a tensile specimen of 5mm diameter and 25mm gauge length. If its diameter is reduced to 4mm through plastic deformation. What is its length at this stage? Also find engineering stress, true stress, engineering strain and true strain where load applied is 500N. **(08 Marks)**

3 a. Illustrate the stages in the cup and cone fracture with suitable sketches. **(08 Marks)**

b. Define stress relaxation. Derive the corresponding expression. **(06 Marks)**

c. A fatigue test is made with mean stress, σ_m = 120MPa and stress-amplitude σ_a = 165MPa find σ_{max}, σ_{min}, σ_{range} and σ_{ratio}. **(06 Marks)**

4 a. Explain the mechanism of solidification. **(06 Marks)**

b. What is a solid solution? Mention the types of solid solution. Also enumerate Hume-Rothary rules governing the formation of solid solution. **(08 Marks)**

c. A cooling curve is shown in figure below, determine the following:

i) The pouring temperature
ii) The solidification temperature
iii) The super heat
iv) The cooling rate, just before solidification begins
v) The total solidification time
vi) The local solidification time. **(06 Marks)**

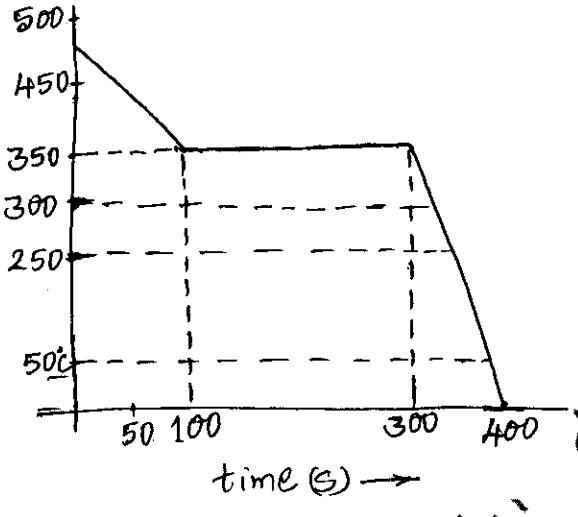

Fig.Q.4(c)

PART – B

5 a. Draw the Iron-Carbon equilibrium diagram and label it. Show the invariant points on it. Write the reactions occurring at these points indicating the temperature and composition of each phase. **(10 Marks)**

b. Two metals A and B have their melting points at 900°C and 800°C respectively. The alloy pair forms an eutectic at 600°C of composition 60% B. They have unlimited liquid solubilities. The solid solubility of A in B is 10% and that of B in A is 5% at eutectic temperature and remains constant till 0°C. Draw the phase diagram and label all the fields. Find the amount of liquid and solid phases in an alloy of 20% B at 650°C. **(10 Marks)**

6 a. Draw the TTT diagram for eutectoid steel and explain the different micro structures obtained at various cooling rates. **(10 Marks)**

b. Mention the types of heat treatment processes. Explain with a suitable sketch the full annealing process. **(10 Marks)**

7 a. Explain the structure, composition and properties of gray cast iron. **(06 Marks)**

b. Briefly explain the effect of alloying elements on properties of steel. **(06 Marks)**

c. Write a short note on the copper and its alloys. **(08 Marks)**

8 a. Define composite material. Give the classification based on matrix, geometry of reinforcement and construction. Also explain briefly the production of filament winding process with a neat sketch. **(10 Marks)**

b. Explain with a neat sketch the pultrusion process and mention its applications. **(10 Marks)**

* * * * *