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06ME32A

# Third Semester B.E. Degree Examination, Dec.09/Jan.10
# Materials 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. Sketch any three types of Bravais lattices. **(06 Marks)**

b. Determine the relationship between atomic radius and lattice parameters in cubic systems [simple cubic, BCC and FCC]. **(06 Marks)**

c. Illustrate the steady-state diffusion. **(08 Marks)**

2 a. From the tensile stress-strain behaviour for the brass specimen shown in Fig. Q2(a), determine the following :

i) The modulus of elasticity

ii) The yield strength at a strain offset of 0.002.

iii) The maximum load that can be sustained by a cylindrical specimen having an original diameter of 12.7 mm.

iv) The change in length of specimen originally 250 mm long which is subjected to a tensile stress of 350 MPa. **(12 Marks)**

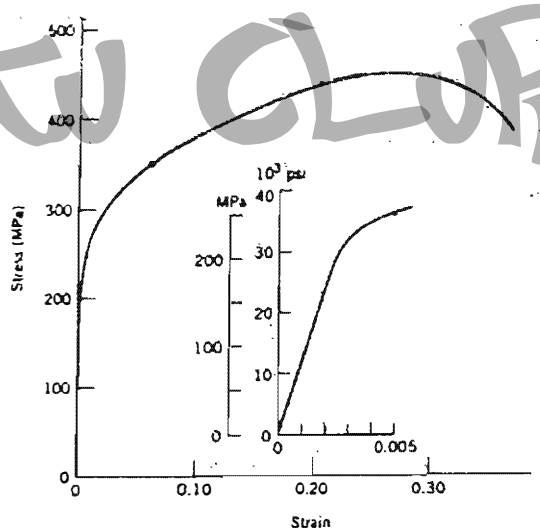


Fig. Q2(a)

b. When a 3000 kg load is applied to a 10 mm diameter ball in a Brinell test of a steel, an indentation of 3.1 mm is produced. Estimate the tensile strength of the steel. **(04 Marks)**

c. A piece of copper originally 300 mm long is pulled in tension with a stress of 270 MPa. If the deformation is entirely elastic, what will be the resultant elongation? ($E \approx 100 \times 10^3$ MPa) **(04 Marks)**

3 a. Illustrate the stages in the cup and cone facture **(08 Marks)**

b. What is fatigue? Draw the SN curves for i) a material that displays a fatigue limit ii) a material that does not display a fatigue limit. **(08 Marks)**

c. Explain how fatigue life can be enhanced. **(04 Marks)**

4 a. Explain unlimited suitability and limited solubility with examples **(08 Marks)**

b. A cooling curve is shown in Fig. Q4(b). Determine the following :

i) The pouring temperature
ii) The solidification temperature
iii) The superheat
iv) The cooling rate, just before solidification beings
v) The total solidification time
vi) The local solidification time.

**(06 Marks)**

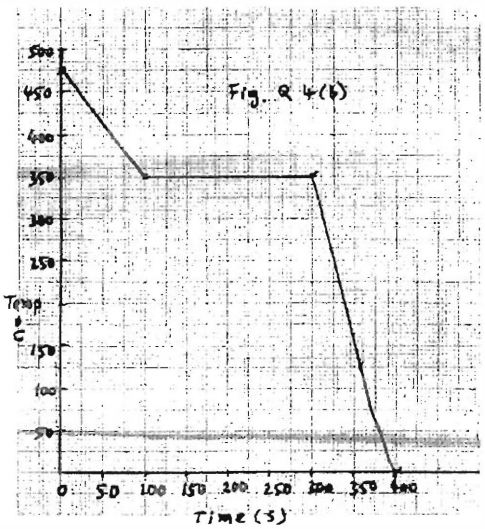


Fig. Q4(b)

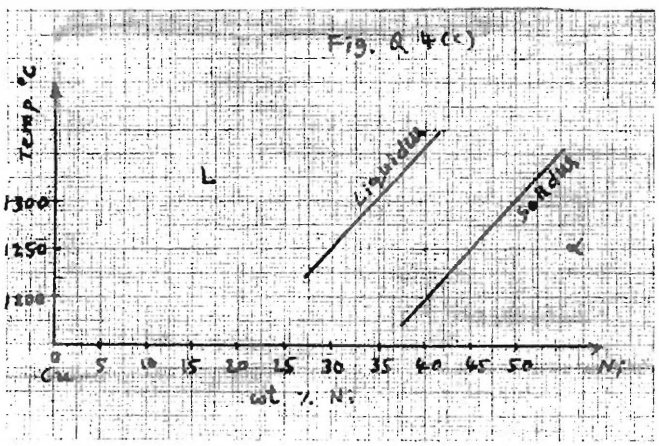


Fig. Q4(c)

c. Calculate the amounts of α and L at 1250°C and 1175°C in the Cu-40% Ni alloy shown in Fig. Q4(c). **(06 Marks)**



## PART-B

5 a. Write the three invariant reactions in the Fe-$Fe_3C$ phase diagram. **(06 Marks)**

b. What is a plain carbon steel? Discuss the transformation of eutectoid steel (0.8% C) with slow cooling. **(08 Marks)**

c. Illustrate the effects alloying elements on the eutectoid temperature of steels. **(06 Marks)**

6 a. Illustrate the variation in the microstructure of eutectoid plain-carbon steel by continuously cooling at different rates. **(12 Marks)**

b. Schematically illustrate the customary quenching and tempering process for a plan-carbon steel. **(08 Marks)**

7 a. Discuss AISI-SAE designation of steels, with examples. **(05 Marks)**

b. Show schematically, the microstructures of the following cast irons : gray iron, white iron, malleable iron, ductile iron and compacted graphite iron. **(15 Marks)**

8 a. What is corrosion? Discuss grain-grain boundary galvanic cells. **(08 Marks)**

b. Explain 'Two metal corrosion'. **(06 Marks)**

c. Explain how underground pipelines are protected using a magnesium anode. **(06 Marks)**

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