Total No. of printed pages = 3

ME 181404

8/8/22

Roll No. of candidate | | | | | | | | | | |

2022

B.Tech. 4th Semester End-Term Examination

MATERIALS SCIENCE

(New Regulation & New Syllabus)

Full Marks – 70

Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No. 1 and any *four* from the rest.

1. Write the correct answer : $(5 \times 2 = 10)$

(i) The first X-ray diffraction (XRD) peak for BCC crystal will be from the plane

(a) (100) (b) (110)

(c) (111) (d) (200)

(ii) The interplaner spacing (d_{hkl}) and the Miller indices for the reflecting plane with XRD peak position $\theta = 20.3^{\circ}$ will be from (Take $\lambda = 1.54\,\mathring{A}$ and lattice parameter $\alpha = 3.16\,\mathring{A}$)

(a) 2.22 $\mathring{A}$ and (110) (b) 2.22 $\mathring{A}$ and (200)

(c) 1.579 $\mathring{A}$ and (110) (d) 1.579 $\mathring{A}$ and (200)

(iii) At atmospheric pressure, an alloy of a particular overall composition shows 3 phases in equilibrium at400°C. The minimum number of components in the system will be

(a) 1 (b) 2

(c) 3 (d) 4

(iv) Slip plane in copper will be

(a) (100) (b) (110)

(c) (111) (d) (0001)

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(v) If engineering strain = 0.2, the true strain will be given by

(a) 0.128 (b) 0.182

(c) 1.282 (d) 1.822

2. (a) Briefly explain the powder method of x-ray diffraction. (2+5=7)

(b) From a powder camera of diameter 114.6 mm, using an x-ray beam of wavelength 1.54 $\mathring{A}$, the following S values in mm are obtained for a material: 86, 100, 148, 180, 188, 232 and 272. Determine the structure and the lattice parameter of the material. (8)

3. Lead (Pb) and tin (Sn) melts at 327°C and 232°C, respectively. In Pb-Sn phase diagram, there is a complete liquid solubility and partial solid solubility between the two elements. Pb forms a solid solution α by dissolving Sn to a maximum solubility of 19 wt.% at 183°C and Sn forms a solid solution β by dissolving Pb to a maximum solubility of 3 wt.% at 183°C. A eutectic reaction takes place at 183°C when liquid of composition 38.1 wt.% Pb and 61.9 wt.% Sn solidifies.

(a) Draw Pb-Sn phase diagram on scale based on the above information. Join known points with straight lines assuming zero solid solubility-at 0 °C for both the terminal solid solutions α and β. Label all the phase fields.

(b) Identify with sketches the microstructure changes that occur during solidification of liquid metal of composition 80 wt.% Sn.

(c) Determine the amount of phases just above and below 183°C for a liquid of the above composition.

(d) Recommend with justification a composition that will act as an effective electronic solder corresponding to the Pb-Sn alloy system (5+3+4+3)

4. (a) Explain the stress-strain curve for a ductile material with a neat diagram. (5)

(b) Suring a tensile test of a specimen with a 16 mm diameter and 50 mm gauge length the following data were obtained:

Maximum load = 100 KN

Fracture load = 80 KN

Fractured diameter = 12 mm

Load at 0.2% offset = 8.2 KN

Gange length at practure = 65 mm

Determine :

(i) Engineering stress at maximum load

(ii) True fracture stress

(iii) True strain at fracture

(iv) Engineering strain at fracture

(v) Yield stress

(vi) Percentage elongation

(vii) Percentage reduction in area. (10)

5. (a) Explain the TTT diagram for eutectoid steel with a neat diagram. (10)

(b) Describe briefly the full annealing heat treatment of steel. (5)

6. (a) What is twining? Explain briefly the mechanism of twining. (5)

(b) Discuss briefly the various dislocation strengthening mechanisms. (10)

Or

(c) Discuss the various point imperfections observed in solids. (15)

7. (a) Name the different types of tool steels along with relative percentage of their components. (5)

(b) Discuss about the properties of different types of cast unions. (10)
