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Roll Number

Thapar Institute of Engineering and Technology, Patiala

School of Physics and Materials Science

END SEMESTER EXAMINATION

B. E.: Semester-IV (2017/18) Course Code: UES012

Course Name: Engineering Materials

21st May 2018

Time: 03 Hours, MM: 100 Name of faculty: KUS, PNS, CBN, BCM, PPS, JTK, CHK

Note: 1. Attempt all parts of questions together.
2. Answers should be precise and to the point.
3. Assume any missing data suitably.

1. (a) Draw a labelled two component (A & B) hypothetical phase diagram from the following data: **(8)**

i. Melting point of A and B are 1400 °C and 1100 °C, respectively.
ii. Maximum solid solubility of A in B is 10% and the solubility drops down to zero at 200 °C.
iii. Solid solubility of B in A is negligible.

The eutectic reaction takes place at 900 °C for 70% of B.

(b) From the above constructed phase diagram for the composition of 20 % B, determine the fraction of liquid and solid phases at 1000 °C. **(4)**

(c) Draw the microstructural changes that occur at 75% of B during cooling from liquid state to solid state. **(4)**

2. (a) Explain stress corrosion cracking with suitable diagram. **(6)**

(b) Differentiate (with suitable diagrams) between **(3x4)**

(i) Type I and Type II superconductors
(ii) Frenkel and Schottky defects
(iii) Intrinsic and Extrinsic semiconductors

3. (a) A steel wire of diameter 4 mm has a breaking strength of $4X10^5$ N. What is the breaking strength of similar steel wire of diameter 2 mm? **(4)**

(b) What is critical resolved shear stress (CRSS) for a material? Derive its expression for an ideal crystal. Why is CRSS of real crystal much lower than that for the ideal crystal? **(10)**

(c) A continuous and aligned fibre-reinforced composite consists of 45 vol % aramid fibres (Y_A=131 GPa) and 55 vol % of a polycarbonate matrix (Y_P = 2.4 GPa). Determine: **(6)**

i. Longitudinal Young's modulus.
ii. Stress in aramid fibres when load of 50 N is applied parallel to fibres.

4. (a) List four planar (2D) crystal imperfections. **(4)**

(b) Draw the most favourable burger vectors for BCC and FCC unit cells. **(4)**

(c) Draw (i) engineering stress-strain curve and (ii) true strain-strain curve for a metallic specimen. **(6)**

5. (a) List four types of polarizations possible in dielectric material. Explain any one of them (with suitable diagram). **(6)**

(b) Differentiate between hard and soft magnetic materials with suitable examples and hysteresis loops. Also give two engineering applications of each. **(8)**

(c) What is Mattheissen rule for resistivity? Draw the temperature dependent resistivity curves for pure Cu and Cu alloyed with Ni. **(4)**

6. (a) List the empirical rules that govern the formation of substitutional solid solution. **(4)**

(b) Draw the following planes and directions: **(4)**
$(1\bar{2}1)$, $(10\bar{1}1)$, $[211]$, $[\bar{1}101]$

(c) Determine the expected location of the XRD peak for the first-order reflection from the (310) set of planes for BCC chromium (a = 0.288 nm) when monochromatic radiation of wavelength 0.0711 nm is used. **(6)**
