

Roll Number

**Thapar Institute of Engineering and Technology, Patiala**

School of Physics and Materials Science

**END SEMESTER EXAMINATION**

B. E.: Semester-III, VII (2017/18)  
(COE/ ECE/ ENC/ELE)

Course Code: UES012

Course Name: Engineering Materials

December 07, 2017

Thursday , 9 AM

Time: 03 Hours, MM: 100

Name of faculty: OPP, KUS, PNS, CBN, BCM, LKB, DBD, PPS,  
JTK, MUK, CDK

**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 neatly labelled binary isomorphous phase diagram of two components A and B having melting points  $700^{\circ}\text{C}$  and  $1000^{\circ}\text{C}$ , respectively. (14)  
(i) For an overall composition of 50 % B at  $850^{\circ}\text{C}$ , calculate the weight fraction of the liquid and solid phases in the system.  
(ii) Calculate the degrees of freedom in two phase region.
- (b) Discuss (with suitable diagram) the microstructural changes which occur for eutectic composition during solidification. (6)
2. (a) Calculate and compare the planar density for (200) plane in monoatomic BCC and FCC crystal structures. (6)  
(b) List any four differences between the screw and the edge dislocations. (6)
3. (a) Draw diagrams for stiff and relax dislocations. In Ni, the dislocation width is 4 times the magnitude of the burger vector; calculate the stress required to move a dislocation. The shear modulus of Ni is 70 GPa. (6)  
(b) Briefly explain (30-40 words):
  - i. Peierls and Nabarro stress for movement of a dislocation
  - ii. Solute strengthening method(c) Sketch the true stress - true strain curve for a ductile specimen. State the relation between;
  - (i) engineering stress and true stress
  - (ii) engineering strain and true strain(2x3)
4. (a) Briefly explain pitting corrosion and galvanic corrosion. Name two methods of prevention for each. (8)  
(b) Write the expression for relaxation time ( $t_r$ ) for an anelastic material. Draw stress - strain curves when (i)  $t \ll t_r$  (ii)  $t \gg t_r$  (iii)  $t \sim t_r$ , where  $t$  is the duration of loading cycle. (8)

5. (a) Differentiate between (using suitable diagrams): (3x6)  
i. Type I and type II superconductors.  
ii. Paramagnetic and ferromagnetic materials  
iii. Electronic and orientational polarization in solids
- (b) List the properties required in a material for the following applications (4)  
i. Heating element  
ii. Electrical contacts
6. (a) Determine the lattice parameter for a cubic crystal from the given XRD peak positions ( $2\theta$ ):  $38.7^\circ, 45.4^\circ, 65.7^\circ, 78.8^\circ$ . ( $\lambda=0.154 \text{ nm}$ ) (8)  
(b) Draw a neatly labelled unit cell for NaCl structure. Draw the Burgers vector, if a dislocation were to occur in this structure. (4)
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