VIT
Vellore Institute of Technology

SCHOOL OF MECHANICAL ENGINEERING

Continuous Assessment Test – I Fall Semester 2019-2020

Programme Name & Branch: B.Tech (Mechanical Engineering)

Course Name & Code: Materials Engineering and Technology (MEE1005)

Class Number: VL2019201001411/ VL2019201001836/ VL2019201001961

Slot: B2+TB2 **Exam Duration: 90 mins** **Maximum Marks: 50**

Answer all questions

1. Classify the following engineering materials and specify the bonding in it. Also arrange them in increasing order of tensile strength and density. Mention any one of the application of each material [10]

   (a) Stainless steel (b) Teflon (c) Alumina (d) Kevlar reinforced epoxy and (e) Inconel

2. (a) Draw the following planes in cubic unit cell [5]

   (i) (110) (ii) $(1\bar{2}1)$ (iii) (210)

   (b) There is a dislocation lying along $[\bar{1}01]$ in a FCC crystal. Its Burgers vector is $\frac{a}{2}[0\bar{1}1]$. What type of dislocation is it? Determine its slip plane. [5]

3. (a) Distinguish between resolved shear stress and critically resolved shear stress in deformation of single crystals with the help of schematic. Give the significance of yield strength. [5]

   (b) Determine the ASTM grain size number of the given materials and predict the nature of grain as shown in Figure 1. Assume all grains are of equal size.

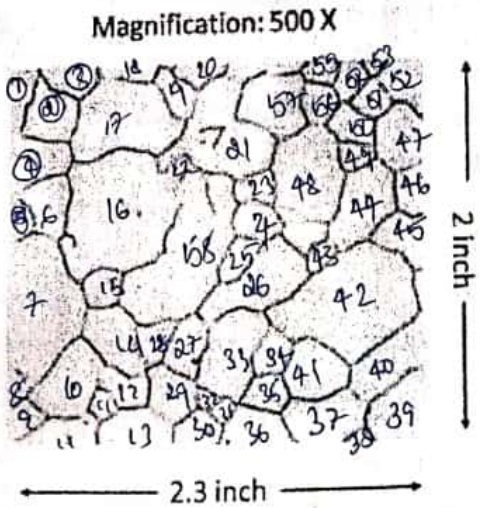

Figure 1 [5]

4. (a) Do you think alloys are superior to metals in their mechanical properties? Justify with examples and application. Discuss the mechanism involved in alloying. [5]

(b) Calculate the fraction of atom sites that are vacant for copper (Cu) at its melting temperature of 1084°C (1357 K). Assume an energy for vacancy formation of 0.90 eV/atom. Repeat this calculation at room temperature (298 K). [5]

5. (a) Atomic radius, crystal structure, electronegativity, and the most common valence are given in the following Table 1 for several elements; for those that are nonmetals, only atomic radii are indicated

Table 1

Element	*Atomic Radius (nm)*	*Crystal Structure*	*Electro-negativity*	*Valence*
Ni	0.1246	FCC	1.8	+2
C	0.071			
H	0.046			
O	0.060			
Ag	0.1445	FCC	1.9	+1
Al	0.1431	FCC	1.5	+3
Co	0.1253	HCP	1.8	+2
Cr	0.1249	BCC	1.6	+3
Fe	0.1241	BCC	1.8	+2
Pt	0.1387	FCC	2.2	+2
Zn	0.1332	HCP	1.6	+2

Which of these elements would expect to form the following with nickel:

(i) a substitutional solid solution having complete solubility

(ii) a substitutional solid solution of incomplete solubility

(iii) an interstitial solid solution [5]

b) Draw the cooling curve of pure Iron (Fe) with various phases marked on it and find the degree of freedom at freezing temperature of Fe [5]