VIT
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

SCHOOL OF MECHANICAL ENGINEERING

CONTINUOUS ASSESSMENT TEST – I

SLOT: B2+TB2

FALL SEMESTER 2022-2023

Programme Name & Branch : **B. Tech Mechanical Engineering**
Course Code/Name : BMEE209L/ Materials Science and Engineering
Faculty Name(s) : Dr. A. Raja Annamalai, Dr. Rijesh M, Dr. M S Sreekanth, Dr. Md.Faseeullakhan, Dr. Ashish
Class Number(s) : VL2022230100536, VL2022230100545, VL2022230100540, VL2022230100560, VL2022230100562

Duration: 90 min. **Max. Marks: 50**

Answer all questions

Q. No	Question	Marks	Course Outcome (CO)	Bloom's Taxonomy (BL)
1	a) Calculate the volume of a BCC unit cell in terms of the atomic radius, R. Show that the atomic packing factor of FCC unit cell is more than that of BCC.	6	1	1
	b) Mention any four details that can be possibly inferred from the microstructure study	4	1	2
2.	a) Calculate the radius of an iridium atom, given that Ir has an FCC crystal structure, a density of 22.4 g/cm^3, and an atomic weight of 192.2 g/mol. Assume NA = 6.02214076×10^{23} mol^{-1}	10	1	1
	b) A piezoelectric ceramic is suspected to have oxygen anions (O^{2-}) at locations 0 ½ ½, ½ 0 ½, ½ ½ 0, calcium cations (Ca^{2+}) at 000, and titanium cations (Ti^{4+}) at ½ ½ ½. Draw and label the contents of a unit cell of this material. What is the chemical formula?		1	1
3.	a) Calculate the planar density of (100) and (110) plane and linear density of [111] and [110] direction in FCC metal (a = 0.5 nm).	10	1	3
	b) What is the angle between a [110] direction and a (110) plane?			
4.	a) Describe allotropic transformation and polymorphism with examples.	10	1	3
	b) Calculate the number of vacancies per cubic meter in gold at 900°C. The energy for vacancy formation is 0.98 eV/atom; the density for Au is 18.63 g/cm^3 (at 900°C) and the atomic weight is 196.9 g/mol. Assume 'k_B' = 1.380649×10^{-23} J·K^{-1}			
5.	a) Explain how the Burgers circuit is drawn to determine the Burgers vector ($\vec{b}$) in edge dislocation.	10	1	2
	b) (i) For a given material, would you expect the surface energy to be greater than, the same as, or less than the grain boundary energy? Why? (ii) The grain boundary energy of a small angle grain boundary is less than for a high angle one. Why is this so?		1	2