VIT
Vellore Institute of Technology

SCHOOL OF MECHANICAL ENGINEERING
CONTINUOUS ASSESSMENT TEST – I
FALL SEMESTER 2022-2023

SLOT:B1+TB1

Programme Name & Branch : B. TECH (MECHANICAL ENGINEERING)
Course Code/Name: BMEE209L
Faculty Name(s):: Prof(s). SITARAM DASH, M. S. SREEKANTH, MD. FASEEULLAKHAN, YAZAR K. U.
Class Number(s): VL2022230100537/561/540/543
Duration: 90 min. **Max. Marks: 50**

General instruction(s):

Answer all questions. Please read questions carefully before answering

Q. No	Question	Marks	Course Outcome (CO)	Bloom's Taxonomy (BL)
1	a) With the help of material tetrahedron explain how structure-property correlation will help material processing requirement? Elucidate your answer with suitable example.(5 marks)	10	1	2
	b) Differentiate between metals and ceramics with respect to density, ductility and electrical conductivity. Justify your answer with suitable explanation and examples. (5 marks)			
2	a) Why are Piezoelectric materials known as smart materials? Why is $BaTiO_3$ piezoelectric? (4 marks)	10	1	2
	b) An FCC unit cell with lattice parameter a transforms to a BCC unit cell with similar lattice parameter. Work out volumetric changes that accompany such a transformation(6 marks)			
3	a)Distinguish crystalline and amorphous solids. Explain atomic arrangement in quartz and glass with suitable schematic. (5 marks)	10	1	3
	b) Draw following crystallographic planes in cubic crystals. (5 marks) $(101),\ (112),\ (1\bar{1}1)$ *and* (011)			
4	a) Draw the crystal structure of Titanium metal. Indicate various types of planes and compute volume of unit cell in terms of lattice parameters a and c. (5 marks)	10	1	1
	b) Draw a bcc unit cell and compute linear density along [111] direction.(5 marks)			
5	a) Compute number of vacancies per cubic meter of Aluminium at 300 degree C. The energy for vacancy formation is 0.56 eV/atom. The atomic weight and density of aluminium are 27 gm/mole and 2.7 gm/cm^3 , respectively.(6 marks)	10	1	1
	b) Conceptually explain difference between deformation by slipping and twinning with the help of suitable schematic. (4 marks)			

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CONTINUOUS ASSESSMENT TEST - 1

SLOT: B1+TB1

FALL SEMESTER 2022-2023

Programme Name & Branch : B.Tech. Mechanical Engineering
Course Code/Name : BMEE209L / Materials Science and Engineering
Faculty Name(s) : Dr. K. Devendranath Ramkumar
Class Number(s) : VL2022230100533
Duration: 90 min.

General instruction(s):

Max. Marks: 50

Q. No	Question	Marks	Course Outcome (CO)	Bloom's Taxonomy (BL)
1.	(a) Calculate the theoretical volume change accompanying a polymorphic transformation in a pure iron from FCC to BCC crystal structure. Assume the hard sphere atomic model and that there is no change in atomic volume before and after transformation.	07	CO1	BL2
	(b) Determine the inter-planar spacing of copper in the closely packed plane (d_{hkl}) with a lattice constant of 0.361 nm?	03		
2.	(a) Derive planar density expressions for FCC (100) and (111) planes in terms of the atomic radius.	07	CO1	BL2
	(b) Compute and compare planar density values for these same two planes for nickel, whose lattice constant is 0.125 nm.	03		
3.	Find the direction common to (110)and (1̄10) planes by (a) geometric methods and (b) the application of Weiss Zone Law.	10	CO1	BL2
4.	(a) Mention in detail any five traits that can be inferred from the microstructure examination	04	CO1	BL3
	(b) Determine the ASTM grain size number if 12 grains per square inch are measured at a magnification of x 500.	03		
	(c) Compare and contrast the thermosetting and thermoplastic polymers based on processing and applications.	03		
5.	(a) The yield strength of mild steel with an average of 0.08 mm is 200 MPa. The yield strength of the same metal is 360 MPa if the grain size is 0.005 mm. What will be the average grain size of the same steel with a yield strength of 240 MPa? Assume the Hall-Petch equation is valid and that changes in the observed yield stress are due to the changes in grain size.	07	CO1	BL2
	(c) What is the metallurgical problem associated with the wreckage of titanic ship?	03		

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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