



SCHOOL OF MECHANICAL ENGINEERING
CONTINUOUS ASSESSMENT TEST - I
FALL SEMESTER 2025-2026

UDN107
3

Programme Name & Branch

: B.TECH. (Mechanical Engineering)

Course Code

: BMEE209L

Course Name

: Materials Science & Engineering

Faculty Name(s)

: Dr. Ariful Rahaman, Dr. Sreekanth M.S, Dr. Padmanabhan K.,
Dr. Narendrakumar U, Dr. Atul Kumar, Dr. Vivek Kumar Barnwal

Class Number(s)

: VL2025260102140; VL2025260102141; VL2025260102136; VL2025260102137;
VL2025260102142; VL2025260102134

Date of Examination

: 18/08/2025

Exam Duration

: 90 minutes

Maximum Marks: 50

General instruction(s):

- Answer All Questions
- M - Max mark; CO - Course Outcome; BL - Blooms Taxonomy Level (1 - Remember, 2 - Understand, 3 - Apply, 4 - Analyse, 5 - Evaluate, 6 - Create)
- Course Outcome Statements:
CO 1: Compare different structures based on the atomic arrangement.
CO 2: Examine various phases of metals and alloys using phase diagrams
CO 3: Assess the mechanical behaviour of materials according to the standards

Q. No	Question	M	CO	BL
1.	Classify the following engineering materials into metals/alloys, ceramics, polymers and specify the bonding. Also mention any two application of these materials: Steel, Boron nitride, Polyethylene, Glass, and Copper.	10	CO1	3
2.	Draw (110) and (111) both the planes in a single FCC unit cell. Calculate the planar density of both planes. Find the Miller indices of the directions which are common to both the planes. Calculate the linear density of common direction in this crystal with lattice parameter (0.4 nm).	10	CO1	4
3.	a) Why is it that the corner atom in a cubic structure always assigned an 1/8 atomic size value though the co-ordination numbers change from 6 for SCC, 8 for BCC and 12 for FCC and HCP. In other words why is it that the fraction is the same despite different co-ordination numbers? Justify with sketches. (5 marks)	10	CO1	4



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	b) On each of three separate drawings of one face of an FCC unit cell, indicate one of each of the following: (i) substitutional impurity; (ii) vacancy; (iii) interstitial impurity (5 marks)			
4.	i) Derive the relationship between the applied tensile stress and the shear stress acting on the slip plane in the slip direction during the plastic deformation of single crystal material. Explain the difference between resolved shear stress and critical resolved shear stress. (5 marks) ii) A single crystal of copper is deformed in tension. The loading axis is $[112]$. Rank the following slip systems in terms of activation (means which slip system will activate first and second). Given: critical resolved shear stress value is 50 MPa, Slip systems: $(\bar{1}\bar{1}1)[110]$; $(1\bar{1}1)[011]$ (5 marks)	10	CO3	4
5.	i) Distinguish between homogeneous nucleation and heterogeneous nucleation. (3 marks) ii) During solidification of gold (FCC), a critical nucleus was formed which consisted of 548 atoms. Predict the degree of undercooling given for homogeneous nucleation. Given: Latent heat of fusion $= 1.16 \times 10^9 \text{ J/m}^3$, Surface free energy $= 0.132 \text{ J/m}^2$, Lattice parameter $= 0.413 \text{ nm}$, Melting point of gold $= 1064^\circ\text{C}$. (7 marks)	10	CO2	4