



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

Programme Name & Branch : B.Tech. Mechanical Engineering
Course Code : BMEE209L
Course Name : Materials Science and Engineering
Faculty Name(s) : Dr. SK Ariful Rahman, Dr. Kishore Kumar Mahato, Dr. Ashish Kumar, Dr. Yazar K U, Dr. Vivek Kumar Barnwal, Dr. Mahesh VP
Class Number(s) : VL2025260107377, VL2025260102144, VL2025260102900, VL2025260102909, VL2025260102143, VL2025260102916
Date of Examination : 18th August 2025
Exam Duration : 90 minutes **Maximum Marks: 50**

General instruction(s):

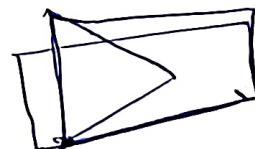
- Answer All Questions
- M - Max mark; CO – Course Outcome; BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)
- Course Outcome Statements:

CO 1: Compare different structures based on the atomic arrangement.

CO 2: Examine various phases of metals and alloys using phase diagrams.

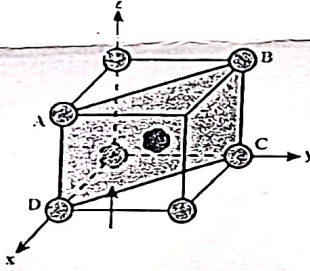
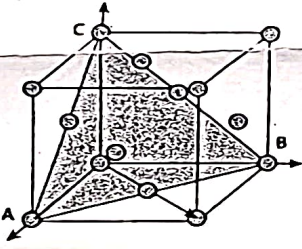
CO 3: Assess the mechanical behaviour of materials according to the standards.

Q. No	Question	M	CO	BL
1.	Identify the class of materials based on the descriptions given below. For each class, provide a brief note along with suitable examples and typical applications: i. A hypothetical category of materials characterized by low density and covalent bonding, primarily known for their use in lightweight structural applications. ii. A group of materials with a <u>well-ordered atomic structure</u> with good balance of <u>strength and ductility</u> . iii. This class comprises materials with strong, non-directional ionic bonds, typically exhibiting high melting points and excellent thermal and electrical insulation properties. iv. Materials in this category possess electrical conductivity values between those of metals and insulators; their conductivity is highly sensitive to trace amount of impurity atoms.	10	01	03
2.	A single crystal of a BCC metal is subjected to a tensile stress of 80 MPa along the [135] direction. The most favourable slip system for BCC is typically the {110}{111} slip system. Given: CRSS of the metal is 30 MPa . Determine:	10	01	04





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	I. The resolved shear stress on the given slip system and discuss whether the crystal will yield under the applied stress? II. Also find out what is the CRSS value, when the stress direction is perpendicular to preferred slip plane and making 45° with the preferred slip direction.			
3.	a) A micrograph of a steel sample is taken at a magnification of $50\times$. In a circular region of 1 inch diameter, there are 95 grains visible. Using the ASTM grain size estimation method, calculate the ASTM grain size number (G). (5 marks) b) A steel exhibits a yield strength of 310 MPa when its average grain size is $25\text{ }\mu\text{m}$. After heat treatment, the grain size is refined to $6.25\text{ }\mu\text{m}$, resulting in an increased yield strength of 470 MPa. Using the Hall-Petch relationship, estimate the yield strength of the same steel when the grain size will be $12.5\text{ }\mu\text{m}$. (5 marks)	10	03	03
4.	Figure-out the Miller Indices of following shaded planes a) ABC and b) ABCD respectively and evaluate the planar density of respective planes, if the lattice parameter is given as $[a = 0.287\text{nm}]$.  (a) (b)	10	01	03
5.	a) Examine and compare the energy diagrams of homogeneous and heterogeneous nucleation. (5 marks) b) Analyse how the rate of cooling affects the size of grains during the solidification of metals. (5 marks)	10	02	04
