

Exam. Code: 1015

Sub. Code: 35218

2056

**M.E. (Mechanical Engineering)-Second Semester
MME-203: Advances in Engineering Materials**

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt five questions in all, selecting atleast two questions from each Section.

Draw neat labeled diagrams wherever required. All questions carry 10 marks.

x-x-x

SECTION A

- Q1. (a) Explain structure–property correlation with engineering examples.
(b) Draw neat diagrams of edge and screw dislocations and explain their role in strengthening.
(c) A material shows increase in strength from 200MPa to 350MPa after cold working. Explain quantitatively using dislocation density concept.
- Q2. (a) Draw stereographic projection of (100), (110), and (111) planes.
(b) Calculate the angle between (110) and (111) planes in a cubic crystal.
(c) Show poles and great circles clearly.
- Q3. (a) Derive Bragg's Law.
(b) X-rays of wavelength $1.54 \text{ \AA}$ give a first-order reflection at $\theta = 30^\circ$. Calculate interplanar spacing (d).
(c) A second peak appears at $\theta = 45^\circ$. Identify possible plane indices (cubic).
(d) Sketch typical XRD pattern for phase identification.
- Q4. (a) Draw DTA, DSC and TGA curves for a material undergoing phase change.
(b) A sample reduces from 120 mg to 90 mg between $400\text{--}600^\circ\text{C}$. Calculate % weight loss.
(c) Explain how DSC is used to determine T_g .

SECTION B

- Q5. (a) Draw optical microscope with labeled components.
(b) Calculate resolving power if $\lambda = 550 \text{ nm}$, $NA = 1.4$.
(c) Discuss limitations and improvements.
- Q6. (a) Draw SEM setup and explain working.
(b) Electron wavelength at $100 \text{ kV} \approx 0.0037 \text{ nm}$. Compare resolution with optical microscope.
(c) Draw TEM schematic and explain diffraction pattern formation.
(d) Explain STM working principle with diagram.

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- Q7. (a) Classify polymers based on structure with diagrams.
(b) Explain glass transition temperature (T_g).
(c) A polymer has $T_g = 100^\circ\text{C}$. Predict behavior at 25°C and 150°C .
(d) Discuss mechanical properties of polymers.

- Q8. (a) Classify nanomaterials and methods of synthesis.
(b) Calculate surface area/volume ratio for a cube of 10 nm side.
(c) Explain Shape Memory Alloy (SMA) with stress-strain diagram.
(d) Write applications of PMMA, ABS, Nylon, Teflon.

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