



End Term (Odd) Semester Examination November 2025

Roll no.....

Name of the Course and semester: B.Tech 3rd Semester (ME)

Name of the Paper: Material Science

Paper Code: TME302

Time: 3 hour

Maximum Marks: 100

Note:

- (i) All the questions are compulsory.
- (ii) Answer any two sub questions from a, b and c in each main question.
- (iii) Total marks for each question is 20 (twenty).
- (iv) Each sub-question carries 10 marks.

Q1. (2X10=20 Marks)

- a. Describe the different types of interatomic bonding found in materials. Illustrate each type with suitable examples. (CO1)
- b. Provide a classification of engineering materials based on their structure and mechanical properties. (CO1, CO2)
- c. Define imperfections (defects) in crystalline solids. Describe their classification and effects on material properties. (CO2)

Q2. (2X10=20 Marks)

- a. What are dislocations in crystals? Describe the nature of edge and screw dislocations with the help of neat, labelled diagrams. (CO1, CO2)
- b. State and explain the Hume-Rothery rules governing the formation of substitutional solid solutions in metals. (CO2)
- c. Calculate the lattice constant of a cubic crystal when the (210) plane gives a first-order reflection at an angle of 40.5° using Cu K α radiation ($\lambda = 1.54 \text{ \AA}$). (CO2, CO3)

Q3. (2X10=20 Marks)

- a. Explain the different kinds of point defects commonly observed in crystalline materials. (CO3)
- b. Explain the kinetics of solid-state phase transformations and illustrate the significance of isothermal transformation (TTT) diagrams. (CO3, CO4)
- c. Discuss the principles, mechanisms, and benefits of various surface hardening techniques, including carburizing, nitriding, carbonitriding, and induction hardening. (CO3)

Q4. (2X10=20 Marks)

- a. Explain the Aluminium-Copper (Al-Cu) and Aluminium-Silicon (Al-Si) alloy systems and discuss their industrial applications and importance. (CO3, CO4)
- b. Illustrate the Iron-Carbon (Fe-Fe₃C) phase diagram, describing all critical points, reactions, and microstructural transformations. (CO3, CO4)
- c. Classify the types of phase transformations and differentiate between homogeneous and heterogeneous nucleation mechanisms. (CO4)

Q5. (2X10=20 Marks)

- a. Describe the various heat treatment processes such as annealing, normalizing, hardening, and tempering, and discuss how each process influences the microstructure and mechanical properties of steel. (CO5)
- b. Describe the properties and applications of dielectric, piezoelectric, ferroelectric, and pyroelectric materials with appropriate examples (CO5, CO6)
- c. Explain the optical properties of solids, including refractive index, light absorption, and transmission, and relate them to material structure. (CO5, CO6)