



Term Evaluation (Odd) Semester Examination September 2025

Roll no.....

Name of the Course: **B.Tech., Mechanical Engineering**

Semester: **III**

Name of the Paper: **Material Science**

Paper Code: **TME 302**

Time: **1.5 hour**

Maximum Marks: 50

Note:

- (i) Answer all the questions by choosing any one of the sub-questions
- (ii) Each question carries 10 marks.

Q1.

(10 Marks)

- a. Calculate the equilibrium number of vacancies per cubic meter for copper at 1000 °C. The energy for vacancy formation is 0.9 eV/atom; the atomic weight and density (at 1000 °C) for copper are 63.5 g/mol and 8.4 g/cm³, respectively. (CO1 & CO5)

OR

- b. Differentiate between solid solutions, intermediate phases, and intermetallic compounds. Give two examples of each and describe their significance in engineering applications. (CO1 & CO5)

Q2.

(10 Marks)

- a. Sketch a unit cell for the simple cubic (SC), body centered cubic (BCC), face centered cubic (FCC), tetragonal, and orthorhombic crystal structure. (CO1 & CO5)

OR

- b. Compute the atomic packing fraction (APF) for the BCC and FCC crystal structure. (CO1 & CO5)

Q3.

(10 Marks)

- a. Within a cubic unit cell, sketch the following directions:

[101] [211] [301] [111] and [012]. (CO1 & CO5)

OR

- b. Determine the unit cell volume of the FCC crystal structure with neat and clean diagram. (CO1 & CO5)

Q4.

(10 Marks)

- a. Calculate the theoretical density of the copper where copper has an atomic radius of 0.128 nm, an FCC crystal structure, and an atomic weight of 63.5 g/mol. (CO1 & CO5)

OR

- b. Discuss Hume-Rothery rules for the formation of substitutional solid solutions. Illustrate with examples how atomic size, electronegativity, valency, and crystal structure affect solubility. (CO2 & CO5)

Q5.

(10 Marks)

- a. Answer the followings:

- (i) Write Fick's first and second laws in equation form, and define all parameters.
- (ii) Differentiate the elastic deformation and plastic deformation in detail. (CO1, CO2 & CO5)

OR

- b. Compare diffusion mechanisms: vacancy diffusion and interstitial diffusion, with suitable examples. Explain the working principle of X-Ray Diffraction (XRD) in determining crystal structures. (CO2 & CO5)