



Daffodil International University
Department of Electrical and Electronic Engineering
Faculty of Engineering
Mid-Term Examination, Fall-2026

Course Code: 0713-215

Course Title: Electrical Properties of Materials

Section: A, B, C, D

Level-Term: L2-T3

Teacher's Initials: SH

Full Marks: 25

Exam Date: October 28, 2026

Time: 1.5 Hours.

[Notes: Answer all the Questions. The second right most column indicates the course outcomes with respective Bloom's level and right most column indicates the allocated marks]

Q1. Briefly **explain** the generalized molecular bonding theory with neat, clear, and well-labeled diagrams.

CO-1 4
(C2)

Q2. A unit cell is shown in the Fig. 1:

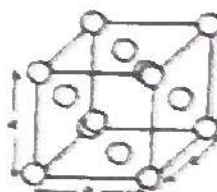
Cell parameter, $a = 0.362 \text{ nm}$ a) **Find** the planner concentration for plane (110).b) **Find** the planner concentration for plane (111).

Fig. 1

CO-1 4
(C2)

Q3. The energy of vacancy formation in the Ge crystal is about 2.2 eV. **Calculate** the fractional concentration of vacancies in Ge at 938 °C, just below its melting temperature. **Estimate** the vacancy concentration given that the atomic mass and density of Ge are 72.64 g mol^{-1} and 5.32 g cm^{-3} , respectively. Neglect the change in the density with temperature.

CO-1 4
(C2)

Q4. a) **Deduce** the expression of the electrical conductivity, $\sigma = en\mu_e$, for a solid using the classical free electron theory.

CO-3 5
(C4)

b) **Calculate** the drift mobility and the mean scattering time of conduction electrons in copper at room temperature, given that the conductivity of copper is $5.9 \times 10^6 \Omega^{-1} \text{ cm}^{-1}$. The density of copper is 8.96 g cm^{-3} and its atomic mass is 63.5 g mol^{-1} . If the applied electric field is 5 V cm^{-1} , **estimate** the mean free path of conduction electrons between collisions.

CO-3 4
(C3)

Q5. Using Fourier's Law of thermal conduction and Ohm's law of resistivity, **derive** the model for thermal resistivity when heat flows through a solid crystal.

CO-3 4
(C4)