Name of the Program: B.Sc. Engg. (EE), 4th Semester Date: March 06, 2024 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

**DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING**

Mid-Semester Examination
Course No.: EEE 4409
Course Title: Semiconductor Physics

Summer Semester, A.Y. 2022-2023
Full Marks: 75
Time: 90 Minutes

There are **05 (five)** questions. Answer **all 5 (five)** questions. Marks for parts of the questions and corresponding CO and PO are indicated in the right margin. Programmable calculators are not allowed. Do not write on this question paper. Symbols carry their usual meanings.

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1. Explain how Fermi function varies with electron energy for T = 0 K and T > 0 K in intrinsic semiconductors and for T > 0 K in extrinsic semiconductors. 15 (CO1) (PO1)

2. Explain Hall effect with equations and diagrams. Also, explain invariance of the Fermi level at equilibrium using equations and diagrams. 4+11 (CO1) (PO1)

3. Formulate the continuity equations for excess electron and hole concentrations in semiconductor using suitable diagram and necessary justifications. From those equations, formulate the diffusion equations. 11+4 (CO1) (PO1)

4. Formulate the equations of injected minority carrier concentrations in the neutral regions of a biased p-n junction as functions of distance from the transition region edges. Using the equations, formulate the equation of diode current. 15 (CO2) ( PO2)

5. An abrupt Si $p^+$-n junction has $N_d = 10^{15}$ cm$^{-3}$, $\tau_p = 10$ μs, $\mu_n = 1300$ cm$^2$/V-s and $\mu_p = 450$ cm$^2$/V-s on n-side and $N_a = 5\times10^{18}$ cm$^{-3}$ on p-side. Cross sectional area of the junction is $10^{-4}$ cm$^2$ and temperature is 300 K. Find out the diode currents under 0.3 V forward bias and 0.04 V reverse bias. 15 (CO2) (PO2)