

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. 2021-2022

Full Marks: 75

Time: 90 Minutes

There are **03 (three)** questions. Answer **all 3 (three)** 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.

1. a) Using suitable diagram, explain the formation of energy bands in solid Si. Explain the concept of effective mass of charge carriers (for conductivity calculation) in semiconductors. 12+3
(CO1)
(PO1, PO2, PO5)
- b) Define direct bandgap and indirect bandgap semiconductors with examples. Explain how extrinsic carrier concentrations in semiconductor vary with temperature. 6+9
(CO1)
(PO1, PO2, PO5)
2. a) Derive the continuity equations for excess electron and hole concentrations in semiconductor using suitable diagram and necessary justifications. From those equations, derive the diffusion equations. 11+4
(CO1)
(PO1, PO2, PO5)
- b) An abrupt Si p-n junction has $N_a = 10^{18} \text{ cm}^{-3}$ on p-side and $N_d = 10^{17} \text{ cm}^{-3}$ on n-side. The junction has uniform cross-sectional area of $2 \times 10^{-5} \text{ cm}^2$. Relative permittivity of Si is 11.8. Calculate: i) W , ii) x_{no} , iii) x_{po} and iv) \mathcal{E}_0 under a reverse-bias of 2 V. 6+3+3+3
(CO2)
(PO1, PO2, PO5)
3. a) Deduce the equation of contact potential of a p-n junction. 5
(CO2)
(PO1, PO2, PO5)
- b) Explain the current flow mechanism in a p-n junction at equilibrium and at non-equilibrium (forward-bias and reverse-bias) using suitable diagrams. 10
(CO2)
(PO1, PO2, PO5)