

Student ID:

Islamic University of Technology (IUT)

Marks:

Organization of Islamic Cooperation (OIC)

Department of Electrical and Electronic Engineering

Course no. : Phy 4421

Course Title : Semiconductor Devices

Class Test : 1B

Date : 23-12-2021

Time : 20 Minutes

Marks : 15

1. Explain how Fermi function varies with electron energy for  $T > 0$  K in intrinsic semiconductors.

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2. Using diagram, show how carrier mobility varies with temperature in semiconductor. Which factors affect mobility in this case?

3+2



3. A sample of Si is doped with  $8 \times 10^{16}$  boron atoms/cm<sup>3</sup>. What Hall voltage would you expect in a sample 90  $\mu\text{m}$  thick if  $I_x = 2$  mA and  $B_z = 10^{-5}$  Wb/cm<sup>2</sup>? What is the value of Hall coefficient?

$$n_0 = 8 \times 10^{16}$$

$$P_0 = \frac{n_0^2}{n_0} = \frac{(1.5 \times 10^{10})^2}{8 \times 10^{16}} = 2812.5$$

$$P_0 = 1.6 \times 10^{-19}$$

~~g~~

$$t = 90 \times 10^{-4}$$

$$I_x = 2 \times 10^{-3} \text{ A}$$

$$B_z = 1 \times 10^{-5} \text{ Wb/cm}^2$$

$$R_H = \frac{1}{q n_0}$$

$$= \frac{1}{1.6 \times 10^{-19} \times 2812.5}$$

$$= 2.222 \times 10^{15}$$

$$V_{AB} =$$

$$R_H =$$

$$R_H = \frac{1}{q n_0}$$

$$0.1 \times \frac{1}{1000} = 0.001 \text{ m}$$

$$= -78.125 \text{ cm}^3/\text{C}$$

$$R_H = \frac{1}{1.6 \times 10^{-19} \times 8 \times 10^{16}} =$$

$$V_{AB} = \frac{I_x B_z R_H}{t}$$

$$= \frac{2 \times 10^{-3} \times 1 \times 10^{-5} \times -78.125}{90 \times 10^{-4}}$$

$$= 1.5625 \times 10^{-4}$$

$$= 15.625 \text{ mV}$$

$$V_{AB} = \frac{I_x B_z}{q n_0 t}$$

$$1 \times 10^{-3} = 0.001$$