Q4. given that

$\rho = 3000$ ohm·m, $\mu_e = 0.12 m^2/V.s$, $\mu_h = c$

$$\rho = \frac{1}{\sigma} = \frac{1}{e n_i (\mu_e + \mu_h)}$$

$$n_i = \frac{1}{e\rho(\mu_e + \mu_h)}$$

$$n_i = \frac{1}{1.6\times10^{-19} \times 3000 (0.12 + 0.045)}$$

$$n_i = 0.365 \times 10^{16} m^{-3}$$

for Intrinsic Semiconductor

$Si + P \rightarrow$ n type

$$n_e \cdot n_h = n_i^2$$

$$n_e \cdot n_h = (1.263\times10^{16})^2 m^{-6}$$

(i) $Si + P \rightarrow$ n type ($\bar{e}$)

$$n_e = 10^{19}/m^3$$

$\therefore$ resistivity $\rho = \frac{1}{e n_e \mu_e} = \frac{1}{1.6\times10^{-19}\times10^{19}\times0.12}$

$$\boxed{\rho = 5.208 \text{ ohm·m}}$$

(ii) $Si \rightarrow$ Boron $\rightarrow$ P type (hole) acceptor

$$n_h - n_e = 2\times10^{19} - 10^{19} = 10^{19}$$

$$\rho = \frac{1}{e n_h \mu_h} = \frac{1}{1.6\times10^{-19}\times10^{19}\times0.045}$$

$\rho = 1.389$ ohm·m