EECS 2210 Notes

Richard Robinson

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1 Semiconductors

The hole density p and electron density n are related by

$$np = n_i^2 \tag{1}$$

where n_i is the number of electrons per unit volume.

In charge carriers, the velocity of electrons and holes are given by

$$\mathbf{v}_e = -\mu_n \mathbf{E} \quad \text{and} \quad \mathbf{v}_h = \mu_p \mathbf{E} \tag{2}$$

where μ is the mobility in $\text{cm}^2/(\text{V} \cdot \text{s})$ and $E = V/L$.

Consequently, the current in a carrier is defined as

$$I = -\rho A v_d \quad \text{for} \quad \rho = nq \tag{3}$$

such that the current density $J_n = I/A$. The total density is given by

$$J_{tot} = q(\mu_n n + \mu_p p)E \tag{4}$$