

Homework 8

EE 362 Electronic, Magnetic, & Optical Properties of Materials (Spring 2026) Wednesday, April 1, 2026

- 1) 8.2 First, calculate the thermal equilibrium minority carrier concentrations for the n & p regions.
- 2) 8.5
- 3) 8.16 Change doping concentrations to $N_a = 4 \times 10^{16} \text{ cm}^{-3}$ and $N_d = 10^{16} \text{ cm}^{-3}$. First, calculate the minority thermal equilibrium carrier concentrations and diffusion lengths for the n & p regions. [Hint: e) find total current & hole current at $x = x_n + L_p/2$, subtract to get electron current.]
- 4) 8.28 **First, calculate the minority thermal equilibrium carrier concentrations and diffusion lengths for the n & p regions.**
- 5) 8.30 **First, calculate the minority thermal equilibrium carrier concentrations, diffusion coefficients D_n and D_p , and diffusion lengths for the n & p regions.**
- 6) 8.39 First, find the small-signal diffusion conductance g_d and capacitance C_d . **[Hint: It's a p⁺n diode. Compare the contribution from the holes versus electrons to the current, one term is negligible.]**
- 7) A GaAs pn junction diode at 300 K has a cross-sectional area of $5 \times 10^{-7} \text{ m}^2$. The length of the p-region is 0.8 mm while the length of the n-region is 0.6 mm. The doping concentrations are $N_a = 2 \times 10^{16} \text{ cm}^{-3}$ and $N_d = 10^{17} \text{ cm}^{-3}$. a) Use Figure 5.3 to get mobilities μ_n and μ_p for each region. b) Use Einstein relation to get the diffusion coefficients D_n and D_p for each region. c) Calculate conductivities σ_n and σ_p for each region. d) Neglecting the depletion layer width, find the series resistance $r_{s,n}$ and $r_{s,p}$ for each region as well as overall r_s .
- 8) An ideal germanium pn junction diode at 300 K has a reverse-saturation current $I_s = 8 \text{ pA}$. a) Calculate the small-signal diffusion resistance r_d for an applied forward bias voltage of 30 mV. b) Calculate r_d for an applied reverse bias voltage of -30 mV.

Due Wednesday, April 8, 2026.

Notes:

- Carry *at least* 6 significant figures on constants/parameters in calculations. Give answers with 4-5 significant figures.
- If a solution requires the use of a graph, include the graph with work shown.
- Read **Note** at beginning of PROBLEMS section on page 323.