**ECE 3030 Spring 2025 HW 5 Hints**

1. Use $g_{op} \cdot \tau$ for extra charges, S&B Fig. 3-17 for $n_{i,}$,and $kT \cdot (T/300K)$ for kT at higher temperature, and Lecture 16, slide 3 for $F_n - F_p$.
2. (a) Use S&B Fig. 3-23 for $\mu$ vs doping. Use electron drift velocity $v_d$ versus electric field from S&B, Fig. 3-24. R vs $\rho$ equation. (Lecture 10, slide 14).
   (b) $\mu_n$ from S&B Appendix III for undoped Si.
3. Use $qn_i(\mu_n + \mu_p)$ with Eq. 3-26 for $n_i(T)$ to calculate how $\sigma_i$ changes with T. Assume $N_C$, $N_V$, and $E_G$ don't change with temperature. Then calculate the ratio of $n_i$ at the two temperatures and use to obtain the higher temperature $\sigma_i$ value.
4. Lecture 11, slide 8. Get $\mu$ from $\rho$.
5. Lecture 17. Slide 4&8. Note: parameter $a = 2(\mu m)^{-1} = 2 \times 10^4 (cm)^{-1}$. Tilted bands have $E_i$ with same tilt, but $E_F$ flat, heading toward valence or conduction band, depending on whether donors or acceptors.
6. (a) Lecture 18. Find stored charge by integration.
   (b) Use lifetime $\tau$ with stored charge.
   (c) Equation 4-40 and $d(\delta p)/dx$.

7. From Hints or Appendix III, $\mu_n = 250\ cm^2/V\text{-}S$ and $\mu_p = 15\ cm^2/V\text{-}S$ for CdS. Solve for $\sigma$, $\rho$, and R to get length L and width W of photoconductor layout to obtain dark resistance. Assume $p_0 = 0$.