

3. A symmetrical Ge p-n-p transistor with emitter-base and collector-base junctions, each 1 mm in diameter, has an impurity concentration of $5 \times 10^{15}$ cm$^{-3}$ in the base and $10^{18}$ cm$^{-3}$ in the emitter and the collector. The base-width is 10 $\mu$m, $\tau_B = 4 \times 10^{-6}$ sec, $\tau_e = 10^{-8}$ sec, and the emitter region is much longer than the diffusion length $L_E$. Calculate the injection efficiency $\gamma$, base transport factor $\alpha_T$, forward current gain $\alpha$, and common emitter gain $\beta$ ($hFE$) of the transistor. Take $D_B = 47$ cm$^2$sec$^{-1}$ and $D_E = 52$ cm$^2$sec$^{-1}$.

4. The emitter and collector regions of a Si alloyed p-n-p transistor are heavily doped, and the impurity concentration in the base is $1E15$ cm$^{-3}$. Calculate the base-width that will make the avalanche breakdown voltage ($BV_{CBO}$) equal to the punch-through voltage. The punch through voltage is given by: $V_{PT} = q N_d W_{bo}^2/(2\varepsilon_s)$, where $W_{bo}$ is the metallurgical base width. Assume that avalanche breakdown occurs when the maximum field strength in the C-B depletion region becomes $E_{crit} = 5 \times 10^5$ V/cm.

Homework assignments will appear on the web at:
http://www.ece.udel.edu/~kolodzey/courses/eleg646s10.html

Note: On each homework and report submission, please give your name, the due date, assignment number and the course number.