Lecture Handout #1

Summary of BJT Cutoff Frequencies

**Base transit time:** \( \tau_B = \frac{W_B'^2}{2D_n} \)

**Collector transit time:** \( \tau_C = \frac{W_C}{2v_s} \)

\( W_C = \) Collector-base depletion thickness

\( v_s = 10^7 \text{ cm } / \text{ sec} = \) saturation velocity

**Intrinsic Cutoff Frequencies:**

\[
\begin{align*}
 f_{ca}^* &= \frac{1}{2\pi\alpha_0(\tau_B + \tau_C)} \\
 f_{cb}^* &= \frac{1}{2\pi\beta_0(\tau_B + \tau_C)} \\
 f_T^* &= \frac{1}{2\pi(\tau_B + \tau_C)}
\end{align*}
\]

**Cutoff Frequencies (Including Junction Capacitances):**

\( \alpha \)-cutoff frequency:

\[
 f_{ca} = \frac{1}{2\pi\alpha_0(\tau_B + \tau_C + r_e C_{JEB})}
\]

\( \beta \)-cutoff frequency:

\[
 f_{cb} = \frac{1}{2\pi\beta_0(\tau_B + \tau_C + \frac{1}{\alpha_0}(C_{JEB} + C_{JBC}))}
\]

Common Emitter unity current gain cutoff frequency:

\[
 f_T = \frac{1}{2\pi(\tau_B + \tau_C + r_e (C_{JEB} + C_{JBC}))}
\]