

Bipolar Junction Transistor Exercises / Homework

Introduction to Semiconductor Devices (Purdue University EE 305/606) Supplemental Homework Exercises

Tutorial questions based on *BJT Lab v1.0* available online at <https://www.nanohub.org/tools/bjt/>

Reference book: Semiconductor Device Fundamentals by Robert E. Pierret (Chapter 10/11)

Q1) Run the standard BJT lab for npn structure in common emitter mode. Set the length and doping as the standard values. Set Material as Silicon (Si) and temperature, $T=300\text{K}$.

- (a) What biasing modes does the device go through for the (V_b/V_e) voltage sweeps.
- (b) Find Emitter efficiency at the final bias (γ).
- (c) Find Base transport factor at the final bias (α_t).
- (d) Find Common Base DC current gain at the final bias (α_{dc}).
- (e) Find Common Emitter DC current gain at the final bias (β_{dc}).

Q2) For the same simulation run answer the following,

- (a) Comment on the 'Net charge density' figure at equilibrium and final bias condition.
- (b) Comment on the 'Recombination rate' figure at equilibrium and final bias condition.
- (c) Plot Common Emitter DC current gain (β_{dc}) Vs I_c (A).
- (d) Calculate Early Voltage for the device from I_c - V_{ce} characteristics.