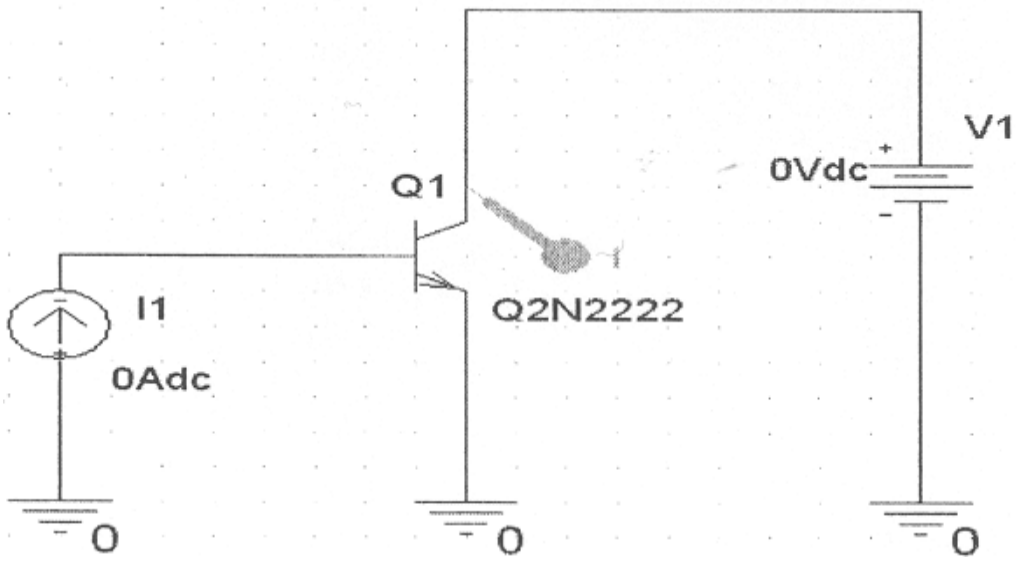
PSPICE simulations &
Bias circuits for voltage divider

Devices on evaluation board

- ✓ Diode: D1N4148
- ✓ Zener diode: D1N750
- ✓ BJT: Q2N2222(npn), Q2N3906(pnp)
- ✓ MOSFET: IRF150(Enhancement-mode N-channel)
- ✓ OP-AMP: uA741

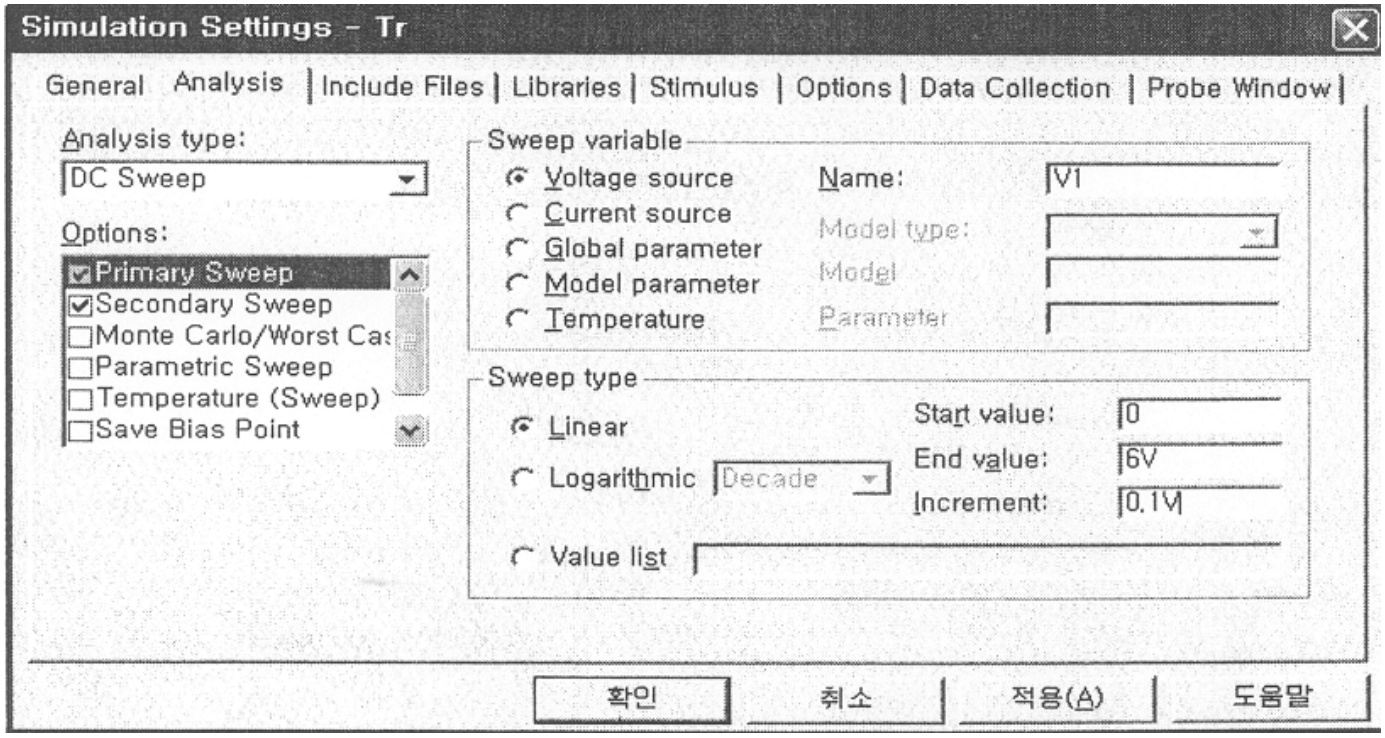
$V_{CE} - I_C$ Characteristic Simulations



Common-Emitter Circuit for V-I Simulations

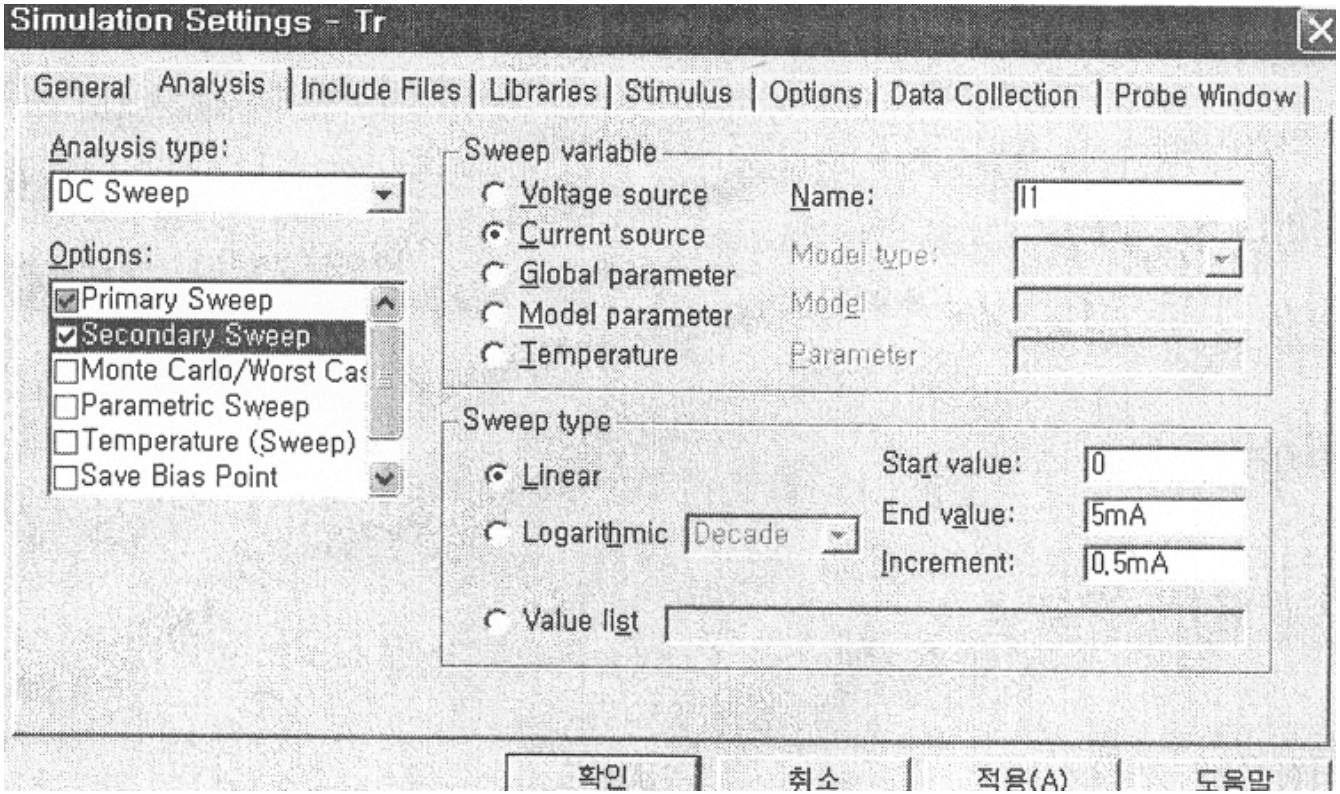
$V_{CE} - I_C$ Characteristic Simulations

- DC sweep



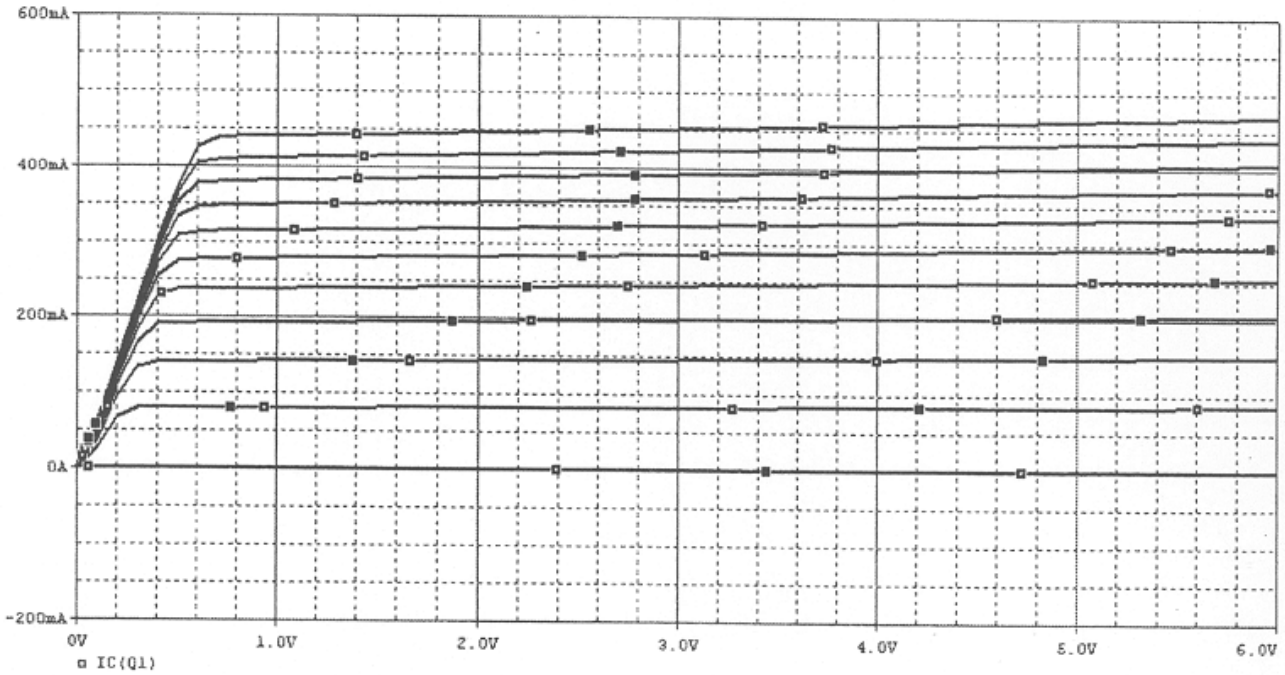
$V_{CE} - I_C$ Characteristic Simulations

- Secondary sweep

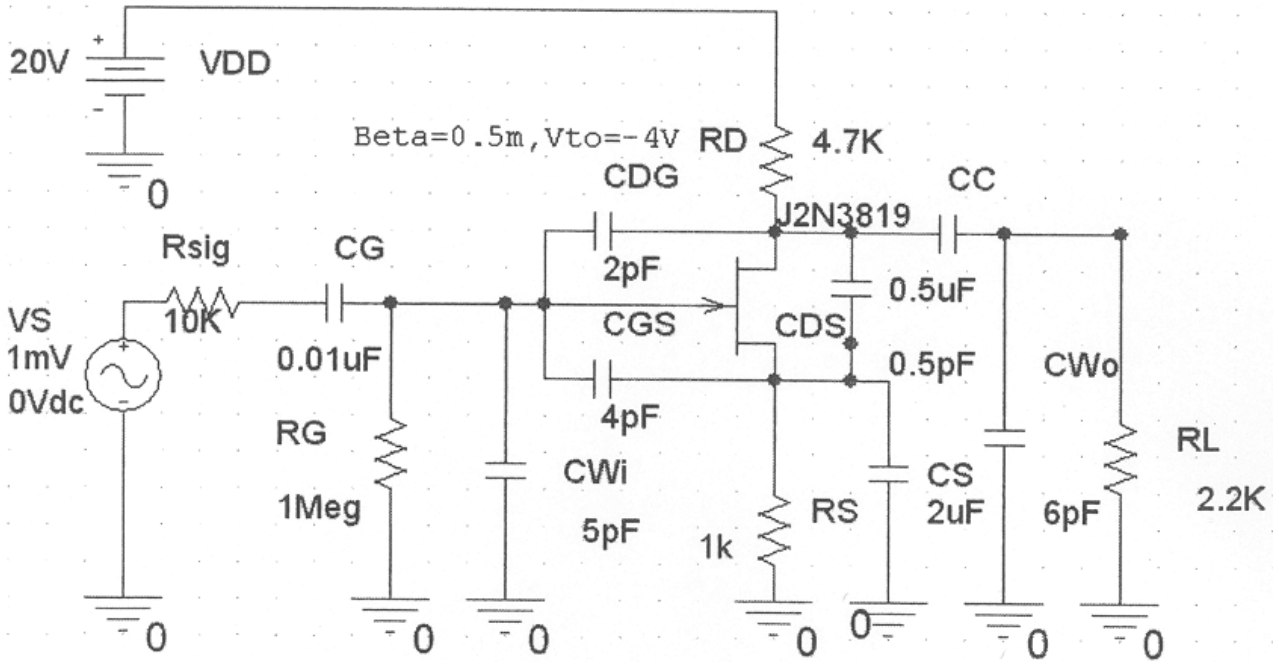


$V_{CE} - I_C$ Characteristic Simulations

- V_{CE}-I_C characteristic curves with variations of I_B



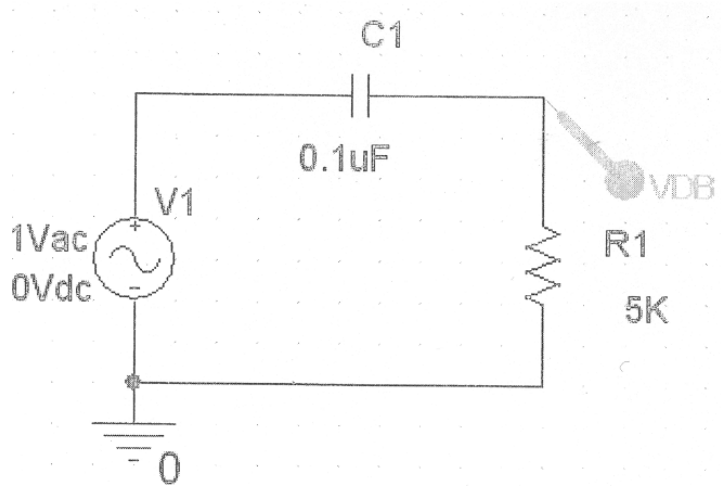
Amplifier Frequency Response Simulations

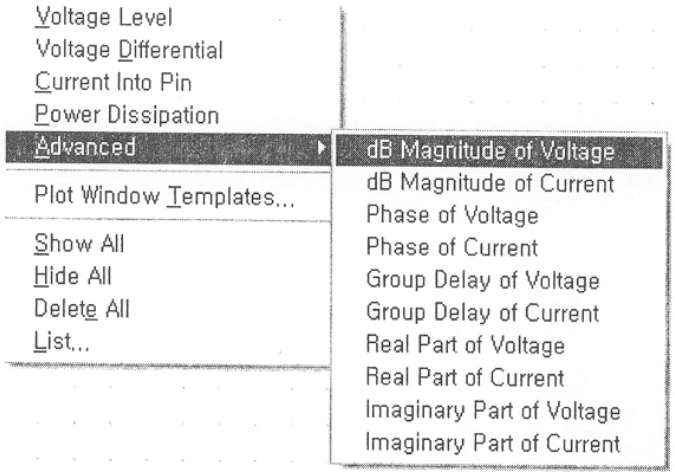


✓ Common-source amplifier with parasitic capacitance

Amplifier Frequency Response Simulations

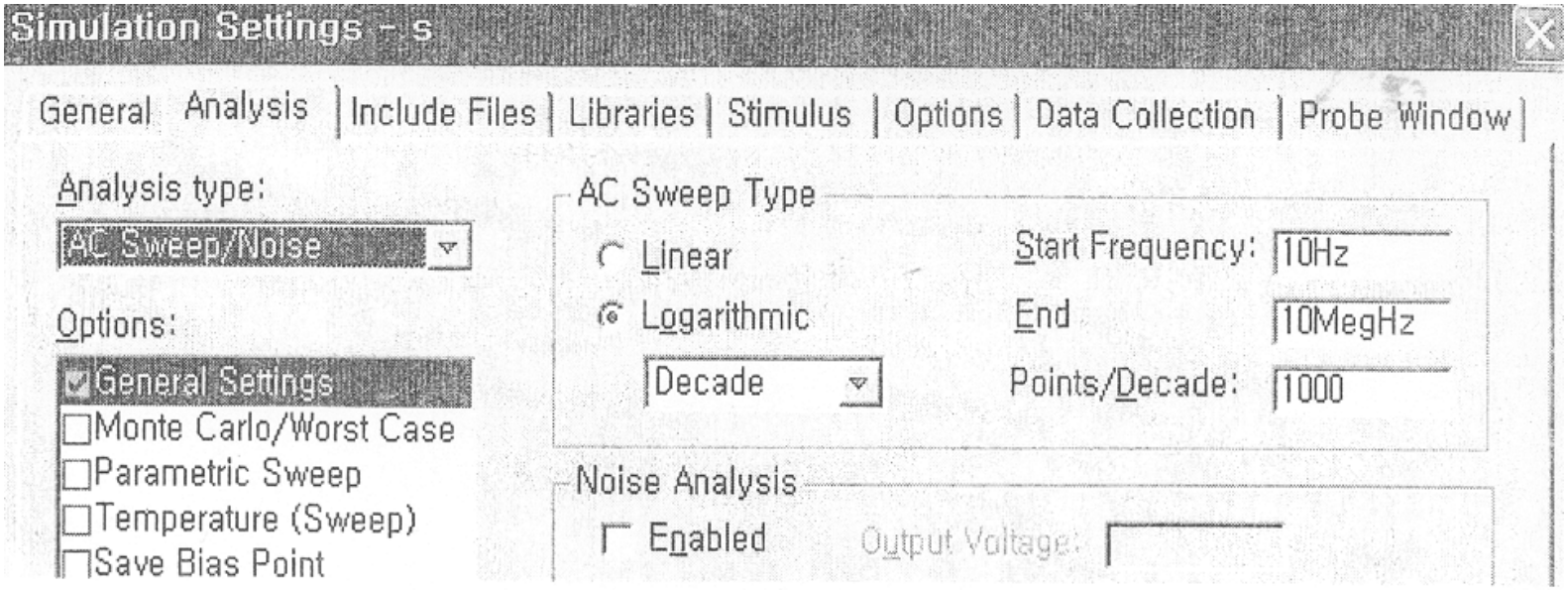
- Setting dB probe





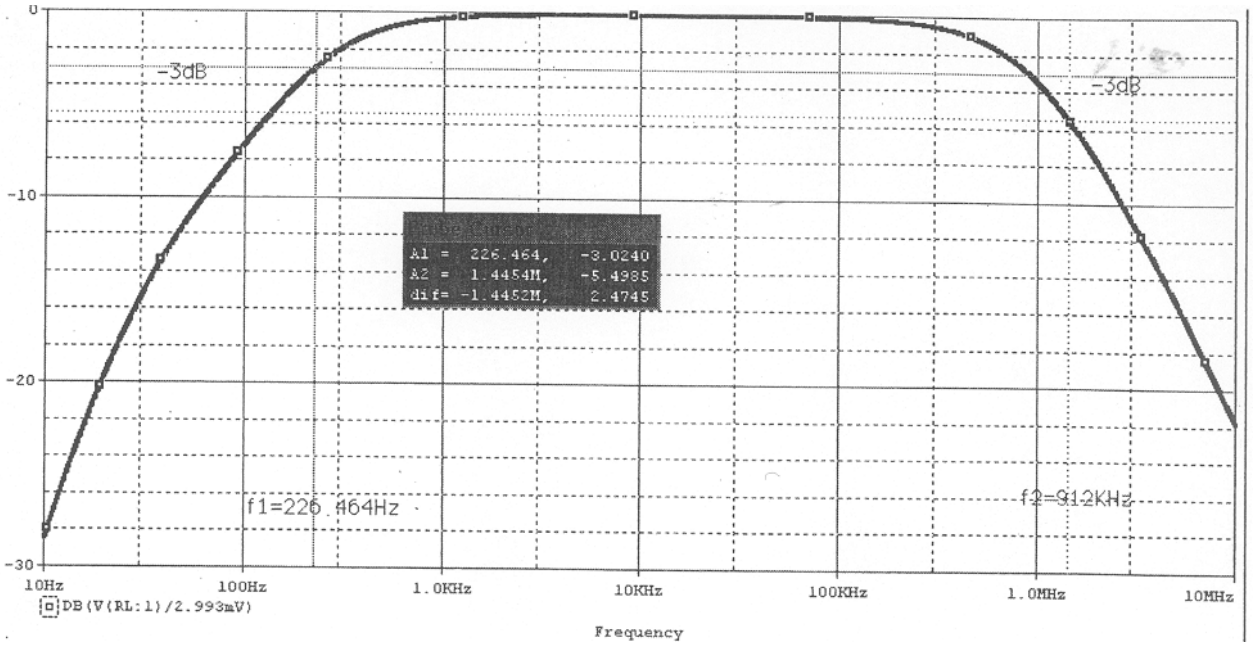
Amplifier Frequency Response Simulations

- Simulation Settings



Amplifier Frequency Response Simulations

- Simulation results (-3dB frequencies)



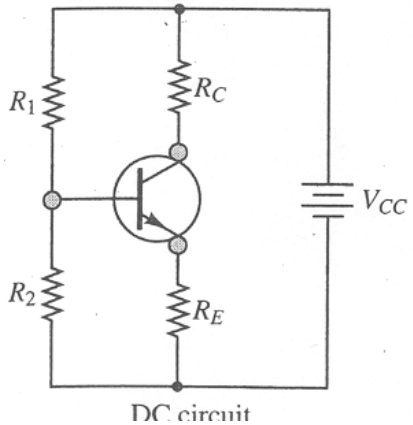
Pre-report (Lab. 2)

- ✓ PSPICE simulations of diodes & rectifiers
- ✓ Submission materials: schematic diagrams and simulation results (waveforms)
- ✓ Make brief!!

DC biasing

- Thevenin equivalent circuit seen by the base:

$$V_{BB} = \frac{R_2}{R_1 + R_2} V_{CC} \qquad R_B = R_1 // R_2 = \frac{R_1 R_2}{R_1 + R_2}$$



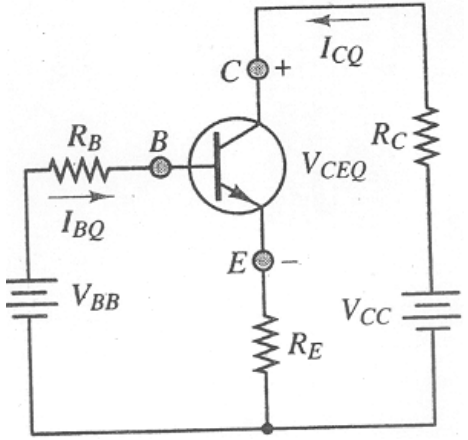
- Quiescent emitter current: $I_{CQ} = \beta I_{BQ}$,

$$I_{EQ} = I_{BQ} + I_{CQ} = I_{BQ} + \beta I_{BQ} = (\beta + 1) I_{BQ} = \frac{\beta + 1}{\beta} I_{CQ},$$

- DC bias point:

$$V_{CEQ} = V_{CC} - I_{CQ} R_C - I_{EQ} R_E = V_{CC} - I_{CQ} R_C - \frac{\beta + 1}{\beta} I_{CQ} R_E,$$

$$V_{BEQ} = V_{BB} - I_{BQ} R_B - I_{EQ} R_E = V_{BB} - I_{BQ} R_B - \frac{\beta + 1}{\beta} I_{CQ} R_E.$$



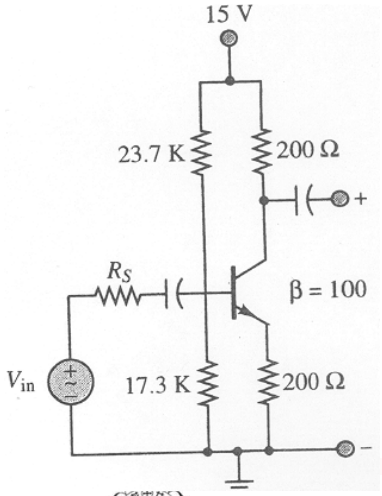
- As for amplifiers: $V_{BEQ} = 0.7V(Si)$.

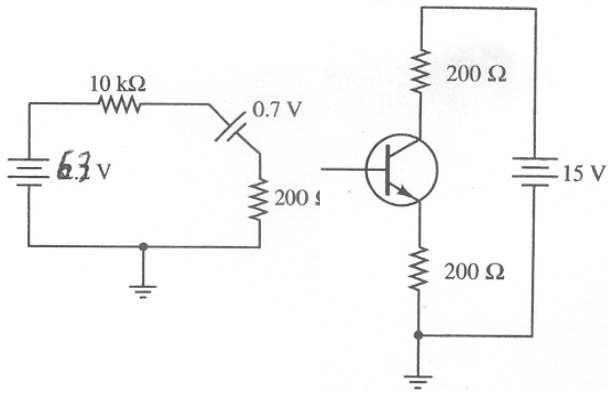
DC biasing

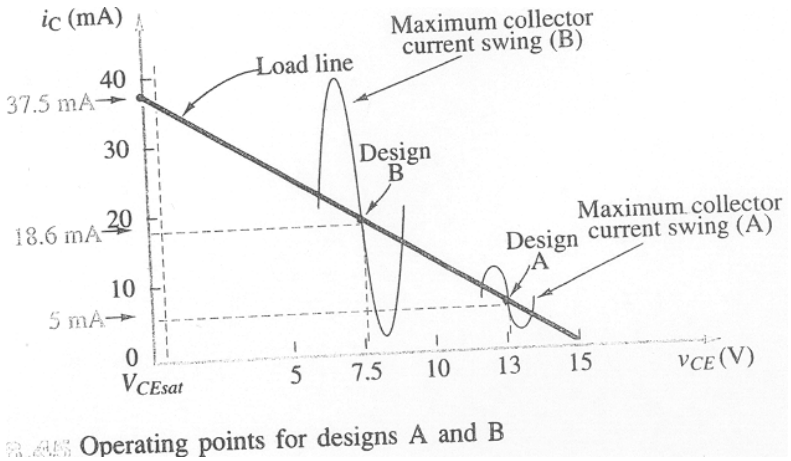
- For the circuit below: $V_{BB} = \dfrac{R_2}{R_1 + R_2} = 6.33\ \text{V}$ $\qquad R_B = \dfrac{R_1 R_2}{R_1 + R_2} = 10\ \text{k}\Omega$
- Base-emitter circuit: $6.33 - 0.7 = I_B R_B + I_E R_E = 10{,}000 I_B + (101)(200) I_B,$

$$\therefore\ I_B = \frac{5.63}{30{,}200} = 186.4\ \mu A,\quad I_C = \beta I_B = 18.64\ mA.$$

- $V_{CE} = 15 - 200 I_C - 200 \dfrac{\beta + 1}{\beta} I_C \cong 7.5\ \text{V}$







Operating points for designs A and B