BJT Common-Emitter Design II

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Equations

$$R_{ac} = (R_C \parallel R_L)$$

Equation 1: Rac resistance

$$|I_{CQ}| = \frac{nV_T |A_v|}{(R_C \| R_L)} = \frac{2nV_T |A_v|}{R_C} = \frac{2nV_T |A_v|}{R_L} = \frac{0.06V |A_v|}{R_L}$$

$$V_{CEQ} = I_{CQ} R_{ac} = \frac{I_{CQ} R_C}{2} = \frac{I_{CQ} R_L}{2}$$

Equations 2 and 3: Q-point values

$$h_{ie} = \frac{V_T}{I_{BQ}} = \beta \frac{V_T}{I_{CQ}} = \beta \, h_{ib} = r_\pi$$

Equations 4 and 5: hie and hib

$$R_{dc} = \frac{V_{CC} - V_T |A_v|}{I_{CQ}}$$

Equation 6: Rdc resistance

$$R_E = R_{dc} - R_C = R_{dc} - R_L$$

Equation 7: Emitter Resistor value

$$R_B = 0.1 \, \beta \, R_E$$

Equation 8: Base Resistor value

$$V_{BB} = V_{BE} + I_{BQ} R_B + I_{CQ} R_E$$

Equation 9: Base Voltage Calculation

$$R_1 = R_B \cdot \frac{V_{CC}}{V_{BB}}$$

$$R_2 = \frac{R_B}{\left(1 - \frac{V_{BB}}{V_{CC}}\right)}$$

Equations 10 and 11: Voltage Divider Biasing Resistor Values

Simulations for Expected Results

Using the values below, all simulations were done as the lab manual has stated

- $\beta = 205,\ V_{BE} = 0.68\ V\ \ A_V = -100$
- $R_C = R_L = 4.7\ k\Omega\ \ V_{CC} = 10\ V$
- $R_{ac} = 2350\ \Omega$ and $R_{dc} = 5795\ \Omega$
- $I_{CQ} = 1.277\ mA$ and $V_{CEQ} = 3\ V$
- $h_{ie} = r_\pi = 4173.84\ \Omega$ and $h_{ib} = 20.36\ \Omega$
- $R_E = 1095\ \Omega$
- $R_B = 22444\ \Omega$
- $V_{BB} = 2.218\ V$
- $R_1 = 101185\ \Omega$
- $R_2 = 28840\ \Omega$
- Assuming a Vi-pp of ~0.02 V, with a voltage gain of -100, the Vo-pp should be ~2V
- Although the above mentioned values are all mathematically correct and derived, assuming Rc is 4.7kiloOhms and RL is also 4.7 kiloOhms, the corresponding simulations that are shown below do not reflect what is expected from a voltage gain of -100.

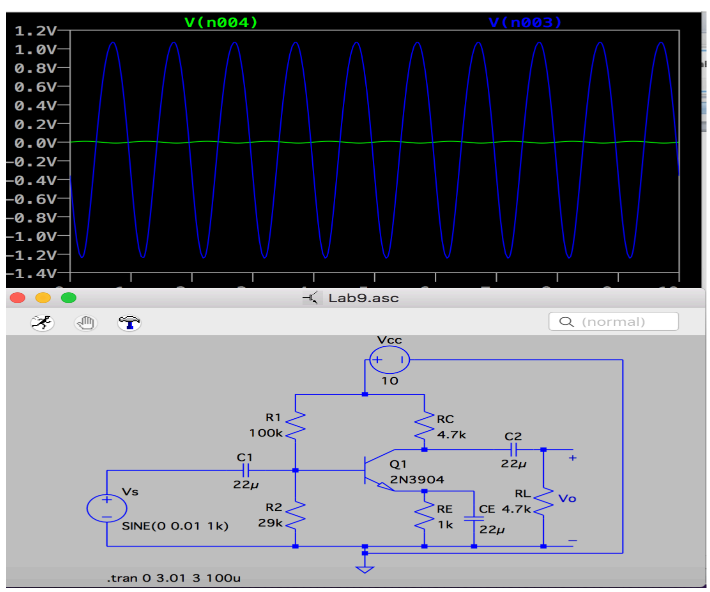

Figure 1: Simulation for Figure 9.1 with the above calculated values (Vs in green and Vo in blue)