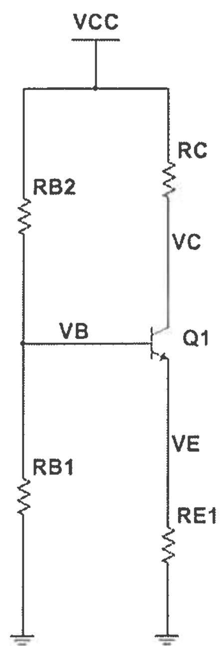
Week 7 Quiz Solutions

1.



The dc bias circuit for a common emitter amplifier is shown in the figure. In the circuit, $V_{CC} = 12V$, $R_{B2} = 105.8k\Omega$, $V_C = 6V$, $V_E = 3V$, $V_B = 3.65V$, $I_E = 2mA$, and $\beta = 75$

.

Solve for the emitter resistor R_{E1} (In kilo ohms to two decimal places)

By Ohm's Law, $I_E = \frac{V_E}{R_{E1}}$

$\Rightarrow R_{E1} = \frac{V_E}{I_E} = \frac{3V}{2mA} = \boxed{1.5k\Omega}$

2. For the circuit of question 1,

Solve for the collector resistor R_C. (In kilo ohms to two decimal places)

$$R_C = \frac{V_{CC} - V_C}{I_C} = \frac{V_{CC} - V_C}{\alpha I_E}$$

$$\alpha = \frac{\beta}{\beta+1} = \frac{75}{76} = 0.9868$$

$$R_C = \frac{12-6}{\alpha(2)} = \frac{6}{2\alpha} = \frac{3}{\alpha} = \boxed{3.04\ k\Omega}$$

3. For the circuit of question 1,

Solve for the base bias resistor R_{B1}. (In kilo ohms to two decimal places)

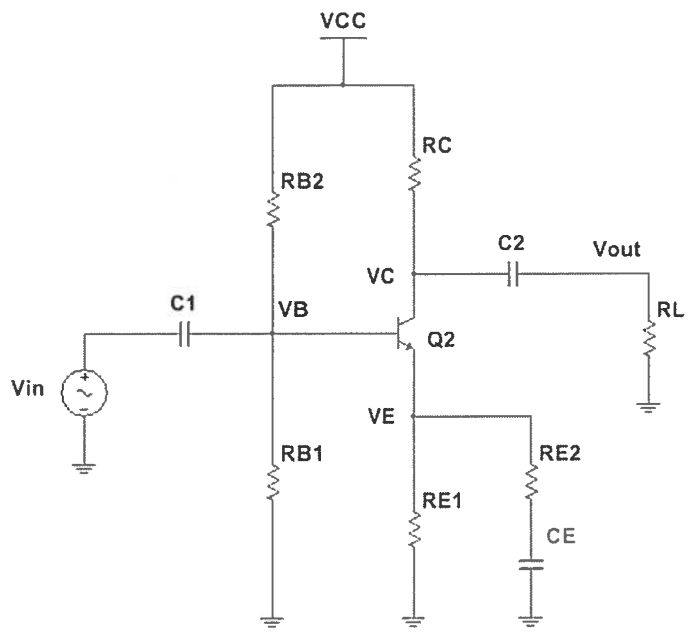
$$I_{RB2} = \frac{V_{CC} - V_B}{R_{B2}} = \frac{12 - 3.65}{105.8} = .07892\ mA$$

$$I_{RB2} - I_B = I_{RB1} = I_{RB2} - \frac{\alpha I_E}{\beta}$$

$$= I_{RB2} - 0.02632 \qquad = .05261\ mA$$

$$R_{B1} = \frac{V_B}{I_{RB1}} = \underline{69.38}3\ k\Omega$$

4.



In the CE amplifier shown,

$V_{CC} = 12V$, $R_{B1} = 15k\Omega$, $R_{B2} = 51k\Omega$, $R_C = 8k\Omega$, $R_{E1} = 1.7k\Omega$, $R_{E2} = 150\Omega$, $R_L = 20k\Omega$, and $\beta = 75$. Assume $V_{BE} = 0.65V$.

Solve for the collector current in milliamps.

$$V_B = V_{CC}\frac{R_{B1}}{R_{B1}+R_{B2}} - I_B R_{B1} || R_{B2}$$

$$\frac{V_B - V_{BE}}{R_{E1}} = \frac{V_E}{R_{E1}} = I_E = \frac{I_C}{\alpha}$$

$$I_B = I_C / B$$

combine these equations to get

4. continued

$$I_c = \frac{\dfrac{V_{CC}}{R_{E1}}\,\dfrac{R_{B1}}{R_{B1}+R_{B2}} - \dfrac{V_{BE}}{R_{E1}}}{\dfrac{1}{\alpha} + \dfrac{R_{B1} \parallel R_{B2}}{\beta R_{E1}}} = \boxed{1.11\,mA}$$

5. For the CE amplifier of question 4, solve for the midband gain.

$$\frac{V_{out}}{V_{in}} = -\alpha \frac{R_C \| R_L}{r_e + R_{E1} \| R_{E2}} = \boxed{-35.06}$$

$$r_e = \frac{V_T}{I_C} = \frac{.0259}{1.1mA} = 0.023\,\Omega$$

6. Select all of the below statements that are true.

In the BJT CE amplifier of question 4, as the emitter resistor R_{E2} is increased,

- the midband gain decreases and the dc collector current remains constant.
- the midband gain increases and the dc collector current decreases.
- the midband gain increases and the dc collector current increases.
- the midband gain decreases and the bias point of the transistor changes.

7. Select all of the below statements that are true.

- [x] A curve tracer may be used to measure the collector current of a BJT for different values of VCE as the base current is held constant.
- [x] A CE amplifier may behave as an attenuator for signals at some frequencies.
- [ ] The overdrive factor used when designing a BJT switch is to ensure that the BJT remains in cutoff no matter what load is placed on the switch.
- [x] The saturation current of a BJT may be determined from a point on its transfer characteristic curve.
- [x] As the collector current of a particular biased BJT is decreased, it's transconductance decreases.