Instructions, notes, and hints:

Provide the details of all solutions, including important intermediate steps. You will not receive credit if you do not show your work.

Some problems might be solvable (or must be solved) using good engineering approximations or assumptions. In those cases, your answer might differ from the posted answer by a fairly large margin. Given typical device variations and component tolerances, that amount of discrepancy is often reasonable. If you justify any approximations you make, you will be given full credit for such answers.

Prob. 6.154: For Part (a), you may assume that $V_{BE} = 0.7 \text{ V}$ in the active region of operation. Solve Part (c) before Part (b); you should see a way to solve Part (b) by making some simple substitutions into your solution for Part (c).

Assignment:

Problems 6.153 and 6.154 in the textbook, plus the following additional problems:

1. Shown below is a typical configuration for a discrete emitter follower circuit. The resistors $R_1$, $R_2$, and $R_E$ form a stable bias network. Find the values of the three resistors required to produce a quiescent collector current $I_C$ of 2 mA and a quiescent emitter voltage $V_E$ of 3 V. Base your design on a $\beta$ value of 100 and current $I_2$ equal to ten times the base current. You may assume that $V_{BE} = 0.7 \text{ V}$, $V_{CE|\text{sat}} = 0.2 \text{ V}$, and $V_A \to \infty$.

![Emitter Follower Circuit Diagram](image-url)
2. Suppose that resistor \( R_2 \) is removed from the circuit in Prob. 1. Select values for \( R_1 \) and \( R_E \) so that the same bias conditions (\( I_C = 2 \) mA and \( V_E = 3 \) V) are achieved when \( \beta = 100 \).

3. [Revised Jan. 29: corrected \( \beta \) value] Determine \( I_C \) and \( V_E \) for the circuits in Probs. 1 and 2 for the case when \( \beta = 300 \). Briefly explain whether or not it is worth the slight extra expense and space to include resistor \( R_2 \).

4. The circuit below illustrates one way to decouple the bias design and small-signal design for a common-emitter amplifier. The quiescent collector voltage \( V_C \) is simply equal to the power supply voltage \( V_{CC} \). (Do you see why?) Assuming that the transformer is ideal, estimate the small-signal voltage gain of the amplifier. Note that you will have to estimate the quiescent collector current to solve the problem. The exact value of \( \beta \) is unknown but lies in the range 50-150. Assume that all of the capacitors act as shorts at the operating frequency and that \( V_{BE} = 0.7 \) V, \( V_{CE|\text{sat}} = 0.2 \) V, and \( V_A \to \infty, n = 1, \) and \( V_T = 25 \) mV.