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, a little discrepancy is often reasonable. If you justify any approximations you make, you will be given full credit for such answers.

Prob. 8.50: The 2-mW power dissipation limit applies to the whole amplifier circuit. That is, it includes the two resistors, the two amplifying transistors, and the ideal current source \( I \). You could total the power dissipations of all five devices, but there is an easier way to determine what the power limit constraint implies.

Prob. 8.69: You need to find the mismatch \( \Delta R_C / R_C \) expressed as a percentage.

Prob. 8.81: Assume that the area of \( Q_1 \) is 120% the area of \( Q_2 \). You will most likely need to express \( I_{C1} \) and \( I_{C2} \) to several significant digits to solve the problem.

Assignment:

Problems 8.50, 8.67, 8.69, and 8.81 in the textbook plus the following additional problems.

1. In the diff amp circuit shown on the next page, the output is taken differentially between the collectors (\( v_{od} = v_{C2} - v_{C1} \)). Assume that \( Q_1 \) and \( Q_2 \) are perfectly matched and that \( V_{BE(on)} = 0.7 \) V, \( V_{CE(sat)} = 0.3 \) V, and \( \beta = 200 \). The quiescent input voltage is 0 V. Ignore the Early effect (i.e., \( r_o \rightarrow \infty \)). Find total voltages \( v_{C1} \) and \( v_{C2} \) and the differential-mode voltage gain \( v_{od} / v_{id} \) for the following two cases (\( v_{id} \) is the signal part of \( v_{IN} \)):
   a. \( R_{C1} = R_{C2} = 10 \) k\( \Omega \).
   b. \( R_{C1} = 11 \) k\( \Omega \) and \( R_{C2} = 10 \) k\( \Omega \).

(continued on next page)
2. The quiescent point in the common-source amplifier shown below has been set at approximately $V_D = 8$ V and $I_D = 10$ mA. If the MOSFET has $V_t = 2.1$ V, find the mid-band gain $\frac{v_o}{v_{in}}$ and the approximate values of the break frequencies $f_{Pi}$, $f_{Po}$, and $f_{Ps}$ associated with capacitors $C_i$, $C_o$, and $C_S$, respectively, that determine the low-frequency response. *Hint: $g_m = \frac{2I_D}{V_{OV}}$. 