Homework 4

Due: Friday, 21 February 2014 at 1pm

This is an individual assignment!

PROBLEM 1 (10pts):
Due to a manufacturing error, resistor R_P has appeared in series with the base of Q_{REF} in Fig. 1. If I_1 is 10% greater than its nominal value, express the value of R_P in terms of other circuit parameters. Assume Q_{REF} and Q_1 are identical.

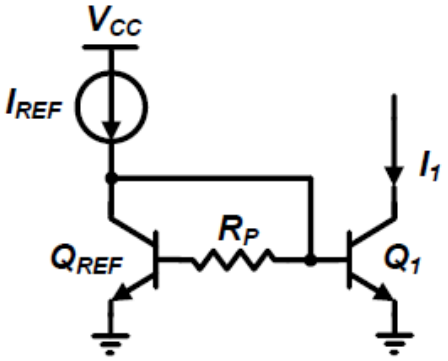


Figure 1

PROBLEM 2 (10pts):
Determine the value of R_P in the circuit of Fig. 2 such that $I_1 = I_{REF} / 2$. With this choice of R_P, does I_1 change if the threshold voltage of both transistors increases by ΔV?

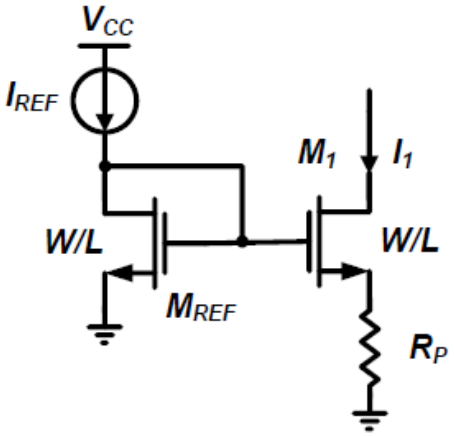


Figure 2

PROBLEM 3 (10pts):
Design the MOS peaking current source in Fig. 3 so that I_{OUT} = 0.1 µA.
(a) First, let I_{IN} = 1 µA and find the required value of R.
(b) Second, let R = 10 kΩ and find the required I_{IN}.
Find the range of W/L that keeps M_1 in saturation. Assume M_1 and M_2 are identical with k' = 200µA/V^2 and V_{th}=0.5V.

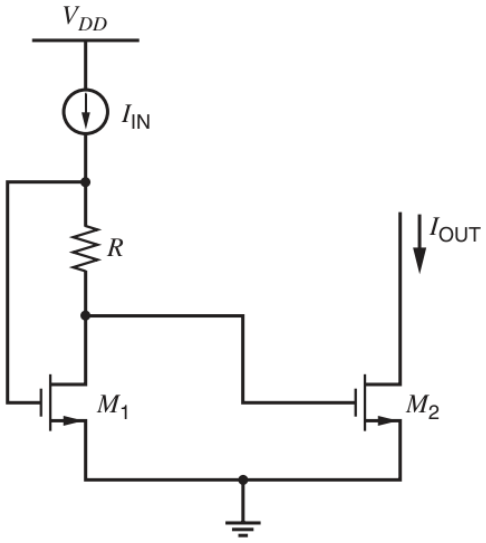
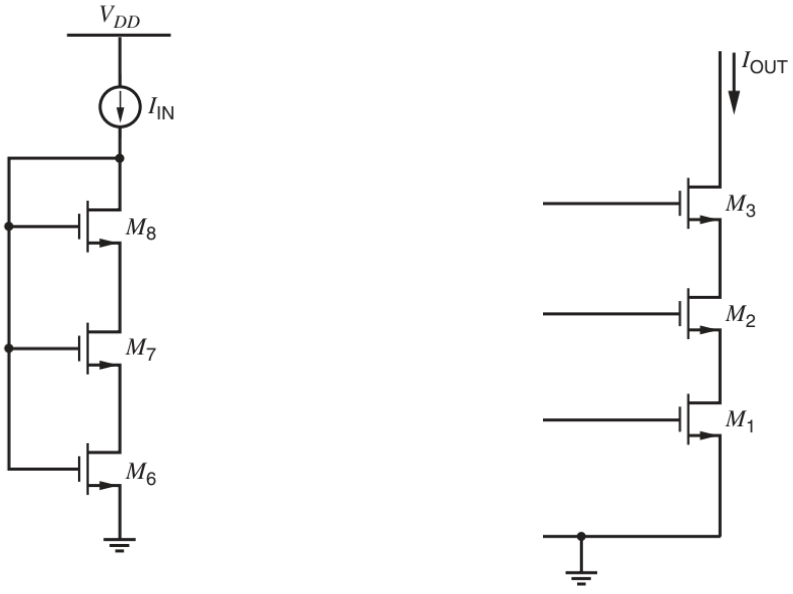


Figure 3

EXTRA PROBLEM FOR EE 240A STUDENTS:
PROBLEM 4 (20pts):

For the circuit of Fig. 4A, assume that $(W/L)_8 = (W/L)$. Ignoring the body effect, find $(W/L)_6$ and $(W/L)_7$ so that $V_{DS6} = V_{DS7} = V_{ov8}$. Draw the schematic of a double-cascode current mirror that uses the circuit of Fig. 4A to bias both cascade devices in the output branch, Fig. 4B. For this current mirror, calculate the output resistance, the minimum output voltage for which all three transistors in the output branch operate in the active region, the total voltage across all the devices in the input branch, and the systematic gain error.



A) B)

Figure 4