EE 414 Introduction to Analog Integrated Circuits
Take Home Exam-2

Due Date: March 25, 2015 (in class)

Problem 1:

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.

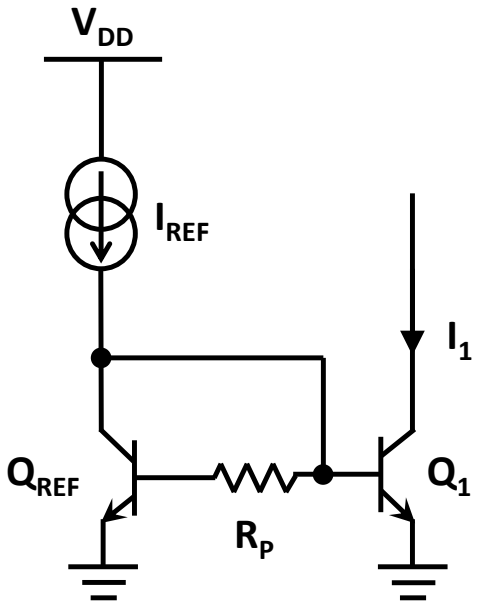

Fig. 1

Problem 2:

Design the MOS peaking current source in Fig. 2 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.

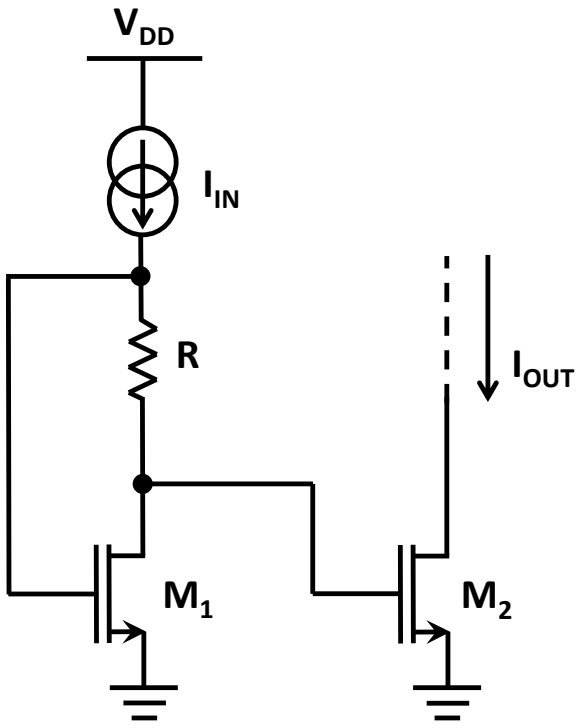

Fig. 2

EE 414 Introduction to Analog Integrated Circuits
Take Home Exam-2

Problem 3:

Due Date: March 25, 2015 (in class)

Determine the output resistance of the current mirror in Fig. 3 as a function of transistor parameters. Neglect the body-effect. Assume that the amplifier in Fig. 3 has finite gain A=100 and infinite input resistance. For small-signal analysis assume $V_o = A(V_+ - V_-)$. Since gain A is high, for DC analysis assume that $V_+ = V_-$. If the size of transistors $M_{1\text{-}4}$ is W/L, find the size of M_5 that minimizes the systematic gain error. What is the resulting gain error?

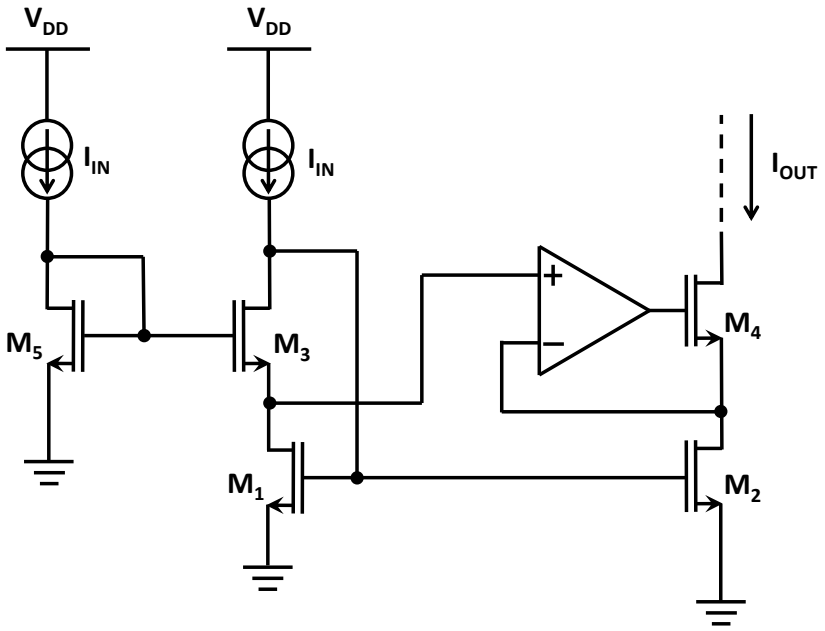

Fig. 3

Problem 4:

Derive the equations that govern the operation of the reference in Fig. 4. (Derive the reference voltage and its temperature dependence in terms of transistor parameters)

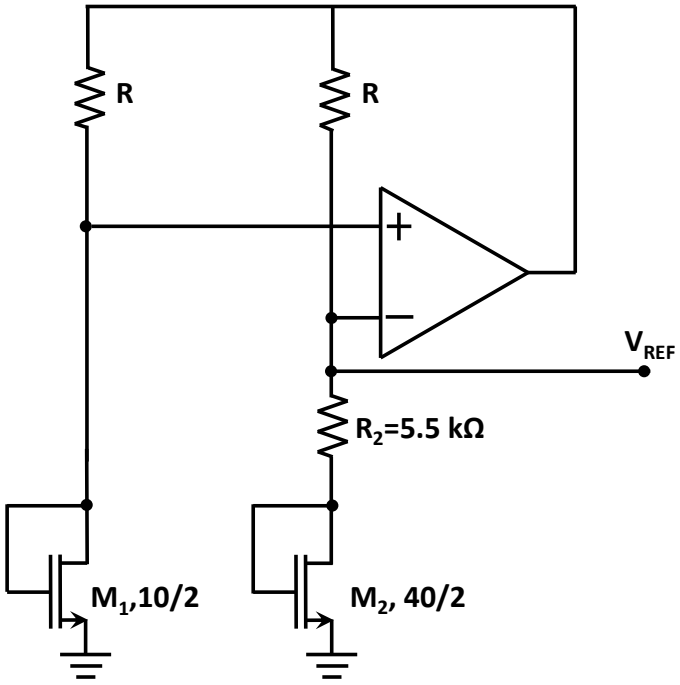

Fig. 4.