

Due: 2 December 2019 @17 o'clock – No late homework will be accepted.

HW assignments will be brought to the TA @ VLSI Laboratory (upstairs) – not to Prof. Yelten.

- 1) Determine the polarity of the feedback for the amplifier in Fig. 1a. Clearly explain your reasoning.
- 2) Consider the feedback circuit depicted in Fig. 1b. Suppose the output quantity of interest is the collector current of Q_2 , I_{out} . Determine the closed loop gain, input and output impedances. Assume that $V_A = \infty$.

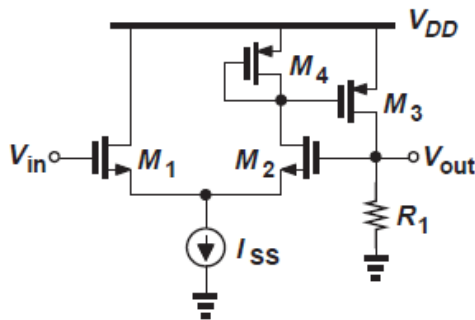


Fig. 1a Figure of Question 1

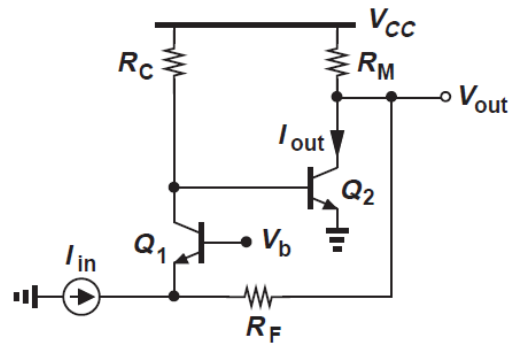


Fig. 1b Figure of Question 2

- 3) Find the closed loop gain, input and output impedances of the amplifier in Fig. 2a. Assume that $\lambda > 0$.
- 4) In the amplifier in Fig. 2b, the transistors have $W/L = 20 \mu\text{m} / 0.18 \mu\text{m}$.
 - a. Determine by simulation the operating point of the circuit for an input DC level of 0.9 V.
 - b. Simulate the closed loop gain, input and output impedances.

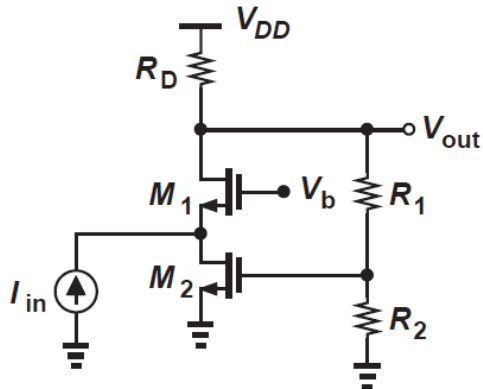


Fig. 2a Figure of Question 3

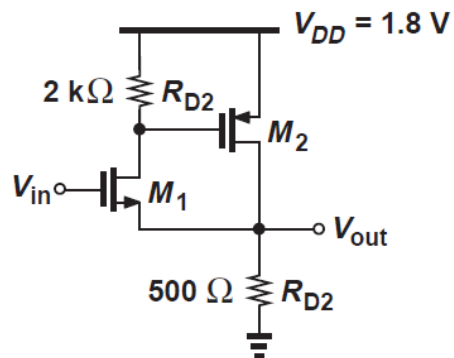


Fig. 2b Figure of Question 4

For this HW, you will use the following NMOS and PMOS models. You can import them into LTSpice or your favorite SPICE simulator. One helpful link regarding LTSpice is provided below.

Models: http://ptm.asu.edu/modelcard/180nm_bulk.txt

Incorporation of the models into LTSPICE: <http://www.linear.com/solutions/1083>