ENSC-852 **Spring 2019**

Analog Integrated Circuits

Homework 2

Distributed: Feb. 7, 2019
Due date: Feb. 26, 2019

Homework format: Please use only single-sided letter size (8.5" by 11") sheets of paper for your Homework solution. Hand-printing is accepted only if readable.

Problem 1: **(15 marks)**

For the current mirror shown in Fig.1, find R_{in}, R_{out}, i_{out}/i_{in}, $V_{MIN(in)}$, $V_{MIN(out)}$. Show all calculations. In your calculations use the MOS transistor model parameters typical for the 0.25µm bulk CMOS process (shown in the slide 9, Lecture 7: Large Signal Model).

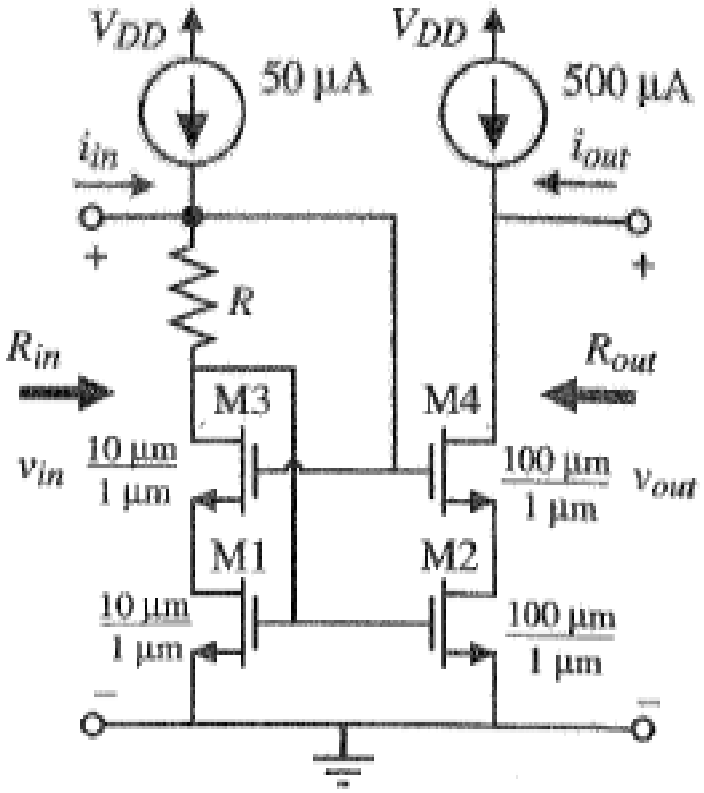

Figure 1.

Problem 2: **(15 marks)**

Derive an expression for the output current of the current reference circuit shown in Fig.2. Assume that the M3 and M4 transistors are identical in size. The sizes of M1 and M2 transistors are different.

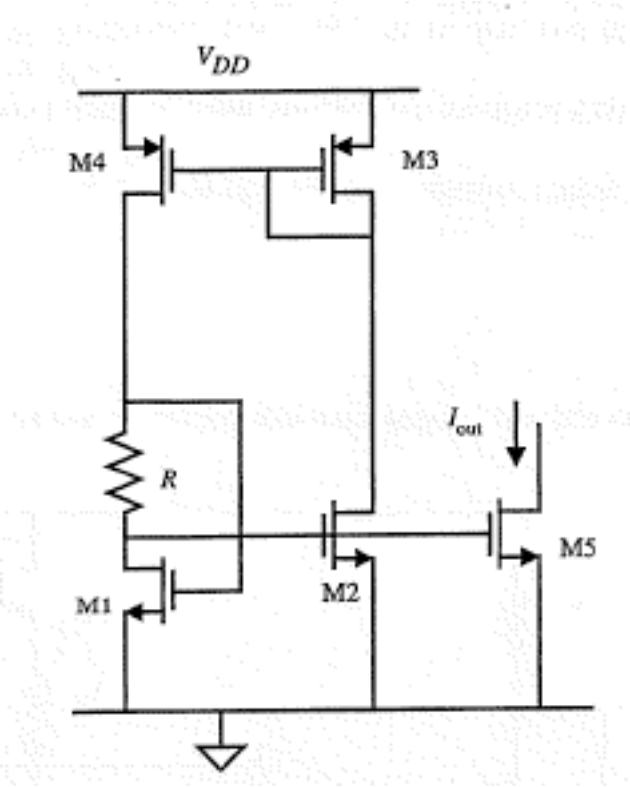

Figure 2.

Problem 3: **(25 marks)**

Design the Cascoded Bootstrapped Current Source (shown in Fig.3) for the output current I_5 = 100μA within the output voltage range V_{out} from 0V to 2.5V and the power supply V_{DD} = 3.3V. Assume that all transistors have the channel length equal 1μm. Assume also that M1 and M2 have the same channel widths. All other assumptions must not limit the circuit operation and should be discussed in detail. Show all your assumptions and calculations, finding the values of resistors and *W/L* ratios of MOS transistors. In your calculations use the MOS transistor model parameters typical for the 0.25μm bulk CMOS process (shown in the slide 9, Lecture 7: Large Signal Model).

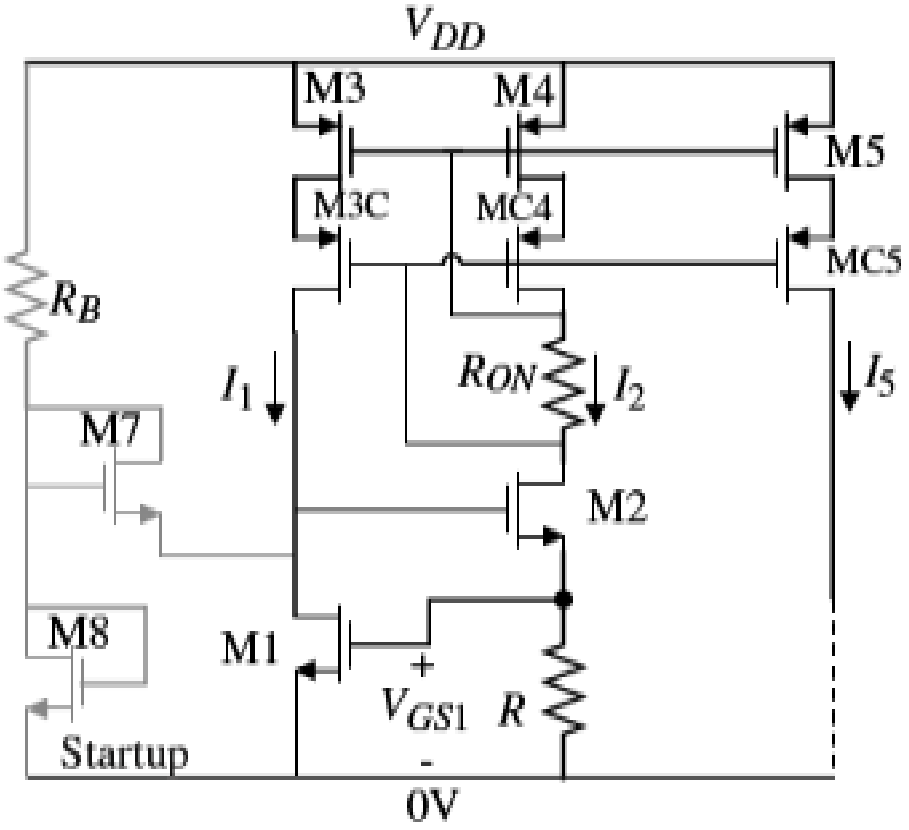

Figure 3.