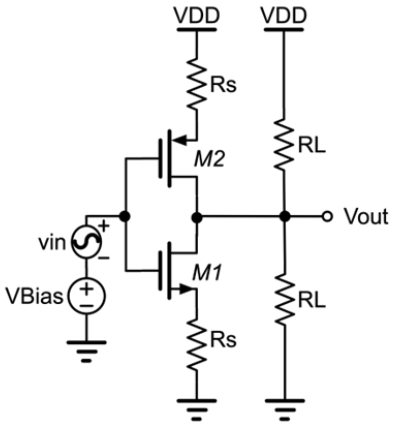
Faculty of Engineering – Cairo University
Electronics and Electrical Communications Department
ELC2020 – Electronics II – Fall2023
Dr. Omar Bakry

Assignment (10 points), Due date: 16/12/2023*

*Late submission policy: you lose 2.5 points per each day

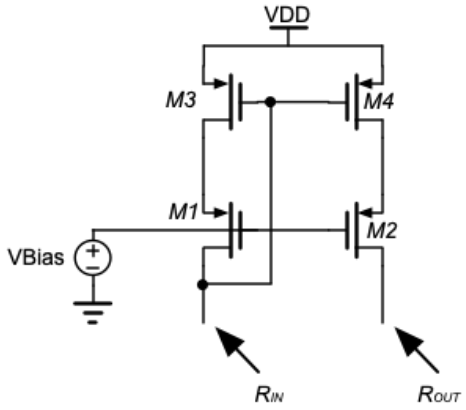
Problem (1): For the common source amplifier shown below, assume M1 and M2 are in saturation.

a) Draw the small signal model.
b) Derive an expression for the amplifier transconductance (G_m)
c) Derive an expression for the amplifier output impedance (R_{out})
d) Derive an expression for the small signal gain ($A_v = v_{out}/v_{in}$)



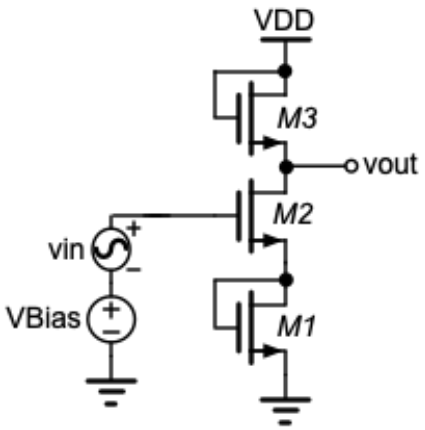
Problem (2): The figure shown below shows a cascode current mirror. Assume all transistors are operating in SAT region. Assume all devices are identical.

a) Derive an expression for the small signal resistance looking at the output (Rout) in terms of small signal transistor parameters.
b) Derive an expression for the small signal resistance looking at the input (Rin) in terms of small signal transistor parameters.



Problem (3): For amplifier shown below, assume $\lambda = 0$ and all devices are identical and in saturation. $V_{th} = 1V, and\ V_{BIAS} = 2.5V$.

a. Draw the small signal model.
b. Derive an expression for the amplifier transconductance (G_m)
c. Derive an expression for the amplifier output impedance (R_{out})
d. Derive an expression for the small signal gain ($A_v = v_{out}/v_{in}$)
e. What is the minimum voltage of VDD such that all the transistors are saturated?



Problem 4: Derive an expression for the transconductance $G_m = i_{out}/(v_1 + v_2)$ of the circuit below. Assume all transistors are in saturation. Ignore channel length modulation. Assume M1-4 are matched, and M5-6 are matched.