EE538_Wi2021_Midterm_Practice

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Midterm Practice

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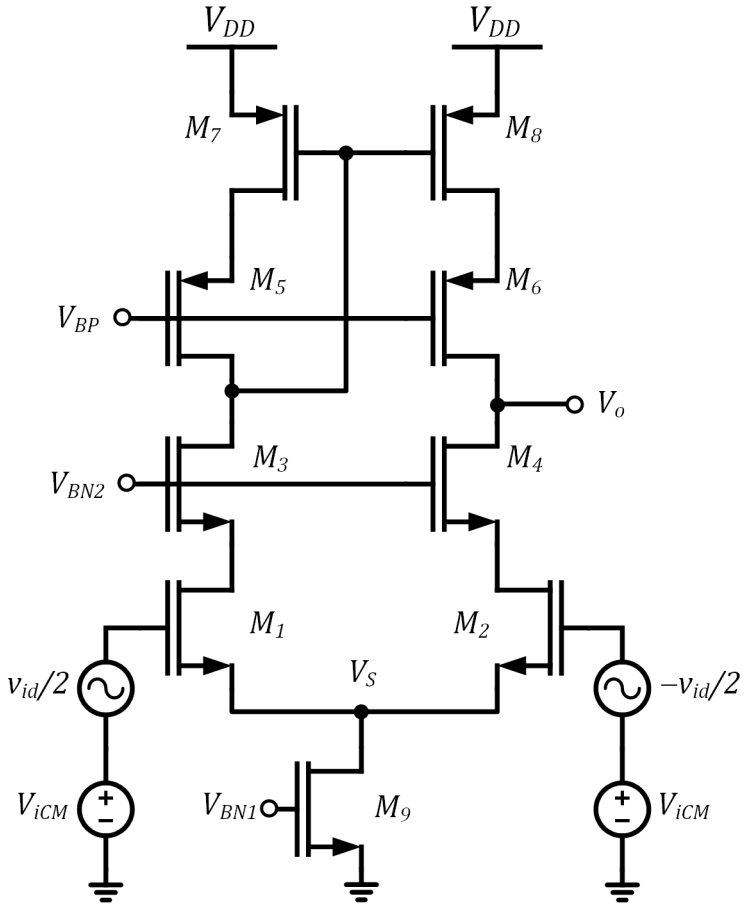
Problem 1:Cascode amplifier design



For the following, use the long channel drain current expression and assume $\lambda = 0$ and $\gamma = 0$ unless otherwise stated.

Use $I_{D9} = 1mA$, $V_{DD} = 3V$, $\mu_n C_{ox} = 100\mu A/V^2$, $\mu_p C_{ox} = 50\mu A/V^2$, $V_{thn} = V_{thp} = 500mV$, $L_n = L_p = L_{eff} = 1\mu m$

a) Size M_5, M_6, M_7, and M_8 for overdrive voltages of $200mV$. What is the DC output voltage of the amplifier?

b) Determine the value of V_{BP} required such that $V_{SD7} = V_{SD8} = 300mV$. Based on this value, are M_5 and M_6 in saturation?

c) Size $M_{1,2}$ for $g_{m1,2} = 10mS$.

d) Size M_3 and M_4 for overdrive voltages of $200mV$.

e) If the maximum value of V_{iCM} is $1.5V$, determine the value of V_{BN2} that ensures $M_{1,2}$ remain in saturation.

f) If the minimum value of V_{iCM} is $1V$, determine size of M_9 that ensures it remains in saturation.

g) Determine the small-signal gain of the amplifier if $\lambda_n = 0.01V^{-1}$ and $\lambda_p = 0.02V^{-1}$.