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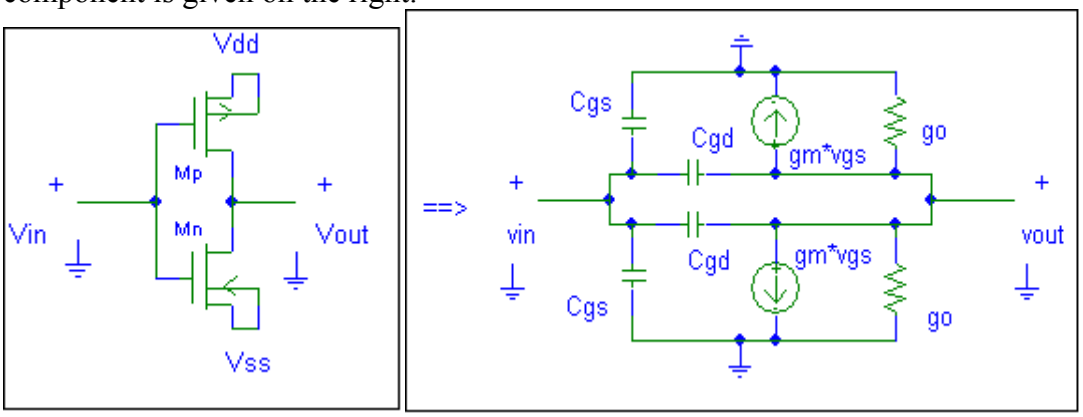
ENEE 303 Spring 2006 final

Open book, open notes, 100 points. If stuck go on to the next problem.
Unless otherwise stated assume complete complementarity with $KP_n=KP_p=KP=10^{-4}$ A/V^2, $VTO_n=-VTO_p=1$ V, $lambda_n=lambda_p=lambda=0.01$, W=L=10uM, Cgs=Cgd=1pFd, Vdd=-Vss=5 V.

1.(50 points, 40 minutes)

Recently the inverter has become important for small signal use. Thus, consider the following inverter (on the left) for which the admittance equivalent circuit of each component is given on the right.



a) Combine all the parallel components of the equivalent circuit and draw the 2-port result. Then give the 2x2 admittance matrix Y(s) for the resulting 2-port.

b) Note that the bias Vin=Vout=0 V. Determine the bias drain currents and the resulting gm and go.

c) Load the inverter in a capacitor CL to ground and find the resulting transfer function Vout(s)/Vin(s).

2. (50 points, 40 minutes)

For DC operation of the following circuit find Vout versus Iin. Use the Ebers-Moll model (page 409) exponential behavior of the BJT at room temperature with $I_{SE}=10^{-12}$ A; assume an open-circuit load.

a) Sketch Vout versus Iin assuming M2 is in saturation.

b) Discuss the range of validity of the assumption of a) and give the equations to solve to determine the limits of Iin to insure M2 is in saturation.