UNIVERSITY OF CALIFORNIA AT BERKELEY
College of Engineering
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Johan Vanderhaegen	**(Due 9/9/02)**	**Fall 2002**

1) Consider the structure shown in figure 1. Determine I_{DS} as a function of V_{GS} and V_{DS}. This structure is equivalent to a single transistor having a different W/L ratio (than the W/L ratio of the individual transistors). Find the W/L ratio and show that this is true. Assume $\gamma = \lambda = 0$.

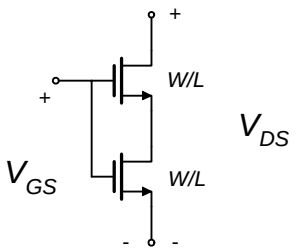

Figure 1.

2) Sketch I_{DS} for M1 from the circuit shown in figure 2 as a function of V_{in} as V_{in} varies from 0 to V_{DD}. Indicate and calculate all the breakpoints (the values of V_{in} and I_{DS}) where the transistor changes region of operation. Do not solve for the exact I_{DS}-V_{in} curve, but indicate whether and explain why the different parts of the curve are approximately a constant, linear or quadratic function of V_{in} . Assume V_{T0} = 0.5 V, $k'W/L$ = 8 mA/V^2, $\gamma = \lambda = 0$, V_{DD} = 3 V, $I1$ = 4 mA, $R1$ = 1 kΩ.

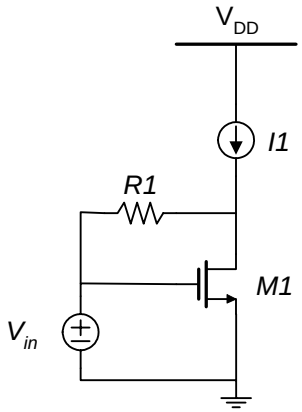

Figure 2.

3) For each of the two circuits figure 3, perform the calculations a and b by hand. Assume V_{T0} = 0.5 V, $k'W/L$ = 4 mA/V^2, γ = 0.5 V$^{1/2}$, λ = 0.25 V^{-1}, $R1$ = 1 kΩ, $R2$ = 300 Ω, V_{DD} = 3.
   a) Determine the dc voltage V_{IN}, so that the output V_{OUT} is at 1.5 V. Assume that V_{IN} is between 0 and V_{DD}.
   b) Calculate the operating point parameters I_{DS}, V_T and V_{DSAT} and the small signal device parameters g_m, g_{mbs} and r_o.

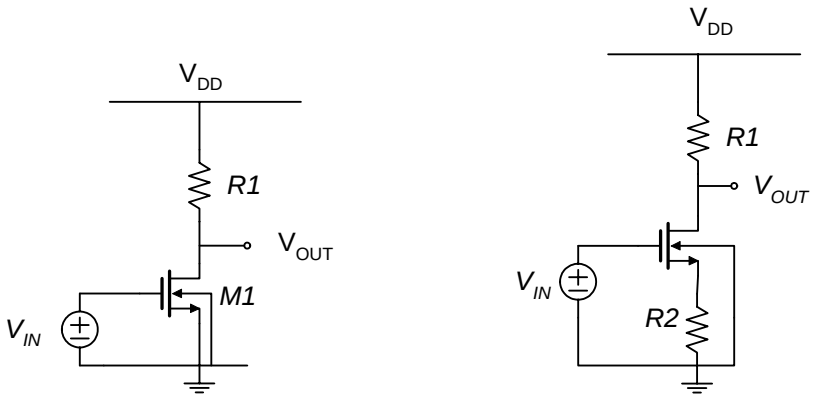

Figure 3.