File: G:/coursesF15/303H/303HF15Final.doc RWN M 12/14/15

ENEE 303H Final Exam – Fall 2015 Take Home: Due by 10am M 12/14/15 @ classroom

150 points, 2 hours, open book, open notes. Notebooks are due at the end of the exam.

Good luck and have a good semester break

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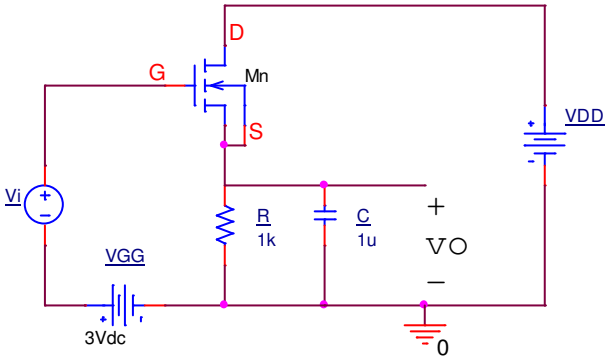
1. (50 points, 30 minutes)

For the circuit of this problem assume that when in saturation the transistor is described by

$$i_D = k(v_{GS}\text{-}VTO)^2$$

The turn-on voltage is VTO = 1; VDD and VGG are ideal DC bias voltage sources and vi is the input small signal voltage source.



a) Find the smallest VDD , VDDmin, for which the transistor is in saturation when the maximum of vi is VGG=3V.

b) Assuming that VDD >>VDDmin, R=1 KOhm and $i_D=I_D$=1 mA is the steady state when no signal input is applied (that is, vi=0), find the transistor parameter k.

c) Under the bias conditions of b) assume further that C=1 microFd. Set up the differential equation for vo(t) for t>0 when at t=0 the input voltage vi changes from 0 to 1Volt (where it remains). Normalize the highest order derivative coefficient to be 1.

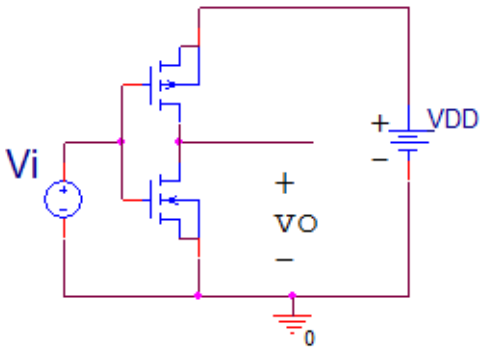
2. (50 points, 30 minutes)

For the following circuit, assume Mp and Mn are fully complementary with λ and Cgs=Cgd=C nonzero, as well as VDD large enough for proper operation.

a) Give the transconductance and output conductance, gm and go, of each transistor at the bias point Vi=VDD/2

b) Draw the small signal equivalent circuit (include the input source and transistor capacitors) for the circuit when biased at $V_i = V_{DD}/2$.

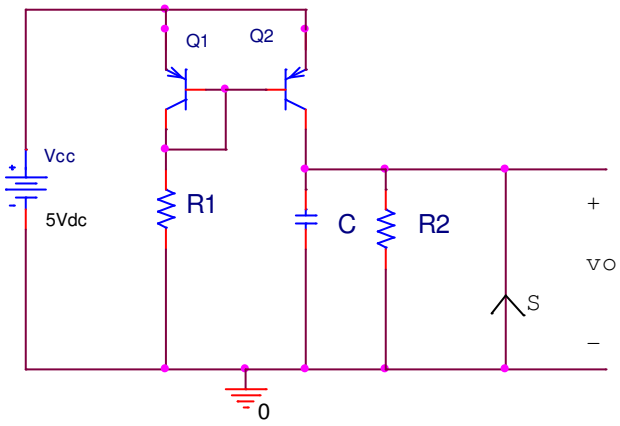
c) Give the small signal transfer function Vo(s)/Vi(s) and find its poles and zeroes.



3. (50 points, 20 minutes)

In the following circuit at t=0 the switch S opens. Assume that the transistors are identical with 0.7V from emitter to base (and that their current mirror acts ideally for its load, that is for all C,R2 & S). Assume also that Vcc=5V.

a) Find R1 to give a current of 1milliAmp. DC in R1.
b) If β=100, what will be the current out of Q2?
c) Give the differential equation for the output voltage, vo(t). Give its solution and sketch vo(t) for any positive finite C & R2.



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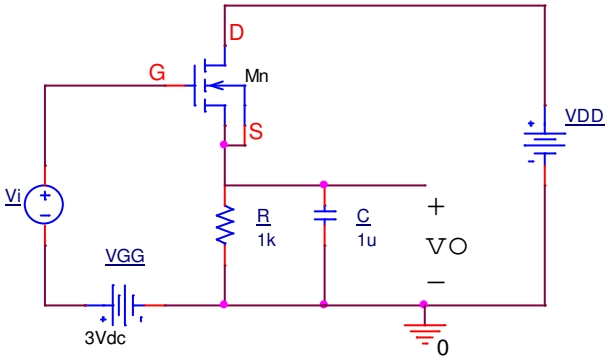

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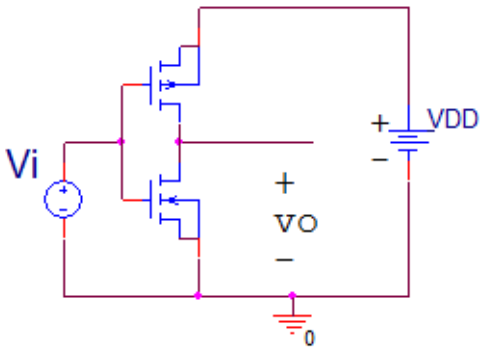

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