File: G:/coursesF12/303/303F12Final.doc RWN 12/13/12b

ENEE 303 Final Exam – Fall 2012

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

Good luck and have a good semester break

For the CMOS transistors assume KP=3*10E-4, |VTO|=1, LAMBDA=λ=10E-6=0.000001, W=L=10E-6. Use VDD = 10V.

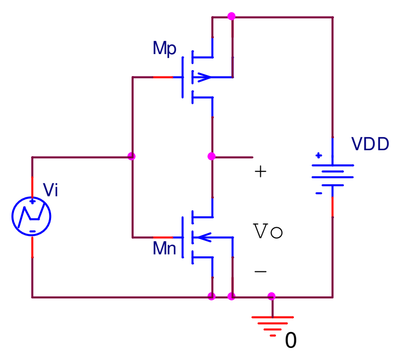
.

1. (50 points)

For the following inverter, using the above transistor models, the input voltage, vi(t) is a triangular wave with period 2 rising linearly from 0V to VDD=10V in 2 seconds.

a) Sketch (in separate sketches) the input, vi(t), and output, vo(t), voltages versus time, for 2 periods.

b) Find the input voltage at which Mp switches from Ohmic (=triode) to Saturation.



2. (50 points)

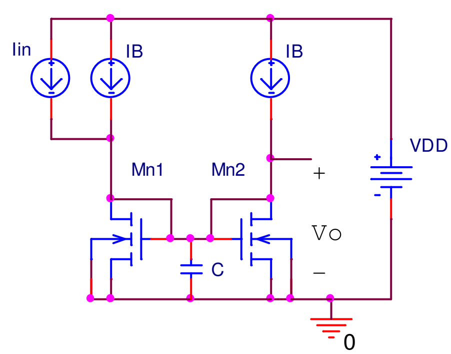
The following circuit has the DC bias current as IB=0.6mA and the small signal input current as i_{in}=0.0002sin(t).

a) Find g_m of Mn1 at the Q point Vo.

b) Set up the differential equation for the small signal steady state output voltage solution, vo_{ss}(t). Assume C includes the two Cgs and is normalized to C=2g_m

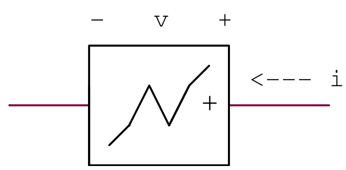
c) Assume vo_{ss}(t)=Asin(t) + Bcos(t) determine A and B.

b) Give the total output voltage, vo(t) [including bias]



3. (50 points,)

A new device has the following symbol



and is described by the 2-terminal device equation

$$i = v[1 + \sin(2\pi v)]$$

a) Sketch the i versus v curve for $0<v<+1$ giving values at v=0,1/4,1/2,3/4,1.
b) Find the small signal conductance for any v in $0<v<1$.
c) Draw the small signal equivalent circuit for the following circuit and give its small signal voltage gain transfer function, T(s)=vo/vi(s). .
d) Find numerically the zeroes and poles of T(s) if the battery voltage is VB=1Volt, C=1 Farad, and the load resistance, RL, is chosen to give a Q point of ½ Volt (=V_O) across the device.