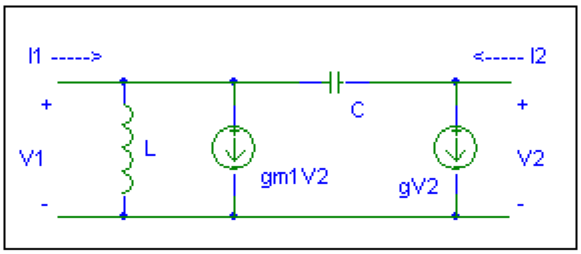
File: f:/coursesF09/303H/303hF09Midtrm.doc RWN 11/04/09

303 Fall 2009 – Midterm Exam Th 11/05/09

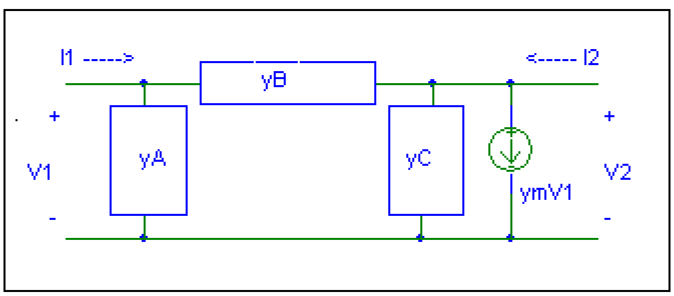
Open book open notes but not open computers; 150 points total; if stuck go on to the next problem. Good luck

DATA: For DC characterization of NMOS transistors assume KP=2mA/V^2, W=L, VTO=2V, LAMBDA=0

1. (50 points, 15 min)
   a) For the following circuit find the admittance matrix Y(s) as a function of complex frequency s.



   b) Give the admittances yA(s), yB(s), yC(s), ym(s) for the following circuit to be equivalent at the ports to the one of part a).



2. (50 points, 25 min)
For the following circuit when M2 is on use for iD2 [from the formula (7.19) p. 694]

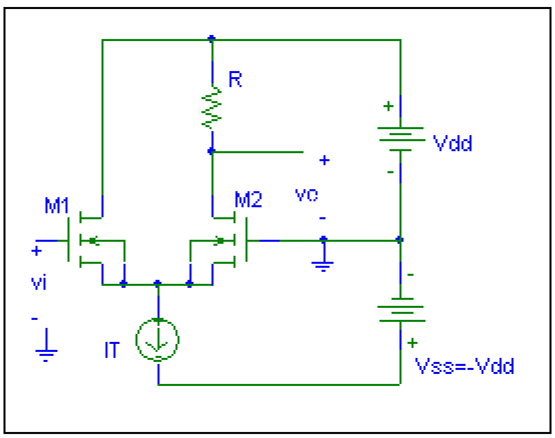
$$i_{D2} = I_T[\frac{1}{2} - (a\frac{vid}{2})\sqrt{1-(a\frac{vid}{2})^2}] \quad \text{where } a = \sqrt{\frac{KP}{I_T} * \frac{W}{L}}$$

also

$$Vov = \frac{1}{a}$$

Choose Vdd=10V, the tail current I_T=8mA and the load resistor to be R=Vdd/(2I_T).

a) evaluate numerically a and Vov of the above formulas and
b) Determine Vo (numerically) as a function of the input voltage vi and sketch for -Vdd<vi<Vdd indicating important points.



3. (50 points, 25 min)
Here Vdd=10V, R=100 Ohm, C=20nFd. The circuit has had vi=0 for -∞<t<0; vi changes at t=0 to Vdd/2 [that is vi(t)=(Vdd/2)1(t) with 1(t) the unit step]. Write vd(t) for the voltage at the drain of the transistor.

a) Find vd(0+) [=vd(0-)].
b) Find vd(+∞), that is when M is on but dvd(t)/dt=0. From this show that M is in the saturation region for 0+<t<+∞.
c) Sketch the load line on two transistor [Id versus Vd] curves holding for t=0- and for t=+∞; use just one graph.
d) Write the differential equation for vd(t) for t>0, solve, and sketch the solution.