**Electronics –II (ELEC 312), Winter 2009 class**

Mid-term test (March 6, 2009)

( Time: 45 minutes Instructor: Dr. R. Raut)

Student ID# Name:

Q.1: Consider the amplifier in Figure 1, built with MOS transistors. The transistor M3 functions as an active load for the transistors M1 and M2. M1 is a common source stage while M2 is a common gate stage.

(a) Draw the small signal ac equivalent circuit for the system. Ignore the *body effect* for M2.

(b) Set up the nodal admittance matrix for the system with a goal to find the small signal voltage gain vo/vi. You DO NOT have to find the voltage gain.



Figure 1:

Q.2: Figures 2(a)-(b) show the cascode and the Wilson current mirror using NMOS transistors. The bias currents are set as *I*REF = *I*o = 20 micro amp. Given that *VA*=20 volts, *Kn*=100 micro amp./V2, *W/L*=10, gm= , gmb= 0.2gm, compare the output resistances that the two mirrors present to an outside circuit. The theoretical expressions for the output resistances are:

(cascode) Rout= , (Wilson) Rout=

Q.3 The BJT differential amplifier is supplied with a differential ac signal vD= v1-v2. The differential output signal is given by the expression 



Where *VT* is the thermal voltage (~ 25 mV). The bias current *I* is arranged to be 2 mA

Determine the voltage gain (vo1-v02)/vD, when (i) vD=20 mV and (ii) vD= 2 mV. How do these compare with the theoretical small signal voltage gain value of | gmRC|, where gm is the trans-conductance of each BJT device.



Figure 3

\*\*\*\*\*\* **Some useful formulae\*\*\*\*\*\*\*\*\*\***

**BJTs** 

 

**Diodes** *I=Is exp(vBE/VT)*