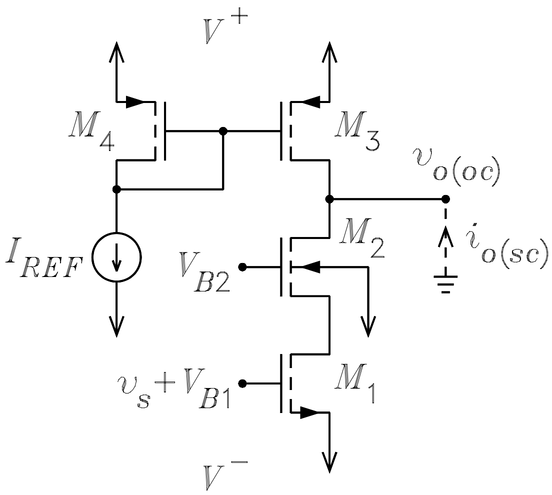
ECE 3050 Analog Electronics Quiz 8
March 4, 2009

Professor Leach Name________________________________

Instructions. Print your name in the space above. **Honor Code:** *I have neither given nor received help on this quiz.* Initials ____________

The figure shows a cascode amplifier. M_1 is operated as a CS amplifier with a small-signal voltage v_s and a dc bias voltage V_{B1} applied to its gate. M_2 is operated as a CG amplifier with a dc bias voltage V_{B2} applied to its gate. M_3 and M_4 form a current mirror with an input dc current I_{REF}. For each MOSFET, it is given that $g_m = 1/200$, $g_{mb} = 1/400$, and $r_0 = 50\,\mathrm{k}\Omega$. Solve for $i_{o(sc)}$ and $v_{o(oc)}$. **To simplify the solution, assume $r_{01} = r_{02} = \infty$ when solving for $i_{o(sc)}$. Then assume $r_{01} = r_{02} = 50\,\mathrm{k}\Omega$ when using $i_{o(sc)}$ to calculate $v_{o(oc)}$.**

$$\chi = \frac{g_{mb}}{g_m} \qquad r_s' = \frac{1}{g_m + g_{mb}} = \frac{1}{g_m(1+\chi)} \qquad r_{id} = r_0\left(1 + \frac{R_{ts}}{r_s'}\right) + R_{ts}$$



$g_m := \frac{1}{200}$ $\qquad g_{mb} := \frac{1}{400}$ $\qquad \chi := \frac{g_{mb}}{g_m}$ $\qquad \chi = 0.5$ $\qquad r_0 := 50000$ $\qquad v_s := 1$

$i'_{d1} := g_m \cdot v_s$ $\qquad i'_{d2} := i'_{d1}$ $\qquad i_{sc} := i'_{d2}$ $\qquad i_{sc} = 5 \cdot 10^{-3}$

$r'_{s2} := \frac{1}{g_m \cdot (1+\chi)}$ $\qquad r'_{s2} = 1.333 \cdot 10^{2}$ $\qquad R_{ts2} := r_0$ $\qquad r_{id2} := r_0 \cdot \left(1 + \frac{R_{ts2}}{r'_{s2}}\right) + r_0$

$r_{id2} = 1.885 \cdot 10^{7}$ $\qquad v_{oc} := -i_{sc} \cdot R_{p2}(r_0, r_{id2})$ $\qquad v_{oc} = -2.493 \cdot 10^{2}$

Answers are i_{sc}/v_s and v_{oc}/v_s.