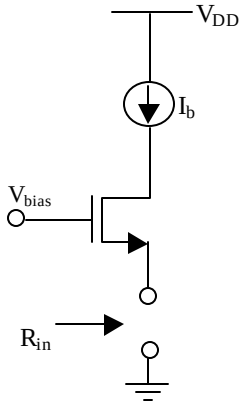
ELEN 689-608 (ESS) **Name _____**
Spring 2000
March 21, 2000

EXAM #1

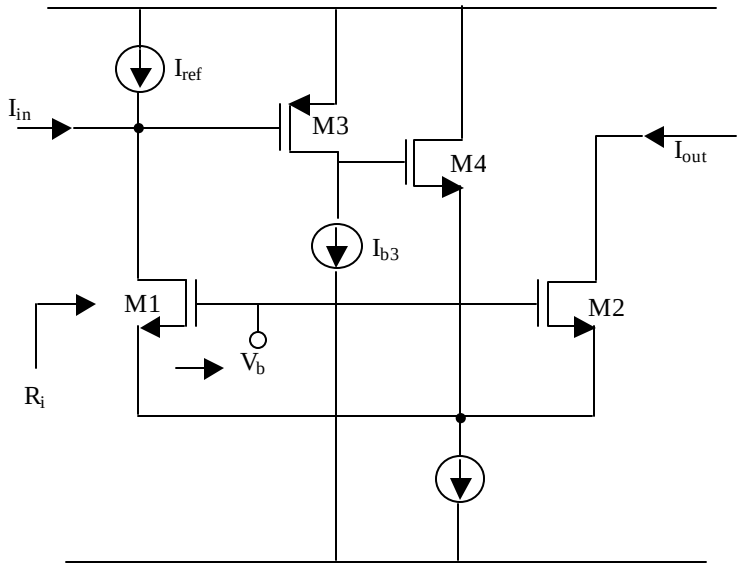
This exam is closed book, no notes, nor book can be used except one information page is allowed. This exam is worth 20% of your final grade.

Prob. 1 (a) (2p) Determine the input impedance of the circuit shown below for two cases, (i) I_b is an ideal current source, and (ii) I_b is substituted by a PMOS (M2) transistor with $g_{ds_2} = g_{ds_1}$ (of transistor M1).

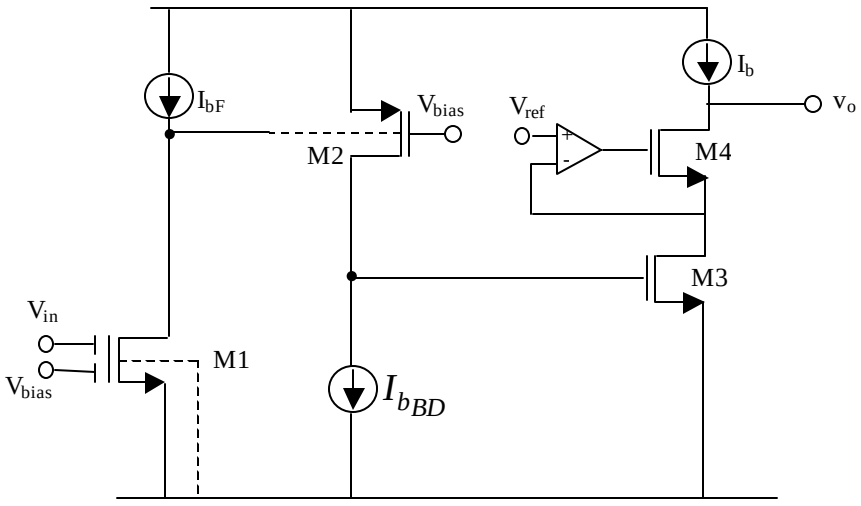


Prob. 1 (b) (4p) Obtain the input resistance expression, simplify the expression making Reasonable approximations and $g_{m4} >> g_{m1}$, what is this circuit and where can you use it?

Hint – Ignore M2 to compute R_i of the circuit. Also neglect bulk effects.

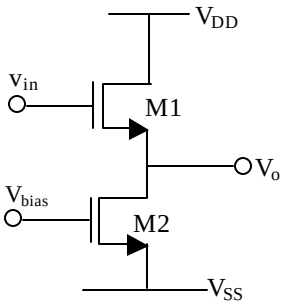


Prob. 2 (3p) Obtain the approximated expression of the small signal voltage gain of the circuit show below. Assume the Op Amp is ideal of finite gain A_o.

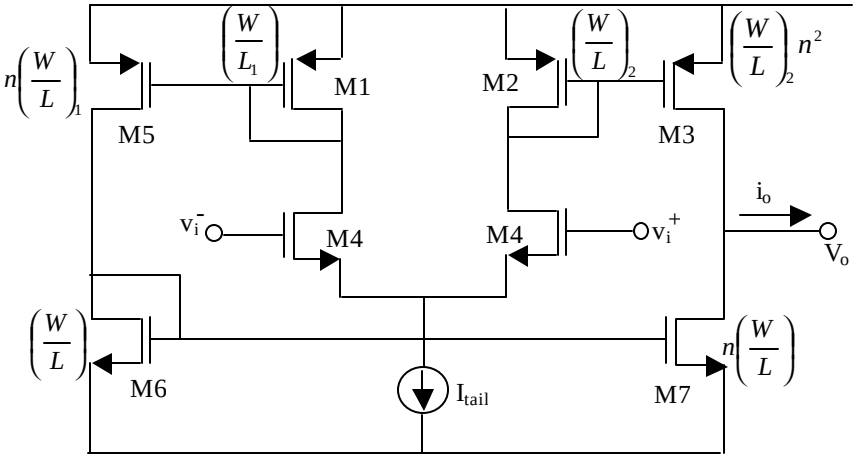


Hint – Identify the effective transconductance and output impedance of each stage.

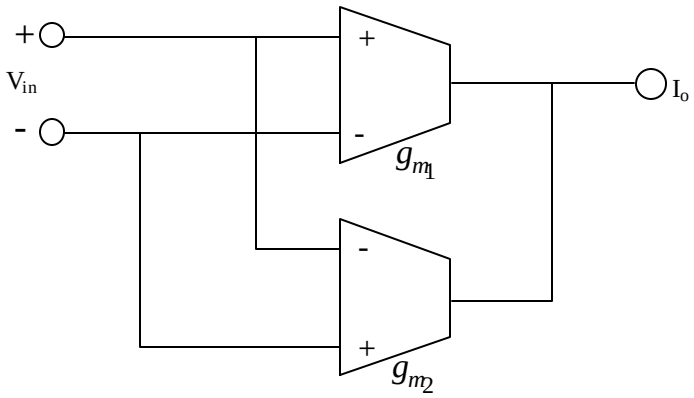
Prob. 3 (4p) (i) Determine the input referred thermal noise spectral. (ii) Indicate how to minimize the input referred thermal noise. Which g_{m1} or g_{m2} must be larger to minimize noise?



Prob. 4 (4p) (a) Determine the (small signal) differential transconductance gain. (b) Also, obtain the output noise spectral density due to only M6 and M7. What is the CMRR(0) for an ideal I_{tail}. (c) Obtain the expressions for the dominant time constants of the OTA.

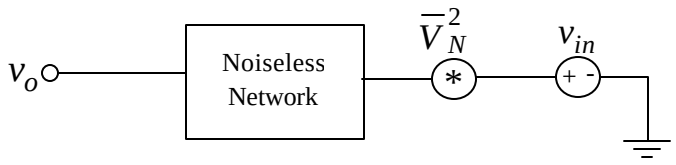


Prob. 5 (3p) Assuming a one dominant pole for each OTA i.e. $g_{m_i} = g_{moi}/(1+S/\omega p_i)$, $i = 1,2$ obtain the effective G_m of the two OTA's combination. Is there any use of this composite OTA?



Extra Credit (2p) No partial credit.

For the system shown below, assume a dominant pole. Obtain the total input referred noise.



$f_{3dB} = 0.636535\,\text{MHz}$ and $\overline{\text{V}}_N = \frac{10^{-5}}{\sqrt{2}} V/\sqrt{\text{Hz}}\,0$