FINAL EXAMINATION – DR. ALLEN

NAME____E-mail____________________

Problem	1	2	3	4	ΣAllen Points	ΣAyazi Points	Total Points
Score							

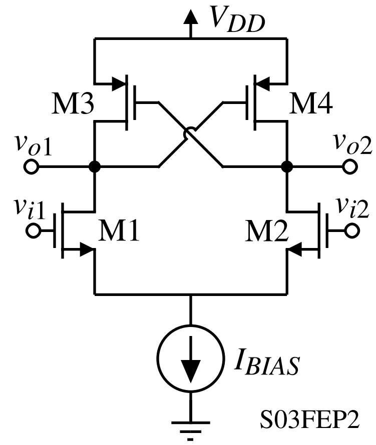
INSTRUCTIONS: This exam is closed book with four sheets of notes permitted. The exam is in two parts. One part is from Dr. Allen and the other is from Dr. Ayazi. You must work the two problems that are required (these problems are Problem 1 on Dr. Allen's part and Problem 1 on Dr. Ayazi's part). You also must work four other problems from the 6 remaining problems (3 on Dr. Allen's part and 3 on Dr. Ayazi's part). You should submit only 6 worked problems for maximum possible 120 points. **Please circle the number in the table above of the remaining three problems you wish graded.** Keep the two exam parts separate when you turn in the exams. Please show your work leading to your answers so that maximum partial credit may be given where appropriate.

Problem 1 - (20 points - This problem is required)

An open-loop comparator has a gain of 10^4, a dominant pole of 10^5 radians/sec., a slew rate of 5V/μs and an output swing of 1V. (a.) If V_{in} = 1mV find the propagation delay time of this comparator (the time for the output to go halfway from one state to the other). (b.) Repeat part (a.) if V_{in} = 10mV. (c.) Repeat part (a.) if V_{in} = 100mV.

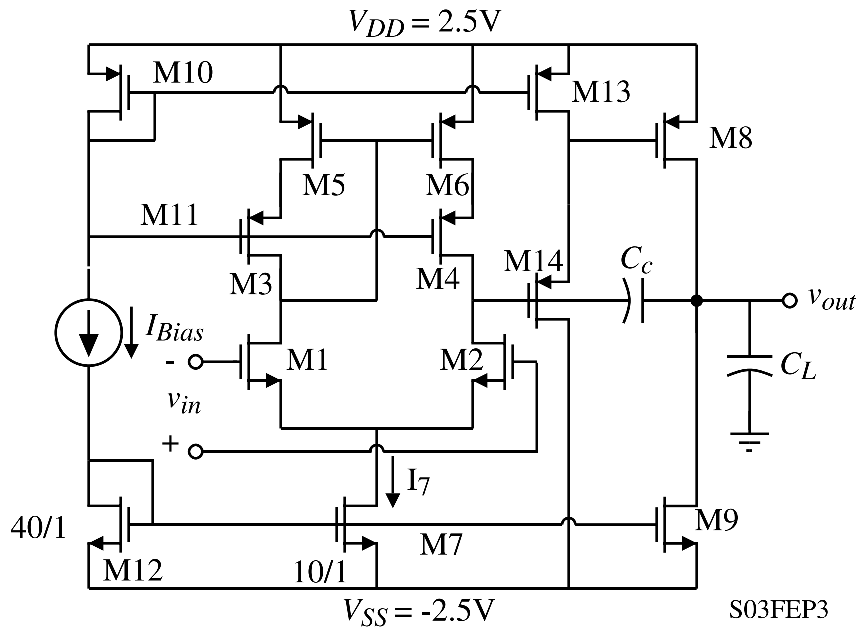
Problem 2 - (20 points - This problem is optional)

Assume the capacitances connected to the drains of M1 and M2 (C_1 and C_2) are initially discharged. Express $\Delta V_{out} = v_{o2} - v_{o1}$ as a function of the applied input, $\Delta V_{in} = v_{i1}$-v_{i2}, in the time domain assuming ΔV_{in} is a step input. If $g_{m1} = g_{m2}$ = 1mS, $g_{m3} = g_{m4}$ = 100µS, and $C_1 = C_2$ = 1pF, what is the propagation delay time ($\Delta V_{out} = |0.5(V_{OH} - V_{OL})|$) for a step input of $\Delta V_{in} = 0.01(V_{OH} - V_{OL})$?



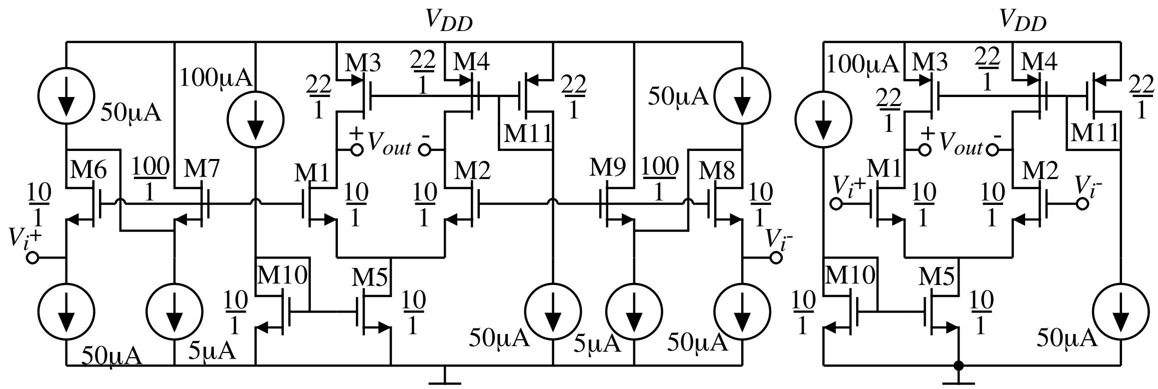
Problem 3 - (20 points - This problem is optional)

An internally-compensated, cascode op amp is shown. (a) Derive an expression for the common-mode input range. (b) Find W_1/L_1, W_2/L_2, W_5/L_5, and W_6/L_6 when I_{BIAS} is 80 A and the input CMR is -1.25 V to +2 V. Use K'_N = 110 A/V^2, K'_p = 50 A/V^2 and $|V_T|$ = 0.6 to 0.8V. (c.) Develop an expression for the small-signal differential-voltage gain and output resistance of the cascode op amp.



Problem 4 - (20 points - This problem is optional)

George P. Burdell has submitted the following input stage for the design challenge problem in ECE 6412. Assuming that the transistor model parameters are K_N' =110µA/V^2, V_{TN} = 0.7V, λ_N=0.04V^{-1}, K_P' =50µA/V^2, V_{TP}= -0.7V, λ_P=0.05V^{-1}, your job is to check this op amp out. In particular, what is the upper and lower input common mode voltages, what is the minimum power supply that gives zero input common mode range, what is the small-signal voltage gain, and compare this input stage with the classical differential input stage (list advantages and disadvantages).



S03FEP4 The George P. Burdell Approach Classical Approach

Extra Page