Name: _____

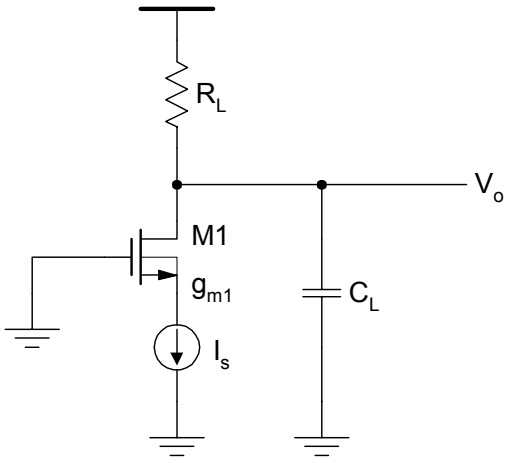
SID: _____

UNIVERSITY OF CALIFORNIA
College of Engineering
Department of Electrical Engineering
and Computer Sciences

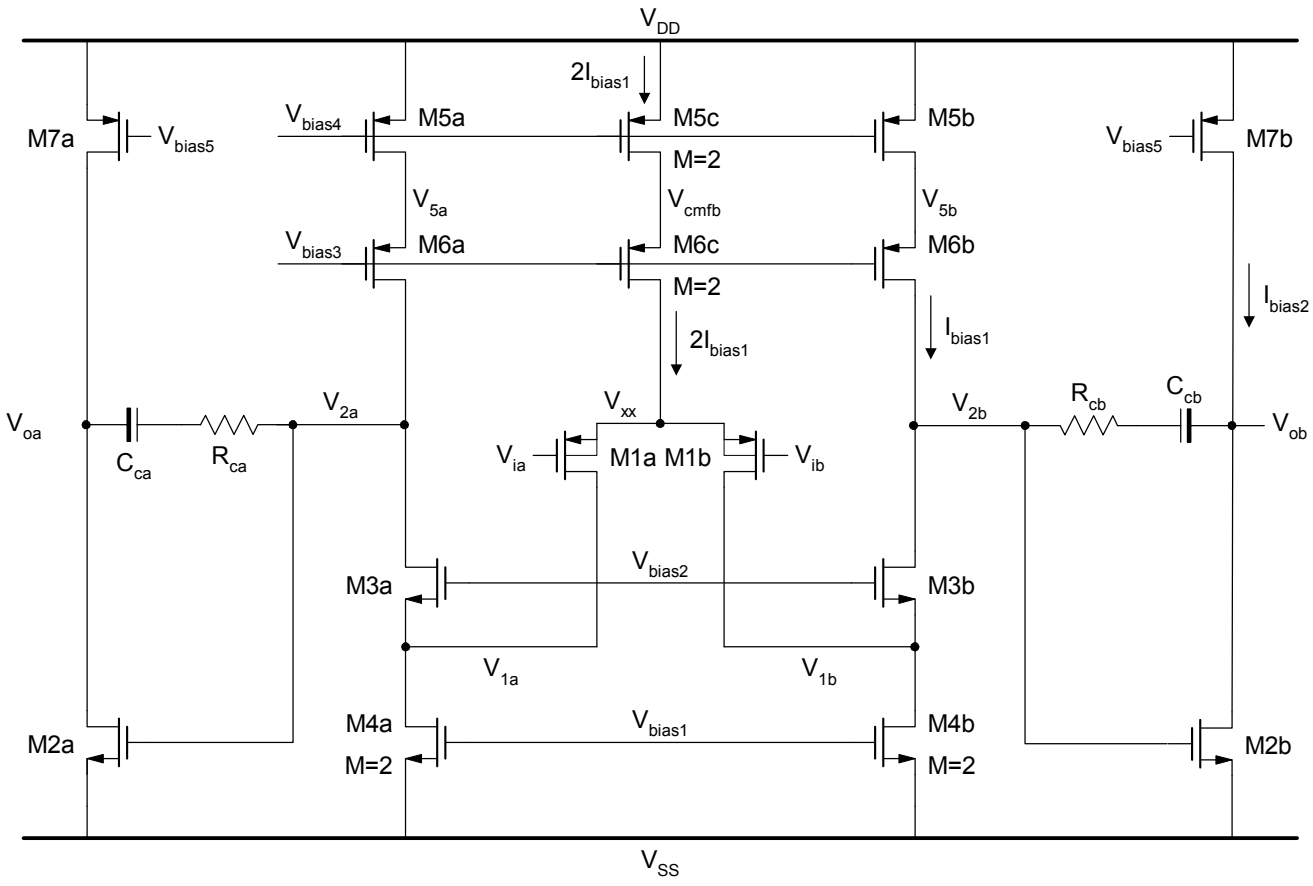
	Final Exam	**EECS 240**
B. E. BOSER	**May 19, 2004**	**SPRING 2004**

*Show derivations and **mark results** with box around them. Erase or cross-out erroneous attempts. Simplify algebraic results as much as possible! Mark your name and SID at the top of the exam and all extra sheets.*

1. Derive an analytical expression for the variance of the thermal noise at the output V_o of the circuit below. State your result as a function of R_L, g_{m1}, γ_1, and k_BT. For simplicity, you may ignore the finite output resistance of the transistor and all capacitors except C_L.

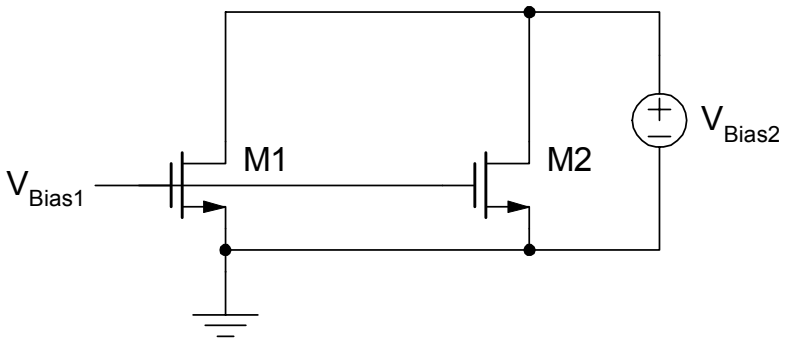


2. Derive an expression for the low-frequency differential-mode input referred thermal noise density $\overline{v_{id,n}^2}/\Delta f$ of the circuit below. State your result in terms of the V* of individual transistors (devices with identical index, e.g. M1a and M1b, have the same V*), I_{bias}, and k_BT. For simplicity you may assume that the output resistance of all devices is infinite. The "noise factor" for all devices is γ=1.



OTA Core

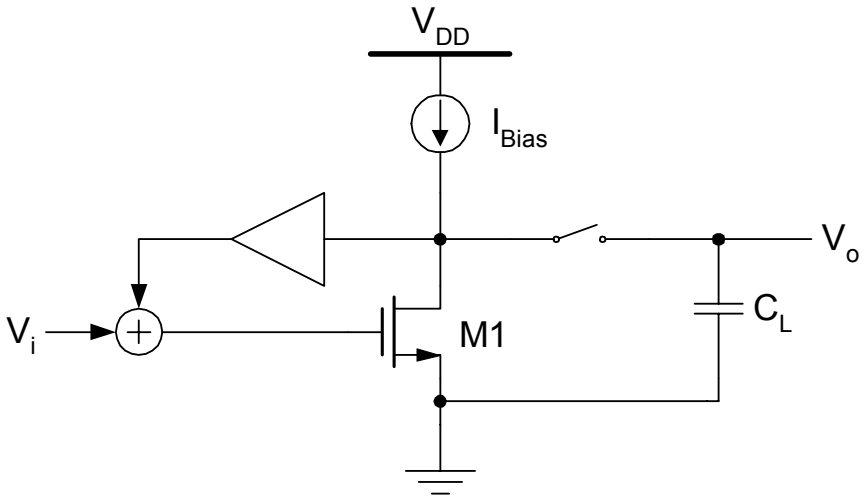
3. Derive an expression for the standard deviation of the relative current mismatch $\Delta I_D/I_D$ of the circuit below. State your result as a function of W, L, V_{TH}, terminal voltages, and A_1, A_2 describing technology mismatches as $\sigma^2_{\Delta(W/L)/(W/L)} = A_1/WL$ and $\sigma^2_{\Delta V_{TH}} = A_2/WL$.



4. Calculate the "power-speed-dynamic range figure-of-merit", FOM_{PSD} of the circuit below. This metric is defined as

$$FOM_{PSD} = \frac{P}{B \times DR},$$

where P is the power dissipation of the circuit, B the unity-gain bandwidth in [rad/sec], and DR the dynamic range at the output V_o when the switch opens. Consider only thermal noise from M1 and ignore finite output and switch on-resistance. Formulate your result as a function of V_{DD}, V*, I_{Bias}, C_L, k_BT, and the ratio r of the peak-to-peak output voltage range $V_{o,pp}$ to the supply voltage, V_{DD}.



5. Sketch the magnitude response and derive expressions for the frequencies and amplitude of all break points for the circuit shown below. Assume that all poles and zeros occur at frequencies that are much smaller than the sampling rate and that the amplifier is ideal.