MIDTERM

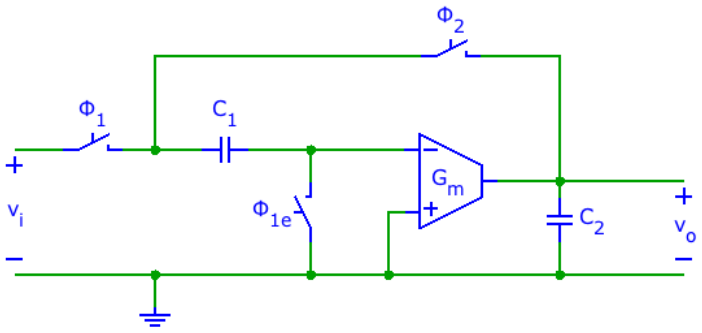
Name: _____

SID: _____

Problem	Score
1	
2a	
2b	
3	
Total (of 100)	

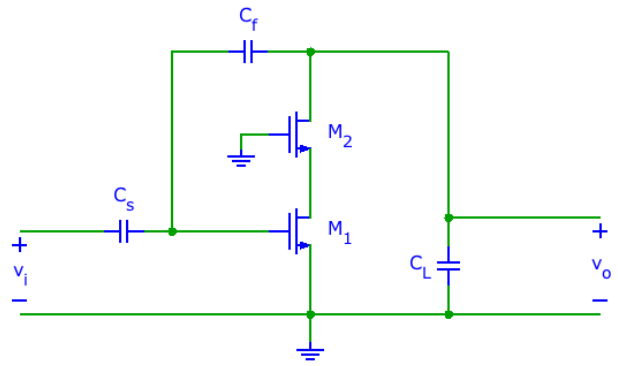
- **1 page of handwritten notes, double sided, 8.5 by 11 inches**
- **Mark all results with a box.**
- Write solutions on the exam sheets. No extra pages.
- Simplify algebraic results as much as possible.
- Show derivations and explain briefly how you arrived at your result.

1. [25 points] The circuit shown below is controlled by an f_s=10MHz non-overlapping two-phase clock. Calculate the standard deviation $\sqrt{\overline{v_{oT}^2}}$ of the noise at the output at the end of phase two.
   Parameter: $C_1 = 1\text{pF}, C_2 = 5\text{pF}, G_m = 5\text{mS}, f_T(G_m) = 1.6\text{GHz}$. The switch on-resistance contributes negligible to the dynamics of the circuit.



2. The amplifier design shown below is from previous project. Your assignment is to modify it to meet new requirements. Show your work and summarize your results in the table below. Neglect slewing and all capacitors except those shown in the schematic diagram and the gate-to-source capacitances of the transistors. Model the transistors as ideal transconductors with $f_T = 10\text{GHz}\cdot(65\text{nm}/L)^2$ and γ=1. Treat each sub-problem separately, i.e. modify the original design, not a previous result.
   a) [25 points] Modify the design to achieve a closed-loop phase margin of 70 degrees without changing other specifications.
   b) [25 points] Modify the parameters such that the total noise from M_1 at the output is 300µV rms.

Parameter	Original	(a)	(b)
C_s	100fF		
C_f	50fF		
C_L	50fF		
g_{m1}	10mS		
I_{D1}	600µA		



Extra page for calculations

3. [25 points] Find the noise factor α (ratio of noise from all sources divided by noise only from input differential pair for differential signals) of the amplifier shown below. State your result in terms of the *V*'s* of the transistors and multiplicity factor *M* of devices M_6 and M_7 (M=1 for all other transistors). Ignore the noise from cascodes and assume that the circuit is balanced (e.g. M_1 and M_2 are identical).
   Suggestion: use the differential mode half circuit.