Practice Midterm Exam – EE 420 Engineering Electronics II and ECG 620 Analog IC Design
University of Nevada, Las Vegas

Name: _____

- Open book and closed notes.
- No scratch paper.
- Put boxes around your answers (only!)
- The exam's length is 1 hour and 15 minutes. **Stop when told to stop.**
- Please use the following parameters in your exam unless specified otherwise.

Long-channel MOSFET parameters for general analog design in this book $VDD = 5$ V and a scale factor of **1 μm** (*scale* = 1e–6)			
Parameter	**NMOS**	**PMOS**	**Comments**
Bias current, I_D	20 μA	20 μA	Approximate
W/L	10/2	30/2	Selected based on I_D and $V_{DS,sat}$
$V_{DS,sat}$ and $V_{SD,sat}$	250 mV	250 mV	For sizes listed
V_{GS} and V_{SG}	1.05 V	1.15 V	No body effect
V_{THN} and V_{THP}	800 mV	900 mV	Typical
	−1 mV/C°	−1.4 mV/C°	Change with temperature
KP_n and KP_p	120 μA/V^2	40 μA/V^2	$t_{ox} = 200$ Å
	1.75 f F/μm^2	1.75 f F/μm^2	
C_{oxn} and C_{oxp}	35 f F	105 f F	PMOS is three times wider
C_{gsn} and C_{sgp}	23.3 f F	70 f F	
C_{gdn} and C_{dgp}	2 f F	6 f F	
g_{mn} and g_{mp}	150 μA/V	150 μA/V	At $I_D = 20$ μA
r_{on} and r_{op}	5 MΩ	4 MΩ	Approximate at $I_D = 20$ μA
$g_{mn}r_{on}$ and $g_{mp}r_{op}$	750 V/V	600 V/V	Open circuit gain
λ_n and λ_p	0.01 V^{-1}	0.0125 V^{-1}	At $L = 2$
f_{Tn} and f_{Tp}	900 MHz	300 MHz	For $L = 2$, f_T goes up if $L = 1$

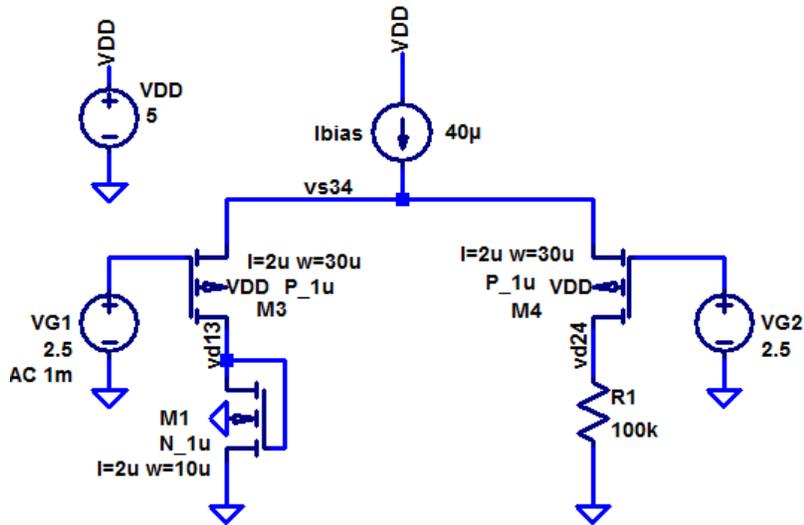1. Plot the current that flows in Vin against Vin for Vin varying between −2 and 2 V. (20 points)
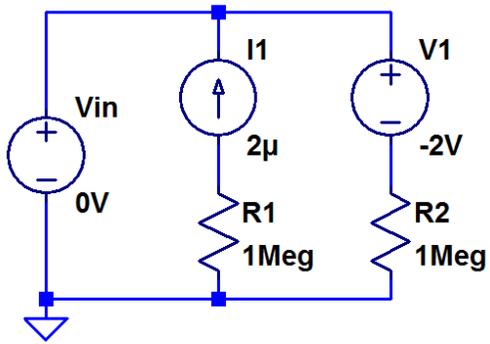
2. Calculate the DC voltages and currents in the following circuit. Show your work for credit. Please don't forget to put boxes around your answers. (20 points)
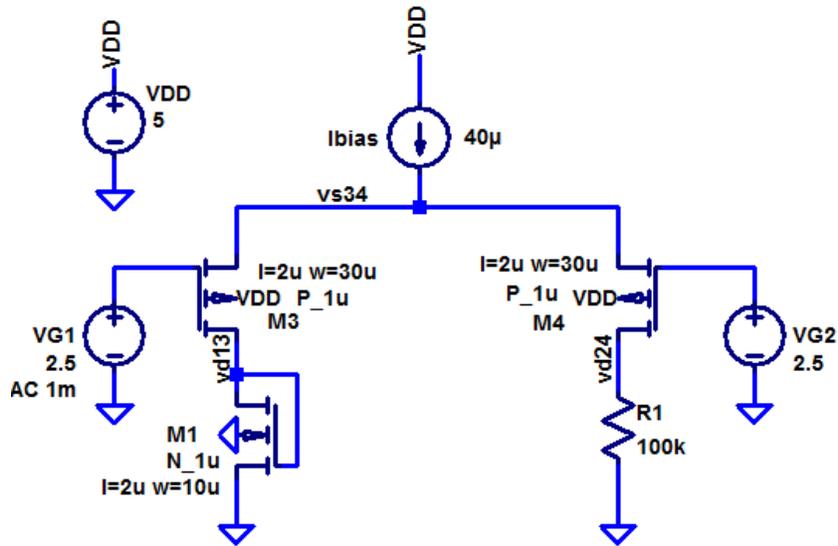
3. Estimate the AC voltages and currents that flow in the following circuit. As always, show your work. Again, as always, put boxes around your answers. Note that you've already calculated the DC operating conditions in problem 2. (20 points)

4. Determine the DC currents and voltages (numbers) in the following circuit. Then estimate the AC current that flows in Vt (again, a number). As always show your work and put boxes around your answers only! (20 points)

5. Estimate the DC current (a number) that flows in the following circuit. As always show your work and put a box around your answer. (20 points)

I=2u w=40u
P_1u
VDD◄►
M3

I=2u w=10u
P_1u
◄►VDD
M4

VDD

VDD

5

M1
N_1u
I=2u w=10u

M2
N_1u
I=2u w=10u

R1
6.5k TC1=0.002

.op
.include cmosedu_models.txt