## EE331 Devices and Circuits 1 Spring 2014

## Homework 6 Assigned on Friday, May 9 2014 Due in class on Friday, May 16 2014

1. Jaeger & Blalock Problem 6.39. Also compute the drain current  $i_D$  when  $v_O = V_L$  for each case. Use the MOSFET parameters shown on p. 355 as needed.

2. Jaeger & Blalock Problem 6.50.

3. (a) Jaeger & Blalock Problem 6.59. (b) Jaeger & Blalock Problem 6.60.

4. Jaeger & Blalock Problem 6.76. Use  $V_{DD} = 2.5 V$ ,  $V_{GG} = 4 V$ , P = 0.2 mW,  $V_L = 0.2 V$ ,  $V_{TO} = 0.6 V$ ,  $K_n' = 100 \ \mu A/V^2$ ,  $\gamma = 0.5 V^{\frac{1}{2}}$ ,  $2\varphi_F = 0.6 V$ .

- 5. Jaeger & Blalock Problem 6.84.
- 6. Jaeger & Blalock Problem 6.87.
- 7. Jaeger & Blalock Problem 6.95.
- 8. Jaeger & Blalock Problem 6.101.

## Homework Problem 6.87 b) Tutorial:

 Use Multisim to create a schematic of a depletion load NMOS inverter. For the NMOS transistors, go to Place >> Component.... and use MOS\_N :



2. Double click the transistor on the schematic for which you would like to change parameters. The following window will appear. Fill in the Value parameter for the Length and Width you found in part a).:

bel I	Display Value Fault	Pins User	r fields			
istance	parameters:				<u>T</u> ools ▼ <u>V</u> iews	•
Name	Description	Value	Units	Use default	Show on schemati	c ^
L	Length	????	m		None	
W	Width	????	m		None	
м	Multiplicity	1		1	None	
AD	Drain area	0	m²	1	None	
AS	Source area	0	m²	$\checkmark$	None	
PD	Drain perimeter	0	m	$\checkmark$	None	
PS	Source perimeter	0	m		None	
NRD	Drain squares	1		✓	None	
NRS	Source squares	1		$\checkmark$	None	
TEMP	Instance temperature	27	°C		None	~
)evice r	nodel level: MOS 1 (Level :	L)			Edit component in D Save component to Edit footprint Edit model	DB

3. In this same window, click the button in the bottom right corner of this window that says "Edit model". Another window will appear to "Edit Model." Fill in the parameters you are given in the problem. Here is an example for one of the transistors:

		Edit Model			
Model .model N	MOS_TRANSISTORS_VIRTUAL_1_	_1 nmos	I	ools 🔹 <u>V</u> iews	•
Name	Description	Value	Units	Use default	^
Level	Device model level	MOS 1 (Level 1)			
VTO	Threshold voltage	0.6	V		
KP	Transconductance parameter	0.0001	A/V <sup>2</sup>		
GAM	Bulk threshold parameter	0	V^0.5	$\checkmark$	
PHI	Surface potential	0.6	V	$\checkmark$	
LAM	Channel length modulation	0	1/V		
RD	Drain ohmic resistance	0	Ω		
RS	Source ohmic resistance	0	Ω		
RG	Gate ohmic resistance	0	Ω		
RB	Bulk ohmic resistance	0	Ω		~
Ch	ange component nge all components				
R	eset to default		Cance	el Help	1

4. Go to Simulate >> Analyses >> DC operating point... and select the desired output. If you did part a) by hand correctly, the result for b) in Multisim should be within 10% of the expected value.