

**PROBLEM SET #5***Issued: Friday, September 21, 2018**Due: Friday, September 28, 2018 at 12:00 noon via Gradescope.*

1. Sedra & Smith, Problem 3.20
2. Sedra & Smith, Problem 4.43
3. Sedra & Smith, Problem 5.24
4. Sedra & Smith, Problem 5.28
5. Sedra & Smith, Problem 5.34

For problems 6 and 7 below, use the parameters in Table PS5.1 as needed.

<i>PARAMETER</i>	<i>NMOS VALUE</i>	<i>PMOS VALUE</i>	<i>UNIT</i>
$V_{TO}$	0.75	-0.75	V
$\gamma$	0.75	0.5	$\sqrt{\text{V}}$
$2\phi_f$	0.6	0.6	V
$K'$	25	10	$\mu\text{A}/\text{V}^2$

Table PS5.1

6. Identify the source, drain, gate and bulk terminals, and find the current  $I$  in the transistors in Figure PS5.1. Assume  $V_{TN} = 0.75$  V.

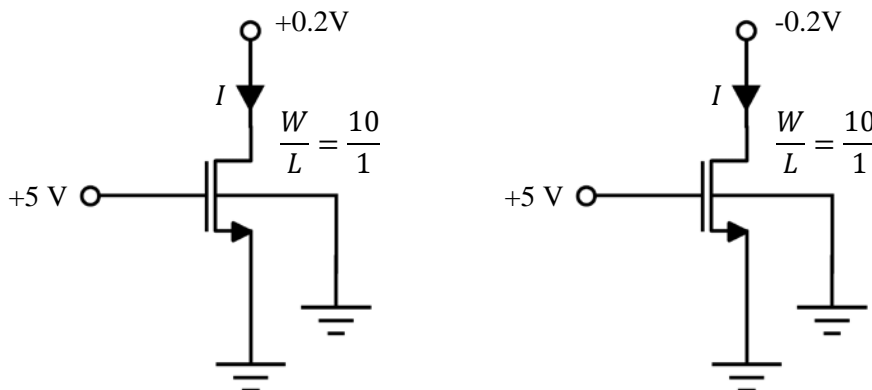


Figure PS5.1

7. Consider transistors operating in their linear regions for the questions below.
- (a) What is the  $W/L$  ratio required for an NMOS transistor to have an on-resistance of  $1\text{ k}\Omega$  when  $V_{GS} = 5\text{ V}$  and  $V_{SB} = 0$ ? Assume  $V_{TN} = 0.75\text{ V}$ .
  - (b) Repeat for a PMOS transistor with  $V_{GS} = -5\text{ V}$  and  $V_{SB} = 0$ . Assume  $V_{TP} = -0.75\text{ V}$ .
8. Identify the region of operation of an NMOS transistor with  $K_n = 250\text{ }\mu\text{A/V}^2$  and  $V_{TN} = 1\text{ V}$  for:
- (a)  $V_{GS} = 5\text{ V}$  and  $V_{DS} = 6\text{ V}$
  - (b)  $V_{GS} = 0\text{ V}$  and  $V_{DS} = 6\text{ V}$
  - (c)  $V_{GS} = 2\text{ V}$  and  $V_{DS} = 2\text{ V}$
  - (d)  $V_{GS} = 1.5\text{ V}$  and  $V_{DS} = 0.5\text{ V}$
  - (e)  $V_{GS} = 2\text{ V}$  and  $V_{DS} = -0.5\text{ V}$
  - (f)  $V_{GS} = 3\text{ V}$  and  $V_{DS} = -6\text{ V}$