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.

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>NMOS VALUE</th>
<th>PMOS VALUE</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{TO}$</td>
<td>0.75</td>
<td>-0.75</td>
<td>V</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>0.75</td>
<td>0.5</td>
<td>$\sqrt{V}$</td>
</tr>
<tr>
<td>$2\phi_f$</td>
<td>0.6</td>
<td>0.6</td>
<td>V</td>
</tr>
<tr>
<td>$K'$</td>
<td>25</td>
<td>10</td>
<td>$\mu A/V^2$</td>
</tr>
</tbody>
</table>

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](image_url)
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 kΩ 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 $K_n = 250 \mu \text{A/V}^2$ 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 $V_{DS} = -6 \text{ V}$