Embedded Systems (CS [45]163) 
Homework 1

February 9, 2009

This homework assignment is due on Thursday, February 12th at 5:00pm. Your work may be handed in electronically (use the Homework 1 digital dropbox on D2L) or in hardcopy form (in person or under door).

This assignment must be done individually: do not share/discuss your answers with others or look at the answers of others.

Question 1

Consider the following circuit:
1. (20pts) Derive an equation for $V$ given $V_x$ and $Rx$, where $x = \{0, 1, 2\}$. 
   Show your work.

2. (10pts) Assume $R_0 = 200$, $R_1 = 100$ and $R_2 = 50$. Simplify the equation for $V$. 

3. (10pts) Fill in the following table.

<table>
<thead>
<tr>
<th>V2</th>
<th>V1</th>
<th>V0</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>5</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>
Question 2

Consider the following circuit:

\[ V0 \]
\[ IR \]
\[ R \]
\[ ID \]
\[ V1 \]

Assume that \( V_f = 1.2V \).

1. (20pts) Derive equations for \( V1 \) and \( ID \) for arbitrary \( V0 \) and \( R \).

2. (10pts) Assume \( V0 = 5V \). Show a plot of \( ID \) as a function of \( R \).
3. (10pts) Assume $R = 100\Omega$. Show a plot of $ID$ as a function of $V0$. Be sure to include all interesting values of $V0$.

**Question 3**

Consider the following circuit:

Assume $V_{fD} = 1V$, $V_{fT} = 0.5V$, $g = 100$, $R1 = 1K\Omega$, $R2 = 100\Omega$ and $V4 = 10V$.  

5
1. (10pts) Given \( V_0 = 5V \), what are \( V_3 \) and \( IR_2 \)?

2. (10pts) Given \( V_0 = 1.6V \), what are \( V_3 \) and \( IR_2 \)?

3. (10pts) Given \( V_0 = 1V \), what are \( V_3 \) and \( IR_2 \)?
**Question 4**

Consider the following circuit:

Assume $R_2 = R_3 = 0$, $R_1 = 500\,\Omega$, $V_{fD_2} = 1\,V$ and $V_{fD_3} = 2\,V$.

1. (10pts) Assume $V_0 = 0.8\,V$, what are $I_D2$ and $I_D3$? Show your derivation.
2. (10pts) Assume $V_0 = 1.5V$, what are $ID_2$ and $ID_3$? Show your derivation.

3. (10pts) Assume $V_0 = 2.5V$, what are $ID_2$ and $ID_3$? Show your derivation.
Question 5 (GRADUATE ONLY)

Consider the circuit from Question 4.

Assume $R_2 = 300\,\Omega$ and $R_3 = 400\,\Omega$.

1. (20pts) Show $V_1$, $I_{D2}$ and $I_{D3}$ as a function of $V_0$.

Question 6 (ALL)

How much time did you spend on this homework assignment?