**EE3954 Microprocessors and Microcontrollers**

**Assignment #3 (due: Friday, 14 March 2016 in class)**

**Problem 1.**

1) The circuit shown at the right shows the connections to pin RC2 of a PIC. Assume that RC2 is configured as an input and has a Schmitt Trigger input buffer. (see data sheets page 33 for diagram)

   ![Circuit Diagram]

   **a)** (1pt) If operating properly what would be the normal (SW1 not pressed) logic state of RC2?

   **b)** (5 pts) What is the minimum resistance value of $R_1$ that would prevent the PIC from being damaged if RC2 was accidentally configured as an output and SW1 was pressed? (consider both cases: RC2 outputs a logic ‘1’ or a logic ‘0’ when switch is closed)
Problem 2.

a) (4 pts) Assume that RC3 is configured as an output. Circle any of the four circuits below that would enable the LED to be lit when RC3 = logic’1’ and not lit when RC3 = logic’0’?

b) (4 pts) What will be the minimum value of R1 to prevent the current through the diode from exceeding 10mA? (assume worst case for $V_{OH}$, and $V_{diode} = 1.4 \text{ V}$)
Problem 3.

The circuit shown at the right shows the connections to pin RC3 of a PIC. Assume that RC3 is configured as an output. (assume Vdiode =1.4 V)

a) (2 pts) What will be the current (I) into RC3, if it is a logic ‘0’?

b) (2 pts) What will be the current (I) into RC3, if it is a logic ‘1’?

Problem 4.

(3 pts) Explain in your own words the “simplified” working of a PMOS (p-type) transistor.
Problem 5.

Given the following output stage for one of the PIC Microcontroller’s port pins:

![Diagram of output stage](image)

Given:
- \( V_{OH} = 4.3 \, \text{V} \)
- \( V_{OL} = 0.6 \, \text{V} \)
- \( I_{OH} \& I_{OL} = 25 \, \text{mA} \)

a) (1 pt) Show the calculation for determining the smallest value for the resistor \( R \) that can be used without damaging the output driver transistor. Note that you have to account for \( V_{OL} \) in this case.

b) (1 pt) Will the LED turn on when the output is at a logic “1” or a logic “0”?

Circle one: Logic “1” Logic “0”

c) (1 pt) What value needs to be written to the TRISC file register bit location if we want the corresponding PORTC pin to be an input?

Circle one: Logic “0” Logic “1”

d) (1 pt) Is it possible to make half of the bits of PORT B inputs and the other half outputs at the same time. (For example bits 0,1,2,3 = inputs, bits 4,5,6,7 = outputs)

Circle one: YES NO
Problem 6.

Given the following diagrams:

![Diagrams](image)

(a)  (6 pts) Determine what logic value must be written to PORTC bit 0 to turn the LED ON and OFF in case of setup (a) and (b), respectively. Determine also what value must be written to TRISC bit 0 to support setup (a) and (b).

<table>
<thead>
<tr>
<th></th>
<th>PORTC bit 0</th>
<th>TRISC bit 0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LED ON</td>
<td>LED OFF</td>
</tr>
<tr>
<td>Setup (a)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Setup (b)</td>
<td></td>
<td></td>
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</tbody>
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(b)  (2 pts) When the LED is turned ON, determine if PORTC pin 0 is **sinking** or **sourcing** current in case of setup (a) and (b).