ECE 1315 - Lab #3: Number Conversion

Design a circuit that controls the segments on a common-anode 7-segment display to produce the patterns shown below in response to a 3-bit binary number input. The output should display the decimal representation of the binary input for the range $011_2 – 111_2$ (i.e. 3 – 7\(10\)). Inputs of $000_2$ through $010_2$ will never be used so it does not matter what the display would show if those input values were applied (Note the order of the x’s).

<table>
<thead>
<tr>
<th>X_2X_1X_0</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>011</td>
<td>3</td>
</tr>
<tr>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>101</td>
<td>5</td>
</tr>
<tr>
<td>110</td>
<td>6</td>
</tr>
<tr>
<td>111</td>
<td>7</td>
</tr>
</tbody>
</table>

Use any of the chips in the cabinet. Minimize the total number of chips that you use in your implementation. Chips you may use are on the left below:

74_00 quad 2-input NAND gates  
74_02 quad 2-input NOR gates  
74_04 hex NOT gates  
74_08 quad 2-input AND gates  
74_10 triple 3-input NAND gates  
74_20 dual 4-input NAND gates  
74_27 triple 3-input NOR gates  
74_30 single 8-input NAND gate  
74_32 quad 2-input OR gates  
74_86 quad 2-input XOR gates  
74_?? quad 2-input XNOR gates

Input variables come from the LogiScan unit, X_2 on pin 3, X_1 on pin 2, and X_0 on pin 1. Your seven output functions will drive the cathodes of a common-anode 7-segment Light Emitting Diode (LED) display. Note that with the displays in the lab, the segments light when you put a 0 on the cathodes, and remain dark when you supply a 1. Be sure to include the 150\(\Omega\) resistor between the common anode of the display and the +5 volt power for the circuit to limit the current in the LED segments, or you’ll burn out the LEDs. The 150\(\Omega\) resistors are in a separate yellow box on the shelves in the lab. Click the red boxes below the variables X_2, X_1, and X_0 on the LogiScan to manually control the values of the variables input to your circuit, so you can view the patterns you produce on the display for each input.

In your report show the circuit that you implement to generate the seven functions for the seven segments of the display, whatever manipulations you used to arrive at that implementation, and the logic diagram with all the inputs on the gates that you use. Remember to get your lab instructor to check your result, and sign his/her sheet with the number of components you used after you’ve answered the questions.

Q#1: Does the 7-seg LED display use positive or negative logic? What does that mean?
Q#2: Since the values $000_2$ through $010_2$ were not specified, what can you treat them as?