Assignment #3 Solutions

1) Design a combinational circuit that converts 4-bit binary code into 4-bit excess-3 code.

This problem was solved in Class.

2) Design a combinational circuit that converts 4-bit binary code into 4-bit gray code.

Refer to quiz 3 for solutions

3) Design a half-subtractor and a full subtractor circuit.

(a) \[
\begin{array}{c|c|c}
\text{x} & \text{y} & \text{z} \\
0 & 0 & 0 \\
0 & 1 & 1 \\
1 & 0 & 1 \\
1 & 1 & 0
\end{array}
\]
\[D = x'y + xy', \quad B = x'y\]

(b) \[
\begin{array}{c|c|c|c|c}
\text{x} & \text{y} & \text{z} & \text{D} \\
0 & 0 & 0 & 0 \\
0 & 1 & 1 & 1 \\
1 & 0 & 1 & 0 \\
1 & 1 & 0 & 1 \\
1 & 0 & 1 & 0 \\
1 & 1 & 0 & 0
\end{array}
\]
\[D = x'y + x'z + yz, \quad B = x'y + x'z + yz\]
4) Design 4-bit combinational circuit 2’s complementer. (The output generates the 2’s complement of the input binary number) Show that the circuit can be constructed using exclusive-OR gates?

5) Design a code converter that converts a decimal digit from 8, 4,-2,-1 code to BCD.
6) Design a combinational circuit that converts a 4-bit Gray code to a 4-bit binary number. Implement the circuit with exclusive-OR gates.

7) Implement the following Boolean function with a multiplexer

\[ F(A, B, C, D) = \sum m(0, 1, 3, 4, 8, 9, 15) \]
8) An 8×1 multiplexer has inputs A, B, and C connected to the selection inputs S₂, S₁, and S₀, respectively. The data inputs I₀ through I₇, are as follows: I₁ = I₂ = I₇ = 0; I₃ = I₅ = 1; I₀ = I₄ = D; and I₆ = D'.

Determine the Boolean function that the multiplexer implements.

\[ A \quad B \quad C \quad D \quad F \]
\[ \begin{array}{c|cccc|c}
\hline
I_3 & 0 & 1 & 1 & 0 & 1 \\
I_5 & 0 & 1 & 0 & 1 & 0 \\
I_6 & 0 & 0 & 0 & 1 & 1 \\
I_7 & 1 & 0 & 0 & 0 & 0 \\
\hline
\end{array} \]

\[ F(A, B, C, D) = \sum (7, 8, 9, 10, 11, 12) \]


Solve the following problems:

From chapter 1, pages 38 - 39

1-10 (a), 1-9 (a, b)
From chapter 2, pages 64 - 65
2-4, 2-6, 2-7, 2-8
From chapter 4, pages 120 – 121

4-12,

<table>
<thead>
<tr>
<th>M</th>
<th>A</th>
<th>B</th>
<th>Sum</th>
<th>C4</th>
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<tr>
<td>0</td>
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<td>0110</td>
<td>1101</td>
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<tr>
<td>1</td>
<td>0000</td>
<td>0001</td>
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<td>0</td>
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</table>

7 + 6 = 13
8 + 9 = 16 + 1
12 - 8 = 4
5 - 10 = -5 (in 2's comp)
6 - 1 = -1 (in 2's comp)

4-13

\[ A - 1 = A + 2\text{'s complement of } 1 = A + 1111 \]