

Logic Design – Tutorial

03

#	Student ID	Student Name	Grade (10)
-			

Q1

Add the following numbers in binary using 2's complement to represent negative numbers. Use a word length of 6 bits (including sign) and indicate if an overflow occurs.

(d) $(-12) + 13$ (e) $(-11) + (-21)$ (c) $(-25) + 18$

Repeat (a), (c), (d), and (e) using 1's complement to represent negative numbers.

Sol
1

$$\begin{array}{r} \text{(c)} \quad 100111 \\ + 010010 \\ \hline 111001 \end{array}$$

$$\begin{array}{r} \text{(d)} \quad 110100 \\ + 001101 \\ \hline (1) 000001 \end{array}$$

$$\begin{array}{r} \text{(e)} \quad 110101 \\ + 101011 \\ \hline (1) 100000 \end{array}$$

$$\begin{array}{r} \text{(c)} \quad 100110 \\ + 010010 \\ \hline 111000 \end{array}$$

$$\begin{array}{r} \text{(d)} \quad 110011 \\ + 001101 \\ \hline (1) 000000 \\ + \quad \quad 1 \\ \hline 000001 \end{array}$$

$$\begin{array}{r} \text{(e)} \quad 110100 \\ + 101010 \\ \hline (1) 011110 \\ + \quad \quad 1 \\ \hline 011111 \end{array}$$

OVERFLOW!

Q2	Add, subtract, and multiply in binary: (a) 1111 and 1001																																																					
Sol 2	<p>(a)</p> <table style="margin-left: 40px;"> <tr> <td style="text-align: right;">111</td> <td></td> <td style="text-align: right;">111</td> <td></td> </tr> <tr> <td style="text-align: right;">1111</td> <td>(Add)</td> <td style="text-align: right;">1111</td> <td>(Subtract)</td> </tr> <tr> <td style="text-align: right;"><u>1001</u></td> <td></td> <td style="text-align: right;"><u>1001</u></td> <td></td> </tr> <tr> <td style="text-align: right;">11000</td> <td></td> <td style="text-align: right;">0110</td> <td></td> </tr> </table> <table style="margin-left: 40px;"> <tr> <td></td> <td></td> <td style="text-align: right;">1111</td> <td>(Multiply)</td> </tr> <tr> <td></td> <td></td> <td style="text-align: right;"><u>1001</u></td> <td></td> </tr> <tr> <td></td> <td></td> <td style="text-align: right;">1111</td> <td></td> </tr> <tr> <td></td> <td></td> <td style="text-align: right;"><u>0000</u></td> <td></td> </tr> <tr> <td></td> <td></td> <td style="text-align: right;">01111</td> <td></td> </tr> <tr> <td></td> <td></td> <td style="text-align: right;"><u>0000</u></td> <td></td> </tr> <tr> <td></td> <td></td> <td style="text-align: right;">001111</td> <td></td> </tr> <tr> <td></td> <td></td> <td style="text-align: right;"><u>1111</u></td> <td></td> </tr> <tr> <td></td> <td></td> <td style="text-align: right;">10000111</td> <td></td> </tr> </table>	111		111		1111	(Add)	1111	(Subtract)	<u>1001</u>		<u>1001</u>		11000		0110				1111	(Multiply)			<u>1001</u>				1111				<u>0000</u>				01111				<u>0000</u>				001111				<u>1111</u>				10000111		
111		111																																																				
1111	(Add)	1111	(Subtract)																																																			
<u>1001</u>		<u>1001</u>																																																				
11000		0110																																																				
		1111	(Multiply)																																																			
		<u>1001</u>																																																				
		1111																																																				
		<u>0000</u>																																																				
		01111																																																				
		<u>0000</u>																																																				
		001111																																																				
		<u>1111</u>																																																				
		10000111																																																				

Q3	Construct a table for 4-3-2-1 weighted code and write 9154 using this code.																																																							
Sol 3	<table style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="border-right: 1px solid black; border-bottom: 1px solid black;"></th> <th style="border-bottom: 1px solid black;">4</th> <th style="border-bottom: 1px solid black;">3</th> <th style="border-bottom: 1px solid black;">2</th> <th style="border-bottom: 1px solid black;">1</th> </tr> </thead> <tbody> <tr> <td style="border-right: 1px solid black;">0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td style="border-right: 1px solid black;">1</td> <td>0</td> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td style="border-right: 1px solid black;">2</td> <td>0</td> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td style="border-right: 1px solid black;">3</td> <td>0</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td style="border-right: 1px solid black;">4</td> <td>1</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td style="border-right: 1px solid black;">5</td> <td>1</td> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td style="border-right: 1px solid black;">6</td> <td>1</td> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td style="border-right: 1px solid black;">7</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td style="border-right: 1px solid black;">8</td> <td>1</td> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td style="border-right: 1px solid black;">9</td> <td>1</td> <td>1</td> <td>1</td> <td>0</td> </tr> </tbody> </table> <p style="margin-left: 100px; margin-top: 20px;">9154 = 1110 0001 1001 1000</p>		4	3	2	1	0	0	0	0	0	1	0	0	0	1	2	0	0	1	0	3	0	1	0	0	4	1	0	0	0	5	1	0	0	1	6	1	0	1	0	7	1	1	0	0	8	1	1	0	1	9	1	1	1	0
	4	3	2	1																																																				
0	0	0	0	0																																																				
1	0	0	0	1																																																				
2	0	0	1	0																																																				
3	0	1	0	0																																																				
4	1	0	0	0																																																				
5	1	0	0	1																																																				
6	1	0	1	0																																																				
7	1	1	0	0																																																				
8	1	1	0	1																																																				
9	1	1	1	0																																																				

Q4	Is it possible to construct a 5-4-1-1 weighted code? A 6-3-2-1 weighted code? Justify your answers.
----	---

Sol 4	<p>5-4-1-1 is not possible, because there is no way to represent 3 or 8. 6-3-2-1 is possible:</p> <table style="margin-left: auto; margin-right: auto;"> <tr><td style="border-right: 1px solid black; padding-right: 5px;">6</td><td>3</td><td>2</td><td>1</td></tr> <tr><td style="border-right: 1px solid black; padding-right: 5px;">0</td><td>0</td><td>0</td><td>0</td></tr> <tr><td style="border-right: 1px solid black; padding-right: 5px;">1</td><td>0</td><td>0</td><td>0</td></tr> <tr><td style="border-right: 1px solid black; padding-right: 5px;">2</td><td>0</td><td>0</td><td>1</td></tr> <tr><td style="border-right: 1px solid black; padding-right: 5px;">3</td><td>0</td><td>1</td><td>0</td></tr> <tr><td style="border-right: 1px solid black; padding-right: 5px;">4</td><td>0</td><td>1</td><td>0</td></tr> <tr><td style="border-right: 1px solid black; padding-right: 5px;">5</td><td>0</td><td>1</td><td>1</td></tr> <tr><td style="border-right: 1px solid black; padding-right: 5px;">6</td><td>1</td><td>0</td><td>0</td></tr> <tr><td style="border-right: 1px solid black; padding-right: 5px;">7</td><td>1</td><td>0</td><td>0</td></tr> <tr><td style="border-right: 1px solid black; padding-right: 5px;">8</td><td>1</td><td>0</td><td>1</td></tr> <tr><td style="border-right: 1px solid black; padding-right: 5px;">9</td><td>1</td><td>1</td><td>0</td></tr> </table>	6	3	2	1	0	0	0	0	1	0	0	0	2	0	0	1	3	0	1	0	4	0	1	0	5	0	1	1	6	1	0	0	7	1	0	0	8	1	0	1	9	1	1	0
6	3	2	1																																										
0	0	0	0																																										
1	0	0	0																																										
2	0	0	1																																										
3	0	1	0																																										
4	0	1	0																																										
5	0	1	1																																										
6	1	0	0																																										
7	1	0	0																																										
8	1	0	1																																										
9	1	1	0																																										

Q5	<p>Convert to hexadecimal, and then give the ASCII code for the resulting hexadecimal number (including the code for the hexadecimal point): (b) 183.81_{10}</p>															
Sol 5	<p>(b) 183.81_{10}</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: right;">$16 \overline{) 183}$</td> <td></td> <td style="text-align: right;">0.81</td> </tr> <tr> <td style="text-align: right;">$16 \overline{) 11}$</td> <td style="text-align: right;">r7</td> <td style="text-align: right;">$\underline{\quad} 16$</td> </tr> <tr> <td style="text-align: right;">0</td> <td style="text-align: right;">r11</td> <td style="text-align: right;">(12).96</td> </tr> <tr> <td></td> <td></td> <td style="text-align: right;">$\underline{\quad} 16$</td> </tr> <tr> <td></td> <td></td> <td style="text-align: right;">(15).36</td> </tr> </table> <p>$\therefore 183.81_{10} = B7.CF_{16}$ $= \underline{100010} \underline{0110111} \underline{0101110} \underline{100011} \underline{1000110}$</p> <p style="text-align: center;">B 7 . C F</p>	$16 \overline{) 183}$		0.81	$16 \overline{) 11}$	r7	$\underline{\quad} 16$	0	r11	(12).96			$\underline{\quad} 16$			(15).36
$16 \overline{) 183}$		0.81														
$16 \overline{) 11}$	r7	$\underline{\quad} 16$														
0	r11	(12).96														
		$\underline{\quad} 16$														
		(15).36														