EE 2310 Homework #4 – Complex Digital Circuits

Name:_____ Student Number:_____

1. **Given the truth table to the right, express its Boolean expression in SOP form. Then construct the Karnaugh Map, simplify the Boolean expression by determining the prime implicants, and draw the new, simplified circuit (you do not have to draw the original circuit).**

w	x	y	z	f
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	1
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	0
1	1	1	1	0

		yz			
		00	01	11	10
wx	00				
	01				
	11				
	10				

2. **We have not done many exercises involving POS Boolean Algebra expressions. This example shows that sometimes the POS version of Boolean expression is the much more convenient. For the truth table on the right, fill in the K-map and write both the <u>original</u> and <u>simplified POS expressions</u>. Then draw the simplified circuit (only). Remember: in a POS K-map, <u>you only need worry about zeros</u>.**

w	x	y	z	f
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	1
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

w+x \ y+z	00	01	11	10
00				
01				
11				
10				

3. **Another way to represent the Boolean expression for a set of logic elements is simply to designate the squares filled with ones on the standard Karnaugh map diagram. For instance (see lecture five notes), one way of expressing a Boolean function is:**

$$f = \Sigma m\,(4,5,6,7,c,d,e,f)$$

Given the above expression, write the <u>original</u> and <u>simplified</u> SOP Boolean expressions, and draw <u>only the simplified circuit</u>.

wx \ yz	00	01	11	10
00				
01				
11				
10				

4. **Consider another logic expression: $f = \Sigma m\,(0, 1, 2, 3, 4, 5, 7, 8, 12, 13)$. Show the Karnaugh map for this Boolean expression, write the <u>simplified</u> the expression, and draw the <u>simplified circuit</u>.**

wx \ yz	00	01	11	10
00				
01				
11				
10				

5. **It is desired to multiplex four different input data lines onto one output. The signals are labeled a through d. Five address lines, (labeled "v" [MSB] through "z" [LSB]) control which line is to be multiplexed onto the output line. This five-input address can be regarded as a hexadecimal number which ranges from 0x00 to 0x1f. Input a is MUXed out on address 0x06, b on address 0x0f, c out on 0x1b, and d out on 0x1e. Using 2- and 5-input AND gates, a four-input OR gate, and inverters (NOTs), draw the MUX circuit.**

8. Consider the K-mapped SOP Boolean function $f = \sum_m 2,6,e$. The input variables operate in a restricted space. Input combinations are limited such that x can never be 0 when w is 1. Map both the 1's in the function and the special "don't care" conditions listed, develop the simplified SOP expression, and draw ONLY the simplified circuit.

		yz			
		00	01	11	10
wx	00				
	01				
	11				
	10				