

UNIVERSITY OF CALIFORNIA, RIVERSIDE
Department of Computer Science and Engineering
Department of Electrical Engineering
CS/EE120A – Logic Design
Midterm 1
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Name: Solution Key Student ID#: _____
Please print legibly

Lab Section: 21 (TR 2-5): _____ 22 (MW 6-9): _____

(Numbers in parenthesis denote total possible points for question.)

1. Write the functional expression that is represented by the following truth table using the Σ of minterms notation. (3)

<i>w</i>	<i>x</i>	<i>y</i>	<i>z</i>	<i>f</i>
0	0	0	0	0
0	0	0	1	0
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	1
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	0
1	1	1	1	1

Answer

$$f(w,x,y,z) = \Sigma(2,4,5,7,9,10,12,13,15)$$

2. Given $f = xy'z' + xy'z + xyz' + xyz$, write the expression for f' using (a) the AND-of-OR terms format and (b) the OR-of-AND terms format. (6)

Answer

- (a) AND-of-OR terms format is obtained by using the *duality principle* or De Morgan's Theorem:

$$f = (x'+y+z) \cdot (x'+y+z') \cdot (x'+y'+z) \cdot (x'+y'+z')$$

- (b) OR-of-AND terms format is obtained by first constructing the truth table for f and then inverting the 0's and 1's to get f' . Then we simply use the AND terms where $f' = 1$.

x	y	z	f	f'
0	0	0	0	1
0	0	1	0	1
0	1	0	0	1
0	1	1	0	1
1	0	0	1	0
1	0	1	1	0
1	1	0	1	0
1	1	1	1	0

$$f' = x'y'z' + x'y'z + x'yz' + x'yz$$

3. Simplify the function $f = w'xy'z + w'xyz + wxy'z + wxyz$ using the axioms and theorems. (4)

Answer

$$\begin{aligned} & w'xy'z + w'xyz + wxy'z + wxyz \\ &= xy'z(w' + w) + xyz(w' + w) \\ &= xy'z + xyz \\ &= xz(y + y') \\ &= xz \end{aligned}$$

4. Perform the following calculations using 5-bit 2's complement binary arithmetic. Point out if there is an overflow error or not. Show your work. (4)

a)

$$\begin{array}{r} 01110 \\ 00111 \\ + 01011 \\ \hline \end{array}$$

Answer

$$\begin{array}{r} 100000 \\ \hline \end{array} \quad \text{overflow error}$$

b)

$$\begin{array}{r} 11001 \\ \times 11010 \\ \hline \end{array}$$

Answer

$$\begin{array}{r} 0000000000 \\ 111111001 \\ 00000000 \\ 1111001 \\ + 000111 \\ \hline 100000101010 \end{array} \quad \text{NO overflow error}$$

5. What is the octal, decimal, and hexadecimal value for the 2's complement binary number 1101001101 (3)

Answer

Octal = 7515₈

Decimal = -179

Hexadecimal = F4D₁₆

6. Draw the circuit for the function $f = [w'xy'z + w'z(y \oplus x)]'$ using only AND, OR, NOT, and XOR gates. You can use 2-, 3-, and 4- input gates if needed. Do not simplify the function or the circuit. (4)

Answer

