**Assignment 1**

**Problem\_1**

Multiply, subtract, and add in binary:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 1 0 1 1  X 1 0 1 1   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  |  |  |  |  | 1 | 1 | 0 | 1 | 1 | |  |  |  |  |  |  | 1 | 0 | 1 | 1 | |  | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | | 1 1 1 1 (Sub)  −1 0 1 0  0101 | 1 1 1 1 (Add)  +1 0 1 0  11001 |

**Problem 2:**

Convert (7813.400)9 to hexadecimal (base 16). Carry out your answer to 3 places past the decimal point.

1683.71C

**Problem\_3**

1. Write a Boolean equation in sum-of-products and product-of-sums canonical form for each of the following truth tables (C) and (D)  
   (I assume you mean D and E)

D.)  
Sum of products form:

Y = A’B’C’D’ + A’B’C’D + A’B’CD + AB’C’D’ + AB’CD’+ABCD’  
Product of Sums Form:

Y = (A’+B’+C’+D’)\*(A’+B’+C+D’)\*(A’+B+C’+D’)\*(A+B’+C’+D)\*(A’+B+C+D)\*(A+B’+C’+D’)\*(A+B’+C+D’)\*(A+B+C’+D’)\*(A+B+C+D’)

E.)  
Sum of products form:  
Y= A’B’C’D’ + A’B’CD + A’BC’D + A’BCD’ + AB’C’D + AB’CD’ + ABC’D’ +ABCD

Product of Sums Form:  
Y=(A’+B’+C’+D)\*(A’+B’+C+D’)\*(A’+B+C’+D’)\*(A’+B+C+D)\*(A+B’+C’+D’)\*(A+B’+C+D)\*(A+B+C’+D)\*(A+B+C+D’)

1. Simplify the obtained solution using the rules of Boolean Algebra  
   D.)

Y=(AB’C’)+(CD’)+(A’B’C)+(A’CD’)

E.)

Y = (AB’C’D)+(A’BCD’)

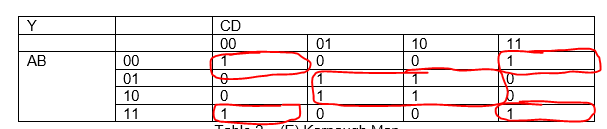
1. Use Karnaugh maps to verify your answers

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Y |  | CD | | | |
|  |  | 00 | 01 | 10 | 11 |
| AB | 00 | 0 | 1 | 1 | 1 |
| 01 | 0 | 0 | 0 | 0 |
| 10 | 1 | 0 | 1 | 0 |
| 11 | 0 | 0 | 1 | 0 |

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Table 1 – (D) Karnaugh Map

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Y |  | CD | | | |
|  |  | 00 | 01 | 10 | 11 |
| AB | 00 | 1 | 0 | 0 | 1 |
| 01 | 0 | 1 | 1 | 0 |
| 10 | 0 | 1 | 1 | 0 |
| 11 | 1 | 0 | 0 | 1 |

  
Table 2 – (E) Karnaugh Map

1. Draw the corresponding circuits for each design  
   D:  
   A diagram of a circuit diagram

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Figure 1 – (D) Circuit Design Based On Simplified Equation In 3-2

A diagram of a circuit

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Figure 2 – (E) Circuit Design Based On Simplified Equation In 3-2

Table

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**Problem\_4**

1. Write Boolean equations for the circuit shown below.

A diagram of a circuit

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A’D BD C’D AB’C ABCD  
Y= ((NOT A) AND D) OR (A AND (NOT C) AND D) OR (A AND (NOT B) AND C) OR (A AND B AND C AND D)

Y = A’D OR AC’D OR AB’C OR ABCD

Z = (B AND D) OR (A AND (NOT C) AND D)

Z = BD OR AC’D

1. Derive the truth table

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A | B | C | D | A’D | BD | AC’D | AB’C | ABCD | Y | Z |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 |
| 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| A | B | C | D | Y | Z |
| 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 | 0 |
| 0 | 0 | 1 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 1 | 0 |
| 0 | 1 | 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 1 | 1 | 1 |
| 0 | 1 | 1 | 0 | 0 | 0 |
| 0 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 1 | 1 | 1 |
| 1 | 0 | 1 | 0 | 1 | 0 |
| 1 | 0 | 1 | 1 | 1 | 0 |
| 1 | 1 | 0 | 0 | 0 | 0 |
| 1 | 1 | 0 | 1 | 1 | 1 |
| 1 | 1 | 1 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 |

Table 3 – Truth Table For 4-2

1. Minimize the obtained equation by rules of Boolean algebra

Y = D+(AB’CD’)

Z = BD OR AC’D

.

1. Verify the solution using Karnaugh maps

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Y |  | CD | | | |
|  |  | 00 | 01 | 10 | 11 |
| AB | 00 | 0 | 1 | 0 | 1 |
| 01 | 0 | 1 | 0 | 1 |
| 10 | 0 | 1 | 1 | 1 |
| 11 | 0 | 1 | 0 | 1 |

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|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Z |  | CD | | | |
|  |  | 00 | 01 | 10 | 11 |
| AB | 00 | 0 | 0 | 0 | 0 |
| 01 | 0 | 1 | 0 | 1 |
| 10 | 0 | 1 | 0 | 0 |
| 11 | 0 | 1 | 0 | 1 |

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Diagram

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**Problem\_5**

1. Simplify the following Boolean equations using Boolean theorems.
2. Check for correctness using a truth table and K-map (You may not need to consider all combinations, just consider few remarkable values)Logo, company name

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3. **Y = (A AND C) OR ( (NOT A) AND (NOT B) AND C)  
   Y = A AND C**

|  |  |  |  |
| --- | --- | --- | --- |
| Y |  | C | |
|  |  | 0 | 1 |
| AB | 00 | 0 | 0 |
| 01 | 0 | 1 |
| 10 | 0 | 1 |
| 11 | 0 | 1 |

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Table 5-2-A

1. **Y = ( (NOT A) AND (NOT B)) OR ( (NOT A) AND B AND (NOT C)) OR NOT(A OR (NOT C))  
   Y = A’B’ + A’BC’ + A’C  
   Y = A’**

|  |  |  |  |
| --- | --- | --- | --- |
| Y |  | C | |
|  |  | 0 | 1 |
| AB | 00 | 1 | 1 |
| 01 | 1 | 1 |
| 10 | 0 | 0 |
| 11 | 0 | 0 |

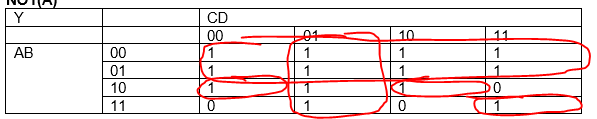
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Table 5-2-B

1. **NOT(ABCD) OR (A AND NOT(B AND C)) OR (A AND C) AND NOT(B AND D)) OR (A AND B AND D) OR (C AND NOT(A AND B AND D)) OR (B AND D AND NOT (C)) OR NOT(A)  
     
   Y = A’ + A’BD’ + ABCD+ C’D**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Y |  | CD | | | |
|  |  | 00 | 01 | 10 | 11 |
| AB | 00 | 1 | 1 | 1 | 1 |
| 01 | 1 | 1 | 1 | 1 |
| 10 | 1 | 1 | 1 | 0 |
| 11 | 0 | 1 | 0 | 1 |

 **Table 5-2-C**

**Problem\_6**

1. Find a minimal Boolean equation for the function shown below

Y = AB’C’D’ + AB’CD + ABC’D’ + ABC’D + ABCD

Y = AB + AB’( C XNOR D)

1. Check for correctness using a truth table and K-map (You may not need to consider all combinations, just consider few remarkable values)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Y |  | CD | | | |
|  |  | 00 | 01 | 10 | 11 |
| AB | 00 | X | X | X | 0 |
| 01 | 0 | X | 0 | X |
| 10 | 1 | 0 | X | 1 |
| 11 | 1 | 1 | X | 1 |

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1. Remember to take advantage of the don’t care entries.

A picture containing shape

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**Problem 7:**

A switching circuit has three inputs (*A*, *B*, *C*) and one output (*Z*). If *A*= 0, the output *Z* is the exclusive-OR of *B* and *C*. If *A* = 1, the output is the equivalence of *B* and *C*.

A drawing of a diagram

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Figure 7 – Sketching Out the Circuit Diagram for the Story Problem 7, I did this first because wow everything else is way more confusing I do not solidly grasp the concepts of minterms or maxterms or simplifying or Karnaugh maps at ALL.

Equivalence of *B* and *C is defined as: (B⊕C)’*

1. Find the truth table for Z.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Minterm | A | B | C | A’(B XOR C) | A (BXNOR C) | Z |
| m0 | 0 | 0 | 0 | 0 | 0 | 0 |
| m1 | 0 | 0 | 1 | 1 | 0 | 1 |
| m2 | 0 | 1 | 0 | 1 | 0 | 1 |
| m3 | 0 | 1 | 1 | 0 | 0 | 0 |
| m4 | 1 | 0 | 0 | 0 | 1 | 1 |
| m5 | 1 | 0 | 1 | 0 | 0 | 0 |
| m6 | 1 | 1 | 0 | 0 | 0 | 0 |
| m7 | 1 | 1 | 1 | 0 | 1 | 1 |

1. Write the minterm expansion for Z in decimal form and in terms of A, B, C.  
   Z = 1 OR 2 OR 4 OR 7  
   Z = (A’B’C)+(A’BC’)+(AB’C’)+(ABC)
2. Write the maxterm expansion for Z in decimal form and in terms of A, B, C.

Z = 0 \*3 \* 5 \* 6

Z = (A’+B’+C’)\*(A’+B+C)\*(A+B’+C)\*(A+B+C)

1. Verify the minterm result by mean of KMap

|  |  |  |  |
| --- | --- | --- | --- |
| Y |  | C | |
|  |  | 0 | 1 |
| AB | 00 | 0 | 1 |
| 01 | 1 | 0 |
| 10 | 1 | 0 |
| 11 | 0 | 1 |

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Table 7-4 KMap

1. Draw the corresponding circuit

I drew this first, please see above.