INSTITUTE OF INFORMATION TECHNOLOGY

JAHANGIRNAGAR UNIVERSITY

Number of Assignment : 01

Name of Assignment : Designing Combinational Logic Circuits.

Course Tittle : Digital Logic Design

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Submitted To

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Problem 1: Due to the low number of People in the mosque of our village, Congregation is not held many times. Design a logic circuit is when the congregation will be and when it will not be. Four inputs A, B, C and D whose output will be HiGH only when a majority of the inputs are HiGH.

Solution:

Step 1. Truth table

On the basis of the Problem Statement the output x should be 1 when ever three or more inputs are 1 for all other cases the Output should be 0.

A	B	C	D	X	
0	0	0	0		
0	0	0	1		
0	0	1	0		
0	0	1	1		
0	1	0	0		
0	1	0	1		
0	1	1	0		
0	1	1	1	1	$\rightarrow \bar{A}BCD$
1	0	0	0		
1	0	0	1		
1	0	1	0		
1	0	1	1	1	$\rightarrow A\bar{B}CD$
1	1	0	0		
1	1	0	1	1	$\rightarrow AB\bar{C}D$
1	1	1	0	1	$\rightarrow ABC\bar{D}$
1	1	1	1	1	$\rightarrow ABCD$

Step 2. Write the AND term for each case where the output is a 1.

$\bar{A}BCD$, $A\bar{B}CD$, $AB\bar{C}D$, $ABC\bar{D}$, $ABCD$

Step 3. Write the sum-of-Products expression for the output.

$$x = \bar{A}BCD + A\bar{B}CD + AB\bar{C}D + ABC\bar{D} + ABCD$$

Step 4. Simplify the output expression.

$$x = \bar{A}BCD + A\bar{B}CD + AB\bar{C}D + ABC\bar{D} + ABCD$$

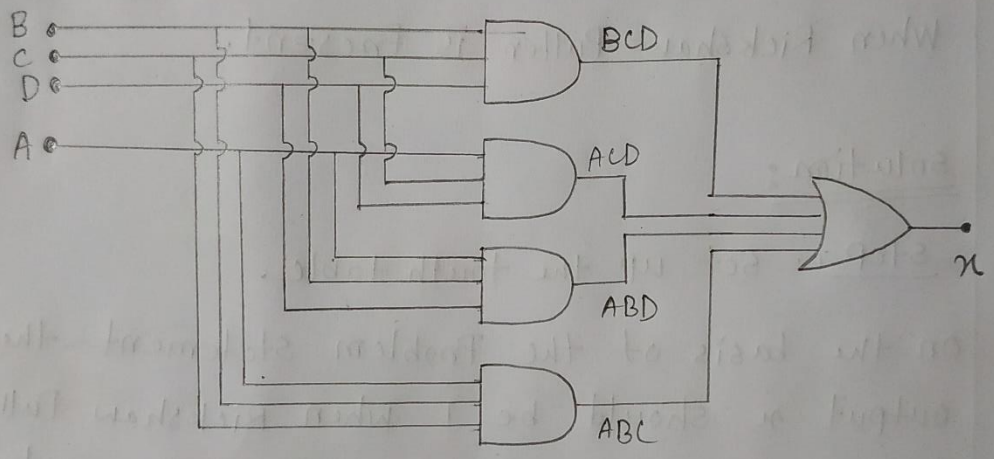
$$= \bar{A}BCD + ABCD + A\bar{B}CD + ABCD + AB\bar{C}D + ABCD + ABC\bar{D} + ABCD$$

$$= BCD(\bar{A}+A) + ACD(\bar{B}+B) + ABD(\bar{C}+C) + ABC(\bar{D}+D)$$

Each term in Parentheses is equal to 1, so we have

$$x = BCD + ACD + ABD + ABC$$

Step 5. Implement the circuit for the final expression.



$$x = BCD + ACD + ABD + ABC$$

Problem 2. When a rickshaw will run and when it will not run. Design a logic circuit that has three inputs, Rickshaw Puller, Passengers1 Passenger 2. and whose output will be High ~~on~~ When Rickshaw Puller is Present.

Solution:

Step 1. Set up the truth table.

On the basis of the Problem statement the output x should be 1 when Rickshaw Puller inputs are 1. for all other cases the output should be 0.

let A = Rickshaw Puller

B = Passenger 1

C = Passenger 2

A	B	C	X
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	$1 \rightarrow A\bar{B}\bar{C}$
1	0	1	$1 \rightarrow A\bar{B}C$
1	1	0	$1 \rightarrow AB\bar{C}$
1	1	1	$1 \rightarrow ABC$

Step 2: Write the AND term for each case where the output is a 1.

$A\bar{B}\bar{C}$, $A\bar{B}C$, $AB\bar{C}$, ABC

Step 3: Write the Sum-of-Products expression

$$x = A\bar{B}\bar{C} + A\bar{B}C + AB\bar{C} + ABC$$

Step 4. simplify expression.

$$x = A\bar{B}\bar{C} + A\bar{B}C + AB\bar{C} + ABC$$

$$= A\bar{B}\bar{C} + AB\bar{C} + A\bar{B}C + ABC$$

$$= A\bar{C}(\bar{B}+B) + AC(\bar{B}+B)$$

$$= A\bar{C} + AC$$

$$= A(\bar{C}+C)$$

$$= A$$

Step 5. Implement the circuit for the final expression.

No Circuit is required.

Problem 3. Shakil, Nahid and Tokee are three friends. They will go to Sylhet. If more of ~~more of~~ them go they will go.

Solution:

Step 1. set up the truth table

let A = Shakil
B = Nahid
C = Tokee

On the basis of the Problem statement the output x should be 1 when-ever two or more inputs are 1 for all other cases the output should be 0.

A	B	C	x	
0	0	0		
0	0	1		
0	1	0		
0	1	1	1	→ $\bar{A}BC$
1	0	0		
1	0	1	1	→ $A\bar{B}C$
1	1	0	1	→ $AB\bar{C}$
1	1	1	1	→ ABC

Step 2. Write the AND term for each case where the output is a 1.

$\bar{A}BC$, $A\bar{B}C$, $AB\bar{C}$, ABC

Step 3: Write the sum-of-Products expression for the output.

$$x = \bar{A}BC + A\bar{B}C + AB\bar{C} + ABC$$

Step 4. simplify the output expression.

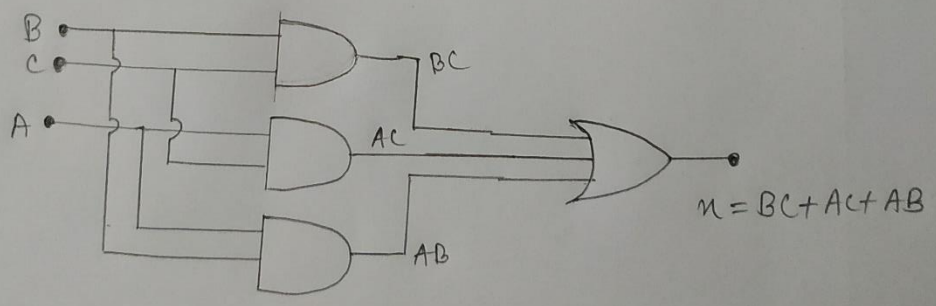
$$x = \bar{A}BC + A\bar{B}C + AB\bar{C} + ABC$$

$$= \bar{A}BC + ABC + A\bar{B}C + ABC + AB\bar{C} + ABC$$

$$= BC(\bar{A}+A) + AC(\bar{B}+B) + AB(\bar{C}+C)$$

$$= BC + AC + AB$$

Step 5. Implement the circuit for the final expression.



Problem 4: IIT 10 batch female class Representative will be elected. Maysha, Monisha, Sanjida and Tasnia are 4 candidates. The output will be High when Mayesha is High. The output will be High when a majority of the inputs are High. Disign the logic circuit to Produce a High at output signal x for the stated conditions.

Solution:

Step 1. Set up the truth table

let A = Mayesha
B = Monisha
C = Sanjida
D = Tasnia

On the basis of the Problem statement the output x should be 1 when A is 1 and three or more inputs are 1 for all other cases the output should be 0.

A	B	C	D	x	
0	0	0	0		
0	0	0	1		
0	0	1	0		
0	0	1	1		
0	1	0	0		
0	1	0	1		
0	1	1	0		
0	1	1	1	1	$\rightarrow \bar{A}BCD$
1	0	0	0	1	$\rightarrow A\bar{B}\bar{C}\bar{D}$
1	0	0	1	1	$\rightarrow A\bar{B}\bar{C}D$
1	0	1	0	1	$\rightarrow A\bar{B}C\bar{D}$
1	0	1	1	1	$\rightarrow A\bar{B}CD$
1	1	0	0	1	$\rightarrow AB\bar{C}\bar{D}$
1	1	0	1	1	$\rightarrow AB\bar{C}D$
1	1	1	0	1	$\rightarrow ABC\bar{D}$
1	1	1	1	1	$\rightarrow ABCD$

Step 2. Write the AND term for each case where output is a 1.

$\bar{A}BCD$, $A\bar{B}\bar{C}\bar{D}$, $A\bar{B}\bar{C}D$, $A\bar{B}C\bar{D}$, $A\bar{B}CD$, $AB\bar{C}\bar{D}$, $AB\bar{C}D$, $ABC\bar{D}$, $ABCD$

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Step 3. Write the sum-of-Products expression for the output.

$$x = \bar{A}BCD + A\bar{B}\bar{C}\bar{D} + A\bar{B}\bar{C}D + A\bar{B}C\bar{D} + A\bar{B}CD + AB\bar{C}\bar{D} + AB\bar{C}D + ABC\bar{D} + ABCD$$

Step 4. Simplify the output

$$x = \bar{A}BCD + A\bar{B}\bar{C}(\bar{D}+D) + A\bar{B}C(\bar{D}+D) + AB\bar{C}(\bar{D}+D) + ABC(\bar{D}+D) + ABCD$$

$$= \bar{A}BCD + A\bar{B}\bar{C} + A\bar{B}C + AB\bar{C} + ABC + ABCD$$

$$= \bar{A}BCD + A\bar{B}(\bar{C}+C) + AB(\bar{C}+C) + ABCD$$

$$= \bar{A}BCD + A\bar{B} + AB + ABCD$$

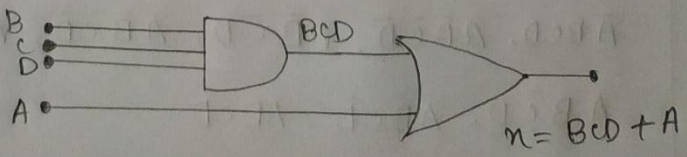
$$= \bar{A}BCD + A(\bar{B}+B) + ABCD$$

$$= \bar{A}BCD + ABCD + A$$

$$= BCD(\bar{A}+A) + A$$

$$= BCD + A$$

Step 5. Implement the circuit for the final expression.



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