DEPT. OF ELECTRICAL & ELECTRONICS ENGINEERING
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Title of Experiment	: **11. Reduction of Boolean expression using K-map**
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Date of Experiment	:13.07.2021

Sl. No.	Marks Split up	Maximum marks (50)	Marks obtained
1	Pre Lab questions	5	
2	Preparation of observation	15	
3	Execution of experiment	15	
4	Calculation / Evaluation of Result	10	
5	Post Lab questions	5	
Total		**50**	

Staff Signature

PRE LAB QUESTIONS:

1. How many Cells are in 4 and 5 Variable K- Map.

4 variables have $2^n = 2^4 = 16$ minterms. A 4 variable K-map will have 16 cells.
5 variable K-map have 32 cells.

2. What do you mean by don't care condition in K-map or truth table?

The "Don't care" conditions allows us to replace the empty cell of K-map to form a grouping of the variables which is larger than that of forming groups without don't cares. While forming groups of cells, we can consider don't care cell as 1 or 0 or we can also ignore that cell. The help us to form a larger group of cells.

3. Write the Distributive property of Boolean algebra.

Distributive laws states that the multiplication of two variables and adding the result with a variable will result in the same value as multiplication of addition of the variable with individual variables. Ex: A + BC = (A+B)(A+C).

4. Write down the De Morgan law.

De Morgan's law states that the complement of the union of two sets is the intersection of their complements and the complement of the intersection of two sets is the union of their complements.

5. State the difference between SOP and POS.

The main difference between SOP and POS is that the SOP is a way of representing a Boolean expression using min terms or product terms, while the POS is a way of representing a Boolean expression using max terms or sum terms.

Experiment No. 11 Date :13.07.2021	**Reduction of Logic Expression using Karnaugh map (K- Map)**

Aim: To simply and verify the Boolean expression using K-map.

Apparatus: Logic trainer kit, logic gates / ICs, wires.

Theory:

Karnaugh maps: Karnaugh maps or K-maps for short, provide another means of simplifying and optimizing logical expressions. This is a graphical technique that utilizes a sum of product (SOP) form. SOP forms combine terms that have been ANDed together that then get ORed together. This format lends itself to the use of De Morgan's law which allows the final result to be built with only NAND gates. The K-map is best used with logical functions with four or less input variables. One of the advantages of using K-maps for reduction is that it is easier to see when a circuit has been fully simplified. Another advantage is that using K-maps leads to a more structured process for minimization. In order to use a K-map, the truth table for a logical expression is transferred to a K-map grid. The grid for two, three, and four input expressions are provided in the tables below. Each cell corresponds to one row in a truth table or one given state in the logical expression. The order of the items in the grid is not random at all; they are set so that any adjacent cell differs in value by the change in only one variable. Because of this, items can be grouped together easily in rectangular blocks of two, four, and eight to find the minimal number of groupings that can cover the entire expression. Note that diagonal cells require that the value of more than two inputs change, and that they also do not form rectangles.

	A'B’ 00	A’B 01	AB 11	AB’ 10
C’ 0				
C 1				

Figure 1. Three variables K Map

	A’ 0	A 1
B’ 0		
B 1		

Figure 2. Two variables K- Map

Given expression

F(C,A,B) = CAB + C'AB + CA'B + C'A'B

Simplification Using Boolean Properties

CAB + C'AB + CA'B + C'A'B	= AB(C + C') + A'B(C + C')	Distributive Property
	= AB + A'B	C + C' is always true
	= (A + A')B	Distributive Property
	= B	A + A' is always true

Simplification using K- Map

	A'B' 00	A'B 01	AB 11	AB' 10
C' 0	0	1	1	0
C 1	0	1	1	0

B

Procedure:

1. Connect the trainer kit to ac power supply.
2. Connect the circuit based on the given logic functions to be simplified.
3. Connect the inputs of first stage to logic sources and output of the last gate to logic indicator.
4. Apply various input combinations and observe output for each one.
5. Verify the output before and after reducing the expression.
6. Switch off the ac power supply.

Result:

Reduction of logic using Kmap has been understood.

Post-lab questions

1. Simply the expression F=AB+AB'

= A (B + B')
= A (1)
F = A

2. Name the different reduction techniques

1. Select K-map according to the number of variables.
2. Identify minterms or maxterms as given in problem.
3. For SOP put 1's in blocks of K-map respective to the minterms (0's elsewhere).
4. For POS put 0's in blocks of K-map respective to the maxterms(1's elsewhere).
5. Make rectangular groups containing total terms in power of two like 2,4,8 ..(except 1) and try to cover as many elements as you can in one group.
6. From the groups made in step 5 find the product terms and sum them up for SOP form.

3. Give the merits and demerits of K-map

Advantages of K-map:

a) It is a fast method for simplifying expression up to four variables.
b) It gives a visual method of logic simplification.
c) Prime and essential implicants are identified fast.
d) It is more suitable for class room teachings on logic simplification.

Disadvantages of K-map:

a) It is not suitable for computer reduction.
b) K-maps are not suitable when the number of variables involved exceed four.
c) Care must be taken to fill in every cell with the relevant entry, such as 0, 1 or don't care terms.

4. What are differences between K-map and Quine McCluskey?

Unlike K-map, the Quine-McCluskey method uses tables, which provides simple pattern recognitions. Quine-McCluskey method is a tabular method that has an advantage when large number of inputs are present. Whit more inputs, pattern recognition in K-map can be tedious and sometimes impossible. The Quine-McClusey consists of two steps: 1. Finding all prime implicants of the function, and 2. Selecting a minimal set of prime implicants of the function.

5. Give steps for reducing two variable expression using K-map?

1. Firstly, we define the given expression in its canonical form.
2. Next, we create the K-map by entering 1 to each product terms into the K-map cell and fill the remaining cells with zeros.
3. Next, we form the groups by considering each one in K-map.
4. In the next step, we find the boolean expression for each group.
5. Lastly, we find the Boolean expression of the output.