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DEPARTMENT OF GRAPHIC & CREATIVE DESIGN AND DATA ANALYTICS

**COURSE NAME : COMPUTER SYSTEM ARCHITECTURE
(23UCU402)**

I YEAR /I SEMESTER

Unit II- LOGICAL GATES

Topic 8: Don't Care Condition

Don't Care Conditions

✓ The Boolean expressions which have been discussed by us were completely specified, i.e., for each combination of input variable we have specified a minterm by representing them as 1 in the K-Map.

✓ But, there may arise a case when for a given combination of input we may not have a specified output or the input combination may be invalid. The combinations for which we don't have any output expression specified are called **don't care combination**.

Don't Care Conditions

✓ Example

✓ For Example, in 8421 code, input states 1001, 1010, 1011, 1100, 1101, 1110 and 1111 are invalid and the corresponding output is the don't care. Similarly, in Excess-3 code, binary input states 0000, 0001, 0010, 1101, 1110 and 1111 are unspecified and are also represented by don't care.

Don't care combinations in the K-Map

- ✓ These don't care combinations in the K-Map are denoted by an X (cross) symbol.
- ✓ The X is called "Don't care conditions".

Rules for Karnaugh Maps with Don't Care Conditions

General rules to be followed while minimizing the expressions using K-Map which include don't care conditions are as follows,

1. After forming the K-Map, fill 1's at the specified positions corresponding to the given minterms. Fill X at the positions where don't care combinations are present.
2. Now, Encircle the groups in the K-Map. One thing to be kept in mind is, now we can treat Don't Care conditions (X) as 1s if these help in forming the largest groups. No such group can be encircled whose all the elements are X.
3. If still there are 1s left which doesn't get encircled in any of the groups, then these isolated 1s are encircled individually.
4. Now, recheck all the encircled groups, and remove any redundancy if present.
5. Write the Boolean expression for each encircled group.
6. The final minimal expression can be obtained by ORing each Boolean expressions that were obtained from each group.

Point to remember

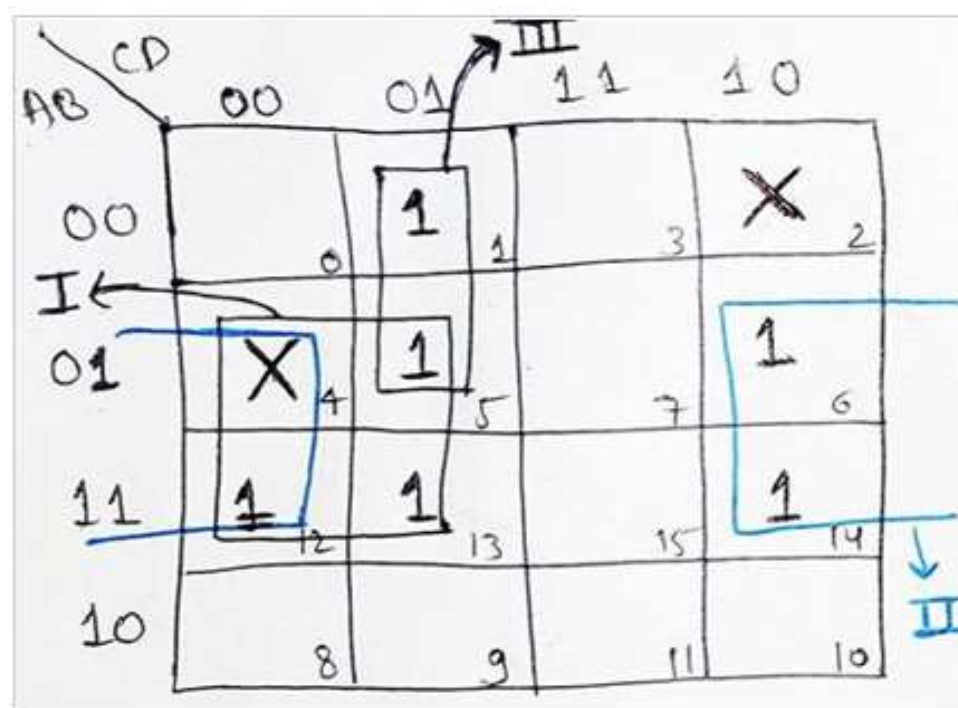
- ✓ While designing K-Map using SOP form, don't care conditions (X) are considered as 1, if it helps form the largest group, otherwise it is considered as 0 and are left during encircling.
- ✓ On the contrary, while designing a K-Map using POS form, don't care conditions (X) are considered as a 0, if it helps form the largest group, otherwise it is considered as 1 and are left during encircling.

Example 1

Minimize the given Boolean Expression by using the four-variable K-Map.

$$F(A, B, C, D) = \sum m(1, 5, 6, 12, 13, 14) + d(2, 4).$$

Solution

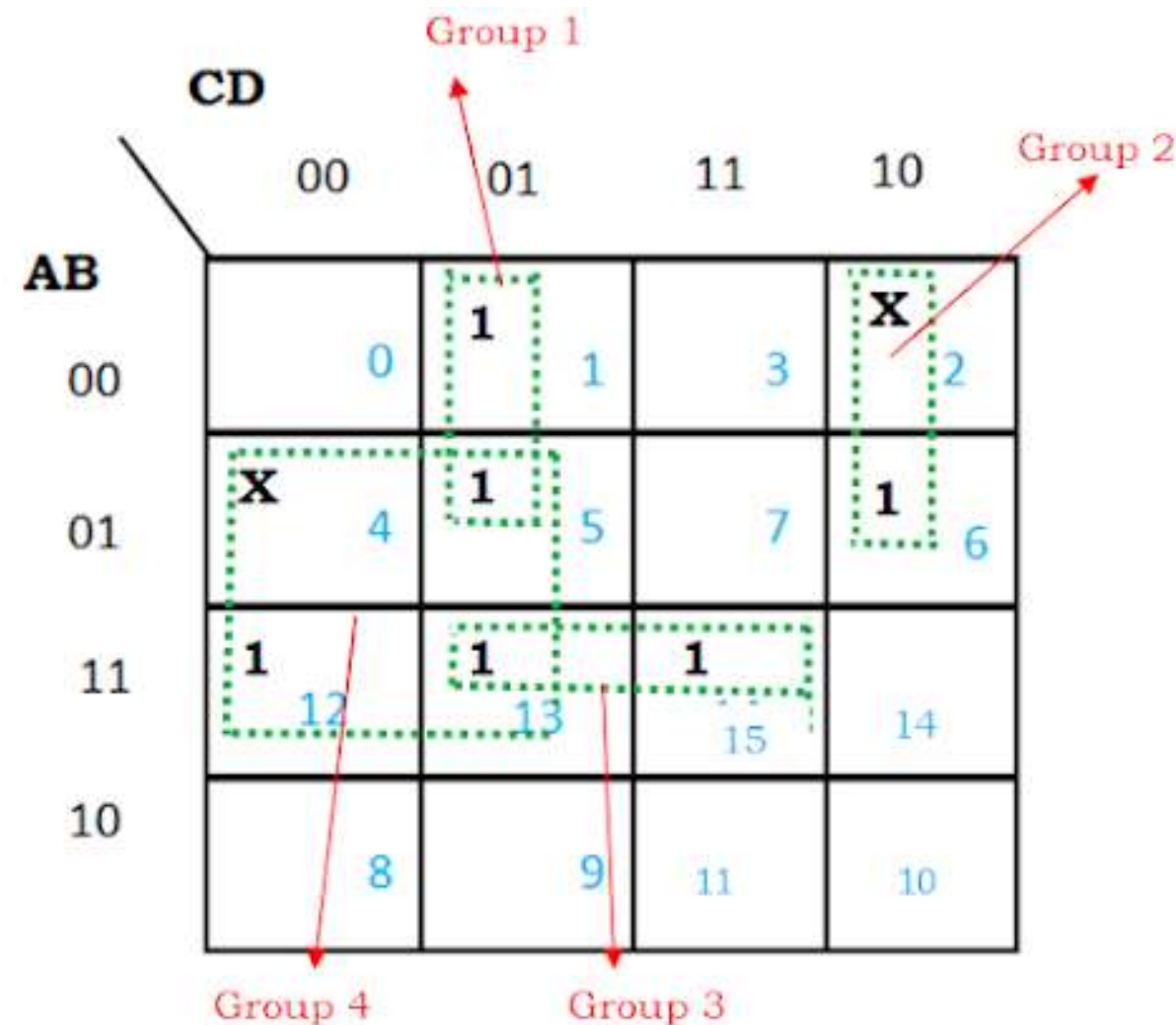


- ✓ We will fill **1s** at the appropriate minterm positions and also the don't care positions will be filled with (**X**).
- ✓ Now, we can encircle these **1s** and **X** using the rules we have discussed earlier. We can observe that we can encircle them into three groups.
- ✓ First Group (encircled by black ink) contains four **1s** and the Boolean expression given by it is **B.C**.
- ✓ Second group is the rolling group (encircled by blue ink) which also contains four **1s** gives **B.D**.
- ✓ Third group is the pair of **1s** which gives **A.C.D**
- ✓ Hence, the resultant simplified Boolean Expression will be:
- ✓ **$F(A, B, C, D) = B.C + B.D + A.C.D$**

Karnaugh Maps with Don't Care Conditions Examples

Minimize the SOP expression using K map(with don't care conditions):

$$F(A,B,C,D)=\sum m(1,5,6,12,13,15)+ d(2,4)$$



There are 4 groups.

1. In group 1 cells 1 and 5 are grouped and the common Minterm is $A'C'D$.

2. In group 2 cells 2 and 6 are grouped and the common Minterm is $A'CD'$.

3. In group 3 cells 13 and 15 are grouped and the common Minterm is ABD .

4. In group 4 cells 4,5,12 and 13 are grouped and the common Minterm is BC' .

First '1' is filled in the cells 1,5,6,12,13 and 14. The cells 2 and 4 are filled with 'X'.

The cells 2 and 4 are grouped along with the adjacent cells.

So the minimized expression from K map is

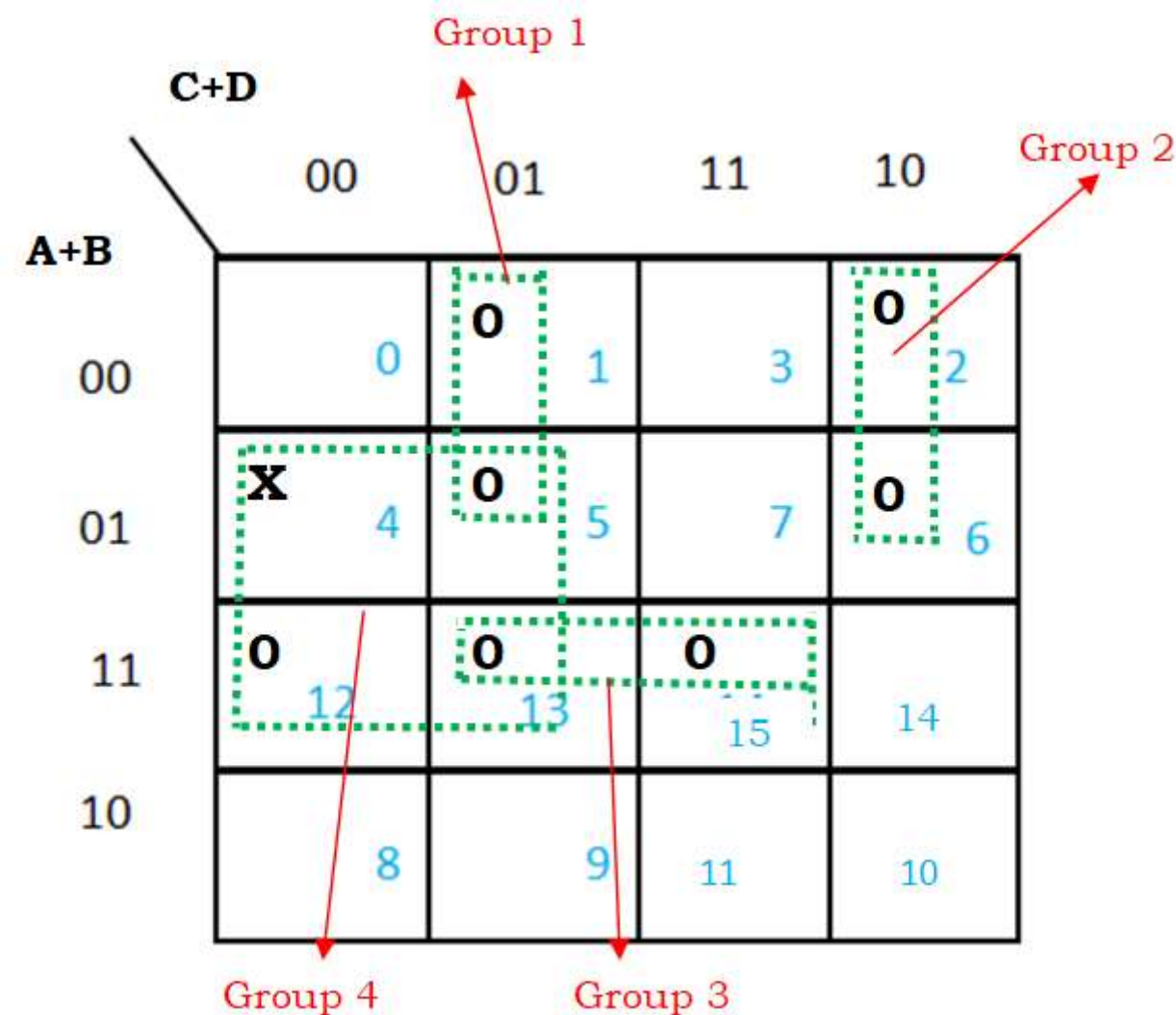
$$F(A,B,C,D)= A'C'D+ A'CD'+ ABD+ BC'$$

Karnaugh Maps with Don't Care Conditions

Examples

Minimize the POS expression using K map(with don't care conditions):

$$f(A,B,C,D)=\pi M(1,5,6,12,13,15)+ d(2,4)$$



K map with don't care condition for POS expression

First '0' is filled in the cells 1,5,6,12,13 and 14. The cells 2 and 4 are filled with 'X'.

The cells 2 and 4 are grouped along with the adjacent cells. There are 4 groups.

1. In group 1 cells 1 and 5 are grouped and the common Maxterm is $A+C+D'$.
2. In group 2 cells 2 and 6 are grouped and the common Maxterm is $A+C'+D$.
3. In group 3 cells 12 and 13 are grouped and the common Maxterm is $A'+B'+D'$.
4. In group 4 cells 4,5,12 and 13 are grouped and the common Maxterm is $B'+C$.

So the minimized expression from K map is

$$f(A,B,C,D)= (A+C+D').(A+C'+D).(A'+B'+D').(B'+C)$$

References

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Thank You