SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A+' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF MECHATRONICS ENGINEERING

19MCT201 - DESIGN OF DIGITAL CIRCUITS

II YEAR - III SEM

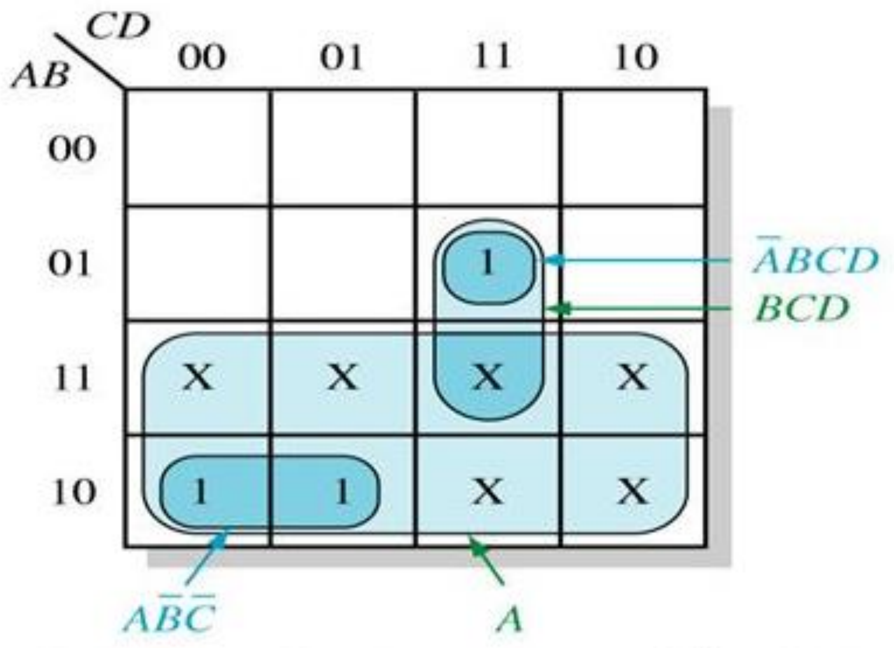
UNIT 1 – MINIMIZATION TECHNIQUES AND LOGIC GATES

TOPIC 5 –K-MAP with Don't Care

Don’t Care Condition in Kmap

- ✓ Real world Problem – All combination will not result with output.
- ✓ Don’t cares in a Karnaugh map, or truth table, may be either 1s or 0s, as long as we don’t care what the output is for an input condition
- ✓ We plot these cells with an asterisk, *, among the normal 1s and 0s.

Inputs A B C D	Output Y
0 0 0 0	0
0 0 0 1	0
0 0 1 0	0
0 0 1 1	0
0 1 0 0	0
0 1 0 1	0
0 1 1 0	0
0 1 1 1	1
1 0 0 0	1
1 0 0 1	1
1 0 1 0	X
1 0 1 1	X
1 1 0 0	X
1 1 0 1	X
1 1 1 0	X
1 1 1 1	X



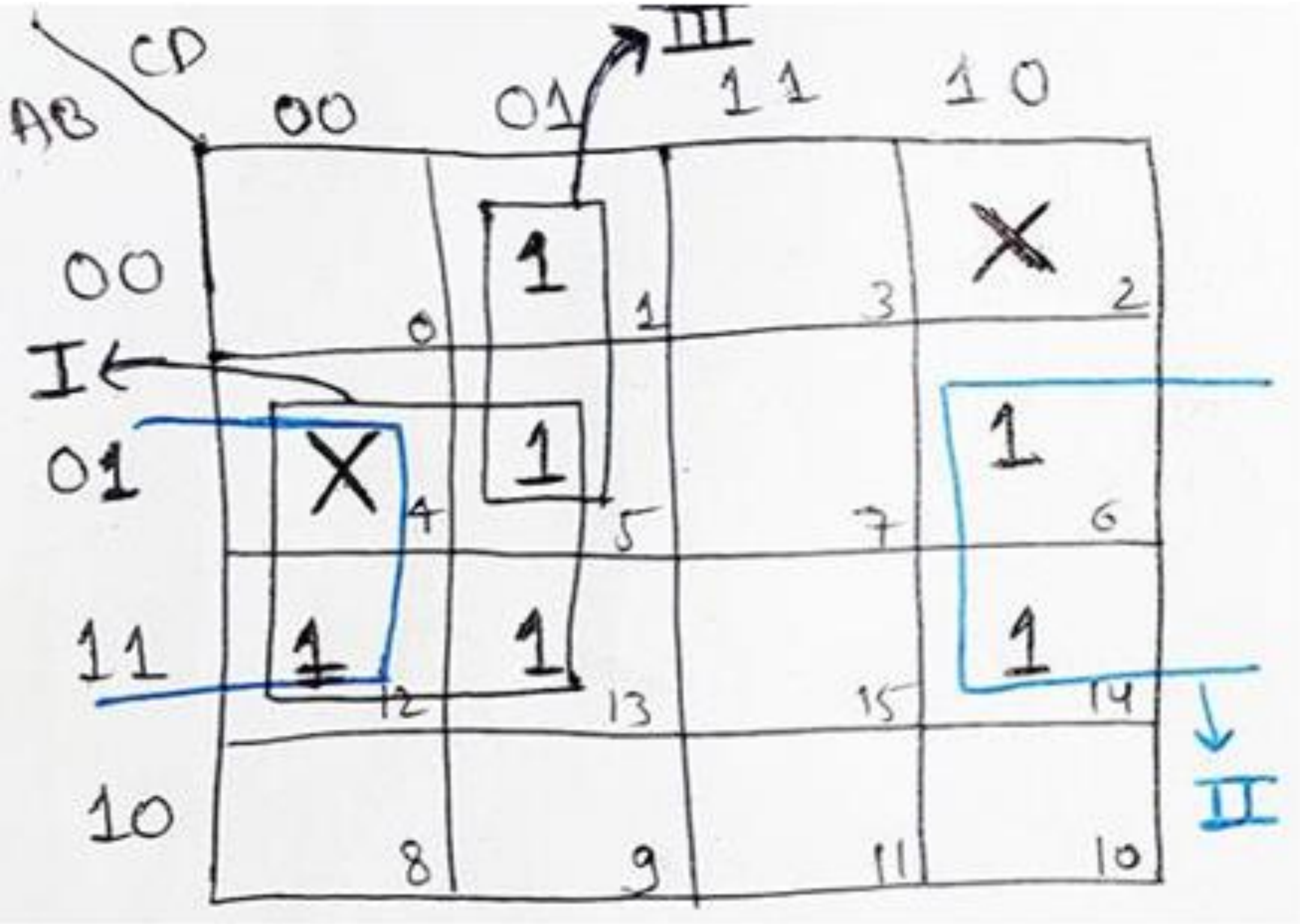
(b) Without “don’t cares” $Y = A\bar{B}\bar{C} + \bar{A}BCD$
With “don’t cares” $Y = A + BCD$

Steps involved in K-Map with Don’t care

- ✓ 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.
- ✓ 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.
- ✓ If still there are 1s left which doesn't get encircled in any of the groups, then these isolated 1s are encircled individually.
- ✓ Now, recheck all the encircled groups, and remove any redundancy if present.
- ✓ Write the Boolean expression for each encircled group.
- ✓ The final minimal expression can be obtained by ORing each Boolean expressions that were obtained from each group.

Karnaugh map Minimization

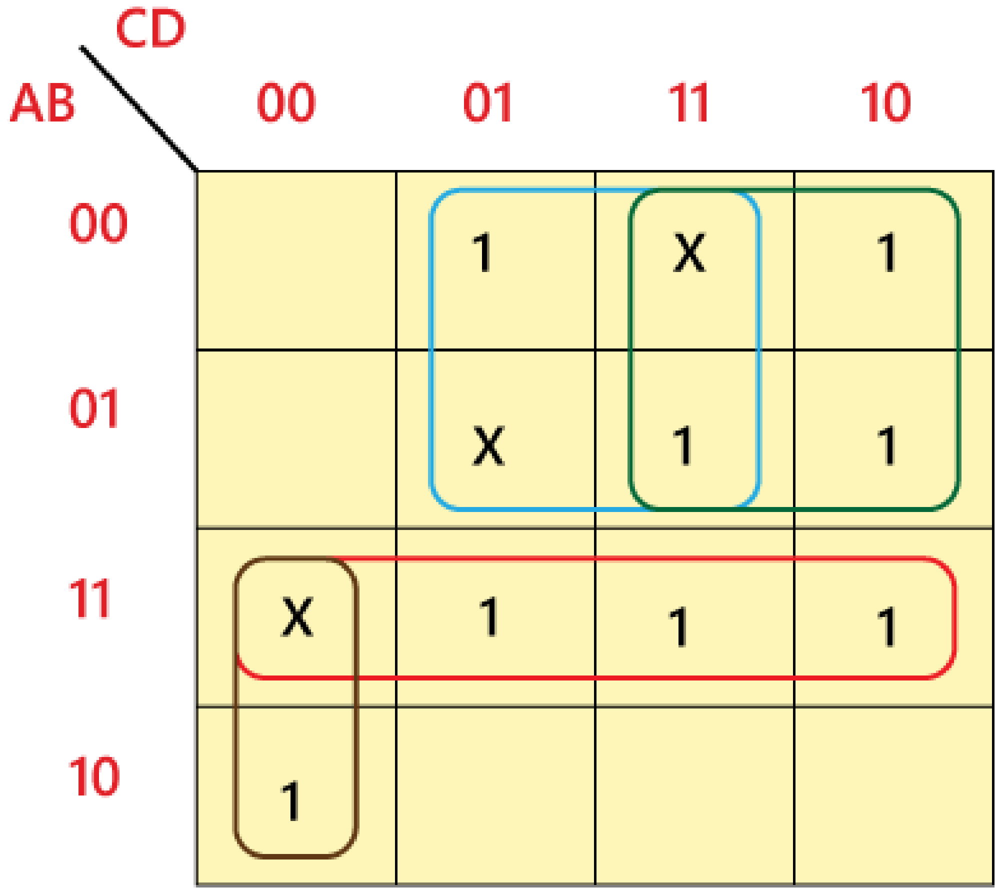
Minimize the given Boolean Expression by using the four-variable K-Map.
F (A, B, C, D) = Σ m (1, 5, 6, 12, 13, 14) + d (2, 4).



$F\ (A,\ B,\ C,\ D) = A + C.\ \bar{D} + \bar{B}.C.\ D + \bar{A}.\bar{B}.\ \bar{D} + B.\ \bar{C}.\ D$

Karnaugh map Minimization

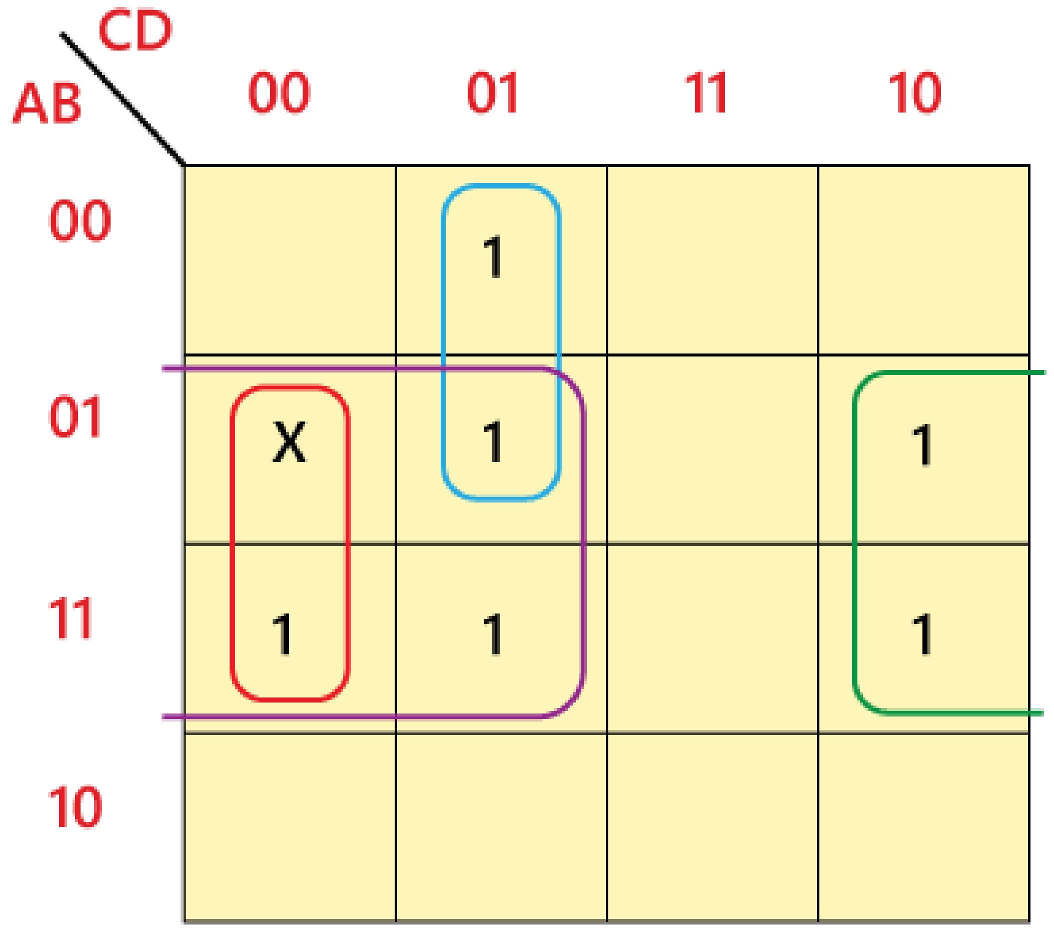
F(A, B, C, D) = m(1, 2, 6, 7, 8, 13, 14, 15) + d(3, 5, 12)



$$f = AC'D' + A'D + A'C + AB$$

Karnaugh map Minimization

Minimize f = m(1,5,6,12,13,14) + d(4) in SOP minimal form

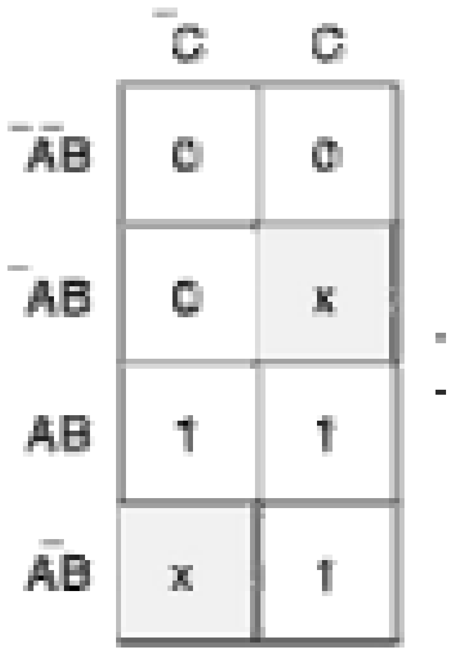


$$f = BC' + BD' + A'C'D$$

Problems in K-map

A	B	C	z
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	x
1	0	0	x
1	0	1	1
1	1	0	1
1	1	1	1

"don't care"



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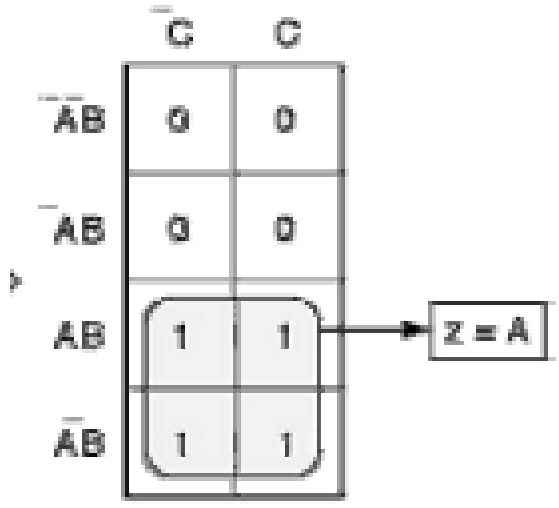


Karnaugh map Minimization

Karnaugh map Minimization

	$\bar{C}$	C
$\bar{A}\bar{B}$	0	1
$\bar{A}B$	0	1
AB	0	1
$A\bar{B}$	0	1

$X = C$

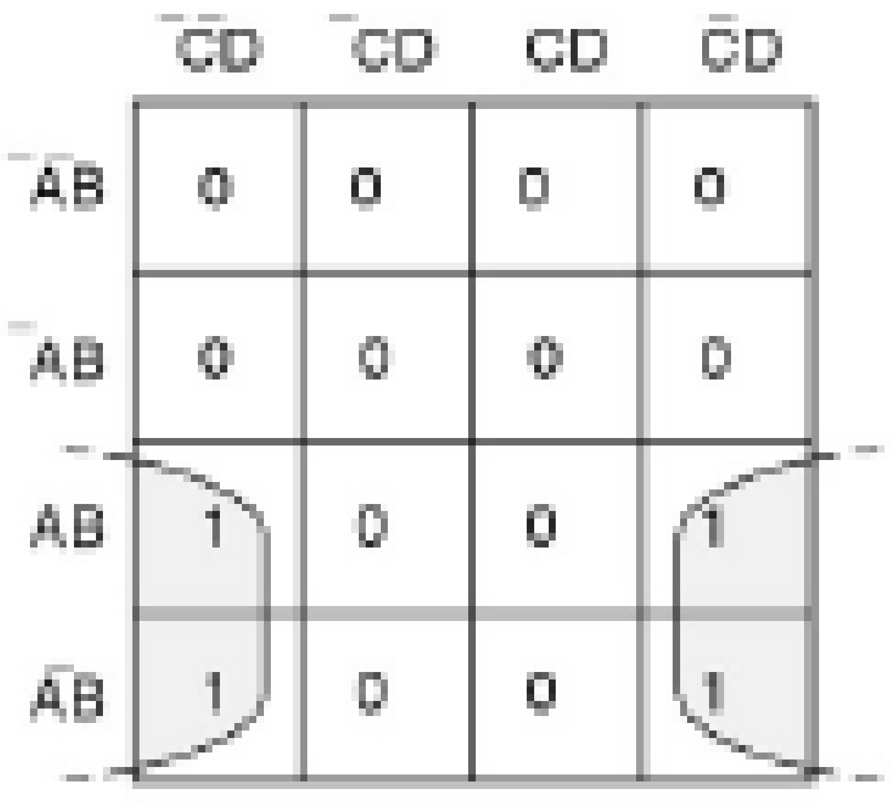
	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$	0	0	0	0
$\bar{A}B$	0	0	0	0
AB	1	1	1	1
$A\bar{B}$	0	0	0	0

$X = AB$

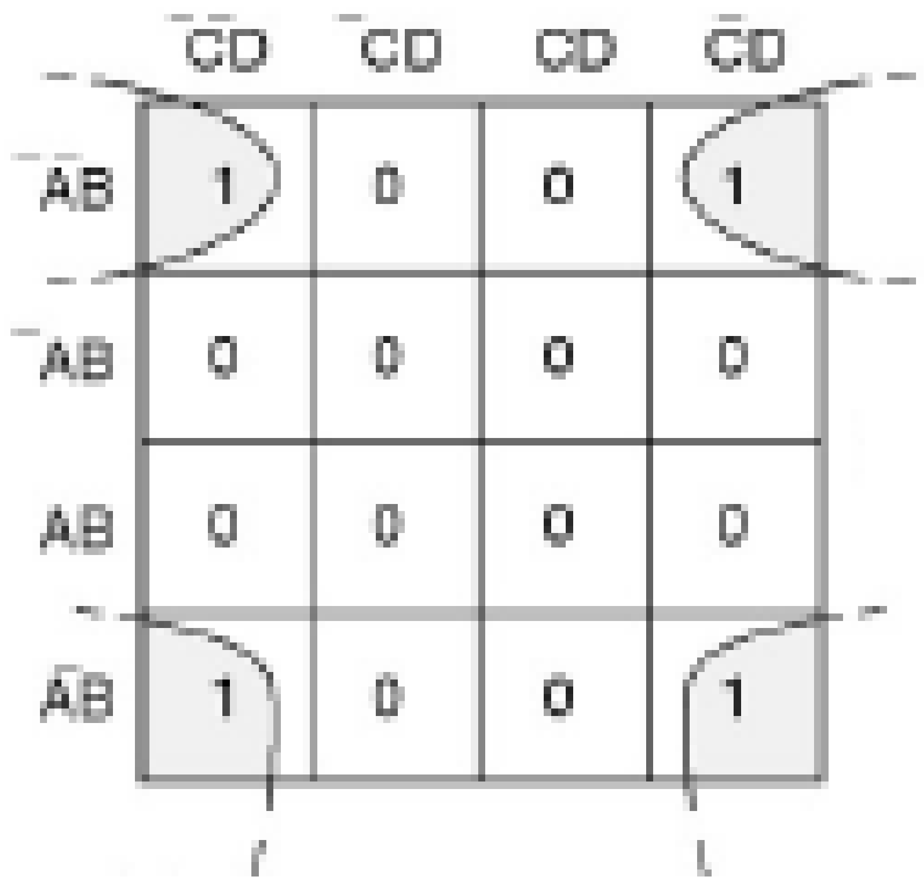
	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$	0	0	0	0
$\bar{A}B$	0	1	1	0
AB	0	1	1	0
$A\bar{B}$	0	0	0	0

$X = BD$

Karnaugh map Minimization

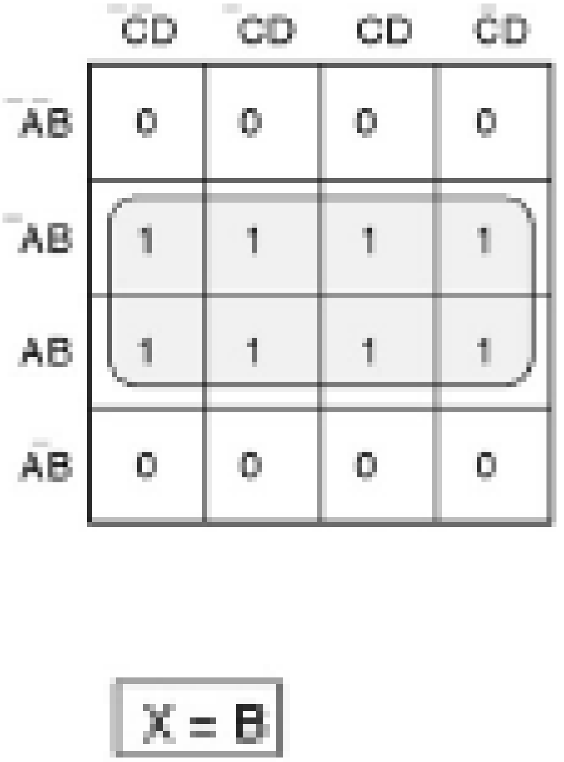


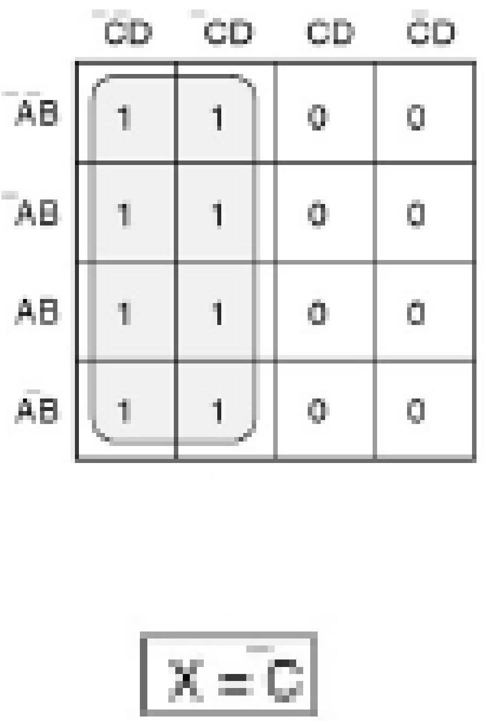
$X = A\bar{D}$

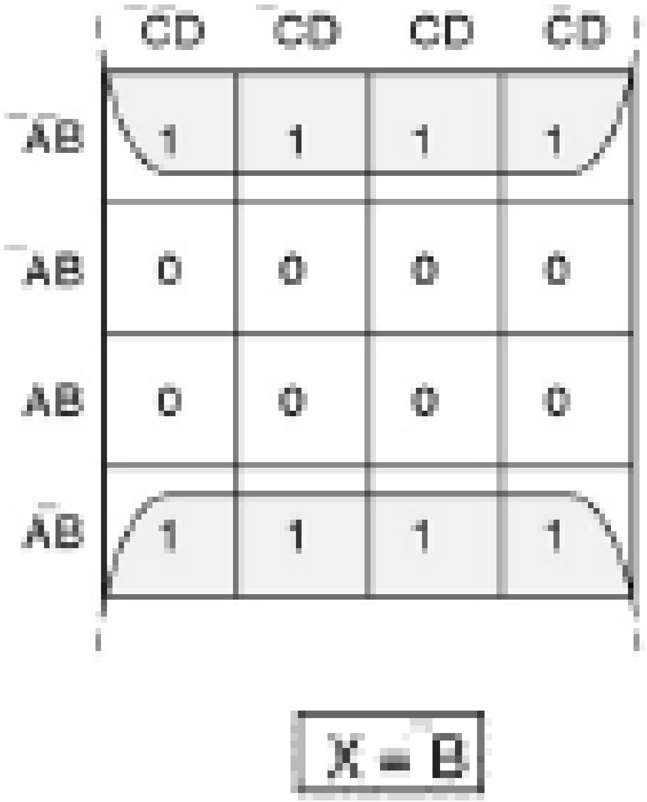


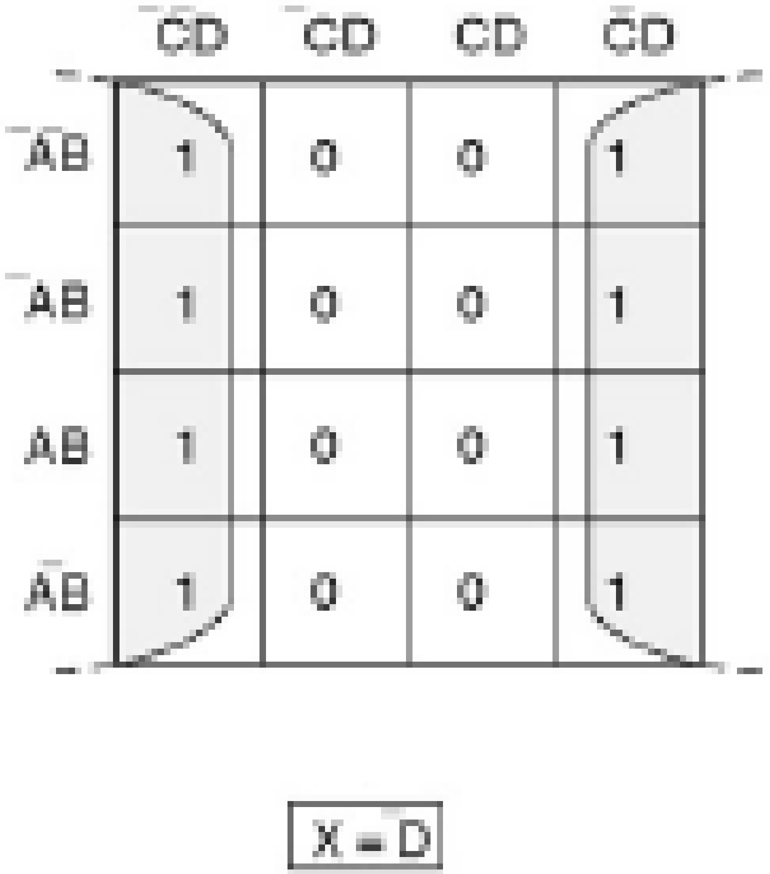
$X = \bar{B}\bar{D}$

Karnaugh map Minimization

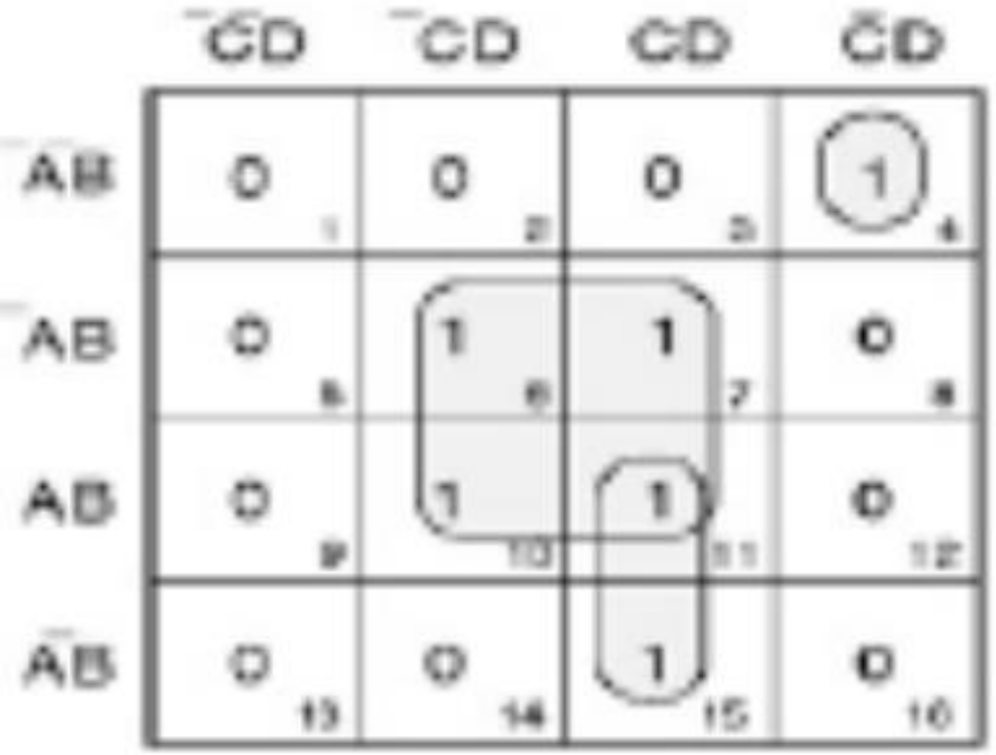








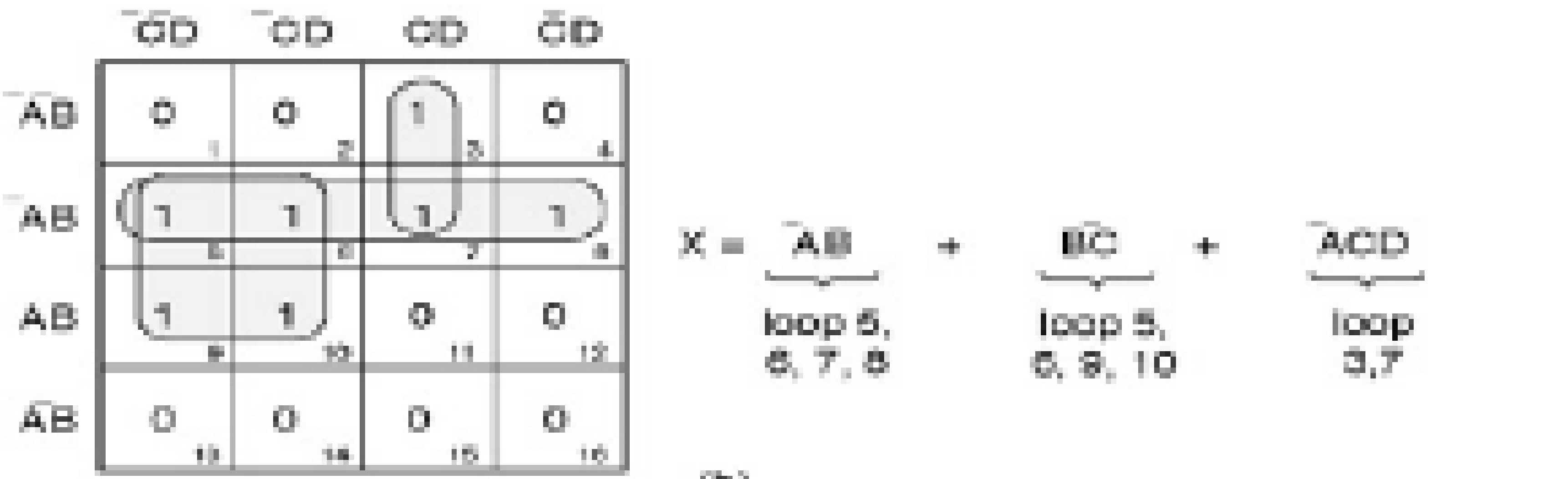
Karnaugh map Minimization



X = ABCD + ACD + BD

- ABCD: loop 4
- ACD: loop 11, 15
- BD: loop 6, 7, 10, 11

K Map- Problems for Practise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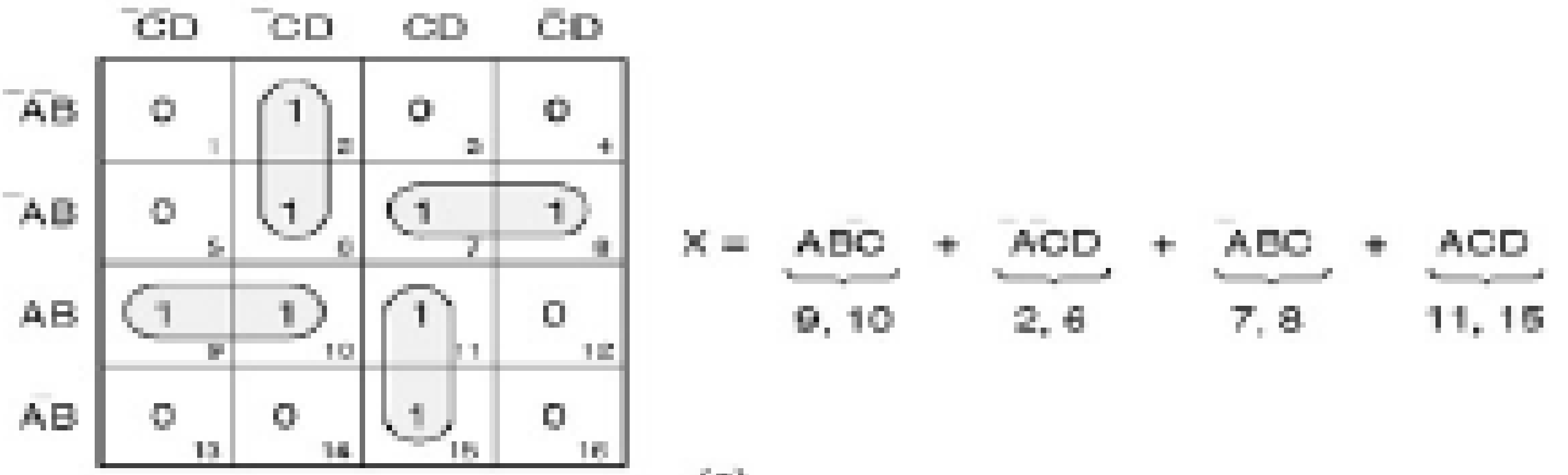
(c)

ASSESSMENT - 1

How Laws relates with us….

Question 1

A Karnaugh map is a systematic way of reducing which type of expression?

a) product-of-sums

a) exclusive NOR

a) sum-of-products

a) those with overbars

Question 2

Occasionally, a particular logic expression will be of no consequence in the operation of a circuit, such as a BCD-to-decimal converter. These result in _______terms in the K-map and can be treated as either _______ or _______, in order to _______ the resulting term

A.don't care, 1s, 0s, simplify

B.spurious, ANDs, ORs, eliminate

C.duplicate, 1s, 0s, verify

D.spurious, 1s, 0s, simplify

References

- https://brilliant.org/wiki/de-morgans-laws/
- https://circuitglobe.com/demorgans-theorem.html
- https://www.electrical4u.com/