

Tutorial 11

1. Apply the rules of Boolean algebra, verify the following.

- i) $y \wedge (x \vee (x' \wedge (y \vee y')))) = y$
 ii) $((x \wedge y') \wedge (z \vee (x \wedge y')))' = x' \vee y$

2. Simplify the following Boolean functions.

- i) $f(x, y) = (x \wedge y') \vee (x' \wedge y) \vee (x \wedge y)$
 ii) $f(x, y, z) = (x' \wedge y' \wedge z') \vee (x \wedge y' \wedge z') \vee (x' \wedge y \wedge z') \vee (x \wedge y \wedge z')$
 iii) $f(x, y, z) = (x \wedge y) \vee [x \wedge (y \wedge z)']$

3. Find the principal disjunctive normal form of the Boolean function f with the truth table given below.

i)

x	y	z	$f(x, y, z)$
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

ii)

x	y	z	$f(x, y, z)$
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

iii)

x	y	z	w	$f(x, y, z, w)$
0	0	0	0	0
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	0

iv)

x	y	z	w	$f(x, y, z, w)$
0	0	0	0	1
0	0	0	1	0
0	0	1	0	1
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	1
1	0	0	0	1
1	0	0	1	0
1	0	1	0	1
1	0	1	1	0
1	1	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	1

4. In the following questions, Karnaugh maps of functions are given, write the simplified Boolean expression for these functions.

i)

	y'	y
x'	1	0
x	0	1

ii)

	y	y'
x	1	1
x'	1	0

iii)

	y'	y'	y	y
x'	1	1	1	1
x	1	0	0	1
	z'	z	z	z'

iv)

	y'	y'	y	y
x'	1	1	0	1
x	0	1	0	1
	z'	z	z	z'

v)

	y'	y'	y	y
x'	1	1	1	1
x	0	0	1	0
	z'	z	z	z'

vi)

	y'	y'	y	y
x'	0	1	0	1
x	1	1	0	1
	z'	z	z	z'

vii)

	w'	w	w	w'	
x'	0	0	1	1	y'
x'	0	0	1	1	y
x	1	0	0	1	y
x	0	1	1	0	y'
	z'	z'	z	z	

viii)

	w'	w	w	w'	
x'	1	1	0	1	y'
x'	1	1	0	1	y
x	0	0	0	0	y
x	1	0	0	1	y'
	z'	z'	z	z	

5. Simplify the expressions in Question 3 by constructing the Karnaugh map.
6. Draw a Karnaugh map for the Boolean expression whose principal disjunctive normal forms are as follow. Hence find a simplified version of the expression.
- i) $f(x, y, z) = (x' \wedge y' \wedge z) \vee (x' \wedge y \wedge z) \vee (x \wedge y \wedge z') \vee (x \wedge y \wedge z)$
- ii) $f(x, y, z, w) = (x \wedge y \wedge z \wedge w) \vee (x \wedge y \wedge z \wedge w') \vee (x' \wedge y \wedge z \wedge w) \vee (x' \wedge y \wedge z \wedge w') \vee (x \wedge y' \wedge z' \wedge w') \vee (x' \wedge y' \wedge z' \wedge w')$

7. Find the principal disjunctive normal form of the Boolean function $f(x, y, z)$ with the following truth table and then draw a Karnaugh map to find a simplified version of $f(x, y, z)$.

x	y	z	$f(x, y, z)$
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

8. Construct a truth table for the Boolean expression $(x \wedge (y' \vee z)) \vee (x' \wedge (y \vee z'))$ and hence determine its principal disjunctive normal form. Draw a Karnaugh map and hence find a simplified version of $f(x, y, z)$.