Long Questions

Q.1 Simplify the Boolean function

$f(x, y, z) = x.\ y.\ \overline{z} + \overline{x}.\ \overline{y}.\ \overline{z} + x.\ \overline{y}.\ \overline{z} + \overline{x}.\ y.\ z$

Solution:

Step 1: We represent the function in the form of a k-map.

x/y.z	$\overline{y.z}$	$\overline{y.z}$	y.z	$\overline{y.z}$
$\overline{x}$	1	0	1	0
x	1	0	0	1

Step 2: We mark any groups of two or four adjacent 1s as shown below

x/y.z	$\overline{y.z}$	$\overline{y.z}$	y.z	$y.\overline{z}$
$\overline{x}$	1	0	1	0
x	1	0	0	1

Step 3: We write simplified expression for each group

Group 1: $\overline{x}.\ \overline{y}.\ \overline{z}$ and $x.\ \overline{y}.\ \overline{z}$ so simplified expression is $\overline{y}.\ \overline{z}$

Group 2: $x.\ \overline{y}.\ \overline{z}$ and $x.\ y.\ \overline{z}$ so simplified expression is $x.\ \overline{z}$

Ungrouped terms:

$$\overline{x}\ .\ y\ .\ z$$

Step 4: We write the final simplified form as a sum of products and the ungrouped term will be added as it is

$$f(\bar{x}, \bar{y}, z) = \bar{y}.\ \bar{z} + x.\ z + x.\ y.\ z$$

Q.2 Simplify the Boolean function

$$f(x, \bar{y}, z) = \bar{x}.\ y.\ \bar{z} + x.\ y.\ z + x.\ \bar{y}.\ z + \bar{x}.\ \bar{y}.\ \bar{z} + x.\ y.\ z$$

Solution:

Step 1: We represent the function in the form of a k-map.

x/y.z	$\bar{y}.\ \bar{z}$	$\bar{y}.z$	y.z	$\bar{y}.z$
$\bar{x}$	0	0	1	1
x	1	0	1	1

Step 2: We mark any groups of two or four adjacent 1s as shown below

x/y.z	$\bar{y}.\ \bar{z}$	$\bar{y}.z$	y.z	$\bar{y}.z$
$\bar{x}$	0	0	1	1
x	1	0	1	1

The groups are

Group 1: $\bar{x}.\ y.\ z$ $x.\ y.\ z$ $\bar{x}.\ y.\ \bar{z}$ $x.\ y.\ \bar{z}$

Group 2: $x.\ \bar{y}.\ \bar{z}$ $x.\ y.\ \bar{z}$

Step 3: We write simplified expression for each group

The groups are

Group 1: $\overline{x}.\ y.\ z$ x. y. z $\overline{x}.\ y.\ \overline{z}$ x. y. $\bar{z}$ so simplified expression is y

Group 2: $x.\ \overline{y}.\ \overline{z}$ x. y. $\overline{z}$ so simplified expression is $x\ .\ \overline{z}$

Step 4: We write the final simplified form as a sum of products

$$f(x, y, \overline{z}) = y + x.\ z$$

Q.3 Simplify the Boolean function

$f(x, y, z) = x.\ y.\ \overline{z} + \overline{x}.\ \overline{y}.\ \overline{z} + x.\ \overline{y}.\ \overline{z} + \overline{x}.\ y.\ z + \overline{x}.\ \overline{y}.\ z + \overline{x}.\ y.\ \overline{z} + x.\ y.\ z$

Solution:

Step 1: We represent the function in the form of a k-map.

x/y.z	$\overline{y}.\overline{z}$	$\overline{y}.z$	y.z	$y.\overline{z}$
$\overline{x}$	1	1	1	1
x	1	0	1	1

Step 2: We mark any group of two or four adjacent 1 as shown below

x/y.z	$\overline{y}.\overline{z}$	$\overline{y}.z$	y.z	$y.\overline{z}$
$\overline{x}$	1	1	1	1
x	1	0	1	1

So there are three groups

Group 1: $\overline{x}.\ \overline{y}.\ \overline{z}$ $x.\ \overline{y}.\ \overline{z}$ x. y. $\overline{z}$ $\overline{x}.\ y.\ \overline{z}$

Group 2: $\overline{x}.\ y.\ z$ x. y. z x. y. $\overline{z}$ $\overline{x}.\ y.\ \overline{z}$

Group 3: $\overline{x}.\ \overline{y}.\ z$ $\overline{x}.\ \overline{y}.\ z$ $\overline{x}.\ y.\ z$ $\overline{x}.\ y.\ \overline{z}$

Step 3: We write simplified expression for each group

Group 1: $\overline{x}.\ \overline{y}.\ \overline{z}$ $x.\ \overline{y}.\ \overline{z}$ x. y. $\overline{z}$ $\overline{x}.\ y.\ \overline{z}$ so simplified expression is $\overline{z}$

Group 2: $\overline{x}.\ y.\ z$ $\quad x.\ y.\ z$ $\quad x.\ y.\ \overline{z}$ $\quad \overline{x}.\ y.\ \overline{z}$ so simplified expression is y

Group 3: $\overline{x}.\ \overline{y}.\ z$ $\quad \overline{x}.\ \overline{y}.\ z$ $\quad \overline{x}.\ y.\ z$ $\quad \overline{x}.\ y.\ \overline{z}$ so simplified expression is $\overline{x}$

Step 4: Write the final simplified form as a sum of products is

$$f(\overline{x}, y, z) = \overline{x} + y + z$$