

GATE QUESTION ECE 2009 Q38

Question

Q58) The following Karnaugh map represents a function F :

The table represents a function F :

$X \backslash YZ$	00	01	11	10
0	1	1	0	0
1	0	0	1	0

Which of the following circuits is a realization of the above function F ?

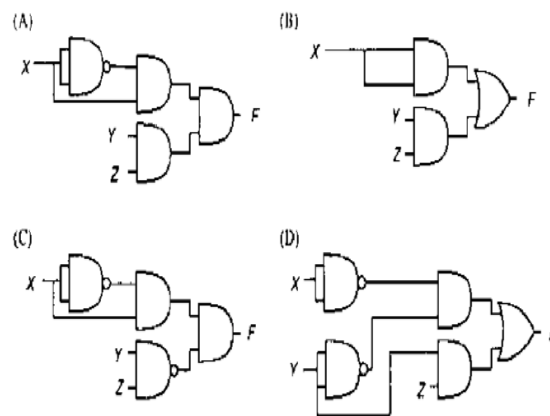


Figure 1

Solution

Given K-map:

$X \backslash YZ$	00	01	11	10
0	1	1	0	0
1	0	0	1	0

From this K-map, the minterms where $F = 1$ are:

1. m_0 : $X = 0, Y = 0, Z = 0 \Rightarrow \overline{X} \overline{Y} \overline{Z}$
2. m_1 : $X = 0, Y = 0, Z = 1 \Rightarrow \overline{X} \overline{Y} Z$

3. m_7 : $X = 1, Y = 1, Z = 1 \Rightarrow XYZ$

So, the Boolean expression is:

$$F = \overline{X}\overline{Y}\overline{Z} + \overline{X}\overline{Y}Z + XYZ$$

Group the first two terms:

$$F = \overline{X}\overline{Y}(\overline{Z} + Z) + XYZ = \overline{X}\overline{Y} + XYZ$$

So the correct simplified form is:

$$\boxed{F = \overline{X}Y + YZ}$$

Now examining the circuits in Q.53:

Circuit (A) performs the following operations:

1. First, invert X to get \overline{X}
2. AND gate: $\overline{X} \cdot Y = \overline{X}Y$
3. AND gate: $Y \cdot Z = YZ$
4. OR gate: $\overline{X}Y + YZ$

This matches the simplified function.

Final Answer:

Option (A)