GATE QUESTION
ECE 2009 Q38

Question

Q58)The following Karnaugh map represents a functionnF:

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

Which of the following circuits is a realization of the above function F?
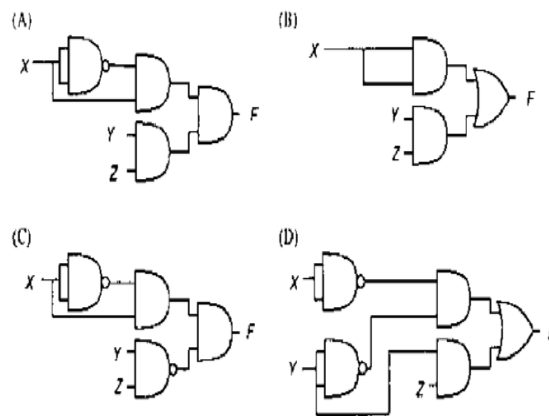
Figure 1

Solution

Given K-map:

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

$$\boxed{\text{Option (A)}}$$