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GATE CS 2010

Question 9

The Boolean expression for the output f of the multiplexer shown below is:

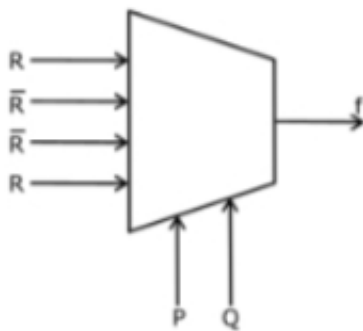


Fig. 1

Options

- (a) $P \oplus Q \oplus R$
- (b) $\overline{P \oplus Q \oplus R}$
- (c) $P + Q + R$
- (d) $\overline{P + Q + R}$

Solution

The given circuit is a 4:1 Multiplexer.

Select lines: P and Q .

Inputs:

$$I_0 = R$$

$$I_1 = \overline{R}$$

$$I_2 = \overline{R}$$

$$I_3 = R$$

General equation of 4:1 MUX:

$$f = \overline{PQ}I_0 + \overline{PQ}I_1 + P\overline{Q}I_2 + PQI_3$$

Substituting values:

$$f = \overline{PQR} + \overline{PQ}\overline{R} + P\overline{Q}\overline{R} + PQR$$

Grouping terms:

$$f = R(\overline{PQ} + PQ) + \overline{R}(\overline{PQ} + P\overline{Q})$$

Using identities:

$$\overline{PQ} + PQ = P \odot Q$$

$$\overline{PQ} + P\overline{Q} = P \oplus Q$$

Therefore,

$$f = P \oplus Q \oplus R$$

Final Answer

$$f = P \oplus Q \oplus R$$

Correct option: (a)