

Q.6 The minterm expansion of $f(P, Q, R) = PQ + Q\bar{R} + P\bar{R}$ is

- (A) $m_2 + m_4 + m_6 + m_7$
(B) $m_0 + m_1 + m_4 + m_5$
(C) $m_0 + m_1 + m_6 + m_7$
(D) $m_2 + m_3 + m_1 + m_3$

Detailed Solution

Given function:

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

We are to find its minterm expansion.

Step 1: Expand each term to include all variables

Term 1: PQ

This term is independent of R , so we expand it as:

$$PQ = PQ(R + \bar{R}) = PQR + PQ\bar{R}$$

Term 2: $Q\bar{R}$

This term is independent of P , so we expand it as:

$$Q\bar{R} = PQ\bar{R} + \bar{P}Q\bar{R}$$

Term 3: $P\bar{R}$

This term is independent of Q , so we expand it as:

$$P\bar{R} = PQ\bar{R} + P\bar{Q}\bar{R}$$

Step 2: Combine all terms

$$\begin{aligned} f(P, Q, R) &= PQR + PQ\bar{R} + PQ\bar{R} + \bar{P}Q\bar{R} + PQ\bar{R} + P\bar{Q}\bar{R} \\ &= PQR + PQ\bar{R} + \bar{P}Q\bar{R} + P\bar{Q}\bar{R} \end{aligned}$$

(Note: $PQ\bar{R}$ appeared multiple times but is considered only once.)

Step 3: Identify minterm indices

| P | Q | R | Expression | Minterm |
|---|---|---|-------------------|---------|
| 1 | 1 | 1 | PQR | m_7 |
| 1 | 1 | 0 | $PQ\bar{R}$ | m_6 |
| 0 | 1 | 0 | $\bar{P}Q\bar{R}$ | m_2 |
| 1 | 0 | 0 | $P\bar{Q}\bar{R}$ | m_4 |

Step 4: Final Answer

Thus, the minterm expansion of the function is:

$$f(P, Q, R) = m_2 + m_4 + m_6 + m_7$$

Correct Option: (A) $m_2 + m_4 + m_6 + m_7$