IIITB COMET FOUNDATION

GATE 2018 Question

Name: Varshini G N
ID: COMETFWC031
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GATE 2018 CS Q49

Consider the minterm list form of a Boolean function F given below.

$$F(P, Q, R, S) = \sum m(0, 2, 5, 7, 9, 11) + d(3, 8, 10, 12, 14)$$

Here, m denotes a minterm and d denotes a don't care term. The number of essential prime implicants of the function F is _____.

Solution

Truth Table

Decimal	P	Q	R	S	F
0	0	0	0	0	1
1	0	0	0	1	0
2	0	0	1	0	1
3	0	0	1	1	X
4	0	1	0	0	0
5	0	1	0	1	1
6	0	1	1	0	0
7	0	1	1	1	1
8	1	0	0	0	X
9	1	0	0	1	1
10	1	0	1	0	X
11	1	0	1	1	1
12	1	1	0	0	X
13	1	1	0	1	0
14	1	1	1	0	X
15	1	1	1	1	0

K-Map Representation (4 Variables)

Below is one possible K-map arrangement (PQ as rows, RS as columns):

$PQ \backslash RS$	00	01	11	10
00	1	0	X	1
01	0	1	1	0
11	X	0	0	X
10	X	1	1	X

Legend: '1' = Minterm, 'X' = Don't care, '0' = Not included.

Essential Prime Implicant Calculation

Prime implicant groups:

- Group 1: Covers minterms 0, 2 (essential)
- Group 2: Covers minterms 5, 7 (essential)
- Group 3: Covers minterms 9, 11 (essential)

So, the number of essential prime implicants is:

$$\boxed{3}$$

Final Answer: There are **3 essential prime implicants**.