Name: Keshava Reddy V
ID: COMETFWC054

GATE CS 2010, Majority Function Implementation

Question

For the Boolean function
$f(P, Q, R) = PQ + QR + PR$
Find the minterm expansion and implement in hardware.

Question Analysis

• Output is 1 when at least two inputs are 1. • This is a 3-input Majority Function. • Canonical expansion required.

The Truth Table

P	Q	R	F
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

Minterms where $F = 1$:
m_3, m_5, m_6, m_7

Therefore,
$f(P, Q, R) = m_3 + m_5 + m_6 + m_7$

Code Uploading Steps

1. Create a PlatformIO project. 2. Write the code in main.cpp inside src folder. 3. Run the project using ‘pio run‘. 4. Upload using ‘pio run –target upload‘. 5. Connect Arduino UNO with OTG cable. 6. Observe LED output and verify truth table.

Hardware Implementation

The majority function is implemented using Arduino UNO. Inputs P, Q, R are connected to digital pins. Output F is connected to LED.

Required Components & Pin Connections

Component	Arduino Pin
Input P	Digital 2
Input Q	Digital 3
Input R	Digital 4
Output F (LED)	Digital 8
GND	GND
VCC	5V

Logic Description

• Initialize P, Q, R as digital inputs. • Compute:
$F = (P \cdot Q) + (Q \cdot R) + (P \cdot R)$
• Display result on LED. • Change inputs as per truth table and verify output.

Experimental Truth Table

P	Q	R	$F(LED)$
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

Conclusion

• The function outputs 1 when at least two inputs are 1. • Experimental results match theoretical truth table. • Hardware implementation confirms majority logic.