

Name: Keshava Reddy V
ID: COMETFWC054

GATE CS 2010

Question 6

The minterm expansion of $f(P, Q, R) = PQ + QR + PR$ is

1. $m_2 + m_4 + m_6 + m_7$
2. $m_0 + m_1 + m_3 + m_5$
3. $m_0 + m_1 + m_6 + m_7$
4. $m_2 + m_3 + m_4 + m_5$

Question Analysis

Given function: $f(P, Q, R) = PQ + QR + PR$

- This is a 3-input Majority Function.
- The output becomes 1 when at least two inputs are 1.

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,

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

Hardware Implementation

- The above Boolean function is implemented using Arduino UNO and a 7447 BCD to Seven Segment Decoder IC.
- The logical output of the function is given as input to the 7447 IC, which drives a Common Anode Seven Segment Display.
- The 7447 converts the BCD input into corresponding segment signals, and 220Ω current limiting resistors are used to protect the display segments.
- The hardware setup verifies the theoretical Majority Function experimentally.

Required Components

1. Arduino UNO
2. Breadboard
3. Seven Segment Display (Common Cathode)
4. 7447
5. Jumper Wires
6. USB Cable

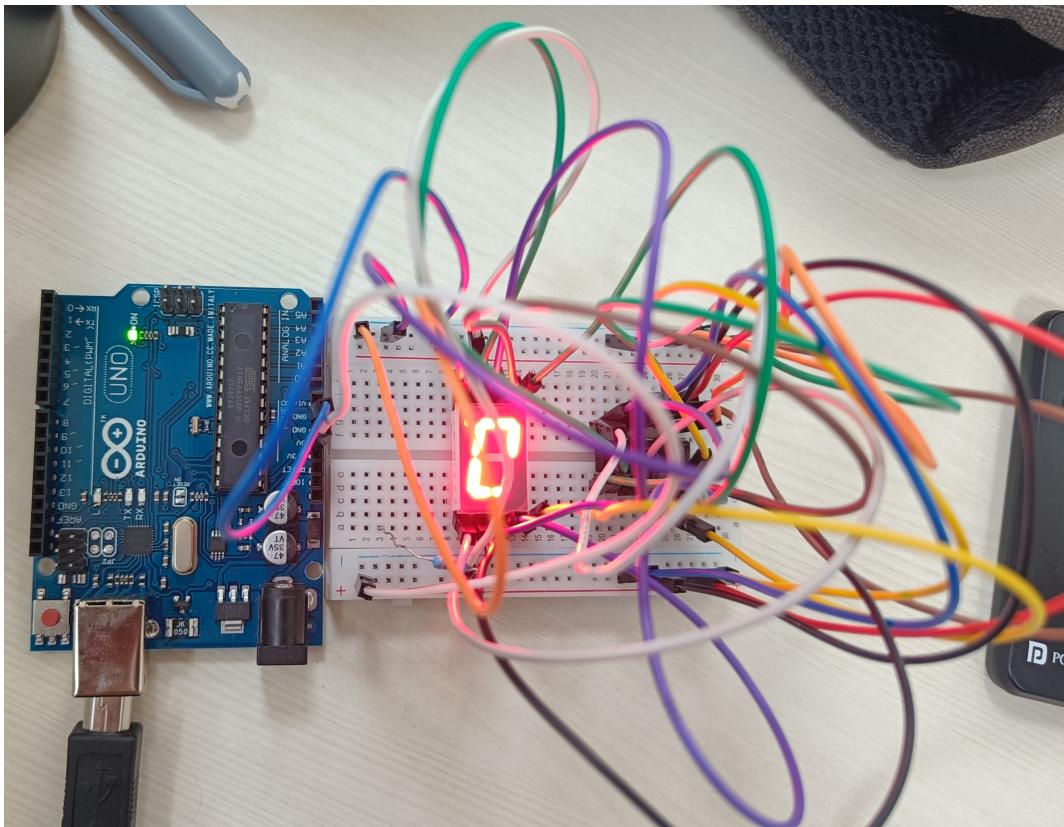
Pin Connections

Component	Arduino Pin
Input P	Digital 2
Input Q	Digital 3
Input R	Digital 4
Segment a	Digital 5
Segment b	Digital 6
Segment c	Digital 7
Segment d	Digital 8
Segment e	Digital 9
Segment f	Digital 10
Segment g	Digital 11
Common Cathode	GND

Code Uploading Steps

1. Create a PlatformIO project.
2. Write the program inside `src/main.cpp`.
3. Run `pio run` to build the project.
4. Connect Arduino UNO using OTG cable.
5. Run `pio run --target upload` to upload the program.
6. Verify the output on hardware.

Circuit Diagram



Conclusion

- The function outputs 1 when at least two inputs are 1.
- The hardware implementation verifies the theoretical Majority Function and matches the minterm expansion:
- $m_3 + m_5 + m_6 + m_7$