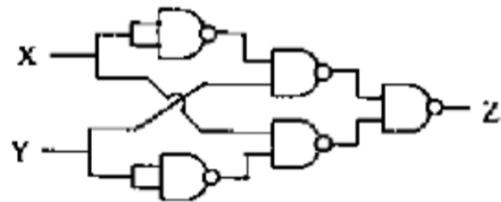


Harshita N Kumar
ID: COMETFWC052

GATE Question no. 42

Question:

The logic gate circuit shown below realizes which function?



Options: XOR, XNOR, Half Adder, Full Adder.

Question Analysis

The given circuit consists only of NAND gates arranged in a cross-coupled structure.

Using Boolean simplification:

$$Z = X\bar{Y} + \bar{X}Y$$

This is the standard expression for XOR.

Therefore,

$$Z = X \oplus Y$$

Truth Table

X	Y	$Z = X \oplus Y$
0	0	0
0	1	1
1	0	1
1	1	0

Required Components

- Arduino UNO
- IC 7447
- Common Anode 7-segment display
- Resistors
- Breadboard
- Jumper wires

Pin Connections

7447 Connections:

Pin 16 → 5V
Pin 8 → GND
Pin 3,4,5 → 5V
Pin 1,2,6 → GND
Pin 7 → Arduino Pin 9

Arduino Inputs:

Pin 10 → X
Pin 11 → Y

7-Segment:

Common Anode pins → 5V
Segments connected from 7447 outputs through resistors.

Logic Description

The XOR function is implemented using NAND logic:

$$P = (X \cdot Y)'$$

$$Q = (X \cdot P)'$$

$$R = (Y \cdot P)'$$

$$Z = (Q \cdot R)'$$

This simplifies to:

$$Z = X \oplus Y$$

Code Uploading Steps

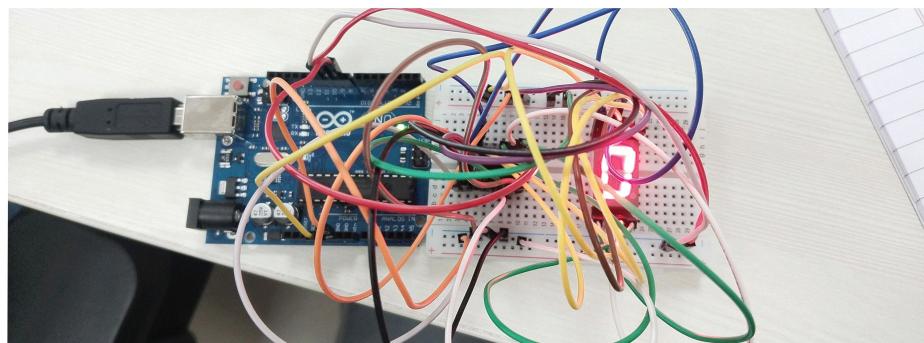
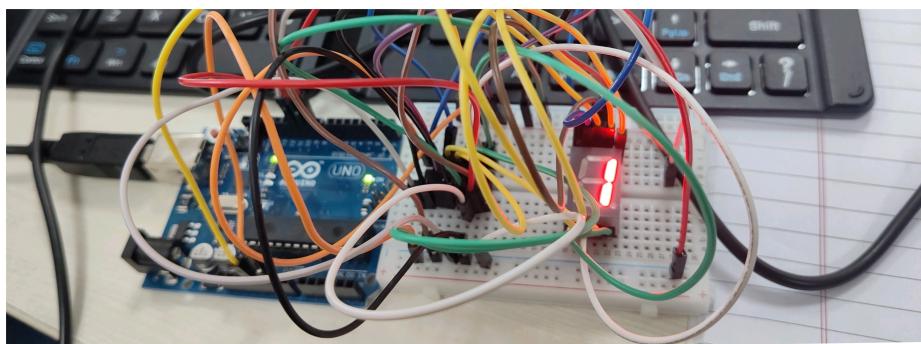
1. Create a Platform IO project.
2. Write the code in main.cpp in src folder.
3. Run the PIO project using command: `pio run`. It creates the .hex file.

4. Copy the hex file to Arduino Droid folder.
5. Connect Arduino UNO to mobile using OTG cable.
6. Upload using “Upload Precompiled” option.
7. Observe output and verify expression.

Experimental Truth Table

X	Y	Observed Output
0	0	0
0	1	1
1	0	1
1	1	0

Hardware Implementation



Conclusion

The given NAND gate circuit realizes the XOR function.

Both theoretical truth table and hardware implementation confirm:

$$Z = X \oplus Y$$

Hence, the correct answer is **XOR**.