IIITB COMET FOUNDATION

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Date: 9th July 2025

GATE Question Paper 2010, IN Question Number 42

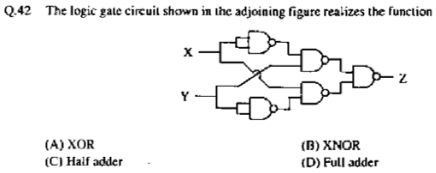

Figure: Logic Gate Circuit

Question Analysis

Given: A combinational logic gate circuit using NOT, AND, and OR gates with inputs X and Y. **Task:** Identify the overall logic function Z.

Solution:

Step 1: Label Gate Outputs for Clarity:

- Let $A = \overline{X}$ and $B = \overline{Y}$
- $C = X \cdot B = X \cdot \overline{Y}$
- $D = A \cdot Y = \overline{X} \cdot Y$
- $Z = C + D$

Step 2: Combine Logic:

$$Z = (X \cdot \overline{Y}) + (\overline{X} \cdot Y)$$

Step 3: Recognize Logic Pattern:

$$Z = X \oplus Y$$

This is the standard definition of the XOR operation.

Correct Option: (A) XOR

Truth Table

X	Y	$\overline{X}$	$\overline{Y}$	Z = $X \oplus Y$
0	0	1	1	0
0	1	1	0	1
1	0	0	1	1
1	1	0	0	0

Table: Truth Table for the Logic Circuit

Hardware Implementation

Logic Expression: $Z = X \oplus Y$

Inputs: X, Y – Push buttons **Output:** Z – LED indicates result

Hardware Requirements

S.No	Component
1	Pico2W or Arduino Uno
2	Breadboard
3	Push Buttons (2x) for X and Y
4	LED for Output Z
5	Resistors (220Ω for LED, 10kΩ for pull-downs)
6	Jumper Wires
7	USB Cable

Required Components for XOR Circuit

GPIO Pin Mapping (Pico2W)

Component	Pico2W Pin	Description
Button X	GP14	Input X
Button Y	GP15	Input Y
LED (Output Z)	GP13	Output XOR
GND	GND	Common Ground
3.3V	3.3V	Pull-up Voltage

Arduino Uno GPIO Mapping

Testing Procedure

1. Power up board and connect circuit.
2. Press combinations of X and Y:
   - 00 → Z = 0
   - 01 → Z = 1
   - 10 → Z = 1
   - 11 → Z = 0
3. Verify LED glows only for XOR condition.

Component	Arduino Pin	Description
Button X	D2	Input X
Button Y	D3	Input Y
LED Z	D6	Output (XOR)
GND	GND	Ground
VCC	5V	Power

Conclusion

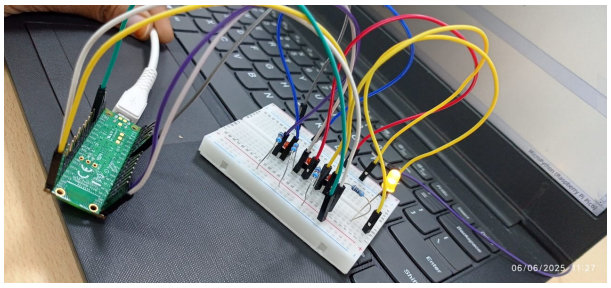

Figure: XOR Implementation Setup (Representative)

The given logic gate network implements the function:

$$Z = X \cdot \overline{Y} + \overline{X} \cdot Y = X \oplus Y$$

Hence, the correct answer is:

$$\boxed{\text{(A) XOR}}$$

Source Code Link

The complete hardware simulation and code implementation for this experiment is available at the following GitHub repository:

GitHub Repo: github.com/aisusmitha/FWC.git