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GATE Question Paper 2010, PH Question Number 41

Q.41 For any set of inputs, A and B, the following circuits give the same output, Q, except one. Which one is it?

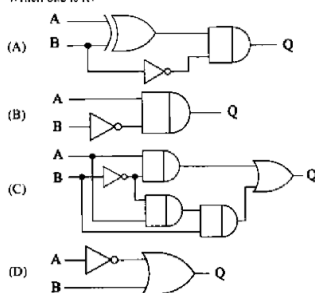


Figure: Logic Gate Circuit

Question Analysis

Given: Four different logic circuits labeled (A) to (D) are presented. **Task:** Identify which one of the circuits gives a different output Q compared to the others.

Solution

Let's evaluate the logic expression for each option:

Option (A): (A)

$$Q_A = \overline{(A + B)} \cdot \bar{A}$$

Option (B): (B)

$$Q_B = \bar{A} \cdot \bar{B} = \overline{(A + B)} \quad (\text{By De Morgan's Law})$$

Option (C): (C) Two expressions:

$$X = \bar{A} \cdot B$$

$$Y = \bar{B} \cdot A$$

$$Q_C = X + Y = A \oplus B$$

Option (D): (D)

$$Q_D = \bar{A} + B$$

Now compare: - (A), (B) simplify to: $Q_A = \overline{(A + B)} \cdot \bar{A}$ — not equal to others directly. - (B) gives $\overline{(A + B)}$ - (C) is clearly $A \oplus B$ - (D) is $\bar{A} + B$

Conclusion: Circuit (C) gives XOR output, while others are variations of NOR or combinations thereof. Hence, ****(C)**** is the different one.

Correct Option: (C)

Truth Table

A	B	Q_A	Q_B	Q_C	Q_D
0	0	1	1	0	1
0	1	0	0	1	1
1	0	0	0	1	0
1	1	0	0	0	1

Table: Comparison of Outputs for Each Circuit

Hardware Implementation Idea

You can simulate and verify each option (A–D) using:

- Raspberry Pi Pico or Arduino Uno
- Push buttons for A and B
- LEDs for output Q

Implement each logic function in code or hardware gates and compare outputs for all four input combinations of A and B.

Conclusion

From analysis and truth table comparison, we find:

Option (C) is the odd one out as it implements XOR logic

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

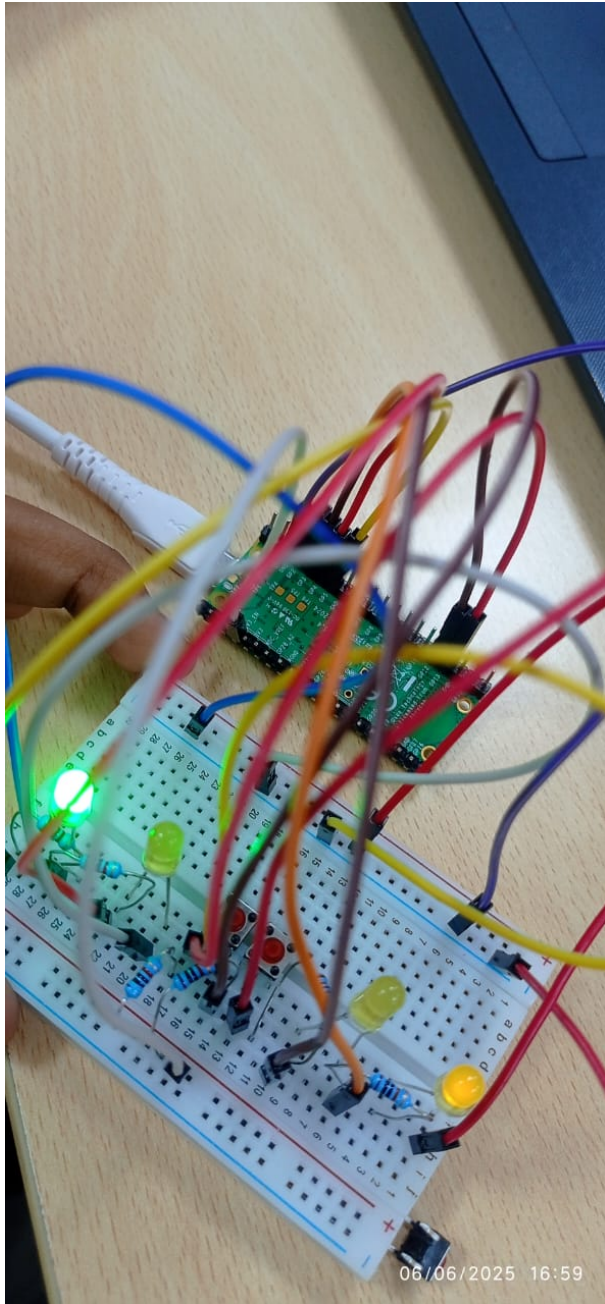


Figure: Representative Logic Circuit Setup