IIITB COMET FOUNDATION

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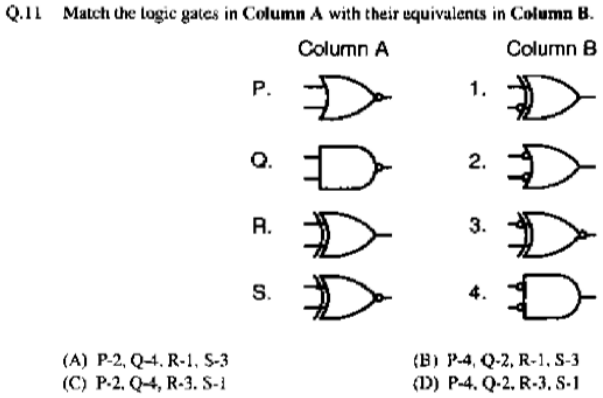
GATE Question Paper 2010, EC Question Number 11



Question Analysis

Given: Column A shows standard logic gates; Column B shows equivalent forms. **Task:** Match logic gate in Column A with its equivalent in Column B.

Step-by-Step Matching

Step 1: P (Column A) – NOR gate (OR + NOT). Matched with Column B Option 4.

Step 2: Q (Column A) – NAND gate (AND + NOT). Matched with Column B Option 2.

Step 3: R (Column A) – XOR gate. Matched with Column B Option 3.

Step 4: S (Column A) – AND gate. Matched with Column B Option 1.

Correct Option: (D)

P-4, Q-2, R-3, S-1

A	B	AND	OR	XOR	NAND
0	0	0	0	0	1
0	1	0	1	1	1
1	0	0	1	1	1
1	1	1	1	0	0

Reference Output Table for Logic Gates

Truth Table for Basic Gates

Hardware Implementation

Goal: Implement each gate using buttons as inputs and LEDs as outputs for visual testing.

Hardware Requirements

S.No	Component
1	Raspberry Pi Pico 2 W / Arduino Uno
2	Breadboard
3	Push Buttons (2x) – for inputs A and B
4	LEDs (4x) – for AND, OR, XOR, NAND outputs
5	Resistors (220Ω for LEDs, 10kΩ for buttons)
6	Jumper wires
7	Micro USB cable

List of Required Components

GPIO Pin Mapping – Pico 2 W

Component	Pico Pin	Function
Button A	GP14	Logic Input A
Button B	GP15	Logic Input B
AND LED	GP10	Output of A·B
OR LED	GP11	Output of A+B
XOR LED	GP12	Output of A⊕B
NAND LED	GP13	Output of $\overline{A \cdot B}$
GND	GND	Common ground
3.3V	3.3V	Pull-up supply

Pico2W GPIO Mapping for Gate Outputs

Arduino Pin Mapping

Steps to Implement (Pico2W)

1. Connect Pico to PC via USB while holding BOOTSEL.

Component	Arduino Pin	Function
Button A	D2	Logic Input A
Button B	D3	Logic Input B
AND LED	D4	Output A·B
OR LED	D5	Output A+B
XOR LED	D6	Output A⊕B
NAND LED	D7	Output $\overline{A \cdot B}$
GND	GND	Common Ground
VCC	5V	Pull-up Supply

Arduino GPIO Mapping for Logic Gate Outputs

2. Copy MicroPython UF2 file.
3. Open Thonny IDE → Select Interpreter as Raspberry Pi Pico.
4. Read GPIO pins for A and B.
5. Calculate AND, OR, XOR, NAND using logic.
6. Output results to 4 LEDs.

Steps to Implement (Arduino)

1. Connect Arduino Uno via USB.
2. Open Arduino IDE.
3. Select Board: Arduino Uno; correct COM Port.
4. Write and upload code to read inputs A and B.
5. Calculate logic functions and output to LEDs.
6. Observe logic gate operations physically.

Conclusion

Summary: Each logic gate was matched to its equivalent using symbol recognition and truth table verification. Hardware implementation using Pico2W or Arduino helps verify gate outputs practically.

Correct Answer: Option (D) — P-4, Q-2, R-3, S-1

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

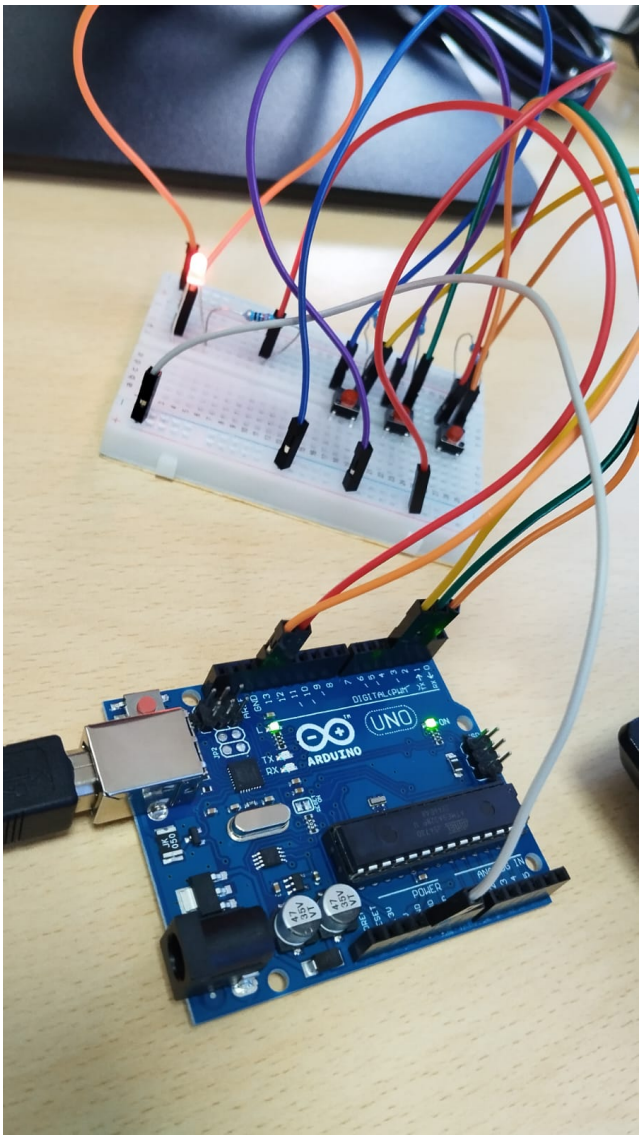


Figure: Hardware Verification Setup (Representative)