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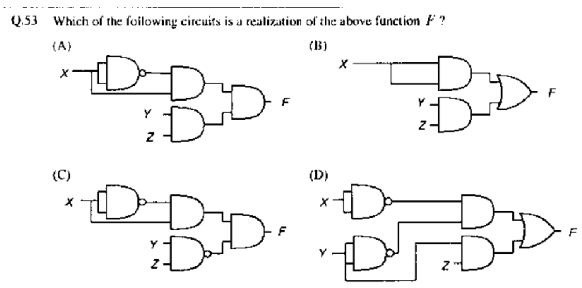
Date: 9th July 2025

GATE Question Paper 2010, EC Question Number 53



Question Analysis

We need to find the circuit that implements the minimized Boolean function:

$$F = \overline{X}Y + YZ$$

Correct Option: (A)

Explanation: Option (A) correctly represents the logic:

$$\overline{X}Y + YZ$$

using AND, OR, and NOT gates.

Solution in Two Steps

Step 1: Expression: $F = \overline{X}Y + YZ$ is in SOP form.

Step 2: Option (A) correctly implements $\overline{X}Y$ and YZ using AND gates and combines them using an OR gate.

Truth Table

X	Y	Z	F = $\overline{X}Y + YZ$
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

Truth Table of $F = \overline{X}Y + YZ$

Hardware Components

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

Table: Required Components

GPIO Pin Connections (Pico2W)

Component	Pico2W Pin	Description
Button X	GP14	Input X
Button Y	GP15	Input Y
Button Z	GP16	Input Z
LED (Output F)	GP13	Output Logic
GND	GND	Common Ground
3.3V	3.3V	Pull-up Supply to Buttons

Pico2W Pin Mapping

GPIO Pin Connections (Arduino Uno)

Component	Arduino Pin	Description
Button X	D2	Input X
Button Y	D3	Input Y
Button Z	D4	Input Z
LED	D13	Output Logic
GND	GND	Ground
Vcc	5V	supply

Arduino Pin Mapping

Uploading Code to Pico2W

1. Connect the Raspberry Pi Pico2W to your computer using a USB cable while holding the **BOOTSEL** button.
2. The board appears as a USB drive on your computer.
3. Download and drag the MicroPython `.uf2` firmware file to the Pico's USB drive.
4. Open the **Thonny IDE** on your computer.
5. In Thonny, go to `Tools` → `Interpreter` and select **MicroPython (Raspberry Pi Pico)**.
6. Write or paste your Python code (logic implementation).
7. Click **Run** or press `F5` to upload and execute the code on Pico2W.
8. Observe the output on the LED based on button inputs.

Uploading Code to Arduino Uno

1. Connect the Arduino Uno to your computer using a USB cable.
2. Open the **Arduino IDE** (download from `arduino.cc` if not installed).
3. Select the correct board and port:
   - Go to `Tools` → `Board` → **Arduino Uno**
   - Then `Tools` → `Port` → Select your device port
4. Write or paste your logic code (e.g., for NOR gate or expression implementation).
5. Click the **Upload** button (right arrow icon) or press `Ctrl+U`.
6. Wait for "Done uploading" message.
7. Test using push buttons and observe output on the LED.

GitHub Repository

`https://github.com/Alekyakuruba/fwc/tree/main/hardware`

Conclusion

Option **(A)** implements the given minimized logic expression $F = \overline{X}Y + YZ$ correctly. Truth table and hardware testing validate the circuit on both Raspberry Pi Pico2W and Arduino Uno.

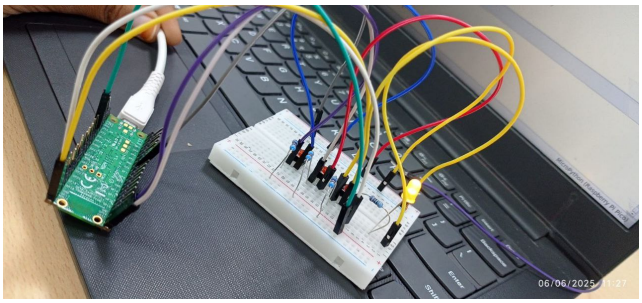


Figure: Logic Circuit Implememtation