IIITB COMET FOUNDATION

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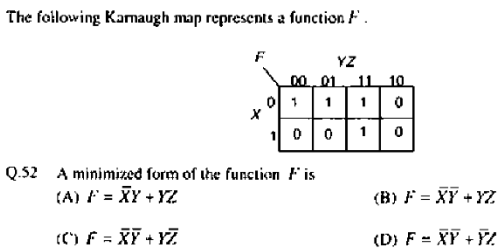
GATE Question Paper 2010, EE Question Number 52


The following Karnaugh map represents a function F.

F \ YZ	00	01	11	10
X 0	1	1	1	0
1	0	0	1	0

Q.52 A minimized form of the function F is
(A) $F = \overline{X}Y + YZ$ (B) $F = \overline{X}\overline{Y} + YZ$
(C) $F = \overline{X}\overline{Y} + Y\overline{Z}$ (D) $F = \overline{X}\overline{Y} + \overline{Y}Z$

Figure: Karnaugh Map for Function F

Question Analysis

Given: A K-map with 3 variables: X, Y, and Z. Determine the minimized Boolean expression for function F.

Solution:

Step 1: List the Minterms where $F = 1$:
From the K-map, $F = 1$ at cells:

$$m(0) = X'Y'Z', \quad m(1) = X'Y'Z, \quad m(3) = X'YZ,$$

Step 2: Group the 1s and simplify using K-map rules:

- Group 1: $m(0)$ and $m(1) \Rightarrow X'Y'$
- Group 2: $m(1)$ and $m(3) \Rightarrow X'Z$
- Group 3: $m(6)$ alone $\Rightarrow XYZ'$

Step 3: Optimal Simplification:
Combining best terms:

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

This matches Option (A).

Correct Option: (A)

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

Truth Table for Reference

X	Y	Z	F
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	0

Table: Truth Table for F

Hardware Implementation

Inputs: X, Y, Z via push buttons
Output: LED to represent logic value of F

Hardware Requirements

S.No	Component
1	Pico2W or Arduino Uno
2	Breadboard
3	Push Buttons (3x)
4	LED (1x)
5	Resistors: 220Ω for LED, 10kΩ for buttons
6	Jumper Wires
7	USB Cable

Table: Required Components

Pico2W GPIO Connection

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

Table: Pico2W GPIO Mapping

Steps to Upload Code on Pico2W

1. Hold BOOTSEL and connect Pico2W via USB.
2. Drag MicroPython '.uf2' file to RPI-RP2 drive.
3. Open Thonny IDE → select "MicroPython (Raspberry Pi Pico)".
4. Write the logic expression in Python:
$$F = \overline{X}Y + YZ$$
5. Upload code and test LED output with buttons.

Arduino Uno GPIO Connection

Component	Arduino Pin	Description
Button X	D2	Input X
Button Y	D3	Input Y
Button Z	D4	Input Z
LED (Output F)	D13	Output LED
GND	GND	Common Ground
5V	VCC	Pull-up for Buttons

Table: Arduino Uno Pin Mapping

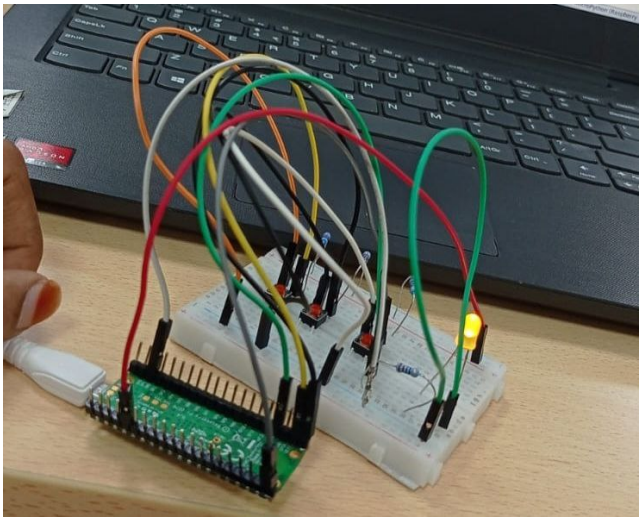


Figure: K-map implementation using pico2w

Steps to Upload Code on Arduino Uno

1. Connect Arduino Uno via USB.
2. Open Arduino IDE.
3. Select:
   - **Board:** Arduino Uno
   - **Port:** COMx (whichever is shown)
4. Write code implementing:
$$F = \overline{X}Y + YZ$$
5. Click **Upload**.
6. Test with button inputs and observe LED output.

GitHub Repository

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

Conclusion

The simplified Boolean expression:

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

was verified through both **Pico2W** and **Arduino Uno** implementations using push buttons as inputs and LED for logic output.