

## GATE Question Paper 2010, EE Question Number 52

### Question 12 Analysis

#### Question:

The following Karnaugh map represents a function F.

	00	01	11	10
0	1	1	1	0
1	0	0	1	0

A minimized form of the function F is

- (A)  $F = \bar{X}Y + YZ$     (B)  $F = \bar{X}\bar{Y} + YZ$     (C)  $F = \bar{X}\bar{Y} + Y\bar{Z}$     (D)  $F = \bar{X}\bar{Y} + \bar{Y}Z$

### Karnaugh Map Simplification Problem

**Given:** The following Karnaugh map represents a function F:

### Step-by-Step Solution

#### 1. Identify variables:

- Variables: X, Y, Z
- Columns in Gray code: 00, 01, 11, 10

#### 2. Extract minterms:

- 1s at: (0, 00), (0, 01), (0, 11), (1, 01)
- Minterms:

$$(0, 00) \rightarrow \bar{X}\bar{Y}\bar{Z}$$

$$(0, 01) \rightarrow \bar{X}\bar{Y}Z$$

$$(0, 11) \rightarrow \bar{X}YZ$$

$$(1, 01) \rightarrow X\bar{Y}Z$$

#### 3. Group minterms:

- Group 1:  $\bar{X}\bar{Y}$
- Group 2:  $\bar{X}YZ + X\bar{Y}Z = YZ$

#### 4. Final Expression:

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

### Correct Option:

Option (B):  $F = \bar{X}\bar{Y} + YZ$

### Implementation using the Arduino Board

### Abstract

This project implements the logic expression using Arduino Uno. Inputs are given via push buttons, and output shown on an LED.

### Hardware Requirements

S.No	Component
1	Arduino Uno Board
2	Breadboard
3	Push Buttons (X, Y, Z)
4	LED
5	Resistors: 220Ω, 10kΩ
6	Jumper Wires
7	USB Cable

Table 1: Hardware Components

## Pin Connections

Component	Arduino Pin
X	Digital 2
Y	Digital 3
Z	Digital 4
F (LED)	Digital 13
GND	GND
VCC	5V

Table 2: Pin Configuration

## Observations

X	Y	Z	F (LED)
0	0	0	1
0	0	1	1
0	1	1	1
1	0	1	1
1	1	0	0
1	1	1	1

Table 4: Truth Table

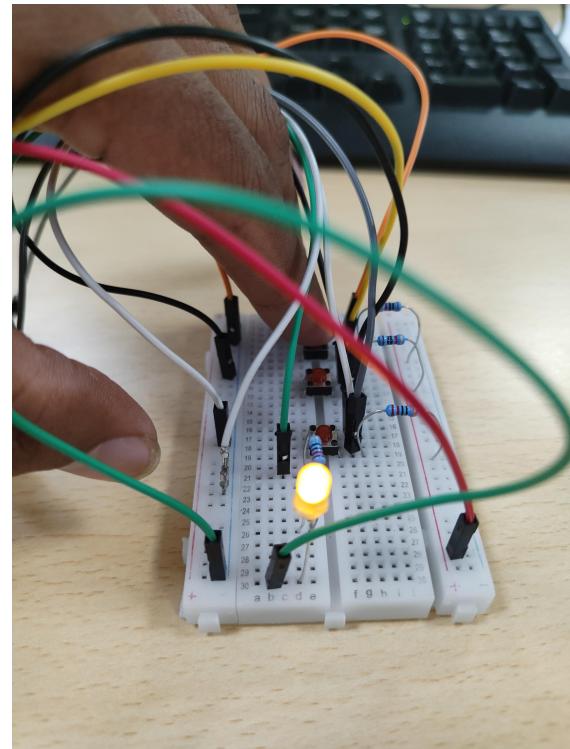
## Karnaugh Map Representation

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

Table 3: Karnaugh Map

## Upload Steps

1. Connect the Arduino board to your mobile using an OTG cable
2. Open the ArduinoDroid app on your mobile
3. Select the correct board and port settings
4. Write or paste the Arduino code in the app
5. Compile and upload the code directly from your mobile
6. Assemble the circuit as per the schematic
7. Test the LED output based on the input conditions



## Conclusion

Arduino-based logic verification confirms the function  $F = \overline{X}\overline{Y} + YZ$  with real-time input testing.

## Implementation using Pico W

### Abstract

This part replicates the same logic on Raspberry Pi Pico W using MicroPython via Thonny IDE.

## Hardware Requirements

S.No	Component
1	Raspberry Pi Pico W
2	Breadboard
3	Push Buttons (X, Y, Z)
4	LED
5	Resistors: $220\Omega$ , $10k\Omega$
6	Jumper Wires
7	Micro USB Cable

Table 1: Hardware Components

## Pin Connections

Component	Pico W Pin
X	GP14
Y	GP15
Z	GP16
F (LED)	GP13
GND	GND
VCC	3.3V

Table 2: GPIO Pin Config

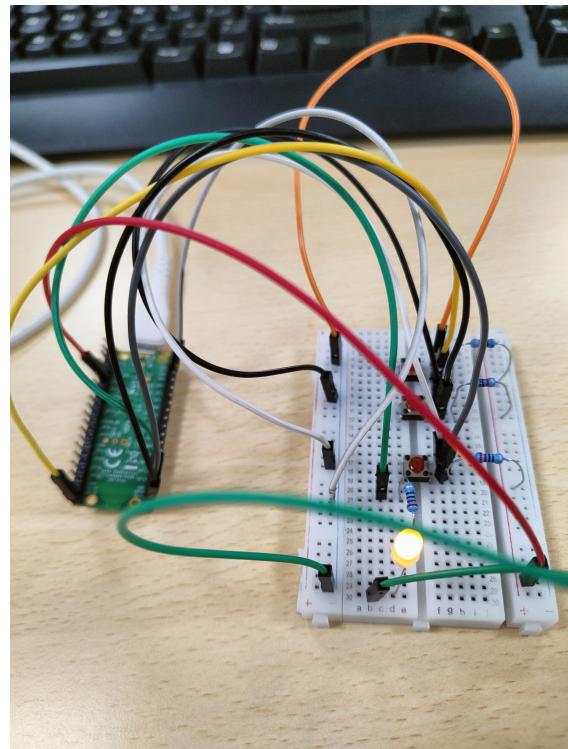
## Upload Steps

1. Connect the Raspberry Pi Pico W to your mobile using an OTG cable
2. Flash the MicroPython firmware (.uf2) by holding BOOTSEL and copying it to the RPI-RP2 drive
3. Open the MicroREPL app on your mobile
4. Connect to the Pico W via the MicroREPL serial interface
5. Write or paste the MicroPython code and run it directly from the app
6. Connect the hardware circuit as required
7. Test the output based on your program

## Observations

X	Y	Z	F (LED)
0	0	0	1
0	0	1	1
0	1	1	1
1	0	1	1
1	1	0	0
1	1	1	1

Table 4: Truth Table



## Conclusion

The logic function was successfully tested on Pico W using MicroPython and validated with real input/output.

**GitHub Repository:** [https://github.com/ashok-kumar-reddy-17/Ashok\\_FWC](https://github.com/ashok-kumar-reddy-17/Ashok_FWC)