VERIFICATION OF BOOLEAN IDENTITIES

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Contents

1 PROBLEM

(GATE CS-2019) Q.6 Which one the following is not a valid identity?

(A) $(x \oplus y) \oplus z = x \oplus (y \oplus z)$

(B) $(x + y) \oplus z = x \oplus (y + z)$

(C) $x \oplus y = x + y, if xy = 0$

(D) $x \oplus y = (xy + x'y')'$

2 COMPONENTS

Component	Value	Quantity
Arduino	UNO	1
Bread board	-	1
IC	7447	1
Jumper wires	M-M	20
SevenSegment Display	-	1
Resistor	150ohms	1

3 INTRODUCTION

An "identity" is merely a relationship that is always true, regardless of the values that any variables involved might take on; similar to laws or properties. Many of these can be analogous to normal multiplication and addition, particularly when the symbols 0,1 are used for FALSE, TRUE.

4 TRUTH TABLE

The Truth Table for the above identities is ass follows:

(A) $(x \oplus y) \oplus z = x \oplus (y \oplus z)$
where $Y1 = (x \oplus y) \oplus z, Y2 = x \oplus (y \oplus z)$

x	y	z	Y1	Y2	Y1==Y2
0	0	0	0	0	1
0	0	1	1	1	1
0	1	0	1	1	1
0	1	1	0	0	1
1	0	0	1	1	1
1	0	1	0	0	1
1	1	0	0	0	1
1	1	1	1	1	1

Table 1

(B) $(x + y) \oplus z = x \oplus (y + z)$
where $Y1 = (x + y) \oplus z, Y2 = x \oplus (y + z)$

x	y	z	Y1	Y2	Y1==Y2
0	0	0	0	0	1
0	0	1	1	1	1
0	1	0	1	1	1
0	1	1	0	1	0
1	0	0	1	1	1
1	0	1	0	0	1
1	1	0	1	0	0
1	1	1	0	0	1

Table 2

(C) $x \oplus y = x + y, if xy = 0$
where $Y1 = x \oplus y = x + y, if xy = 0$

x	y	Y1	Y2	Y1==Y2
0	0	0	0	1
0	1	1	1	1
1	0	1	1	1

Table 3

(D) $x \oplus y = (xy + x'y')'$
where $(xy + x'y')' = (x' + y')(x + y)$
$= x \oplus y$
The Truth Table for $x \oplus y$ is as follows:

x	y	$x \oplus y$
0	0	0
0	1	1
1	0	1
1	1	0

Table 4

Here, Except **(B)** identity all other identies are valid according to the mentioned truth tables.

5 ARDUINO CONNECTIONS

1) The connections between IC 7447 and Seven Segment Display are as follows:

7447	$\bar{a}$	$\bar{b}$	$\bar{c}$	$\bar{d}$	$\bar{e}$	$\bar{f}$	$\bar{g}$
DISPLAY	a	b	c	d	e	f	g

Table 5

2) The connections between IC 7447 and Arduino are as fllows:

IC7447	A
ARDUINO	2

Table 6

3) The inputs **x,y,z** here are connected to Arduino D5,D6,D7 pins.

4) The values for these inputs are conncted either to GND or 5V according to the truth table.

6 CODE

The arduino code can be downloaded from the below link.

https://github.com/madhu-addanki/FWC/tree/main/ide