CHECKING THE BELOW EQUATIONS IF THEY ARE TRUE USING FPGA(VAMAN)

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1 Problem

(GATE2019-QP-CS)
Q.6. Which one of the following is NOT a valid identity?

1. $(x \oplus y) \oplus z = x \oplus (y \oplus z)$
2. $(x + y) \oplus z = x \oplus (y + z)$
3. $x \oplus y = x + y$,if $xy = 0$
4. $x \oplus y = (xy + x'y')'$

2 Introduction

The above question can be answered by evaluating the expressions using the digital logic identities and properties,the following cases are evaluated using digital logics and properties:

1. $(x \oplus y) \oplus z = x \oplus (y \oplus z)$
   Explanation:This option follows associative property of XOR,so this is TRUE for every value of x,y and z.
2. $(x + y) \oplus z = x \oplus (y + z)$
   Explanation:This is not a TRUE identity because this identity is not applicable for every value of x,y and z.
3. $x \oplus y = x + y$,if $xy = 0$
   Explanation:As $x \oplus y = (x'y + xy')$,so if x or y is considered to be 0 and after substituting in the equation it results in $x + y$.
   Example: Let us consider $x = 0$ and $y = 1$,so for this case
   $x \oplus y = (0)'1 + 0(1)' = (1)1 + 0(0) = 1 + 0 = 1$.(since (0)'=1,(1)'=0)
   $x + y = 1 + 0 = 1$
   Hence proved that this a TRUE identity.The same can be proved for the rest three cases.
4. $x \oplus y = (xy + x'y')'$
   Explanation:As $(xy + x'y') = (x \odot y)$ and the complement of $(x \odot y)' = (x \oplus y)$.
   So,this is TRUE for all cases of x and y.

3 Components

Components	**Value**	**Quantity**
Breadboard		1
Resistor	$\geq 220\Omega$	1
Vaman	pygmy	1
Seven Segment Display	Common Anode	1
Decoder	7447	1
Flip Flop	7474	2
Jumper Wires		20

Table 1: Components

3.1 Vaman

The Vaman (pygmy) has some ground pins, digital pins that can be used for both input as well as output.It also has two power pins that can generate 3.3V. In the following exercises, we use digital pins,GND and 5V .

3.2 Seven Segment Display

The seven segment display has eight pins, *a,b,c,d,e,f,g* and *dot* that take an active LOW input,i.e. the LED will glow only if the input is connected to ground.Each of these pins is connected to an LED segment.The *dot* pin is reserved for the LED.

4 Implementation

The above problem can be implemented using vaman and led's by connecting both of them as mentioned below:

```
// Note: Quickfeather uses the QFN package so the format is: set <signal name> <QFN pin #>
set_io X                64
set_io Y                62
set_io Z                63

set_io optiona          59
set_io optionb          57
set_io optionc          56
set_io optiond          55
```

5 Software

To implement the above code using arm the following code can be used to implement:

```
module helloworldfpga(
    input wire X,
    input wire Y,
    input wire Z,

    output wire optiona,
    output wire optionb,
    output wire optionc,
    output wire optiond
    );

    always @(*)
    begin
        optiona = (((X^Y)^Z)==(X^(Y^Z)));
        optionb = (((X|Y)^Z)==(X^(Y|Z)));
        optionc = ((X^Y)==(X|Y));
        optiond = ((X^Y)==(~((X&Y)|((~X)&(~Y)))));
    end
endmodule
```