

Implementation of Boolean Logic in ESP32

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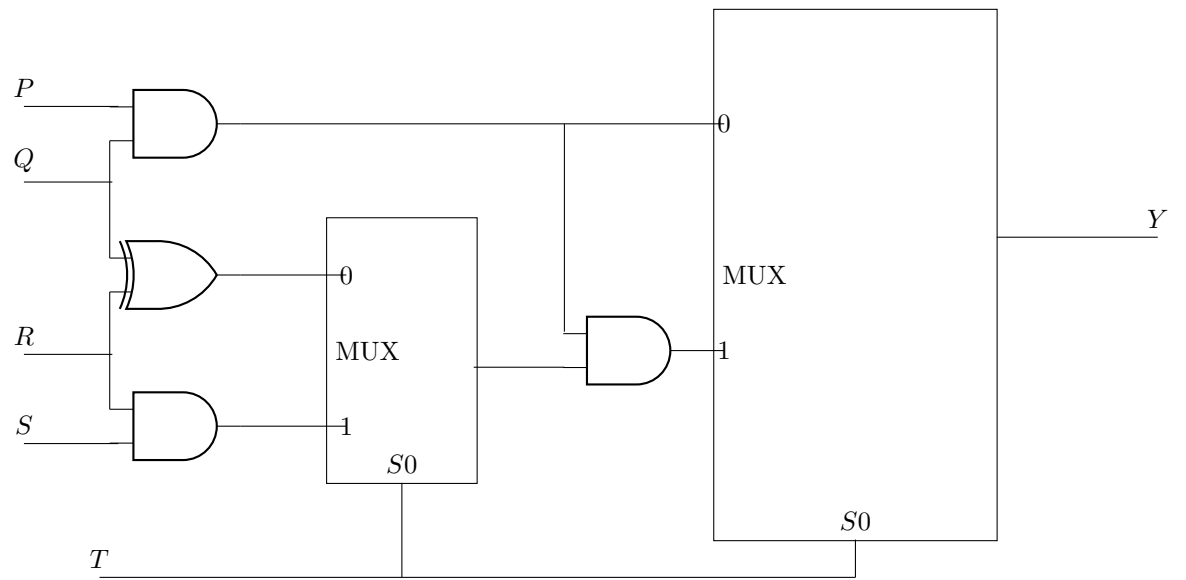
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1 Problem

(Gate EC-2021)

Q.31. The propagation delays of the XOR gate, AND gate and multiplexer (MUX) in the circuit shown in the figure are 4 ns, 2 ns and 1 ns, respectively.



If all the inputs P, Q, R, S and T are applied simultaneously and held constant, the maximum propagation delay of the circuit is

1. 3 ns
2. 5 ns
3. 6 ns
4. 7 ns

2 Introduction

In the given circuit, the output of first multiplexer can be considered as the input to the second multiplexer so that the second multiplexer output can be verified using an led with the inputs being P, Q, R, S, T and output being Y.

3 Components

Table 1: Table1
COMPONENTS

Component	Value	Quantity
UART		1
Vaman	esp32	1
Jumper Wires	M-M	20
Breadboard		1

4 Hardware

Make the connections in Arduino by giving the inputs P,Q,R,S,T to observe the output Y which is verified using led.

5 Software

1. In the truth table in Table4, P,Q,R,S,T are the inputs and Y is the output.

Table 2: Table4

Truth Table					
P	Q	R	S	T	Y
x	x	0	x	x	0
x	x	x	0	x	0
0	0	x	x	1	0
x	x	1	1	0	1
1	1	1	1	x	1

2. The k map for this truth table will be a five variable k map. So, two k maps can be drawn with one map having one input variable as zero and the other k map having that input variable as one as shown below.

		ST						ST			
		00	01	11	10			00	01	11	10
QR	00	0	0	0	0			0	0	0	0
	01	0	0	0	1			0	0	0	1
	11	0	0	0	1			0	0	1	1
	10	0	0	0	0			0	0	0	0
		$P=0$						$P=1$			

3. Since, the output of the mux is either 0 or 1, this output of mux i.e, Y can be verified using led.
4. The boolean expression for the output (Y) of the second mux with the inputs (P,Q,R,S,T) will be simplified as 1

$$Y = RS(T' + PQ) \quad (1)$$

5. The code below realizes the Boolean logic for A with y being the input to A.

```
//Declaring and initializing all variables as integers

int P,Q,R,S,T,Y;

//the setup function runs once when you press reset or
power the board

void setup(){
pinMode(12,INPUT);
pinMode(13,INPUT);
pinMode(14,INPUT);
pinMode(15,INPUT);
pinMode(16,INPUT);
pinMode(17,OUTPUT);
}

//the loop function runs over and over again forever

void loop(){
P=digitalRead(12);
Q=digitalRead(13);
R=digitalRead(14);
S=digitalRead(15);
T=digitalRead(16);
Y=(!T&&P&&Q)||(P&&Q&&R&&S&&T);
digitalWrite(17,Y);
}
```

6. Execute the above code and compare the results of output theoretically and practically.