

EC2018₄₆(*FINDING AVERAGE VOLTAGE*)

CHELIMI NANDINI (FWC22160)

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1 PROBLEM

(GATE EC-2018) Q.46 In the circuit shown below, a positive edge-triggered D flip-flop is used for sampling input data D_{in} using clock CK. The XOR gate outputs 3.3 volts for logic HIGH and 0 volts for logic LOW levels. The data bit and clock periods are equal and the value of $\Delta T/T_{ck} = 0.15$, where the parameters ΔT and T_{ck} are shown in the figure. Assume that the Flip and the XOR gate are ideal.

2 COMPONENTS

Component	Value	Quantity
Arduino	UNO	1
Bread board	-	1
IC	7474	1
Jumper wires	M-M	20
LCD	16X2	1
Resistor	1000ohms	2
Led	-	2

3 INTRODUCTION

Determining the average voltage at node X in a circuit that includes a positive edge-triggered D flip-flop and

an XOR gate. The given parameters include the probability of input data bit (D_{in}) transitions, the characteristics of the XOR gate, and the relationship between clock and data periods. The XOR gate outputs 3.3 volts for logic HIGH and 0 volts for logic LOW Level.

Expression : $X = D_{in} \oplus Q$

4 TRUTH TABLE

Here truth table for output XOR

time	D_{in}	Q	X
t1	1	0	1
t2	1	1	0
t3	0	1	1
t4	0	0	0
t5	1	0	1

Table 1:

5 CALCULATIONS

Solution: if the probability of input data bit (D_{in}) transition in each clock period is 0.3. $V_{avg} = 0.85 * V_{high} * P_{high} + 0.15 * V_{low} * P_{low}$
 $V_{avg} = 0.85 * 3.3 * 0.3 + 0.15 * 0 * 0.7$ $V_{avg} = 0.8415$

6 ARDUINO CONNECTIONS

step1: Connect the 5V pin of the Arduino to an extreme pin of the Breadboard. Let this pin be V cc .

step2: Connect the GND pin of the Arduino to the opposite extreme pin of the Breadboard. Let this pin be Ground.

step3: Connect Arduino pins to 7474 IC (D Flipflop)

Step4: We have to change D_{in} manually from 0 (GND) to 1 (VCC) using Jumpwires. Initially

IC7474	ARDUINO
pin1	vcc
pin2(din)	pin3
pin3(clk)	pin4
pin4	vcc
pin5(out)	pin5
pin7	GND
pin14	vcc

Table 2:

Dflipflop output consider as 0.

To see Dflipflop output we have to connect LED.LED(-ve to GND through 1kohm).7474 pin5 to LED(+ve).

Step5: Then D_{in} and Dflipflop as input to Xor Output.Ouput can see through the LED(-ve to GND through 1kohms resistor).Arduino Pin6 LED(+ve).

step6: Connect LCD to Arduino

LCD	ARDUINO
pin1(Vss)	GND
pin2(Vcc)	Vcc
pin3(VEE)	220ohms(GND)
pin4(RS)	pin8
pin5(RW)	GND
pin6(En)	pin9
pin11(D4)	pin10
pin12(D5)	pin11
pin13(D6)	pin12
pin14(D7)	pin13
pin15(LED)	Vcc
pin16(LED)	GND

Table 3:

7 CODE

The arduino code can be downloaded from the below link.

8 RESULT

According to the Probability Average Voltage will be displayed in LCD.