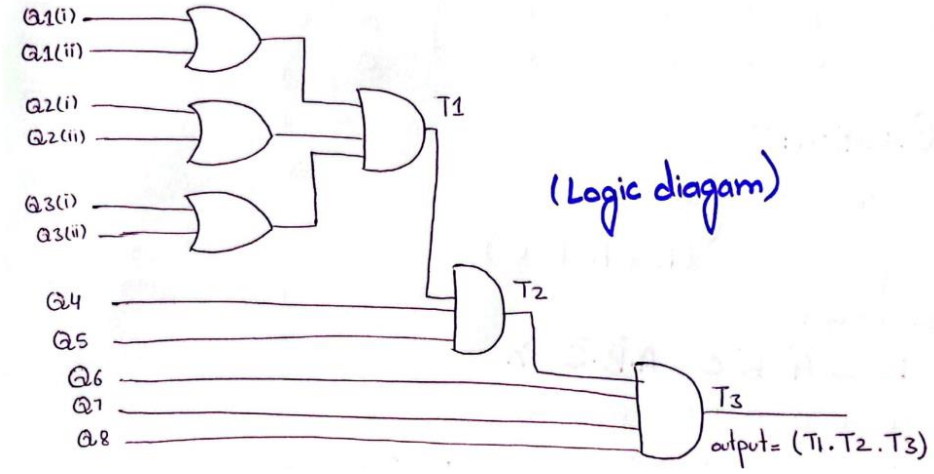
Class Participation # 6
Solution Manual

Question 1:

FAST-NUCES is announcing a scholarship program for the students of engineering and computer science. For this purpose three different modular exams would be taken.
If any student wants to get this scholarship he/she should pass all three exams. In the first exam there are three questions and each question has two parts. If any one part is correct that question would be considered correct. If all three questions are correct then that exam would be considered PASSED.
Now after the passing of first exam, he/she would be allowed for the second exam. There are two questions in the second exam. If both the answers are correct then only the exam would be considered PASSED.
Now after passing of second exam, he/she would be allowed for the third exam. There are three questions in this exam. All correct answers are required to pass that exam, and then he/she can get the scholarship.
Design a logical circuit for the above scenario

Solution:



Question 2:

An electronic system will only operate if three switches P, S and T are correctly set. An output
signal (X = 1) will occur if R and S are both in the ON position or if R is in the OFF position and S and T are both in the ON position. Design a logic circuit and write the Logic notation to represent the above situation and draw the truth table?

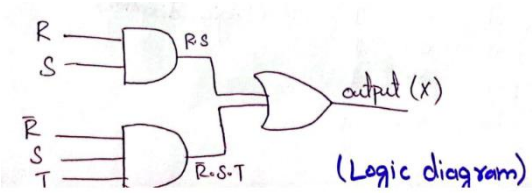
Solution:

Logic Notation:
We can represent the conditions using the following logic notation:

- R and S are both in the ON position: RS
- R is in the OFF position and S and T are both in the ON position: R'ST

Truth Table:

P	S	T	RS	R'ST
0	0	0	0	0
0	0	1	0	0
0	1	0	0	0
0	1	1	1	1
1	0	0	0	0
1	0	1	0	0
1	1	0	1	1
1	1	1	1	1



Question 3:

A traffic c light system uses logic gates as part of the control system. The system is operated when the output D has the value 1. This happens when: either (a) signal A is red or (b) signal A is green and signals B and C are both red (NOTE: You may assume for this problem that red = 0 and green = 1). Design a logic circuit and write the Logic notation to represent the above situation and draw the truth table

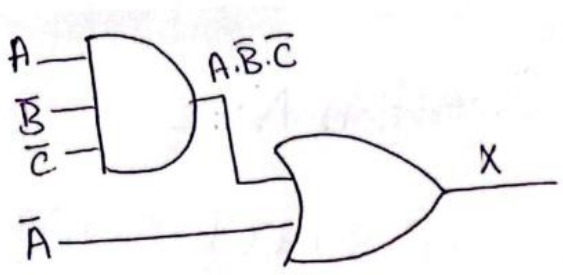
Solution:

- Signal A is red = A'
- Signal A is green and B,C are red = A.B'.C'

Equation becomes:

D = A' + (A.B'.C')

P	S	T	D = A' + (A.B'.C')
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	0



Question 4:

Description:

An alert will be displayed when certain conditions occur in a nuclear reactor.

Conditions:

The output, X, of a logic circuit that drives the display of the alert must have a value of 1 when either one of the conditions is met:

- carbon dioxide pressure too low and temperature > 300°C
- water pressure > 10 bar and temperature > 300°C

Inputs (inputs can be increased or reduced based on the scenario):

The inputs to the system are:

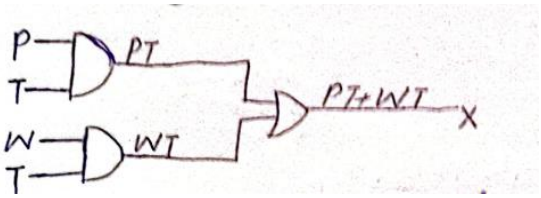
Input	Binary	Condition
P	0	carbon dioxide pressure acceptable
	1	carbon dioxide pressure too low
T	0	temperature <=300°C
	1	temperature >300°C
W	0	water pressure <= 10 bar
	1	water pressure > 10 bar

Solution:

Condition	Logic Gate Representation
Carbon dioxide pressure too low and temperature > 300°C	(P=1 AND T=1)
Water pressure > 10 bar and temperature > 300°C	(W=1 AND T=1)

F = P.T + W.T

P	T	W	F
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1



Question 5:

Comparison of 2-bit binary number?

Solution:

Inputs				Outputs		
A1	A0	B1	B0	A<B	A=B	A>B
0	0	0	0	0	1	0
0	0	0	1	1	0	0
0	0	1	0	1	0	0
0	0	1	1	1	0	0
0	1	0	0	0	0	1
0	1	0	1	0	1	0
0	1	1	0	1	0	0
0	1	1	1	1	0	0
1	0	0	0	0	0	1
1	0	0	1	0	0	1
1	0	1	0	0	1	0
1	0	1	1	1	0	0
1	1	0	0	0	0	1
1	1	0	1	0	0	1
1	1	1	0	0	0	1
1	1	1	1	0	1	0

Question 6:

A nuclear power station has a safety system based on three inputs to a logic circuit (network). A warning signal (S=1) is produced when certain conditions in the nuclear power station occur based on these three inputs.

Inputs	Binary values	Description of plant status
T	1	Temperature > 115°C
	0	Temperature <= 115°C
P	1	Reactor pressure > 15 bar
	0	Reactor pressure <= 15 bar
W	1	Cooling water > 120 litres/hour
	0	Cooling water <= 120 litres/ hour

A warning signal (S = 1) will be produced when any of the following occurs:

a) Temperature > 115°C and Cooling water <= 120 liters/ hour

OR

b) Temperature <= 115°C and Reactor pressure > 15 bar

OR

c) Cooling water <= 120 liters/hour

Draw a logic circuit (network) and truth table to show all the possible situations when the warning signal (S) could be received.

Solution:

A)

The stop signal will excute when following conditions will happen:

Â (a) Temperature > 115°C and Cooling water <= 120 litres/hour

or

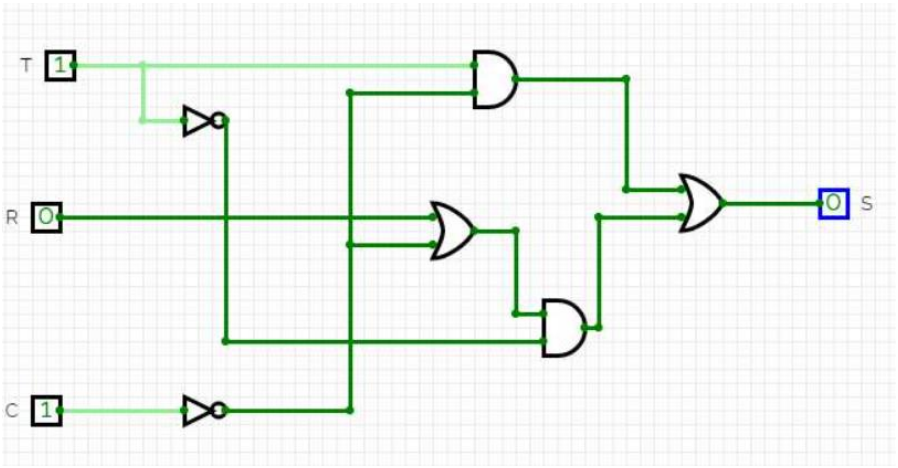
(b) Temperature <= 115°C and Reactor pressure > 15 bar or Cooling water <= 120 litres/hour

The S=1 when

1. T=1 and C=0
2. T=0 and P=1 or C=0

The following variables can be write into boolean expression as:

$$S = T.\overline{C} + \overline{T}.(R + \overline{C})$$



B.) Truth Table of above design is:

T	R	C	S
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

The following table helps us to understand the Reactor warning signal execution