Name: **SOLUTION_HS**

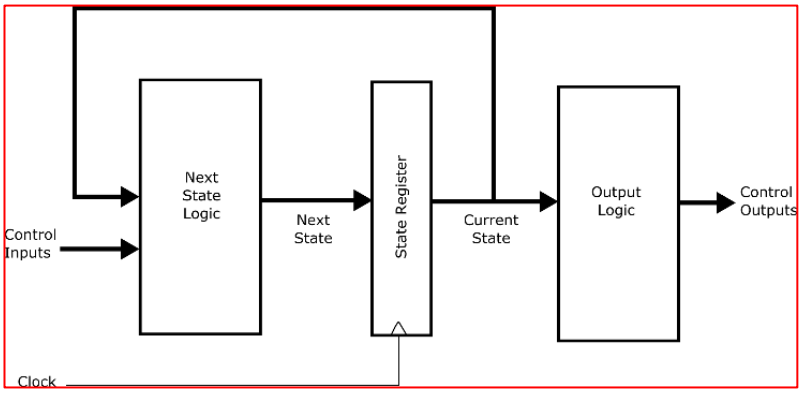
Total Marks : 20
Time : 40 Minutes

QM no. | | | | | | | | | | BUPT no. | | | | | | | | | |

Answer ALL the following questions

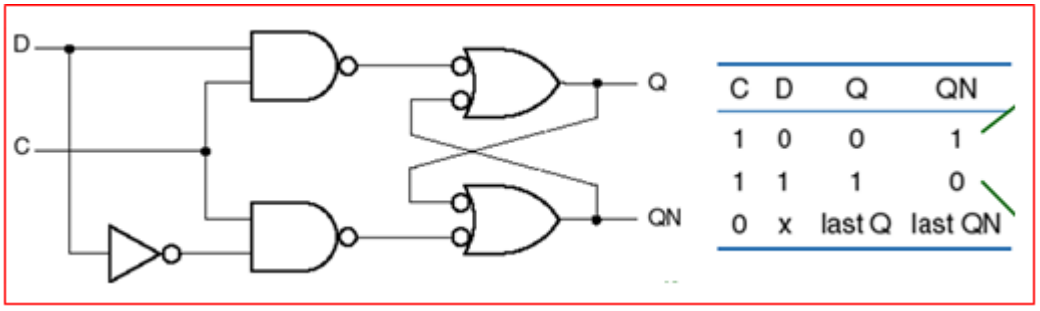
1. (a) Briefly explain the term 'Mealy State Machine'. **[2 marks]**

In a Mealy machine the output depends on both its input & current state. **[1 mark]**



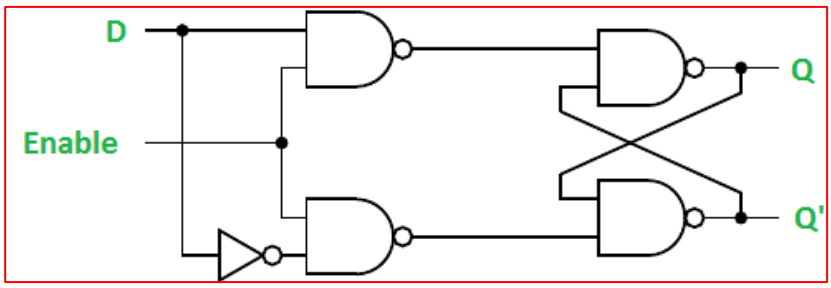
[1mark]

(b) Draw the gate logic diagram of a D Latch with control input and provide its Function Table. **[4 marks]**



C	D	Q	QN
1	0	0	1
1	1	1	0
0	x	last Q	last QN

OR (both are correct)



2 marks for diagram and 2 marks for Function Table

(c) What is the Characteristic Equation of a S-R latch to find the next Q? **[1 marks]**

$Q^* = S + R'Q$ **[1 mark]**

2. Design an autonomous **2-bit** binary up counter by using JK bistables. Minimise the logic circuit and draw the circuit diagram. The transition table of JK Flip-Flop is given in Figure 1 below. **[6 marks]**

J	K	CLK	Q	QN
x	x	0	last Q	last QN
x	x	1	last Q	last QN
0	0	↓	last Q	last QN
0	1	↓	0	1
1	0	↓	1	0
1	1	↓	last QN	last Q

Figure 1: Transition Table for Edge Triggered JK Flip-Flop

Present St		**Next State**		**JK inputs**	
Q_A	Q_B	Q_A^*	Q_B^*	J_AK_A	J_BK_B
0	0	0	1	0x	1x
0	1	1	0	1x	x1
1	0	1	1	x0	1x
1	1	0	0	x1	x1

K-Mp	Q_A	
Q_B	**0**	**1**
0	0	X
1	1	X

$J_A = Q_B$

K-Mp	Q_A	
Q_B	**0**	**1**
0	X	0
1	X	1

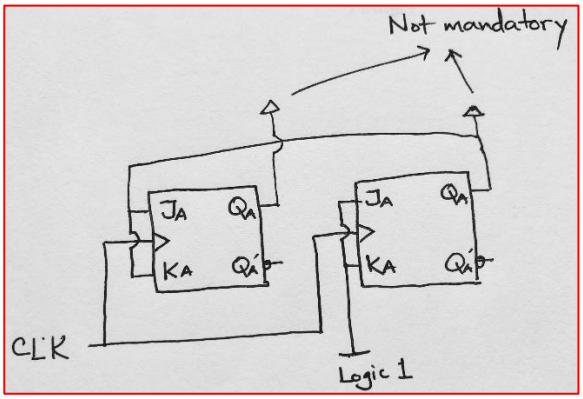
$K_A = Q_B$

K-Mp	Q_A	
Q_B	**0**	**1**
0	1	1
1	X	X

$J_B = 1$

K-Mp	Q_A	
Q_B	**0**	**1**
0	X	X
1	1	1

$K_B = 1$



[1 mark each for transition table, K-maps and circuit diagram]

3. Figure 2 represents a finite state machine designed by two flip-flops that are controlled by the same clock signal (CLK). Derive the necessary equations, construct the State/Output table and draw a state diagram for the circuit. **[7 marks]**

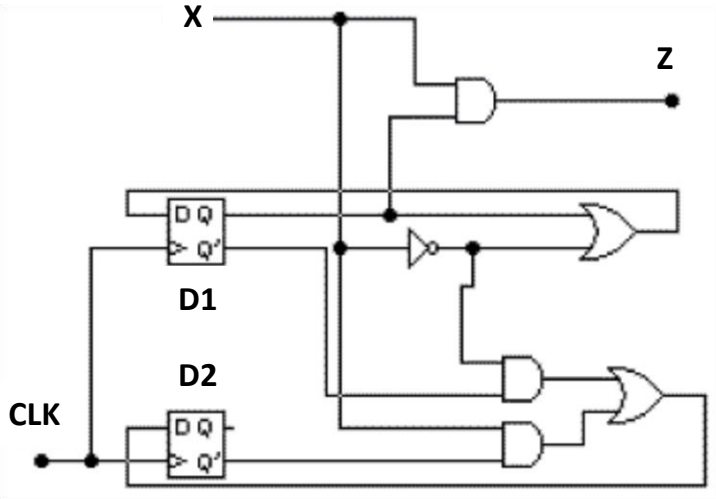


Figure 2

Input Eqn: D1 = X' + Q1

D2 = X * Q2' + X' * Q1' **[1 mark]**

Output Eq: Z = X * Q1 **[1 mark]**

Next State: Q1* = D1 = X' + Q1

Q2* = D2 = X * Q2' + X' * Q1' **[1 mark]**

Transition Table with output:

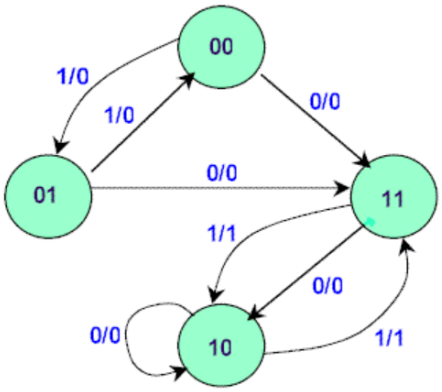
Present State	Next State		Output	
Q1Q2	X= 0	X=1	X=0	X=1
00	11	01	0	0
01	11	00	0	0
10	10	11	0	1
11	10	10	0	1

[2 mark]

State Table with O/P:

Present State	Next State	
Q1Q2	X= 0	X=1
M	P,0	N,0
N	P,0	M,0
O	O,0	P,1
P	O,0	O,1

[1 mark]



[1 mark]