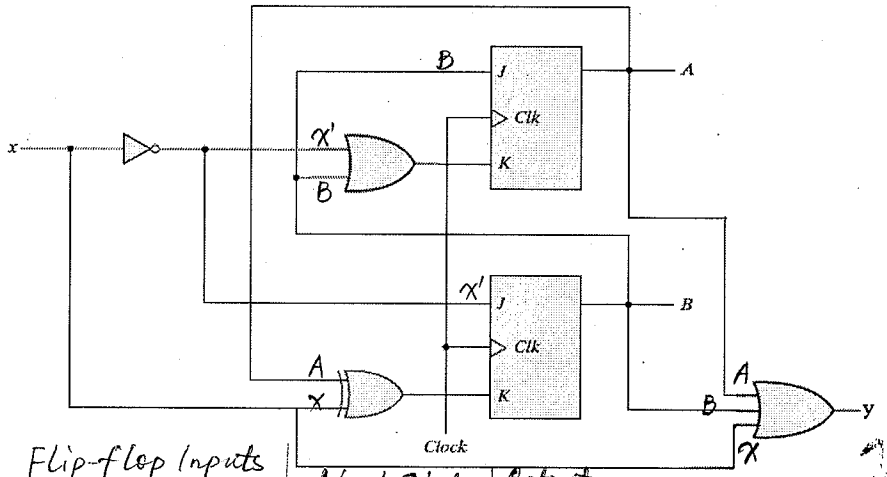
EECE256 Quiz 3 – section 101

1. Derive the state table, including (flip-flop input equations) excitation equations (4 marks), and state diagram (3 marks) for the following circuit. Is the circuit a Mealy circuit or a Moore? (1 mark)

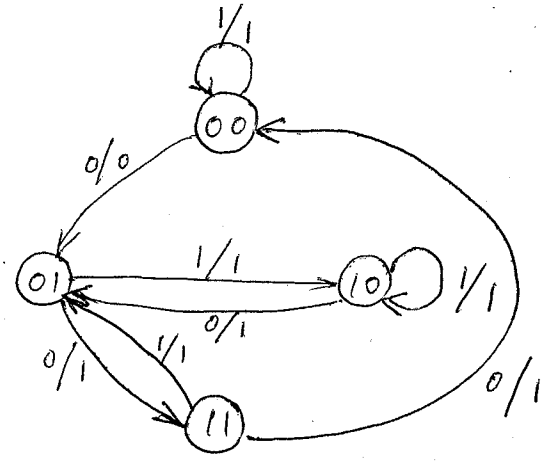


Flip-Flop Characteristic Table

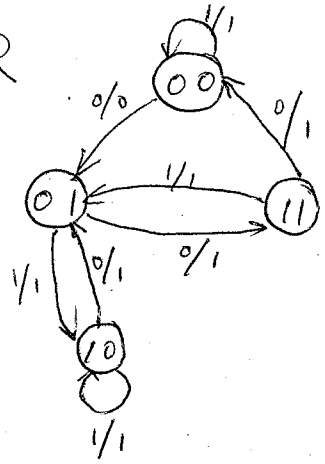
J K	Q(t+1)	
0 0	Q(t)	No change
0 1	0	Reset
1 0	1	Set
1 1	Q'(t)	Complement

$J_A = B$
$K_A = B + x'$
$J_B = x'$
$K_B = A \oplus x$

Present State A	B	Input x	Flip-flop Inputs J_A	K_A	J_B	K_B	Next State A	B	Output y
0	0	0	0	1	1	0	0	1	0
0	0	1	0	0	0	1	0	0	1
0	1	0	1	1	1	0	1	1	1
0	1	1	1	1	0	1	1	0	1
1	0	0	0	1	1	1	0	1	1
1	0	1	0	0	0	0	1	0	1
1	1	0	1	1	1	1	0	0	1
1	1	1	1	1	0	0	0	1	1

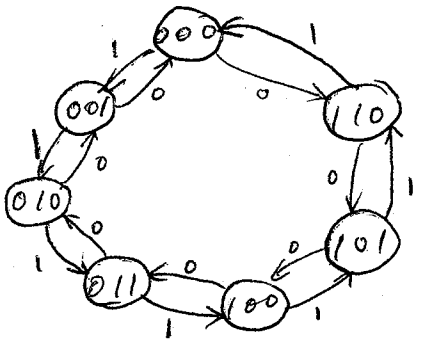


OR



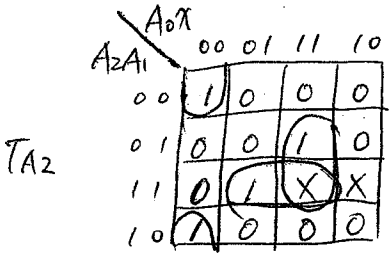
Mealy circuit.
(Since output y is a function of both the present state and the input)

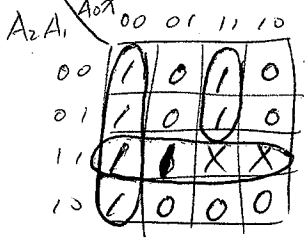
2. Design an up-down binary counter that counts from 0-6 using T flip-flops. Show your state diagram (3 marks), state table (4 marks), and karnaugh maps (3 marks).

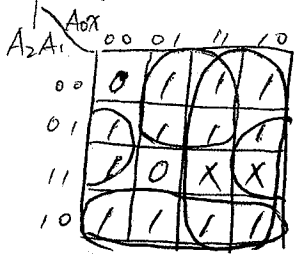


Present state $A_2\ A_1\ A_0$	Input x	Next state $A_2\ A_1\ A_0$	Flip-Flop Inputs $T_{A_2}\ T_{A_1}\ T_{A_0}$
0 0 0	0	1 1 0	1 1 0
0 0 0	1	0 0 1	0 0 1
0 0 1	0	0 0 0	0 0 1
0 0 1	1	0 1 0	0 1 1
0 1 0	0	0 0 1	0 1 1
0 1 0	1	0 1 1	0 0 1
0 1 1	0	0 1 0	0 0 1
0 1 1	1	1 0 0	1 1 1
1 0 0	0	0 1 1	1 1 1
1 0 0	1	1 0 1	0 0 1
1 0 1	0	1 0 0	0 0 1
1 0 1	1	1 1 0	0 0 1
1 1 0	0	1 0 1	0 1 1
1 1 0	1	0 0 0	1 1 0
1 1 1	0	X X X	X X X
1 1 1	1	X X X	X X X

$Q(t)$	$Q(t+1)$	T
0	0	0
0	1	1
1	0	1
1	1	0

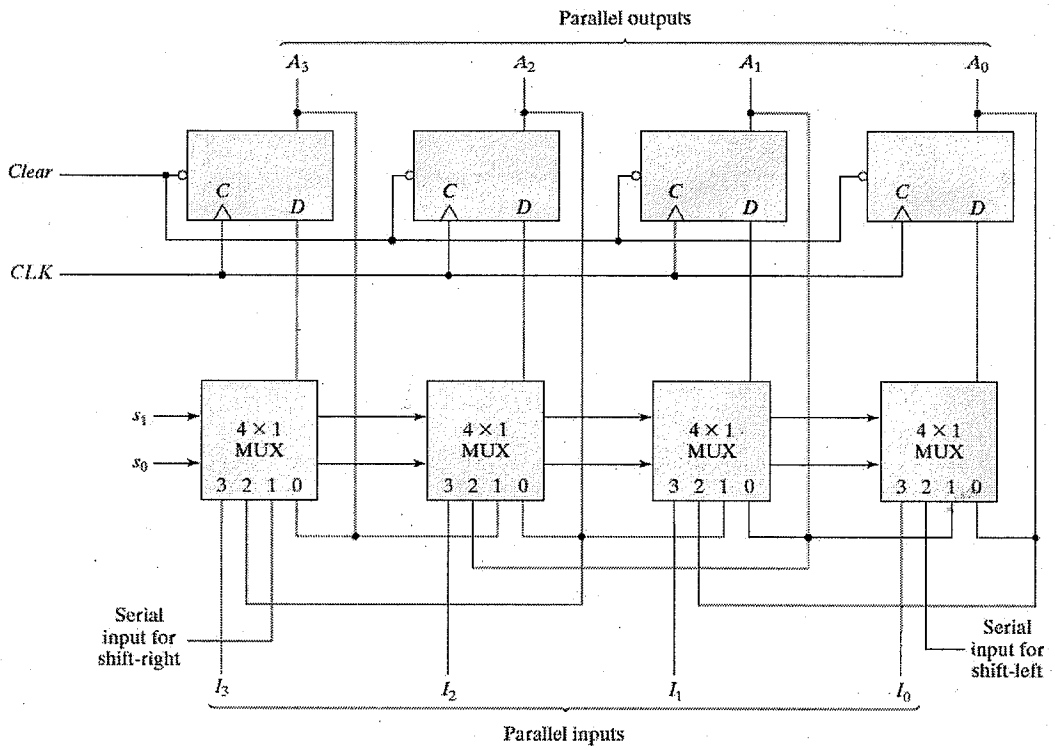






$T_{A_2} = A_1'A_0'x' + A_2A_1x + A_1A_0x.$ $T_{A_1} = A_0'x' + A_2A_1 + A_2'A_0x.$ $T_{A_0} = A_2A_1' + A_0 + A_1x' + A_2'x$

3. Specify the next value in the register shown below based on the following sequence of inputs. The 'next' value becomes the 'current' value on the following line. Assume a starting 'current' value of 0001 (already specified in the chart). MSB is the serial input for shift right, while LSB is the input for shift left. (4 marks)



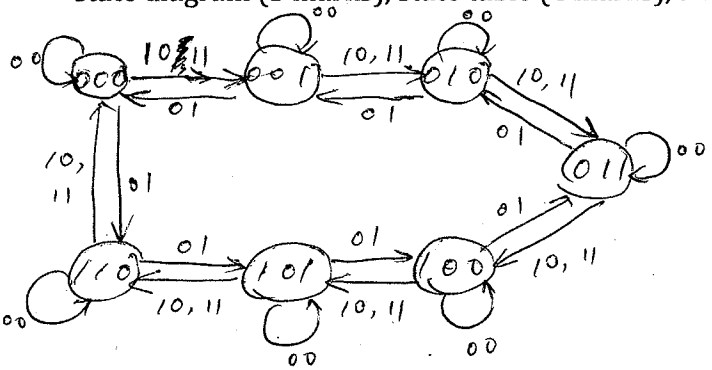
S	Clear	I	MSB	LSB	Current	Next
01	1	0101	1	1	0001	1000
11	0	0101	1	0	1000	0000
11	1	1010	0	1	0000	1010
10	1	0100	1	0	1010	0100
10	1	1010	0	1	0100	1001
01	1	0001	0	0	1001	0100

What are the five operations of this universal shift register? (2 marks)

Clear (Mode control)S

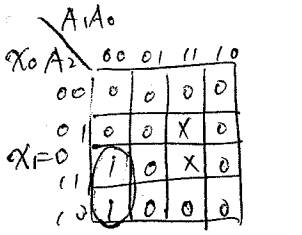
1	01	shift right
1	10	shift left
1	11	parallel load
1	00	No change
0	XX	clear the register to all 0's

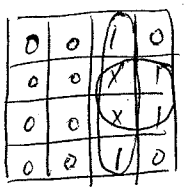
2. Design an up-down binary counter that counts from 0-6 using T flip-flops. Show your state diagram (3 marks), state table (4 marks), and karnaugh maps (3 marks).



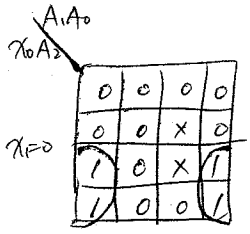
Q(t)	Q(t+1)	T
0	0	0
0	1	1
1	0	1
1	1	0

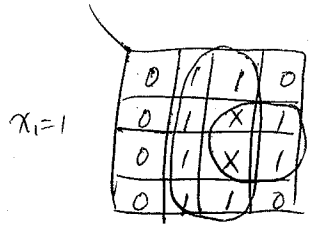
Input Up/down	Present state			Next state			Flip-flop Inputs		
X_1	X_0	A_2	A_1	A_0	A_2	A_1	A_0	TA_2	TA_1	TA_0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	1	0	0	1	0	0	0
0	0	0	1	0	0	1	0	0	0	0
0	0	0	1	1	0	1	1	0	0	0
0	0	1	0	0	1	0	0	0	0	0
0	0	1	0	1	1	0	1	0	0	0
0	0	1	1	0	1	1	0	0	0	0
0	0	1	1	1	X	X	X	X	X	X
0	1	0	0	0	1	1	0	1	1	0
0	1	0	0	1	0	0	0	0	0	1
0	1	0	1	0	0	0	1	0	1	1
0	1	0	1	1	0	1	0	0	0	1
0	1	1	0	0	0	1	1	1	1	1
0	1	1	0	1	0	1	0	1	1	0
0	1	1	1	0	0	1	1	1	0	1
0	1	1	1	1	X	X	X	X	X	X
1	0	0	0	0	0	0	1	0	0	1
1	0	0	0	1	0	1	0	0	1	1
1	0	0	1	0	0	1	1	0	0	1
1	0	0	1	1	1	0	0	1	1	1
1	0	1	0	0	1	0	1	0	0	1
1	0	1	0	1	1	1	0	0	1	1
1	0	1	1	0	1	1	1	0	0	1
1	0	1	1	1	X	X	X	X	X	X
1	1	0	0	0	0	0	1	0	0	1
1	1	0	0	1	0	1	0	0	1	1
1	1	0	1	0	0	1	1	0	0	1
1	1	0	1	1	1	0	0	1	1	1
1	1	1	0	0	1	0	1	0	0	1
1	1	1	0	1	1	1	0	0	1	1
1	1	1	1	0	1	1	1	0	0	1
1	1	1	1	1	X	X	X	X	X	X



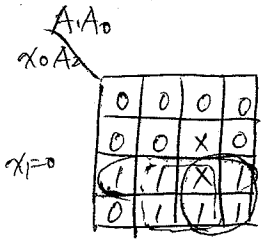


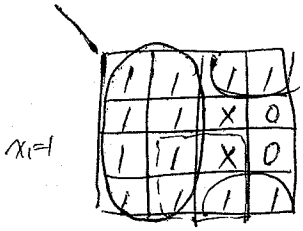
$$TA_2 = X_1' X_0 A_1' A_0' + X_1 A_1 A_0 + X_1 A_2 A_1$$





$$TA_1 = X_1' X_0 A_0' + X_1 A_0 + X_1 A_2 A_1$$





$$TA_0 = X_1' X_0 A_2 + X_1' X_0 A_1 + X_0 A_0 + X_1 A_1' + X_1 A_2' A_1$$