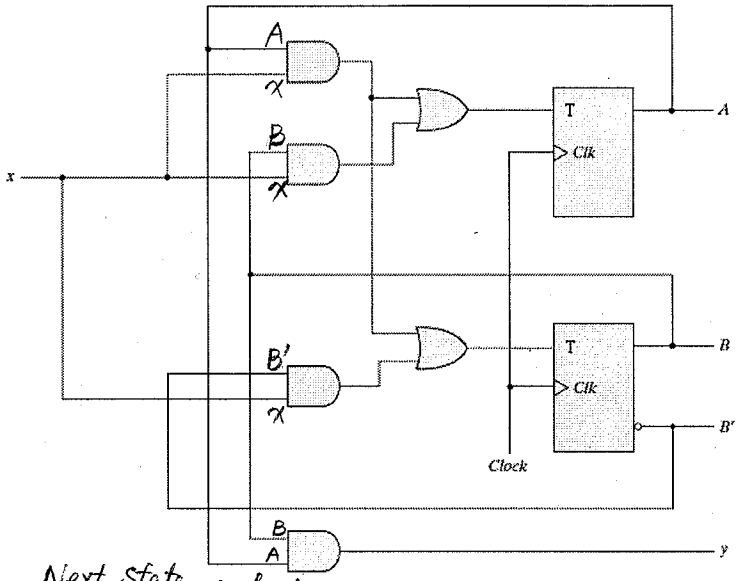
EECE256 Quiz 3 – section 102

1. Derive the state table, including 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

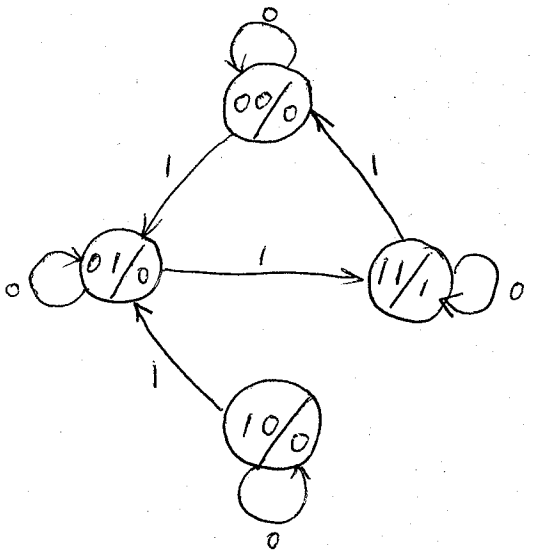
T	Q(t+1)
0	Q(t) No change
1	Q'(t) Complement

$T_A = Ax + Bx$

$T_B = Ax + B'x$

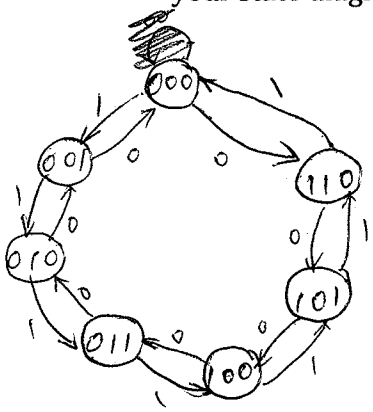
Next State output

A	B	x	T_A	T_B	A	B	Y
0	0	0	0	0	0	0	0
0	0	1	0	1	0	1	0
0	1	0	0	0	0	1	0
0	1	1	1	0	1	1	0
1	0	0	0	0	1	0	0
1	0	1	1	1	0	1	0
1	1	0	0	0	1	1	1
1	1	1	1	1	0	0	1



Moore circuit.
(Since the output y is a function of only the present state)

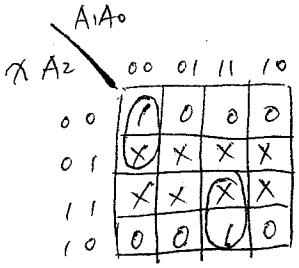
2. Design an up-down binary counter that counts from 0-6 using J/K flip-flops. Show your state diagram (3 marks), state table (4 marks), and karnaugh maps (3 marks).



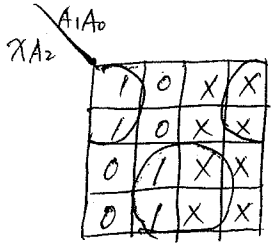
Input Up/Down	Present State			Next State			Flip-Flop Inputs					
x	A_2	A_1	A_0	A_2	A_1	A_0	J_{A_2}	K_{A_2}	J_{A_1}	K_{A_1}	J_{A_0}	K_{A_0}
0	0	0	0	1	1	0	1	X	1	X	0	X
0	0	0	1	0	0	0	0	X	0	X	X	1
0	0	1	0	0	0	1	0	X	X	1	1	X
0	0	1	1	0	1	0	0	X	X	0	X	1
0	1	0	0	0	1	1	X	1	1	X	1	X
0	1	0	1	1	0	0	X	0	0	X	X	1
0	1	1	0	1	0	1	X	0	X	1	1	X
0	1	1	1	X	X	X	X	X	X	X	X	X
1	0	0	0	0	0	1	0	X	0	X	1	X
1	0	0	1	0	1	0	0	X	1	X	X	1
1	0	1	0	0	1	1	0	X	X	0	1	X
1	0	1	1	1	0	0	1	X	X	1	X	1
1	1	0	0	1	0	1	X	0	0	X	1	X
1	1	0	1	1	1	0	X	0	1	X	X	1
1	1	1	0	0	0	0	X	1	X	1	0	X
1	1	1	1	X	X	X	X	X	X	X	X	X

Q(t)	Q(t+1)	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

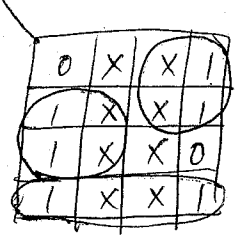
JK Flip-Flop excitation table



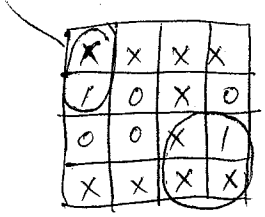
$J_{A_2} = x'A_1'A_0' + xA_1A_0$



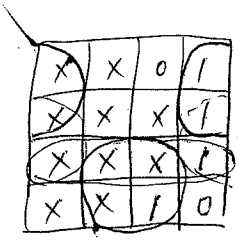
$J_{A_1} = x'A_0' + xA_0$



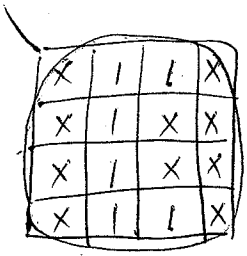
$J_{A_0} = A_2A_1' + x'A_1 + xA_2'$



$K_{A_2} = x'A_1'A_0' + xA_1$

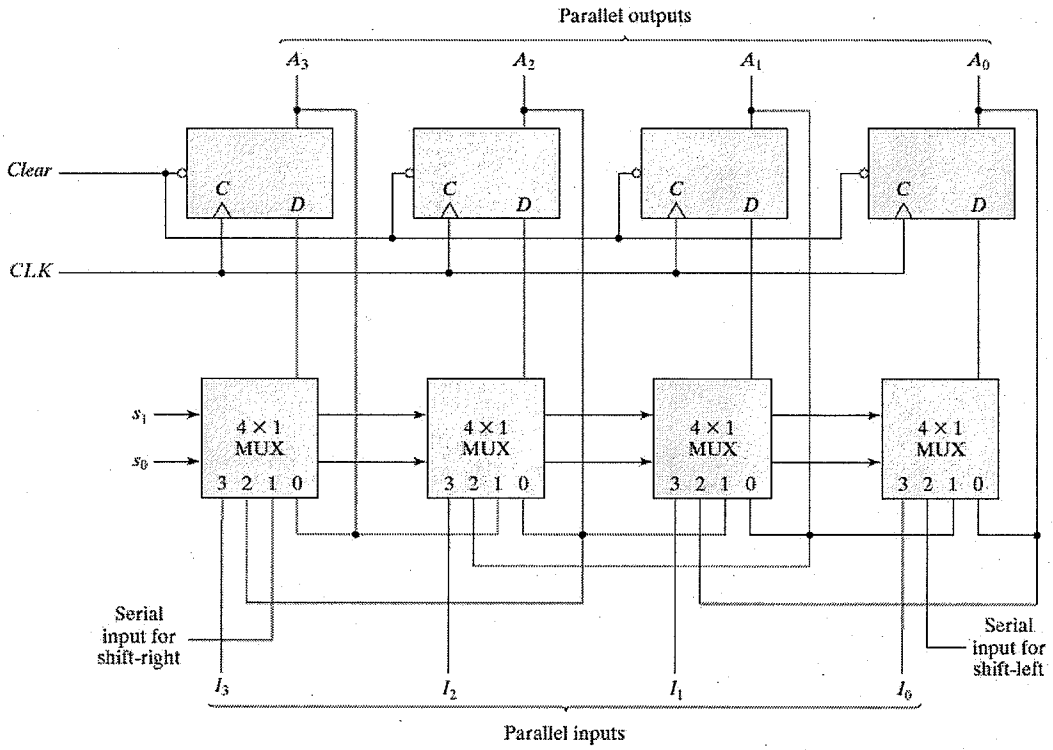


$K_{A_1} = xA_0 + x'A_0' + xA_2$
OR $+ A_2A_0'$



$K_{A_0} = 1$

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 0010 (already specified in the chart). MSB is the serial input for shift right, while LSB is the input for shift left. (4 marks)

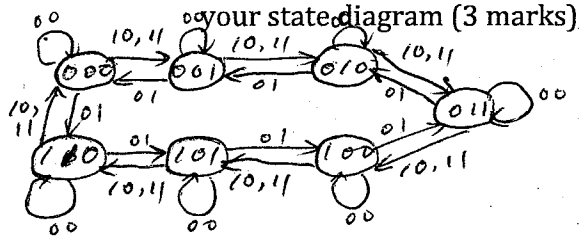


S	Clear	I	MSB	LSB	Current	Next
01	1	0101	1	1	0010	1001
10	0	1001	1	0	1001	0000
11	1	1010	0	1	0000	1010
01	1	0100	1	0	1010	1101
01	1	1010	0	1	1101	0110
10	1	0001	1	0	0110	1100

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

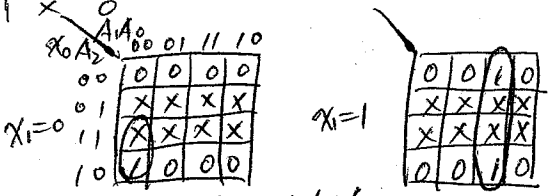
Clear	S	
1	01	shift right
1	10	shift left
1	11	parallel load (load inputs)
1	00	No change
0	XX	clear the register to all 0's (clear to 0)

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

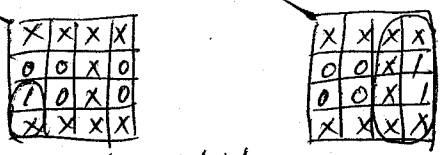


Q(t)	Q(t+1)	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

Input Up/down x_1	x_0	Present State A_2	A_1	A_0	Next State A_2	A_1	A_0	JA_2	KA_2	JA_1	KA_1	JA_0	KA_0
0	0	0	0	0	0	0	1	0	X	0	X	1	X
0	0	0	0	1	0	1	0	0	X	1	X	X	1
0	0	0	1	0	0	1	1	0	X	X	0	1	X
0	0	0	1	1	1	0	0	1	X	X	1	X	1
0	0	1	0	0	1	0	1	X	0	0	X	1	X
0	0	1	0	1	1	1	0	X	0	1	X	X	1
0	0	1	1	0	1	1	1	X	0	1	X	1	X
0	0	1	1	1	X	X	X	X	X	X	X	X	X
0	1	0	0	0	1	1	0	1	X	1	X	0	X
0	1	0	0	1	0	0	0	0	X	0	X	X	1
0	1	0	1	0	0	0	1	0	X	X	1	X	X
0	1	0	1	1	0	1	0	0	X	X	0	X	1
0	1	1	0	0	0	1	1	X	1	1	X	X	1
0	1	1	0	1	0	0	0	X	1	0	X	0	X
0	1	1	1	0	0	0	1	X	1	0	X	1	X
0	1	1	1	1	X	X	X	X	X	X	X	X	X
1	0	0	0	0	0	0	1	0	X	0	X	1	X
1	0	0	0	1	0	1	0	0	X	1	X	X	1
1	0	0	1	0	0	1	1	0	X	X	0	1	X
1	0	0	1	1	1	0	0	1	X	X	1	X	1
1	0	1	0	0	1	0	1	X	0	0	X	1	X
1	0	1	0	1	1	1	0	X	0	1	X	X	1
1	0	1	1	0	1	1	1	X	0	1	X	1	X
1	0	1	1	1	X	X	X	X	X	X	X	X	X
1	1	0	0	0	0	0	1	0	X	0	X	1	X
1	1	0	0	1	0	1	0	0	X	1	X	X	1
1	1	0	1	0	0	1	1	0	X	X	0	1	X
1	1	0	1	1	1	0	0	1	X	X	1	X	1
1	1	1	0	0	1	0	1	X	0	0	X	1	X
1	1	1	0	1	1	1	0	X	0	1	X	X	1
1	1	1	1	0	1	1	1	X	0	1	X	1	X
1	1	1	1	1	X	X	X	X	X	X	X	X	X

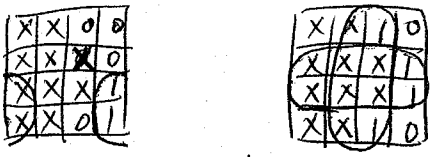


$JA_2 = x_1' x_0 A_1' A_0' + x_1 A_1 A_0$



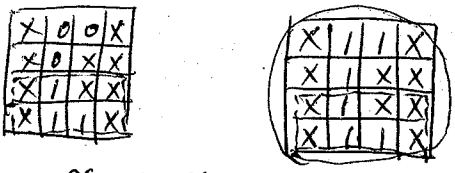
$KA_2 = x_1' x_0 A_1' A_0' + x_2 A_1$

$JA_1 = x_1' x_0 A_0' + x_1 A_0$



$KA_1 = x_1' x_0 A_0' + x_1 A_2 + x_1 A_0$

$JA_0 = x_1' x_0 A_2 + x_1' x_0 A_1 + x_1 A_1' + x_1 A_2'$



$KA_0 = x_0 + x_1$