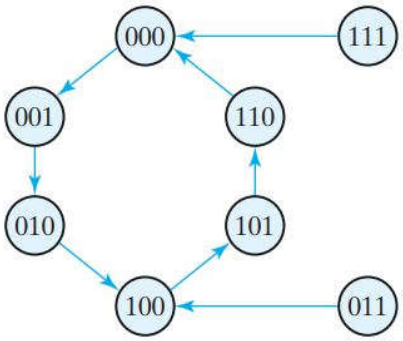
(Affiliated To Tribhuvan University)

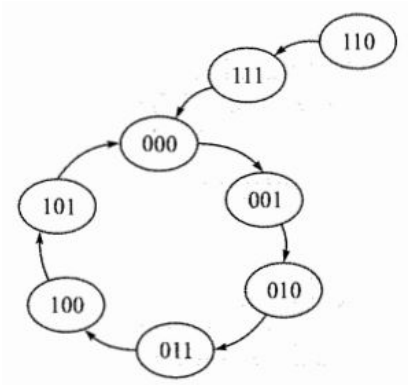
NIST College
Department of BScCSIT
First Semester
Digital Logic Design
Tutorial - 5

Counter as Synthesis Problems / Sequential Machine

1. Design MOD-6 synchronous counter.
2. Design MOD-7 synchronous counter.
3. Design a synchronous BCD counter using T flip-flops.
4. Design a synchronous BCD counter with JK flip-flops
5. For the given state transition diagram, design the counter. Use JK flip flop. (i.e. counter with unused state).

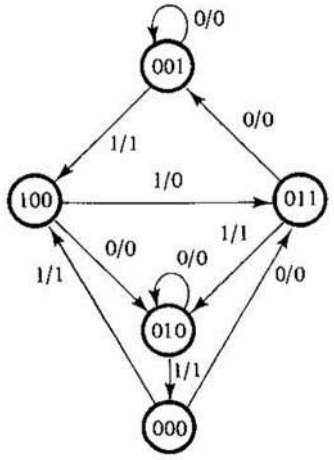


6. For the given state transition diagram design the counter using JK flip-flop.



7. Design a 4-bit binary ripple counter with D flip-flops.
8. Design a 4-bit synchronous counter with D flip-flops.

9. Design a sequential circuit with two D flip-flops, A and B, and one output, x. When x = 0, the state of the circuit remains the same. When x = 1, the circuit goes through the state transitions from 00 to 01 to 11 and to 10 back to 00, and repeats.
10. Design a sequential circuit with two JK flip-flops, A and B, and two inputs, E and x. If E = 0, the circuit remains in the same state regardless of the value of x. When E = 1 and x = 1, the circuit goes through the state transitions form 00 to 01 to 10 to 11 back to 00, and repeats. When E = 1 and x = 0, the circuit goes through the state transitions from 00 to 11 to 10 to 01 back to 00, and repeats.
11. Design a sequential circuit with two D flip-flops and two inputs, P and Q. If P = 0, the circuit remains in the same state regardless of the value of Q. When P = 1 and Q = 1, the circuit goes through the state transitions from 00 to 01 to 10 back to 00, and repeats. When P = 1 and Q = 0, the circuit goes through the state transitions from 00 to 10 to 01 back to 00, and repeats. The circuit is to be designed by treating the unused state(s) as don't care condition(s).
12. Design a counter with the following repeated binary sequence: 0, 1, 2, 4, 6. Use D flip-flops.
13. Design a counter with the following repeated binary sequence: 0, 1, 3, 5, 7. Use T flip-flops.
14. Design a counter with the following repeated binary sequence: 0, 1, 3, 6, 4. Use T flip-flops.
15. A sequential circuit has three flip-flops, A, B, C; one input, x; and one output, y. The sate diagram is shown in figure below. The circuit is to be designed by treating the unused states as don't care conditions.
    a. Use D flip-flops in the design.
    b. Use JK flip-flops in the design,
    c. Use T flip-flops in the design.
    d. Use SR flip-flops in the design.



16. Reduce the number of states in the following state table and tabulate the reduced state table and draw the reduced state diagram. And design the circuit.

Present State	**Next State**		**Output**	
	x=0	*x = 1*	*x = 0*	*x = 1*
a	*f*	*b*	0	0
b	*d*	*c*	0	0
c	*f*	*e*	0	0
d	*g*	*a*	1	0
e	*d*	*c*	0	0
f	*f*	*b*	1	1
g	*g*	*h*	0	1
h	*g*	*a*	1	0

17. Draw the state diagrams for the sequence pattern recognizer of bit patterns 000 to 111.
18. Draw the state diagrams for the sequence pattern recognizer of bit patterns 0000 to 1111.
19. Design a sequential machine that can go through 2-bit gray code combinations of states. The machine changes its state when serial input is one and remains in the same state when input is zero. The machine produces one when it passes through all states and finally goes back to initial state. Use JK flip-flops.
20. Design a synchronous sequential machine such that if give output Z = 1 if input contains the message 110 and it retains in its own state for other condition giving output zero. Use JK flip-flops.
21. Design a sequential machine that has a single input 'x' and single output 'z'. The machine is required to give high output when it detects the serial sequence of 011. Use D flip-flops.
22. A sequential machine has to detect serial input sequence of 1010, the machine output will be high. The machine contains two JK flip-flops, A and B. Assume: single input, x and single output Y.
23. Design a sequential machine that has one serial input and one output, z. The machine is required to give on output z = 1 when the input X contains the message 1100. Use T flip-flops.