Tutorial 6

1.A sequential network has one input (X) and two outputs (Z1 and Z2). An output Z1 = 1 occurs every time the input sequence 010 is completed provided that the sequence 100 has never occurred. An output Z2 = 1 occurs every time the input 100 is completed. Note that once a Z2 = 1 output has occurred, Z1 = 1 can never occur, but not vice versa. Find a Mealy state graph and state table (minimum number of states is 8).

2.A sequential network has one input (X) and one output (Z). Draw a Mealy state graph for The output is Z = 1 iff the total number of 1's received is divisible by 3 and the total number of 0's received is an even number greater than zero (9 states are sufficient).

3.A Moore sequential network has one input and one output. When the input sequence 011 occurs, the output becomes 1 and remains 1 until the sequence 011 occurs again in which case the output returns to 0. The output then remains 0 until 011 occurs a third time, etc. For example, the input sequence

X = 01011010110100111 Has output Z = 00001111100000011

4.A sequential network has an input X and an output Z. The output is the same as the input was three clock periods previously. For example,

X = 0101101011010001
Z = 0000101101011010

The first three values of Z are 0. Find a Mealy state graph and table for the network.

5.A sequential network is to be used to control the operation of a vending machine which dispenses a \$0.25 product. The network has three inputs, N, D, and Q, and two outputs, R and C. The coin detector mechanism in the vending machine is synchronized with the same clock as the sequential network you are to design. The coin detector outputs a single 1 to the N, D, or g input for every nickel, dime, or quarter, respectively, that the customer inserts. Only one input will be 1 at a time. When the customer has inserted at least \$0.25 in any combination of nickels, dimes, and quarters, the vending machine must give change and dispense the product. The coin return mechanism gives change by returning nickels to the customer. For every 1 output on C, the coin return mechanism will return one nickel to the customer. The product is dispensed when the network outputs a single 1 on output R. The network should reset after dispensing the product.

EXAMPLE: The customer inserts a nickel, a dime, and a quarter. The network inputs and outputs could look like this:

INPUTS: N = 00010000000000000
D = 00000001000000000
Q = 00000000001000000
OUTPUTS: R = 00000000000000100
C = 00000000000111000

Note that any number of zeros can occur between 1 inputs. Derive a Moore state table for the sequential network, and for each state indicate how much money the customer has inserted or how much change is due.

6 .Reduce the following state table to a minimum number of states.

Present State	Next State $X = 0$	Next State $X = 1$	Present Output $X = 0$	Present Output $X = 1$
a	c	f	0	0
b	d	e	0	0
c	h	g	0	0
d	b	g	0	0
e	e	b	0	1
f	f	a	0	1
g	c	g	0	1
h	c	f	0	0

7.Digital engineer B.I.Nary has just completed the design of a sequential network which has the following state table:

Present State	Next State $x = 0$	Next State 1	Output 0	Output 1
S_0	S_5	S_1	0	0
S_1	S_5	S_6	0	0
S_2	S_2	S_6	0	0
S_3	S_0	S_1	1	0
S_4	S_4	S_3	0	0
S_5	S_0	S_1	0	0
S_6	S_5	S_1	1	0

His assistant, F.L.Ipflop, who has just completed this course, claims that his design can be used to replace Mr. Nary's network. Mr. Ipflop's design has the following state table:

	Next State $x = 0$	1	Output 0	1
a	a	b	0	0
b	a	c	0	0
c	a	b	1	0

(a) Is Mr. Ipflop correct? (Prove your answer.)
(b) If Mr. Nary's network is always started in state S0, is Mr. Ipflop correct?
(Prove your answer by showing equivalent states, etc.)

8.Reduce the following state table to a minimum number of states using an implication chart. & Realize the table using J-K flip-flops.

	$X = 0$	1	Z
A	A	B	1
B	C	E	0
C	F	G	1
D	C	A	0
E	I	G	1
F	H	I	1
G	C	F	0
H	F	B	1
I	C	E	0

9.Design a sequential circuit with two JK flip-flops A and B and two inputs E and F . If E = 0, the circuit remains in the same state regardless of the value of F . When E = 1 and F = 1, the circuit goes through the state transitions from 00 to 01, to 10, to 11, back to 00, and repeats. When E = 1 and F = 0, the circuit goes through the state transitions from 00 to 11, to 10, to, 01, back to 00, and repeats.

10.Draw the logic diagram of a four-bit register with four D flip-flops and four 4 × 1 multiplexers with mode selection inputs s1 and s0.The register operates according to the following function table.

s_1	s_0	Register Operation
0	0	No change
1	0	Complement the four outputs
0	1	Clear register to 0 (synchronous with the clock)
1	1	Load parallel data