University of California, Santa Barbara

Department of Electrical and Computer Engineering

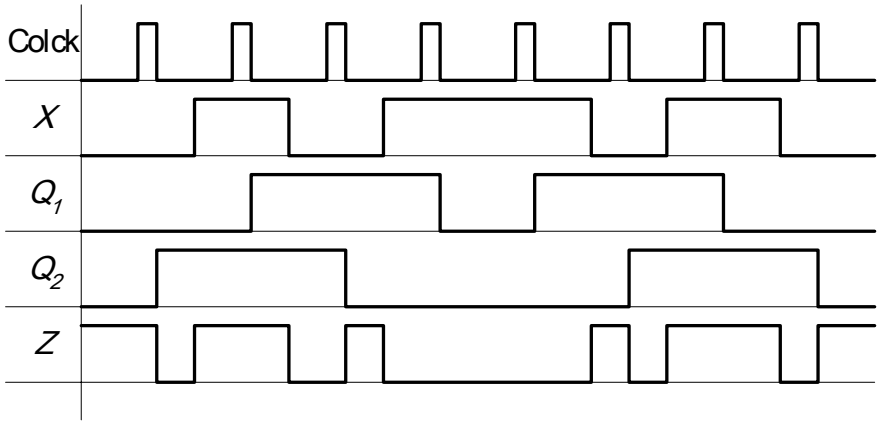
Homework #7

(Due by 5:00PM on 03/14/03)

Note: Place your homework in the homework-box for ECE 152A located on the fifth floor of Eng. I

1. Determine which of the machine with the following specifications is realizable with a finite number of states. If any machine is not realizable, explain why. **(10 points)**
   (a) A machine is to produce an output of 1 whenever the number of 1's in the input sequence, starting at $t = 1$, exceeds the number of 0's. For example, of the input is 01100111, the output is 00100011.
   (b) A machine with a single input line and 10 output lines numbered 0 through 9 is to be designed so that, following the nth input pulse, only one output pulse will be produced in the line whose corresponding number is equal to the nth digit of π (i.e., 3.14……).

2. A Mealy sequential network has 1 input, 1 output, and 2 flip-flops. A timing chart for the network follows. Construct a state table and state graph for the network.
   (20 points)



3. A sequential network has an input X and two outputs, D and B. X represents a 4-bit binary number N which is input least significant bit first. D represents a 4-bit binary number equal to N - 2, which is output least significant bit first. At the time the fourth input occurs, $B = 1$ if N - 2 is less than 0; otherwise, $B = 0$. The network always resets after the fourth bit of X is received. Find the Mealy and Moore state graph and table for the network. **(20 points)**

4. A logic designer who had not taken this course designed a sequential network with an input W using 3 T flip-flops. The input equations for these flip-flops are **(10 points)**

$$T_A = W'A'B + W'BC' + A'BC' + AB'C + WB'C + WAC$$
$$T_B = W'A'C + W'A'B + A'BC + AB'C' + WB'C' + WAC'$$
$$T_C = W'AC + W'B'C' + WBC + WA'C'$$

And the output equation is $Z = W'A'BC'$.

Find an equivalent sequential network which uses fewer states. Try to minimize the amount of logic required.

5. Networks N and M have the state tables that follow. **(10 points)**
   (a) Without first reducing the tables, determine whether networks N and M are equivalent.
   (b) Reduce each table to a minimum number of states, and then show that N is equivalent to M by inspection of the reduced tables.

M

	$X = 0$	1	
S_0	S_3	S_1	0
S_1	S_0	S_1	0
S_2	S_0	S_2	1
S_3	S_0	S_3	1

N

	$X = 0$	1	
A	E	A	1
B	F	B	1
C	E	D	0
D	E	C	0
E	B	D	0
F	B	C	0

6. A sequential network has one input (X) and two outputs (Z_1 and Z_2). An output $Z_1 = 1$ occurs every time the input sequence 010 is completed provided that the sequence 100 has never occurred. An output $Z_2 = 1$ occurs every time the input 100 is completed. Note that once a $Z_2 = 1$ output has occurred, $Z_1 = 1$ can never occur, but *not* vice versa. **(30 points)**
   (a) Find a Mealy state graph and state table (minimum number of states is 8).
   (b) Make a suitable state assignment and realize the state table of (a) using J-K flip-flops and NAND gates.