Each problem is worth the number of points show. Clearly show the final answer to each problem by drawing a heavy square around it (where appropriate). Show your work in a neat, organized and easily followed sequence if you expect to get any partial credit.

Due Thursday, Dec 12th *in Class.*

Problem 1 - 5 points

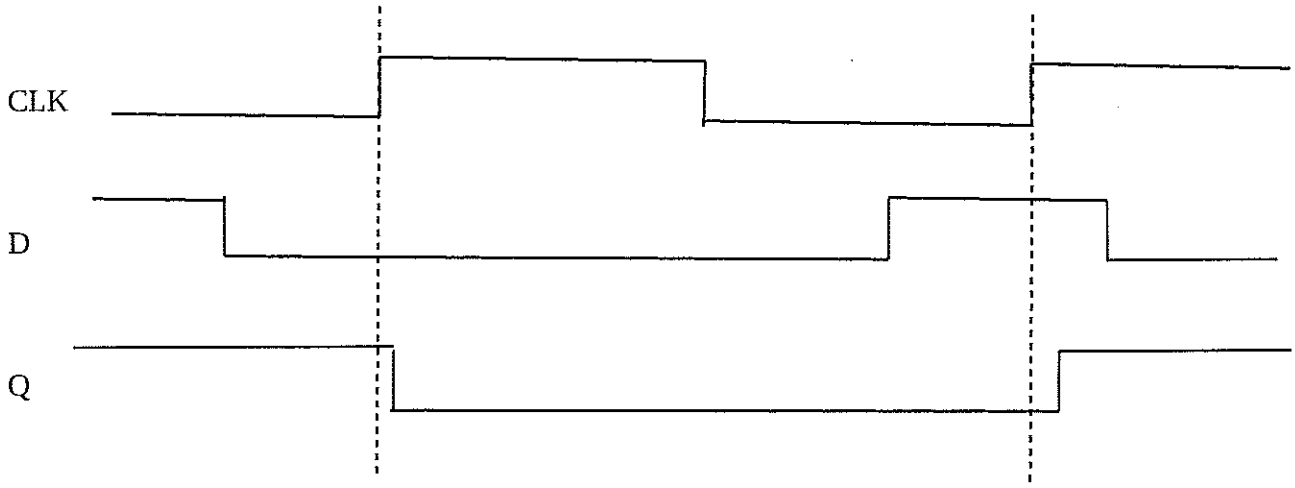
Completely define the following timing parameters associated with D flip flops

Propagation Delay – t_{ff} (both high to low and low to high)

Setup Time -- t_{su}

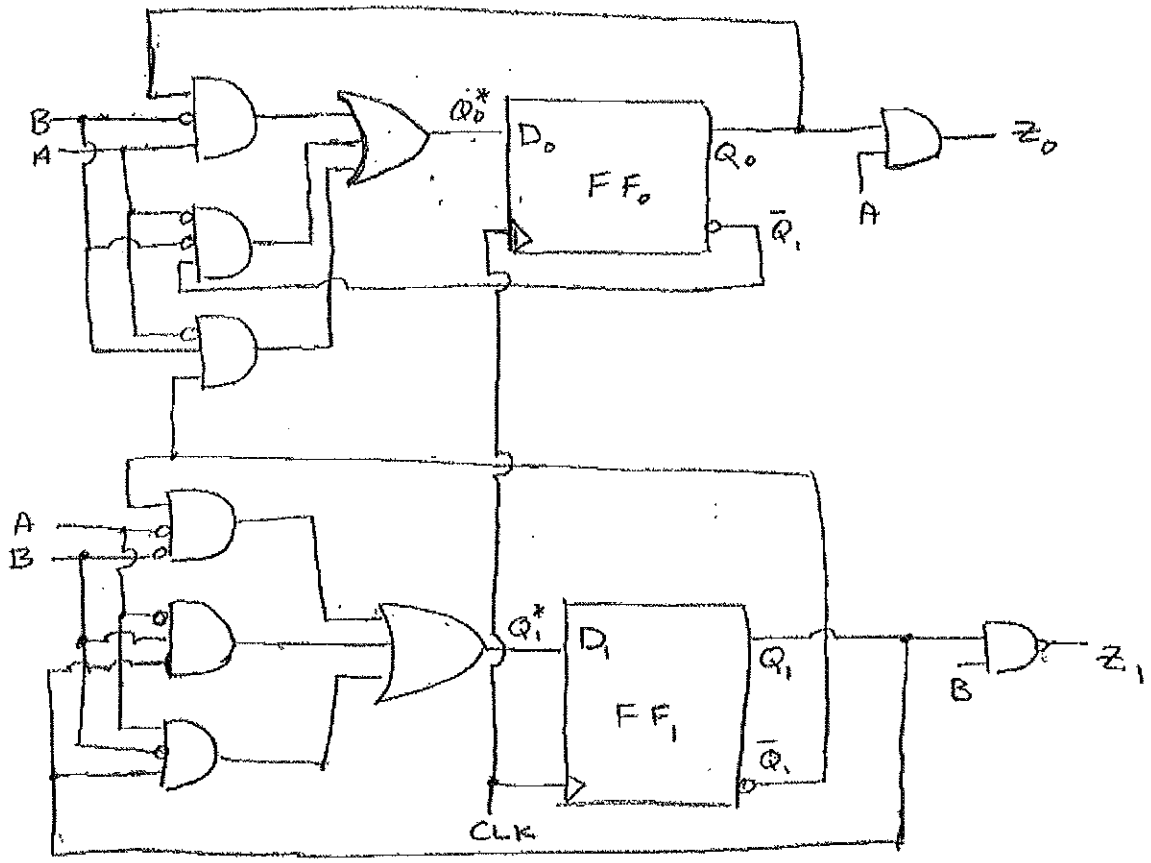
Hold Time -- t_{hold} =

Label each of these quantities in the timing diagram below.



Problem 2 - 20 points

Analyze the clocked synchronous state machine shown below



a) Clearly *circle* and *label* the Next State logic block, State Memory, and the Output logic block.

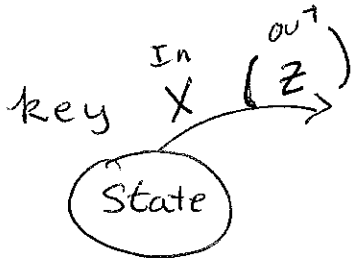
b) What are the Next State (or excitation) expressions and Output logic expressions? Is this a Mealy machine or a Moore machine? How do you know?

c) Fill in the full state transition table for the circuit.

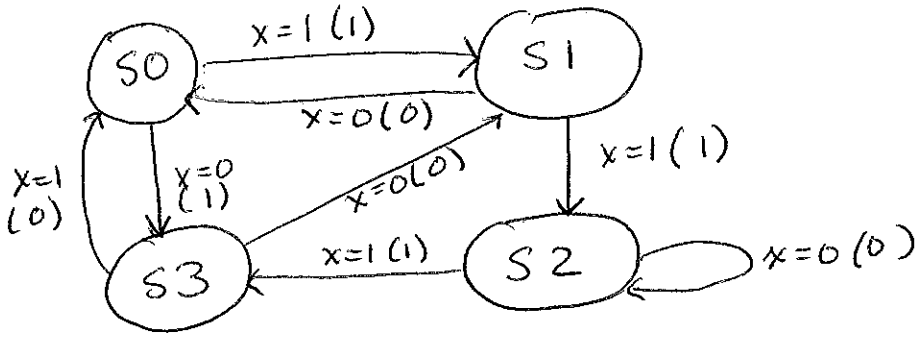
d) Draw state diagram. Indicate transitions for all inputs and the corresponding output values. (Include a key)

e) Label states as S0 = Q_1Q_0 = 00, S1 = Q_1Q_0 = 01, S2 = Q_1Q_0 = 10, S3 = Q_1Q_0 =11 and draw a symbolic state table indicating output values.

Problem 3 - 20 points



Answer the questions below for the state transition diagram shown.



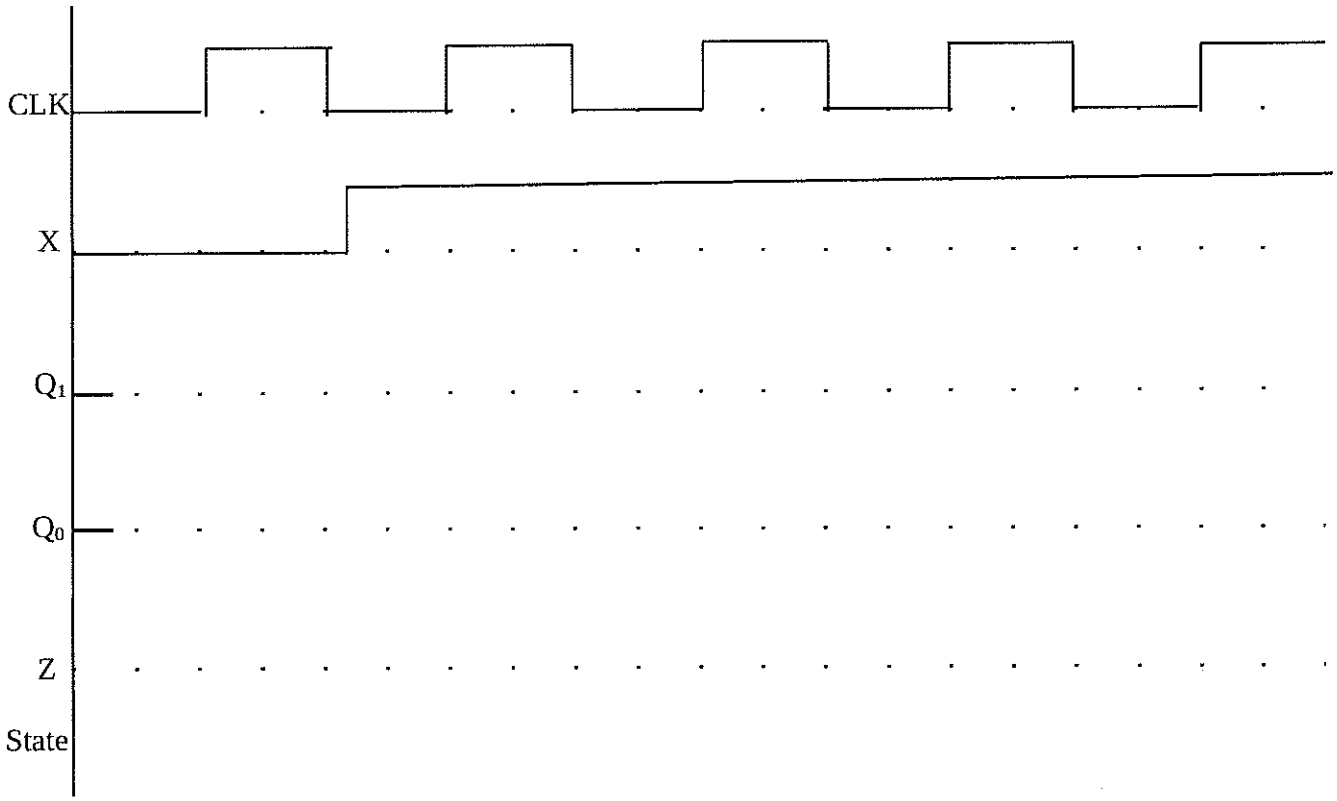
a) Draw the symbolic state table associated with this state transition diagram. Indicate transitions for all inputs and the corresponding output values.

b) Complete a full state transition table assuming that the states are encoded in to two state variable Q_1Q_0 (stored in 2 flip flops) as

$S0 = Q_1Q_0 = 00$, $S1 = Q_1Q_0 = 01$, $S2 = Q_1Q_0 = 10$, $S3 = Q_1Q_0 = 11$

c) Determine the minimized next state and ouput logic expressions

d) Complete the timing diagram below. Assume that initially $Q_1Q_0 = 00$.



Problem 4 – 20 points

Design a state machine that repeatedly generates the sequence 1, 0, 0, 0, 1, 0, 1. The output of this state machine will be the repeating bit pattern below. This type of state machine is called a sequencer.

1, 0, 0, 0, 1, 0, 1, 1, 0, 0, 0, 1, 0, 1, 1, 0, 0, 0, 1, 0, 1, ...

Your sequencer should have a Reset input. When ever Reset = 1 the sequence start over at the beginning (state 0)

a. How many inputs and outputs does this state machine require? What are they?

b. Using the gumball machine example as a starting point, draw the state transition diagram for this state machine.

c. Generate the symbolic state transition/output table. How many state variables (and flip flops) will your design need?

d. Draw the full state transition table and generate the next state and output logic expressions.

e. Draw your state machine labeling your next state logic, state memory and output logic blocks

Problem 5 – 25 points

A few years ago I went on vacation to the South of France. It was really great except that a load of laundry at the laundromat cost 5 euro! Design the cash acceptor circuit for this ridiculously overpriced washer. The washer accepts 1 euro and 2 euro coins and accepts 1 coin at a time. When 5 euro is received the washer starts. The machine can give change but there is no money return button. Also the machine accepts no more money while currently in a wash cycle.

a. How many inputs and outputs does this state machine require? What are they?

b. Using the gumball machine example as a starting point, draw the state transition diagram for this state machine.

c. Generate the symbolic state transition/output table. How many state variables (and flip flops) will your design need?

d. Draw the full state transition table and find the next state and output expressions.

e. Draw your state machine.

ECE2022 Homework #5

Submitted by:_____

ECE Box #:_____

Date:_____

Question	Grade
1 (5)	
2 (20)	
3 (20)	
4 (20)	
5 (25)	
Total:	