Cpr E 281 HW 10

ELECTRICAL AND COMPUTER ENGINEERING
IOWA STATE UNIVERSITY

Synchronous Sequential Circuits
Assigned Date: Thirteenth Week
Due Date: Apr. 14, 2014

P1. (10 points) Problem 6.23 in your textbook.

P2. (10 points) Problem 6.24 in your textbook.

P3. (10 points) Problem 6.25 in your textbook.

P4. (10 points) Consider the state machine specified by the following state transition table.

Current	Input	Next
X Y	I	X Y
0 0	0	1 1
0 0	1	0 1
0 1	0	0 0
0 1	1	1 0
1 0	0	0 1
1 0	1	1 1
1 1	0	1 0
1 1	1	0 0

(a) Draw the state transition diagram of the machine.
(b) Write two next-state expressions for X and Y that will implement the transitions of the state machine. Please make your expressions as simple as possible, and use XOR gates and NOT gates only.
(c) Implement the state machine using D flip-flops, XOR gates, and NOT gates.
(d) Suppose the machine is initially in 00 (i.e., X=0 and Y=0). Indicate for each input sequence below, the state the machine is in after the last digit has been read in. Assume the digits are read in from left to right.
   a. 111111
   b. 10011000011100
   c. 432 1s followed by 321 0s

P5. (10 points) Design a state machine with three output bits. The machine will repeatedly output the sequence 100, 101, 111, 111, 000, 001, 011, 011.
(a) Draw a state diagram for the machine.
(b) Write a truth table for the next state logic and the output logic.
(c) Simplify the expressions for the next state logic and the output logic using K-maps.
(d) Implement the state machine using D flip-flops, AND gates, OR gates, and NOT gates.

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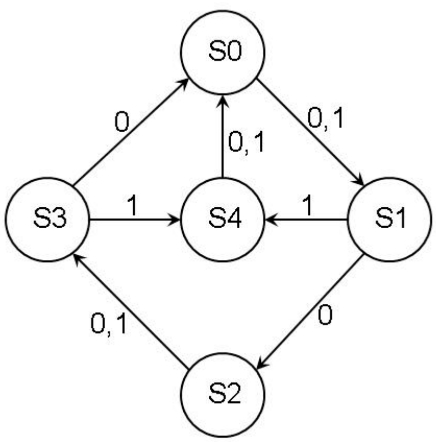
P6. (10 points) A state machine has no input (except a clock input) and a single bit output Q. The value of Q is 1 if and only if the number of clock ticks (after reset) is either a multiple of 2 or a multiple of 3. Otherwise, the value of Q is 0. Draw a state diagram for the state machine using as few states as possible (Hint: More than three states are required).

P7. (10 points) A state machine has one input P in addition to the clock input and one output Q. The value of Q is 1 if and only if the number of 1's in the sequence of input P is not divisible by 2 and not divisible by 3. Otherwise, the output value Q is 0. Draw a state transition diagram for the state machine using as few states as possible.

P8. (10 points) Give a state-assigned next state table corresponding to the state diagram given below. Note that you have one input variable, W. A transition labeling of "0, 1" means that the input can be either 0 or 1. Write the state assignment clearly. Label your table appropriately.



P9. (10 points) (a) Draw a state transition diagram for a state machine that reads in a sequence of binary digits, one at a time, and stops when it has read in five 1s (need not be consecutive). To "stop" the machine, merely have it loop in the state it reaches after a successful match. (b) Now draw a state transition diagram for a state machine that stops when it has read in at least three consecutive 1s followed by a 0.

P10. (10 points) Design a three-bit counter-like circuit controlled by the input w. If w=0, then the counter subtracts 1 from its contents (acting like a normal down-counter). If w=1, then the counter adds 2 to its contents, wrapping around if the count has to become 8 or 9. Thus if the current state is 6 (or 7) and w=1, then the next state is 0 (or 1). Use D flip-flops in your circuit.