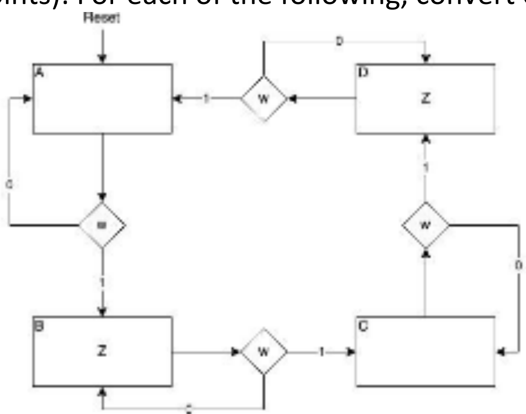
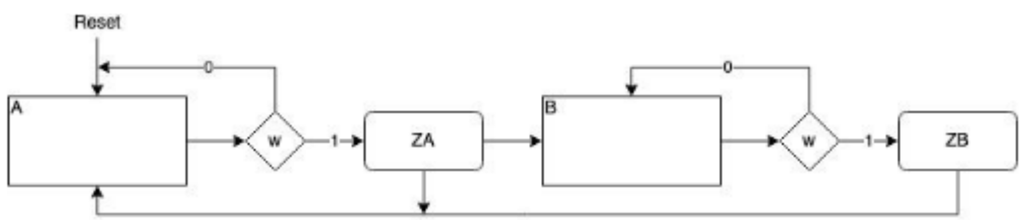
CprE 281 HW12
ELECTRICAL AND COMPUTER ENGINEERING
IOWA STATE UNIVERSITY

Analysis of Syn. Seq. Circuits, ASM charts/examples, Register Machines
Assigned Date: Thirteenth Week
Finish by Dec. 01, 2021

P1 (10 points): For each of the following, convert each ASM chart to a FSM diagram:



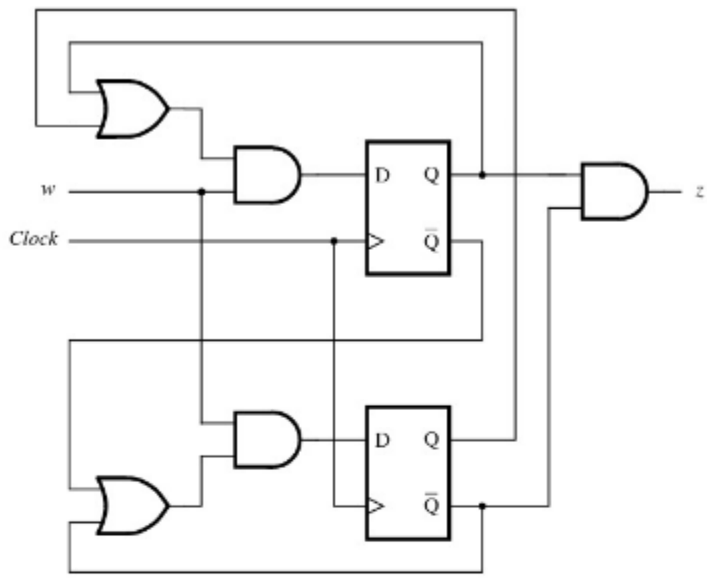
a.



b.

P2. (20 points) Design and implement a Moore machine that detects the pattern 1001 on its 1-bit serial input stream (i.e., input line w). Explain the logic behind your solution. Show all partial steps: FSM diagram/graph, state table, state assigned table, logic expressions derived using K-maps, and the circuit diagram in terms of D Flip Flops.

P3: (20 points) Reverse engineer the following circuit. Derive the logic expressions, the state-assigned table, the state table, and the state diagram/graph. Also, explain with words the functionality of this FSM (i.e., what sequence of input values on w is detected by this circuit when it sets z to 1)?



P4. (20 points) Design a 2-bit up-counter from first principles. Draw the state diagram/graph, the state table, and the state assigned table. Then, use K-maps to derive logic expressions for the input and output logic. Finally, draw the circuit diagram using D Flip-Flops and any other logic gates. Label all inputs, outputs, and pins.

P5: (10 points) Consider the following register machine program:

Step	Instruction	Register	Go to step	[Branch to step]
1	Deb	1	2	7
2	Deb	2	3	5
3	Inc	0	4	
4	Inc	3	2	
5	Deb	3	6	1
6	Inc	2	5	
7	End			

(Note that register R0 is shortened to 0, register R1 is shortened to 1, etc.)

a. Let R0 = 0, R1 = 3, R2 = 2, and R3 = 0: What will be the values stored in R0, R1, R2, and R3 after the machine finishes running this program?

b. Let R0 = 0, R1 = 0, R2 = 100, and R3 = 0: What will be the values stored in R0, R1, R2, and R3 after the machine finishes running?

c. Let R0 = 0, R1 = x, R2 = y, and R3 = 0 where x and y are two random integers. Write the values of R0, R1, R2, and R3 in terms of x, y, and any necessary constant numbers.

P6: (10 points) Consider a register machine with three registers R0, R1, and R2. Let the initial values be: R0 = 0, R1 = x, and R2 = y. The values x and y are two random integers. Write out the instructions (in the table format shown above) for the register machine such that it will add x and y and store the sum in R0. Write a short comment for each line/block of your program.

P7: (10 points) Consider a register machine with four registers R0, R1, R2, and R3. Write a complete register machine program (in the table format shown above) that copies the contents of register 2 into register 1 using register 3 as a temporary storage. The value of R2 at the end of the program must be the same as its value at the beginning of the program. Hint: you may fist have to clear R1 and R3 to zero them. Write a comment for each line/block of your program.