Laboratory 4 (100 Points)

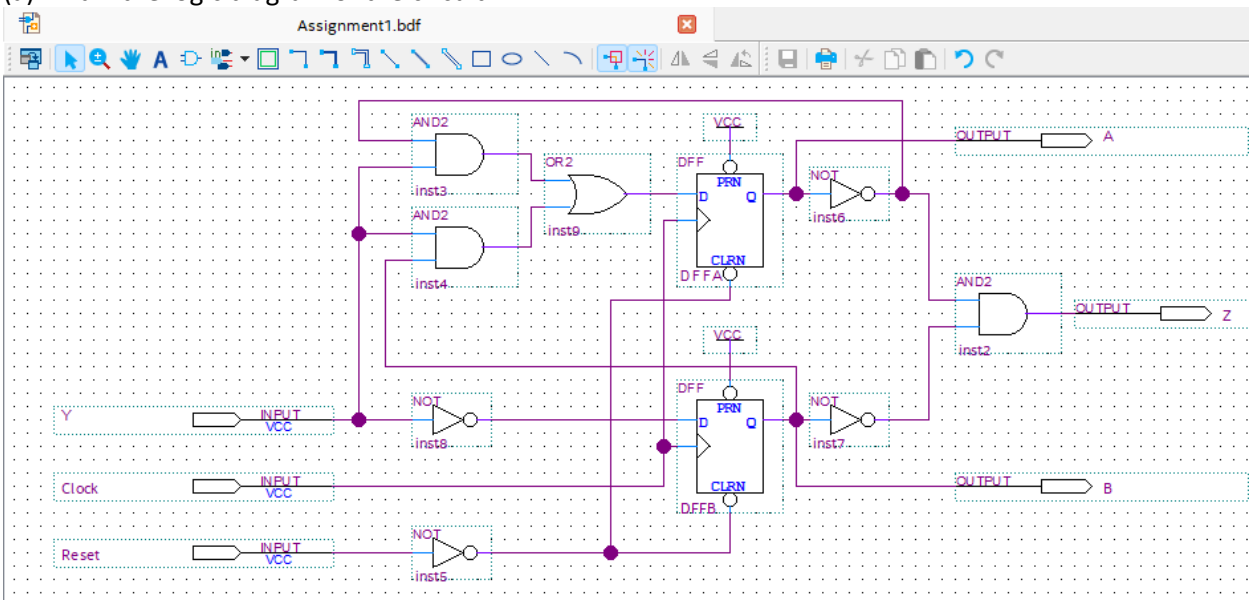
Assignment 1 (20 Points)

(4-5) A sequential circuit with two D flip-flops A and B, one input Y, and one output Z is specified by the following input equations:

$$D_A = BY + \bar{A}Y, \qquad D_B = \bar{Y}, \qquad Z = \bar{A}\bar{B}$$

(a) Draw the logic diagram of the circuit.
(b) Derive the state table.
(c) Derive the state diagram.
(d) Simulate the circuit:
- Initial state: 00
- Input sequence: 0100
- Check the output Z with the state table

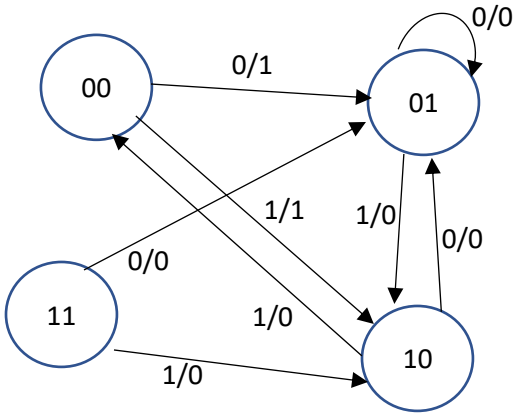
(a) Draw the logic diagram of the circuit



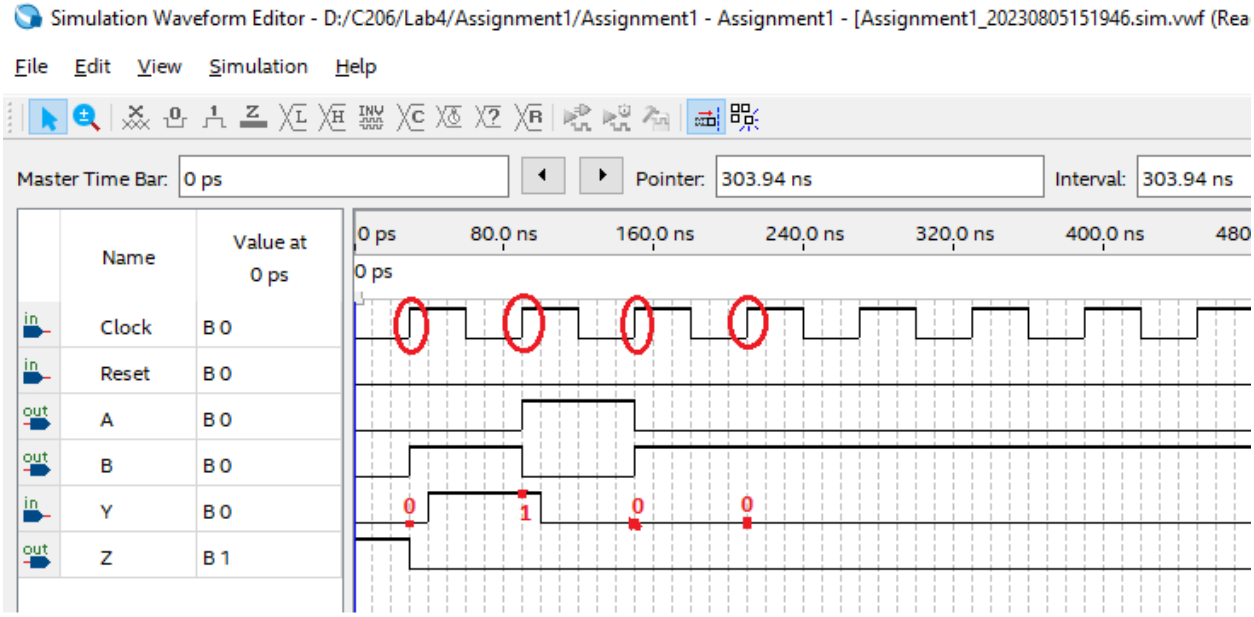
(b) Derive the state table.

Present State		Input	Next State		Output
A	B	Y	A	B	Z
0	0	0	0	1	1
0	0	1	1	0	1
0	1	0	0	1	0
0	1	1	1	0	0
1	0	0	0	1	0
1	0	1	0	0	0
1	1	0	0	1	0
1	1	1	1	0	0

(c) Derive the state diagram.

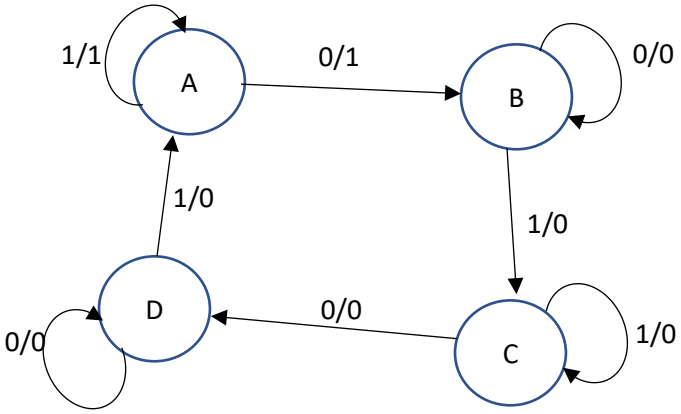


(d) Simulate the circuit with initial state AB = 00 and input sequence Y = 0100



Assignment 2 (20 Points)

The state diagram of a sequential circuit is shown in the following figure. Design the circuit with D flip-flops using binary code state assignment. Simulate the circuit.



(a) Derive the state table from the above state diagram

The circuit has 4 states A, B, C and D, one input X and one output Y.

Present State	X	Next State	Y
A	0	B	1
A	1	A	1
B	0	B	0
B	1	C	0
C	0	D	0
C	1	C	0
D	0	D	0
D	1	A	0

(b) State assignment with using binary codes

Four states: Using 2 flip-flops

State assignment: A: 00 B: 01 C: 10 D:11

Present State	X	Next State	Y
00	0	01	1
00	1	00	1
01	0	01	0
01	1	10	0
10	0	11	0
10	1	10	0
11	0	11	0
11	1	00	0

Using 2 flip-flops named **A** and **B**:

Present State A	Present State B	X	Next State A	Next State B	Y
0	0	0	0	1	1
0	0	1	0	0	1
0	1	0	0	1	0
0	1	1	1	0	0
1	0	0	1	1	0
1	0	1	1	0	0
1	1	0	1	1	0
1	1	1	0	0	0

D_A D_B

(c) Draw the logic diagram of the circuit.

- Input equation for the FF A: D_A

D_A		BX			
		00	01	11	10
A	0			1	
	1	1	1		1

$$D_A = A\bar{B} + A\bar{X} + \bar{A}BX$$

- Input equation for the FF B: D_B

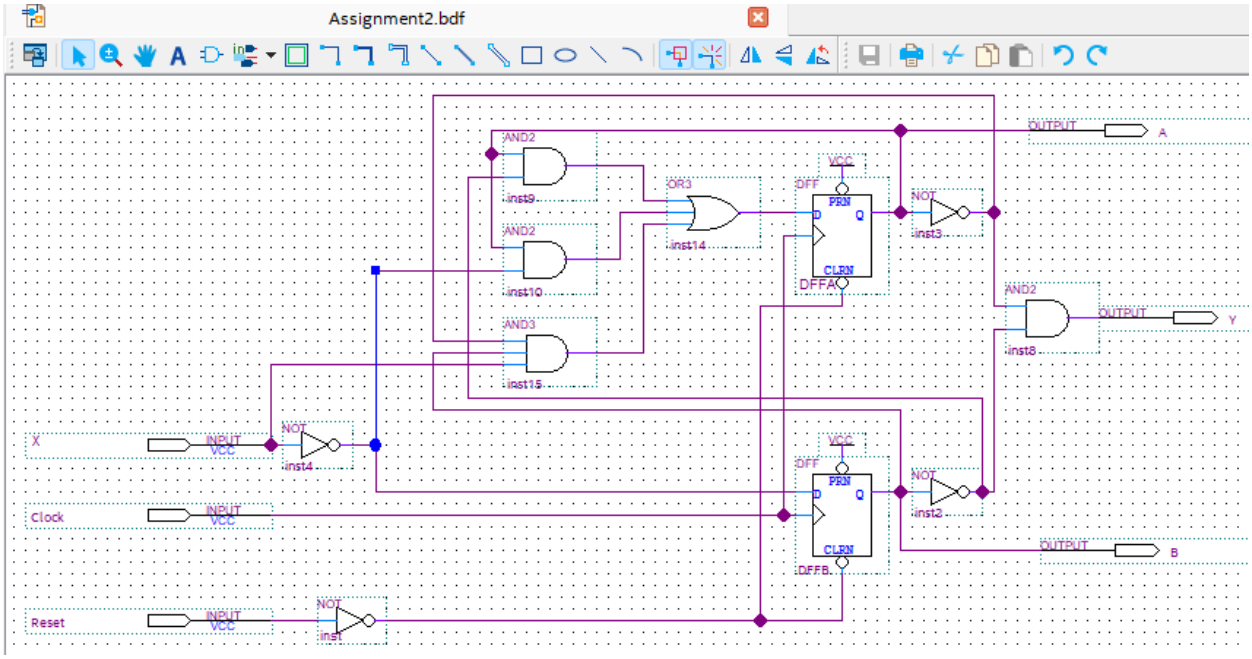
D_A		BX			
		00	01	11	10
A	0	1			1
	1	1			1

$$D_B = \bar{X}$$

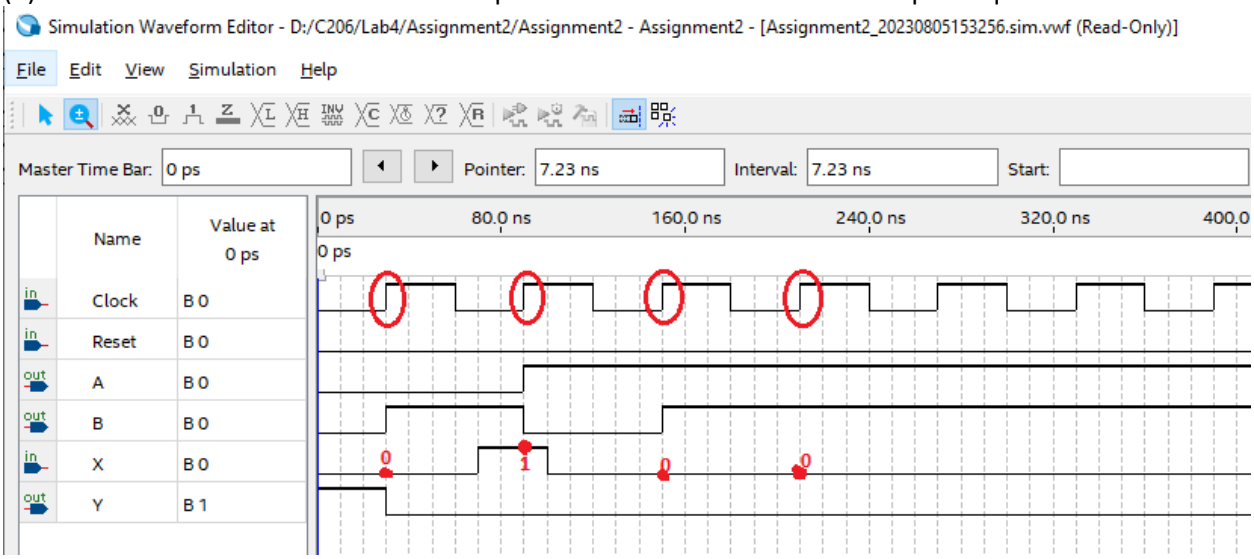
- Input equation for the output: Y

Y		BX			
		00	01	11	10
A	0	1	1		
	1				

$$Y = \bar{A}\bar{B}$$



(d) Simulate the circuit and check the output with initial state AB = 00 and input sequence X = 0100



Assignment 3 (20 Points)

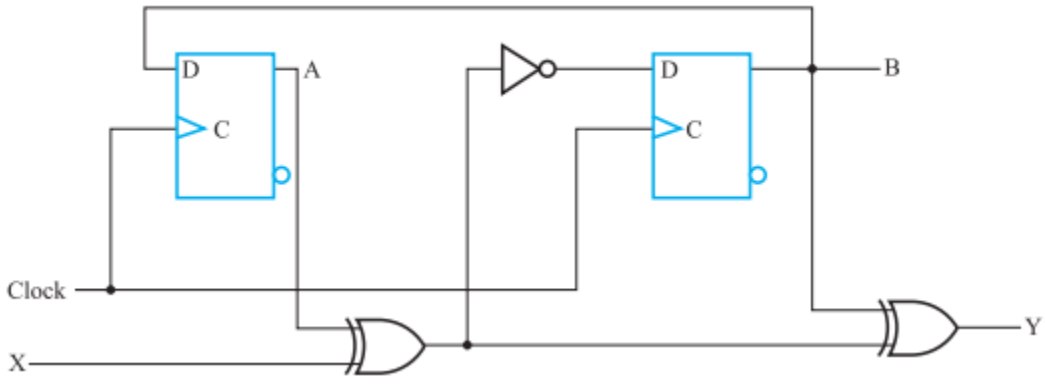
(4-6) A sequential circuit with two D flip-flops A and B, two inputs X and Y, and one output Z is specified by the following input equations:

$$D_A = XA + \overline{X}\,\overline{Y},\quad D_B = XB + \overline{X}A,\quad Z = \overline{X}B$$

(a) Draw the logic diagram of the circuit.
(b) Derive the state table.
(c) Derive the state diagram.
(d) Simulate the circuit:
- Initial state: 00
- Input sequence: (Given by you)
- Check the output Z with the state table

Assignment 4 (20 Points)

(4-11) A sequential circuit has two D flip-flops, one input X, and one output Y. The logic diagram of the circuit is shown in the following figure. Derive the state table and state diagram of the circuit.



Assignment 5 (20 Points)

(4-13) Design a sequential circuit with two D flip-flops A and B and one input X. When X = 0, the state of the circuit remains the same. When X = 1, the circuit goes through the state transitions from 00 to 10 to 11 to 01, back to 00, and then repeats.