CISC 3310

Chapter 3 Lab Exercises

BOOLEAN ALGEBRA

Question 21

Complete the truth tables for these two Boolean expressions:

$$\text{Output} = \overline{A} + B$$

A	B	Output
0	0	
0	1	
1	0	
1	1	

$$\text{Output} = A + \overline{A}B$$

A	B	Output
0	0	
0	1	
1	0	
1	1	

Question 22

Complete the truth tables for these two Boolean expressions:

$$\text{Output} = \overline{A} + \overline{B} + C$$

A	B	C	Output
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

$$\text{Output} = A(B + AC + \overline{A})$$

A	B	C	Output
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

KARNAUGH MAPS

- Simplify the following Boolean function

$$F(A, B, C) = \sum m(0, 1, 4, 5) = \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + A\bar{B}\bar{C} + A\bar{B}C$$

- Simplify the following Boolean function

$$F(A, B, C) = \sum m(0, 1, 4, 6, 7) = \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + A\bar{B}\bar{C} + AB\bar{C} + ABC$$

- Simplify the following Boolean function

$$F(A, B, C) = \prod M(2, 3, 5) = (A + \bar{B} + C)(A + \bar{B} + \bar{C})(\bar{A} + B + \bar{C})$$

LOGISIM EXERCISES (from the textbook)

42. Draw a half-adder using only NAND gates

43. Draw a full-adder using only NAND gates

DECODER VS. MULTIPLEXER (from the textbook)

58. Describe how each of the following circuits works and indicate typical inputs and outputs. Also provide a carefully labeled "black box" diagram for each.

A. Decoder

B. Multiplexer

TRUTH TABLES (from the textbook)

59. Little Susie is trying to train her new puppy. She is trying to figure out when the puppy should get a dog biscuit as a reward. She has concluded the following:

1. Give the puppy a biscuit if it sits and wiggles but does not bark.
2. Give the puppy a biscuit if it barks and wiggles but does not sit.
3. Give the puppy a biscuit if it sits but does not wiggle or bark.
4. Give the puppy a biscuit if it sits, wiggles and barks.
5. Don't give the puppy a treat otherwise.

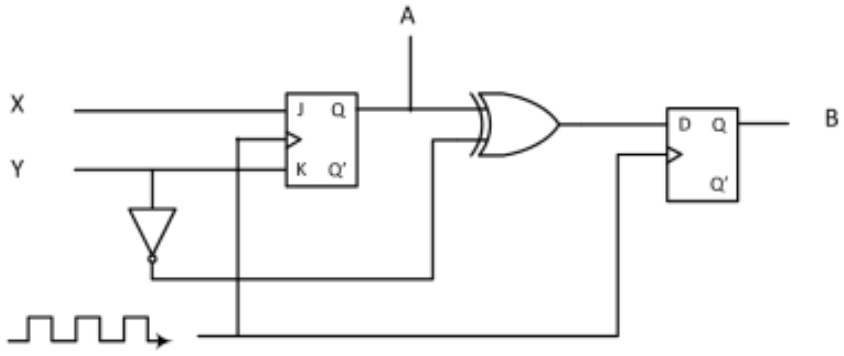
Use the following:

- S: Sit (0 for not sitting; 1 for sitting)
- W: Wiggles (0 for not wiggling; 1 for wiggling)
- B: Barking (0 for not barking; 1 for barking)
- F: Biscuit function (0, don't give the puppy a biscuit; 1, give the puppy a biscuit)

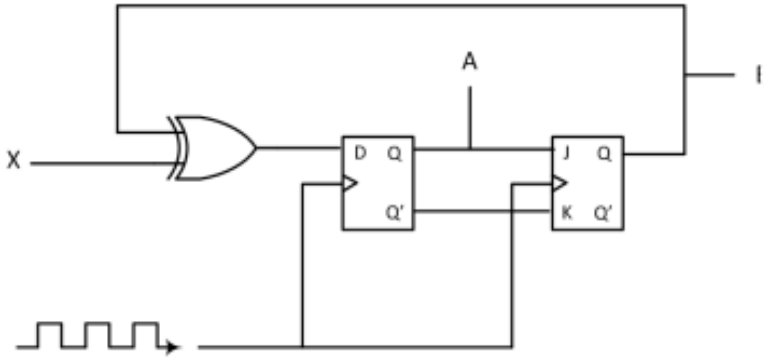
Construct a truth table and find the minimized Boolean function to implement the logic telling Susie when to give her dog a biscuit.

SEQUENTIAL CIRCUITS (from the textbook)

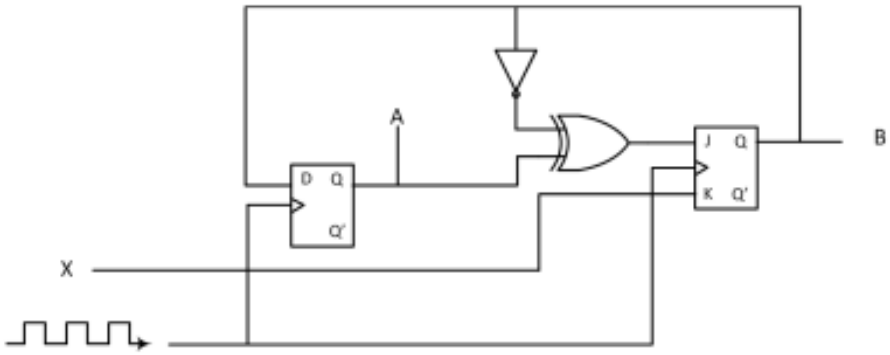
- 62. Complete the truth table for the following sequential circuit:



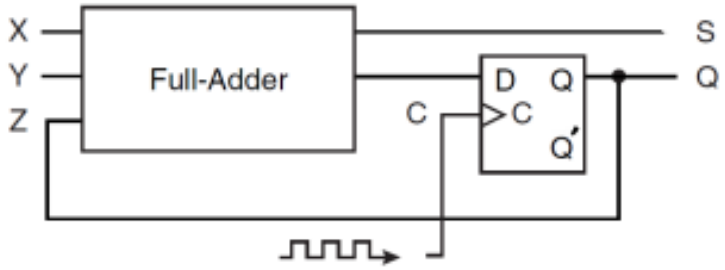
63. Complete the truth table for the following sequential circuit:



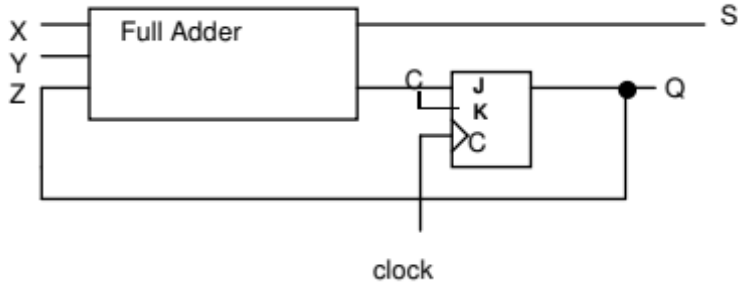
65. Complete the truth table for the following sequential circuit:



♦66. Complete the truth table for the following sequential circuit:



67. A sequential circuit has one flip-flop; two inputs X and Y; and one output, S. It consists of a full-adder circuit connected to a JK flip-flop, as shown below. Fill in the characteristic table for this sequential circuit by completing the *Next State* and *Output* columns.



MEALY AND MOORE MACHINES (from the textbook)

74. Construct a Moore machine that counts to modulo 5

75. Construct two parity checkers using a Moore machine for one and a Mealy machine for the other.

Additional Questions – Boolean Algebra (extra credit):

Solve the following:

1) $a+0=$ _____

2) $\bar{a}\cdot 0=$ _____

3) $a+\bar{a}=$ _____

4) $a+a=$ _____

5) $a+ab=$ _____

6) $a+\bar{a}b=$ _____

7) $a(\bar{a}+b)=$ _____

8) $ab+\bar{a}b=$ _____

9) $(\bar{a}+\bar{b})(\bar{a}+b)=$ _____

10) $a(a+b+c+\ldots)=$ _____

For (11),(12), (13), $f(a,b,c)=a+b+c$

11) $f(a,b,ab)=$ _____

12) $f(a,b,\bar{a}\cdot\bar{b})=$ _____

13) $f[a,b,\overline{(ab)}]=$ _____

14) $y+y\bar{y}=$ _____

15) $xy+x\bar{y}=$ _____

16) $\bar{x}+y\bar{x}=$ _____

17) $(w+\bar{x}+y+\bar{z})y=$ _____

18) $(x+\bar{y})(x+y)=$ _____

19) $w+[w+(wx)]=$ _____

20) $x[x+(xy)]=$ _____

21) $\overline{(\bar{x}+\bar{x})}=$ _____

22) $\overline{(x+\bar{x})}=$ _____

23) $w+(w\bar{x}yz)=$ _____

24) $\bar{w}\cdot\overline{(wxyz)}=$ _____

25) $xz+\bar{x}y+zy=$ _____

26) $(x+z)(\bar{x}+y)(z+y)=$ _____

27) $\bar{x}+\bar{y}+xy\bar{z}=$ _____