6. Create the Kmaps and then simplify for the following functions:

a. $F(w,x,y.z) = w'x'y'z' + w'x'yz' + w'xy'z + w'xyz + w'xyz' + wx'y'z' + wx'yz'$

b. $F(w,x,y,z) = w'x'y'z' + w'x'y'z + wx'y'z + wx'yz' + wx'y'z'$

c. $F(w,x,y,z) = y'z + wy' + w'xy + w'x'yz' + wx'yz'$

Ans.

a. $x'z' + w'xz + w'xy$ *or* $x'z' + w'xz + w'yz'$

WX \ YZ	00	01	11	10
00	1	0	0	1
01	0	1	1	1
11	0	0	0	0
10	1	0	0	1

b. $x'y' + wx'z'$

WX \ YZ	00	01	11	10
00	1	1	0	0

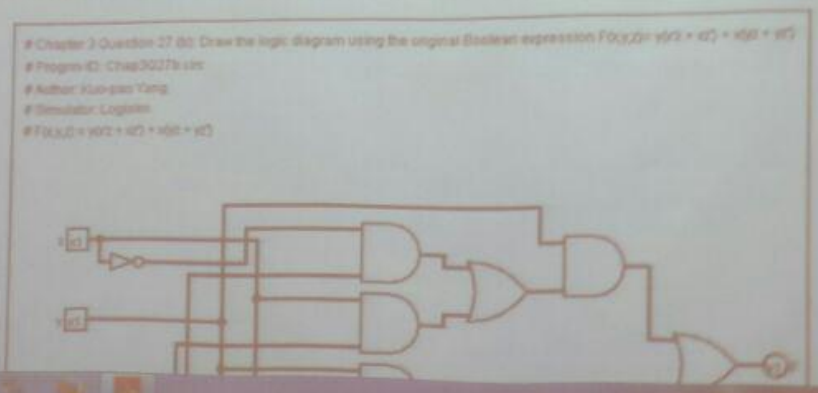
b. Draw the logic diagram using the original Boolean expression
c. Simplify the expression using Boolean algebra and identities.
d. List the truth table for your answer in part c.
e. Draw the logic diagram for the simplified expression in part c.

Ans.

a. Truth table for F(x,y,z) = y(x'z + xz') + x(yz + yz')

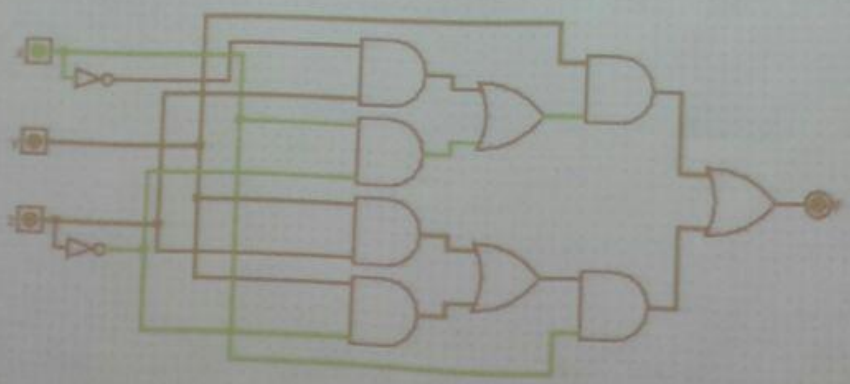
x	y	z	x'z	xz'	y(x'z + xz')	yz	yz'	x(yz + yz')	F
0	0	0	0	0	0	0	0	0	0
0	0	1	1	0	0	0	0	0	0
0	1	0	0	0	0	0	1	0	0
0	1	1	1	0	1	1	0	0	1
1	0	0	0	1	0	0	0	0	0
1	0	1	0	0	0	0	0	0	0
1	1	0	0	1	1	0	1	1	1
1	1	1	0	0	0	1	0	1	1

b. Logic diagram for F(x,y,z) = y(x'z + xz') + x(yz + yz')



a. Truth table for F(x,y,z) = y(x'z + xz') + x(yz + yz')

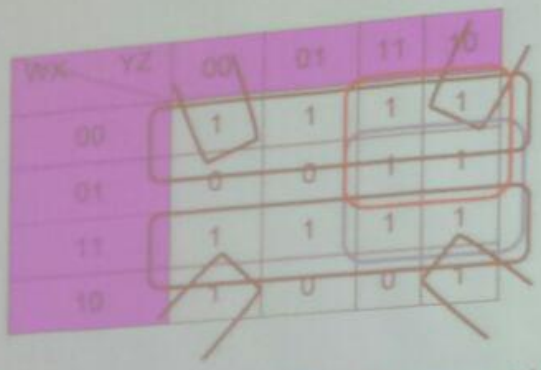
x	y	z	x'z	xz'	y(x'z + xz')	yz	yz'	x(yz + yz')	F
0	0	0	0	0	0	0	0	0	0
0	0	1	1	0	0	0	0	0	0
0	1	0	0	0	0	0	1	0	0
0	1	1	1	0	1	1	0	0	1
1	0	0	0	1	0	0	0	0	0
1	0	1	0	0	0	0	0	0	0
1	1	0	0	1	1	0	1	1	1
1	1	1	0	0	0	1	0	1	1



Ans.

$w'z' + x'y'z' + wyz$

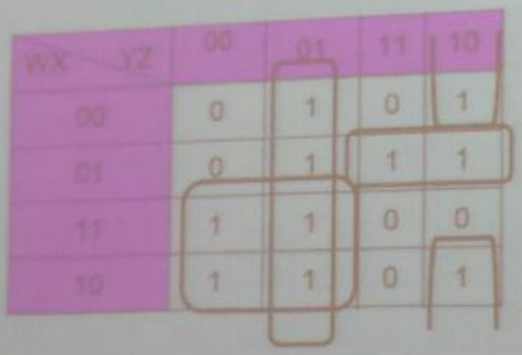
b.



Ans.

$w'x' + wx + x'z' + w'y$ OR $w'x' + wx + x'z' + xy$

c.



Ans.

$wy' + y'z + w'xy + x'yz'$

= xy + yz

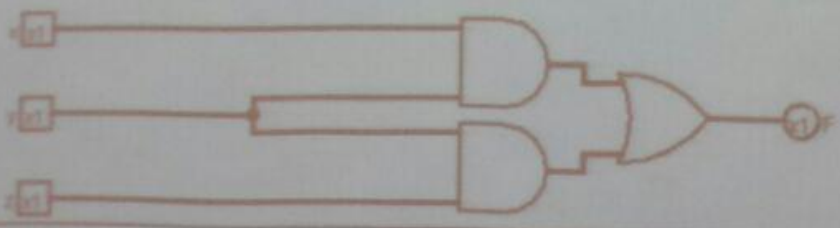
Identity

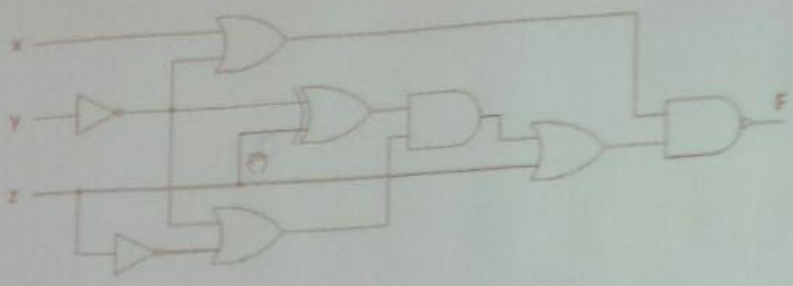
d. Truth table for F(x,y,z) = xy + yz

x	y	z	xy	yz	F
0	0	0	0	0	0
0	0	1	0	0	0
0	1	0	0	0	0
0	1	1	0	1	1
1	0	0	0	0	0
1	0	1	0	0	0
1	1	0	1	0	1
1	1	1	1	1	1

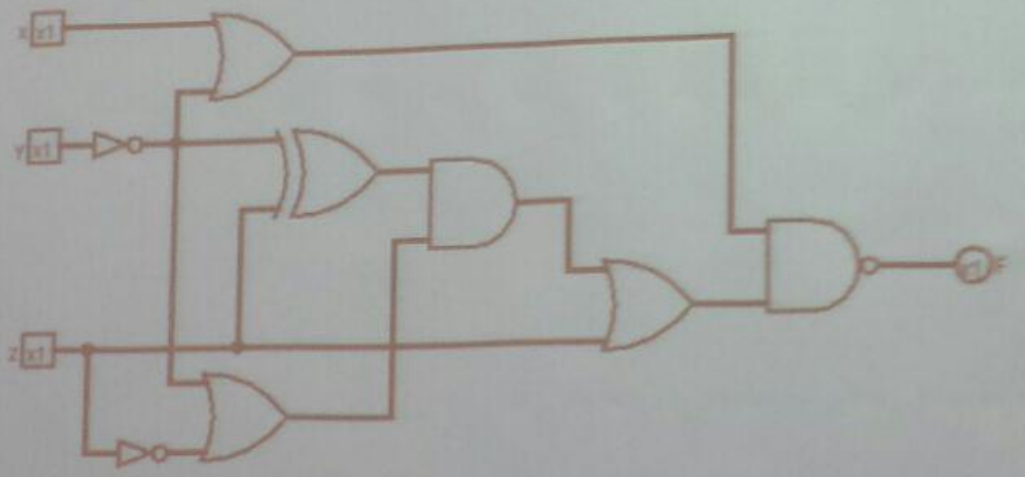
e. Logic diagram for F(x,y,z) = xy + yz

Chapter 3 Question 27 (e): Draw the logic diagram using the original Boolean expression F(x,y,z) = xy + yz
Progrm-ID: Chap3Q27e.circ
Author: Xiao-bao Yang
Simulator: Logisim
F(x,y,z) = xy + yz





Ans.



x	y	z	F
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	0

b) $xy + xyz + xy'z + x'y'z = xy(1 + z) + (x + x')y'z$ — Distributive
$= xy(1) + (1)y'z$ — Idempotent
$= xy + y'z$ — Identity

c) $xy'z + x(y + z')' + xy'z' = xy'z + xy'z + xy'z$ — DeMorgan
$= xy'z + xy'(z + z')$ — Distributive
$= xy'z + xy'(1)$ — Inverse
$= xy'z + xy'$ — Identity
$= xy'(z + 1)$ — Distributive
$= xy'(1)$ — Null
$= xy'$ — Identity

22. The truth table for a Boolean expression is shown below. Write the Boolean expression in sum-of-products form.

x	y	z	F
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

Ans.

$F(x,y,z) = x'y'z' + x'yz' + xy'z + xyz' + xyz$

11	0	0	0	0
10	1	0	0	1

b. $x'y' + wx'z'$

WX \ YZ	00	01	11	10
00	1	1	0	0
01	0	0	0	0
11	0	0	0	0
10	1	1	0	1

c. $y'z + wy' + w'xy + x'yz'$

WX \ YZ	00	01	11	10
00	0	1	0	1
01	0	1	1	1
11	1	1	0	0
10	1	1	0	1

c. y(x'z + xz') + x(yz + yz') = x'yz + xyz' + xyz + xyz' Distributive/Commutative

= x'yz + xyz + xyz' Idempotent

= x'yz + xyz + xyz + xyz' Idempotent

= (x'+ x)yz + xy(z+ z') Distributive

= 1yz + xy1 Inverse

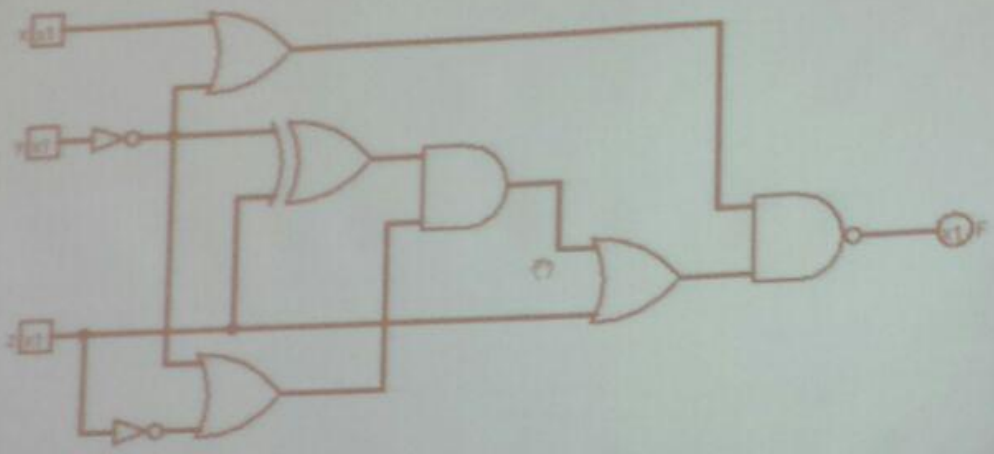
= xy + yz Identity

d. Truth table for F(x,y,z) = xy + yz

x	y	z	xy	yz	F
0	0	0	0	0	0
0	0	1	0	0	0
0	1	0	0	0	0
0	1	1	0	1	1
1	0	0	0	0	0
1	0	1	0	0	0
1	1	0	1	0	1
1	1	1	1	1	1

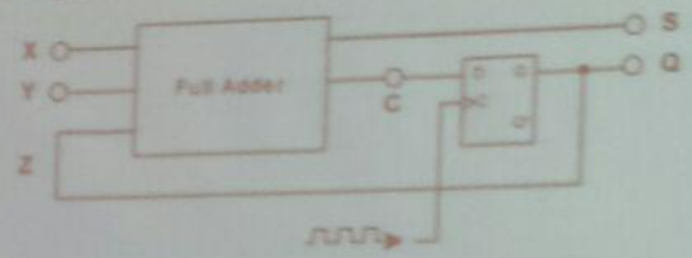
e. Logic diagram for F(x,y,z) = xy + yz

Ans.

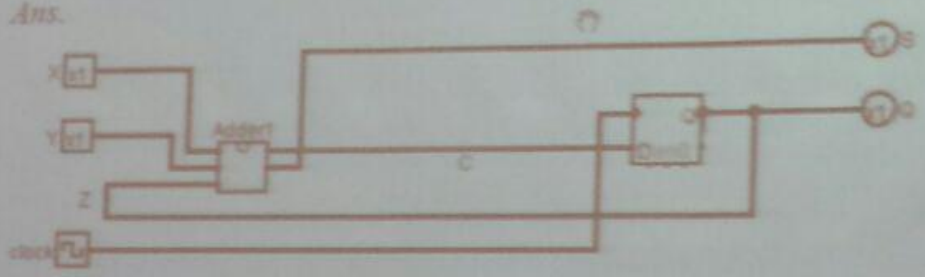


x	y	z	F
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	0

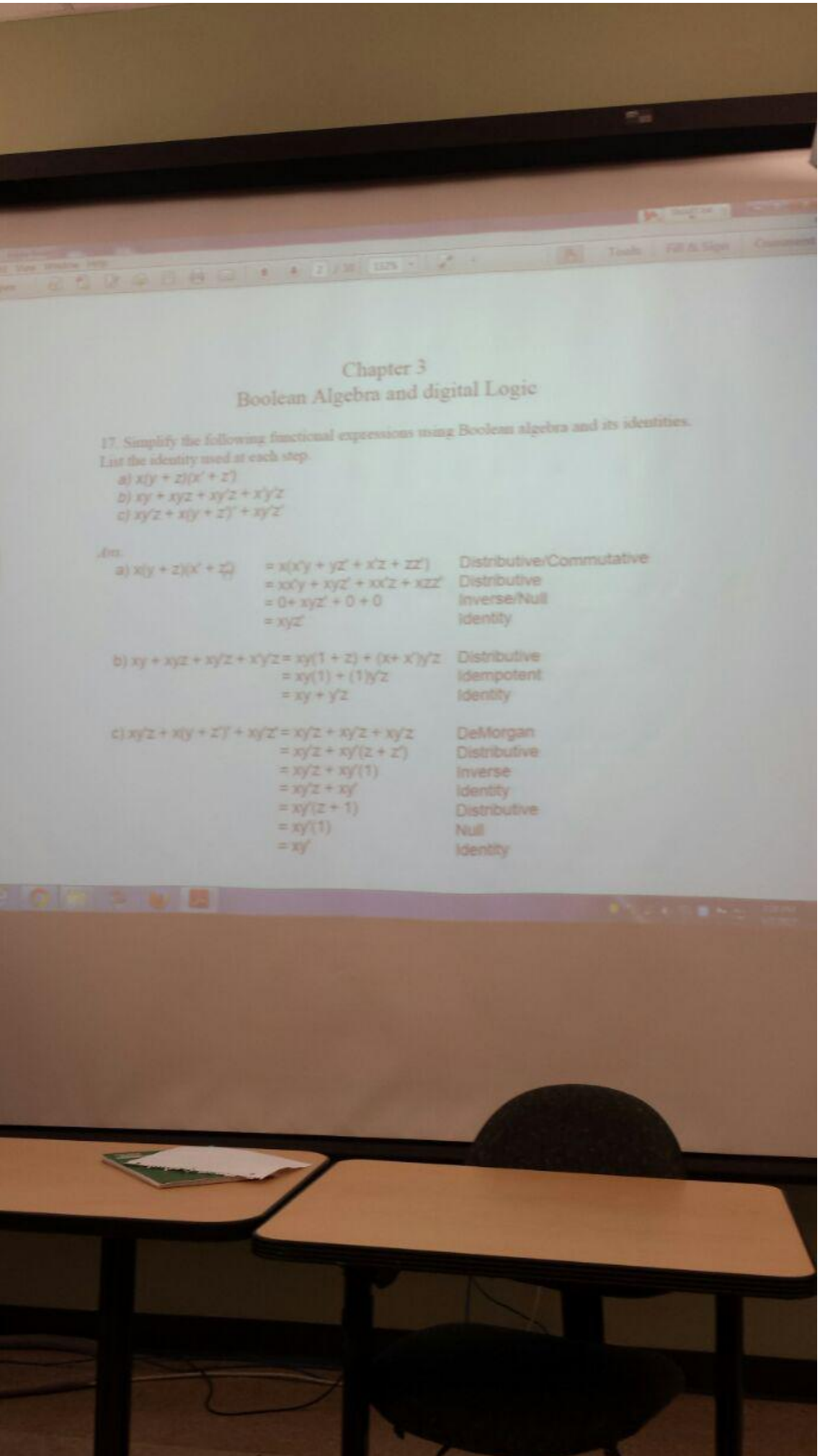
54. Complete the truth table for the following sequential circuit:



Ans.



			Next State	
X	Y	Z	S	Q
0	0	0	0	0
0	0	1	0	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	1	1
1	1	1	1	1



Chapter 3
Boolean Algebra and digital Logic

17. Simplify the following functional expressions using Boolean algebra and its identities. List the identity used at each step.

a) x(y + z)(x′ + z′)
b) xy + xyz + xy′z + x′y′z
c) xy′z + x(y + z′)′ + xy′z′

Ans.

a) x(y + z)(x′ + z′)
= x(x′y + yz′ + x′z + zz′) Distributive/Commutative
= xx′y + xyz′ + xx′z + xzz′ Distributive
= 0+ xyz′ + 0 + 0 Inverse/Null
= xyz′ Identity

b) xy + xyz + xy′z + x′y′z = xy(1 + z) + (x+ x′)y′z Distributive
= xy(1) + (1)y′z Idempotent
= xy + y′z Identity

c) xy′z + x(y + z′)′ + xy′z′ = xy′z + xy′z + xy′z DeMorgan
= xy′z + xy′(z + z′) Distributive
= xy′z + xy′(1) Inverse
= xy′z + xy′ Identity
= xy′(z + 1) Distributive
= xy′(1) Null
= xy′ Identity

Chapter 3A: Focus On Kmaps

4. Write a simplified expression for the Boolean function defined by each of the following Kmaps.

a.

WX \ YZ	00	01	11	10
00	1	0	0	1
01	1	0	0	1
11	0	0	1	0
10	1	0	1	0

Ans

$w'z' + x'y'z' + wyz$

b.

WX \ YZ	00	01	11	10
00	1	1	1	1
01	0	0	1	1
11	1	1	1	1
10	1	0	0	1

a. $F(w,x,y,z) = w'x'y'z' + w'x'yz' + w'xy'z + w'xyz + w'xyz' + wx'y'z' + wx'yz'$

b. $F(w,x,y,z) = w'x'y'z' + w'x'y'z + wx'y'z + wx'yz' + wx'y'z'$

c. $F(w,x,y,z) = y'z + wy' + w'xy + w'x'yz' + wx'yz'$

Ans.

a. $x'z' + w'xz + w'xy$ *or* $x'z' + w'xz + w'yz'$

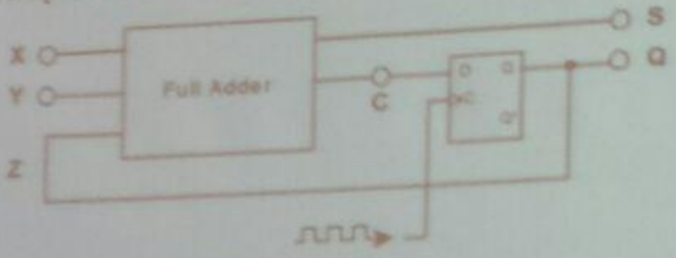
WX \ YZ	00	01	11	10
00	1	0	0	1
01	0	1	1	1
11	0	0	0	0
10	1	0	0	1

b. $x'y' + wx'z'$

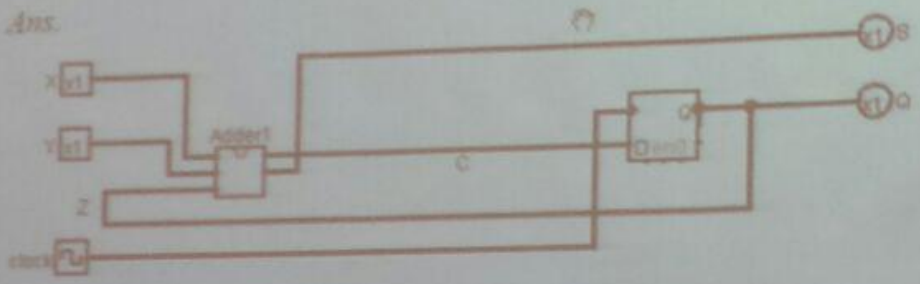
WX \ YZ	00	01	11	10
00	1	1	0	0
01	0	0	0	0
11	0	0	0	0
10	1	1	0	1

c. $y'z + wy' + w'xy + x'yz'$

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



Ans.



			Next State	
X	Y	Z	S	Q
0	0	0	0	0
0	0	1	0	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	1	1
1	1	1	1	1

9. Write a simplified expression for the Boolean function defined by each of the following Kmaps.

a.

X \ YZ	00	01	11	10
0	1	1	0	X
1	1	1	1	1

Ans.

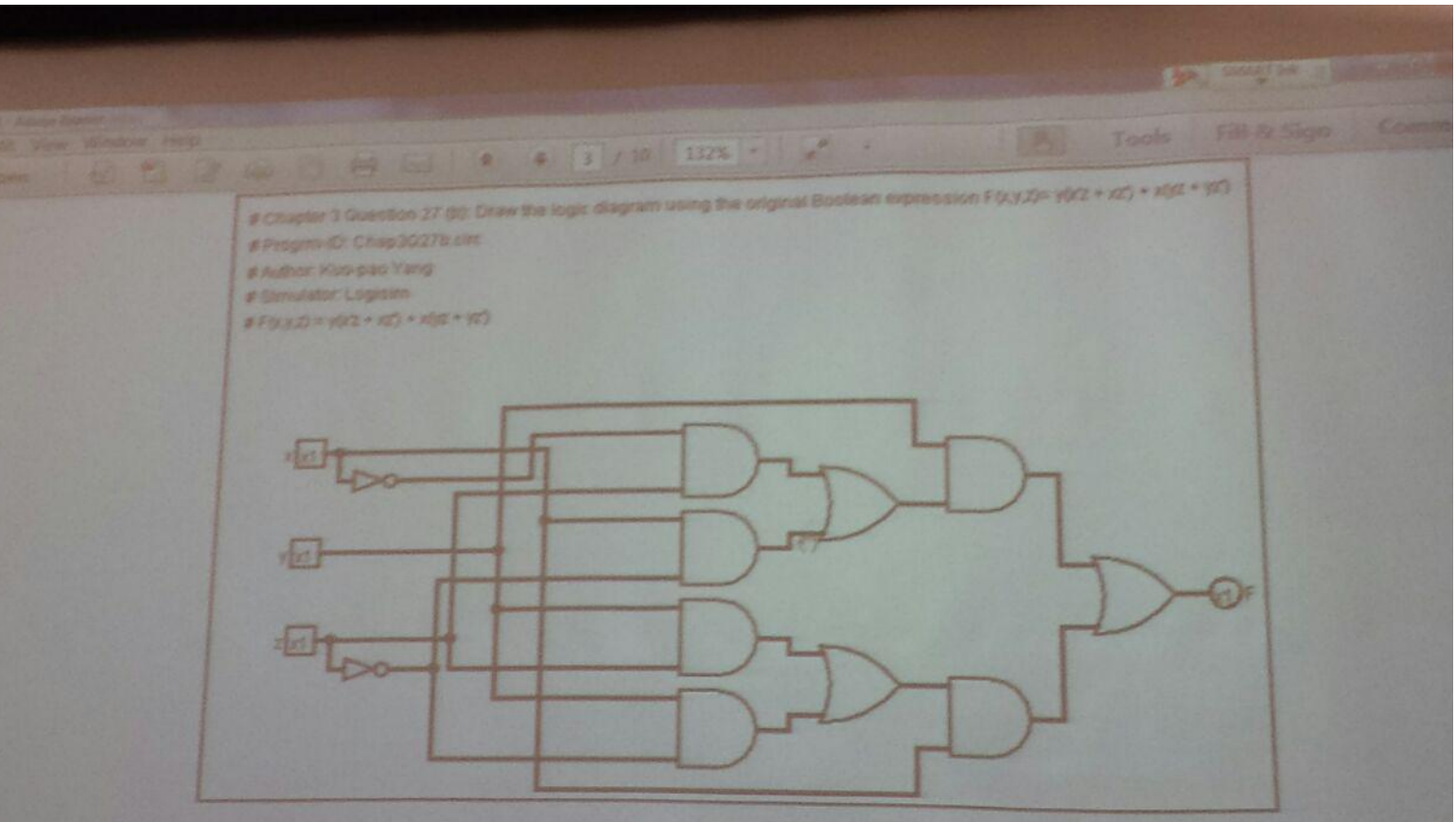
$x + y'$ (We don't want to include the "don't care" as it doesn't help us.)

b.

WX \ YZ	00	01	11	10
00	1	1	1	1
01	0	X	1	X
11	0	0	X	0
10	1	0	X	1

Ans.

$x'z' + w'z$


Tools
Fill & Sign
Chapter 3 Question 27 (d): Draw the logic diagram using the original Boolean expression F(x,y,z)= y(z' + xz') + x(z + y')
Progrm-ID: Chap3Q27d.cir
Author: Kuo-pao Yang
Simulator: Logisim
F(x,y,z) = y(z' + xz') + x(z + y')