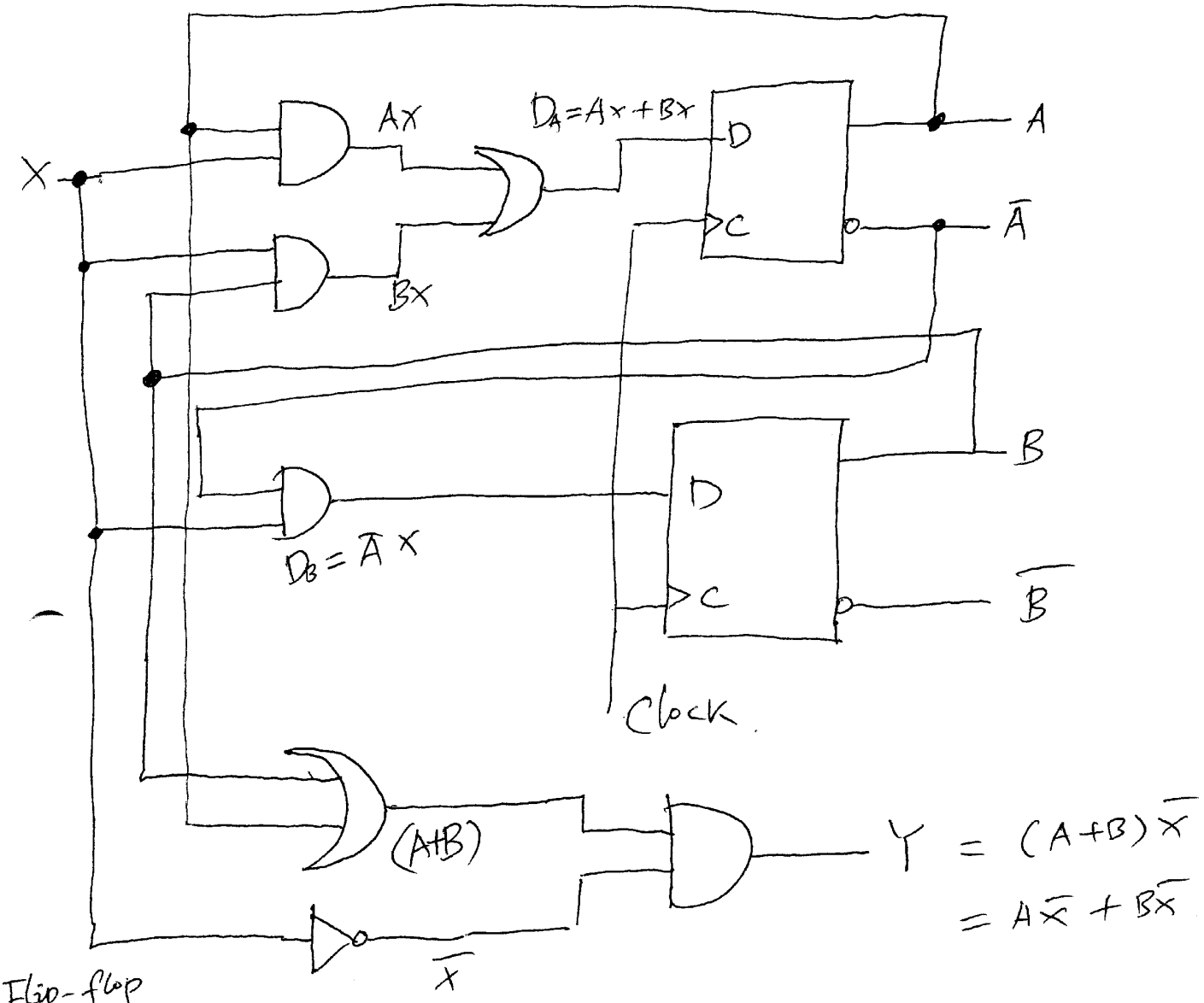
4-4 Sequential Circuit Analysis (P201)

Figure 4-18 (on page 203)



Flip-flop Input equations

$D_A = Ax + Bx$, $D_B = \bar{A}x$.

Output equations.

$Y = (A+B)\bar{x} = A\bar{x} + B\bar{x}$

The next states of flip-flops

$A(t+1) = D_A = Ax + Bx$

$B(t+1) = D_B = \bar{A}x$.

State Table

A State table lists the functional relationships between the inputs, outputs, and flip-flop states of a sequential circuit.

Present state A(t)	Present state B(t)	Input X(t)	Next state A(t+1)	Next state B(t+1)	Output Y	Flip-flop inputs D_A	Flip-flop inputs D_B
0	0	0	0	0	0	0	0
0	0	1	0	1	0	0	1
0	1	0	0	0	0	0	0
0	1	1	1	1	0	1	1
1	0	0	0	0	1	0	0
1	0	1	1	0	0	1	0
1	1	0	0	0	1	0	0
1	1	1	1	0	0	1	0

Next state: states of the flip-flops one clock period later

One-dimensional state table

It is one-dimensional in the sense that the present state and input combinations are combined into a single column of combinations.

Two dimensional state table

Present state A	Present state B	Next state X=0 A	Next state X=0 B	Next state X=1 A	Next state X=1 B	Output X=0 Y	Output X=1 Y
0	0	0	0	0	1	0	0
0	1	0	0	1	1	1	0
1	0	0	0	1	0	1	0
1	1	0	0	1	0	1	0

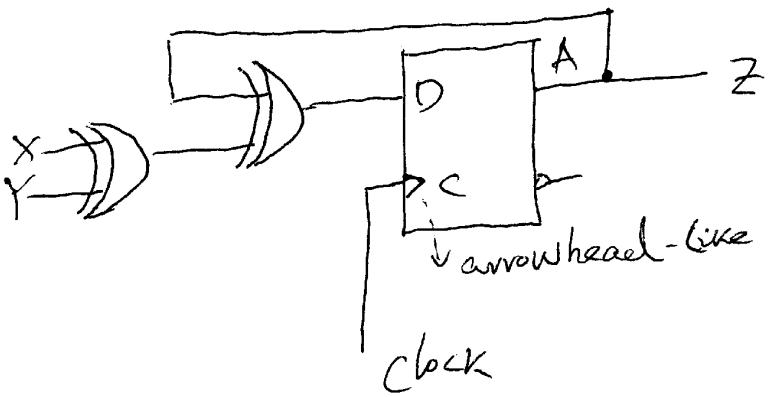
The analysis with JK Flip-flops is similar. J_A, K_A, J_B K_B

Mealy & Moore Models

Sequential circuits in which the outputs depend on the inputs, as well as on the states, are referred to as Mealy model circuits. Otherwise, if the outputs depend only on the states, the circuits are called Moore model circuits. Each model is named after its originator.

The example above is a Mealy model circuit.

An example of a Moore model circuit: Figure 4-19. (Pg. 205)



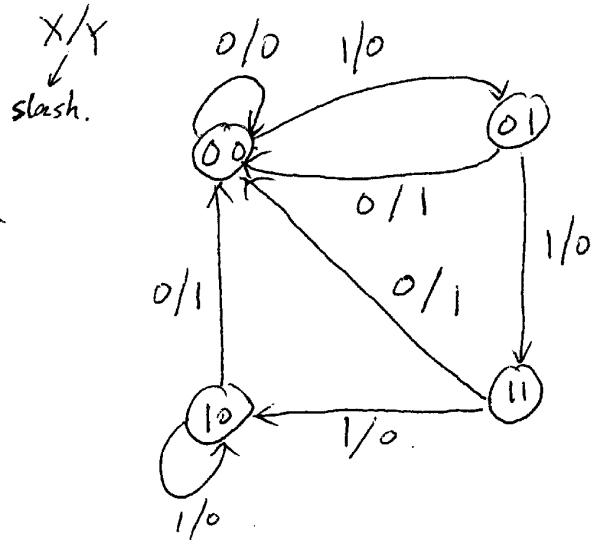
$$\begin{cases} D_A = A \oplus X \oplus Y \\ Z = A \end{cases}$$

$$A(t+1) = D_A = A \oplus X \oplus Y$$

present state A	inputs X	inputs Y	Next State A	output Z
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	0
1	0	0	1	1
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

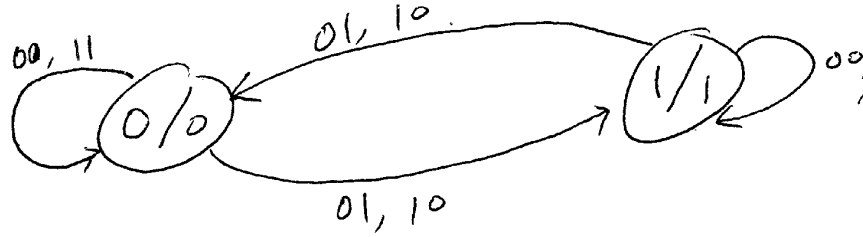
State Diagram

The information available in a state table may be represented graphically in the form of a state diagram. In this type of diagram, a state is represented by a circle, and transitions between states are indicated by directed lines connecting the circles. The state diagram provides the same information as the state table and is obtained directly from it.



For Mealy model circuits, X/Y input/output.

For a Moore model circuit, the slash and output is not included, since the outputs depend only on the state and not on the input values. Instead, the output is included under a slash below the state in a circle.



separated by a comma.