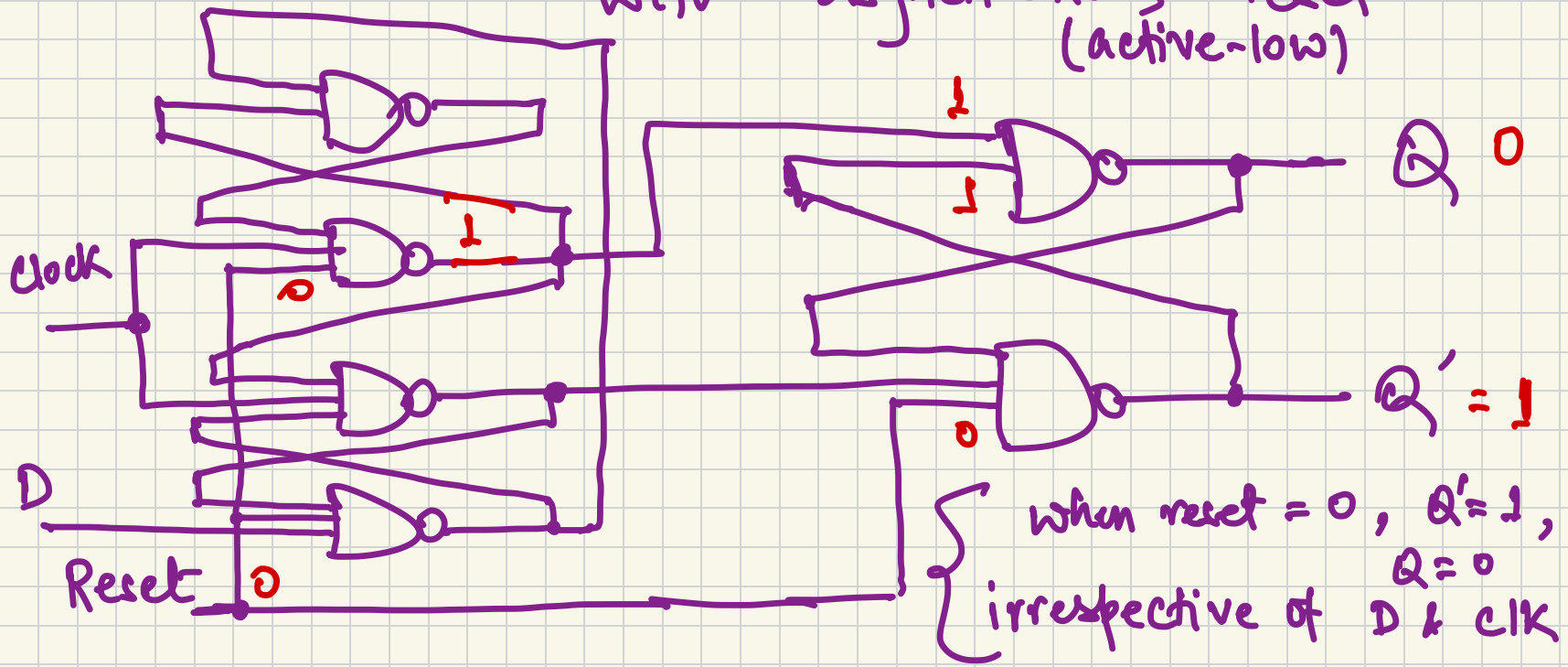
ACOL 215

(10th Nov.)

Positive-edge triggered D flip-flop with asynchronous reset (active-low)



Exercise

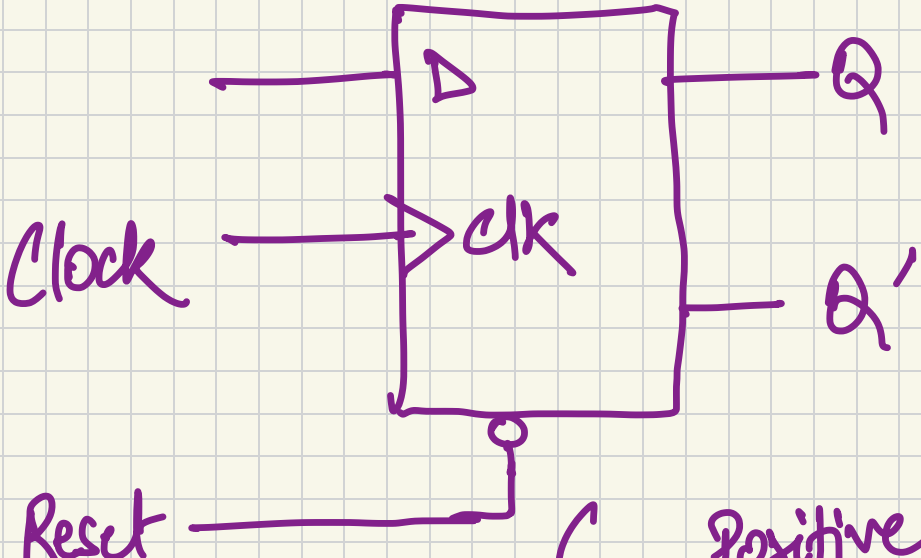
asynchronous active-low set

set = 0 then Q = 1

When reset is 1 this behaves like a positive edge-triggered D flip-flop

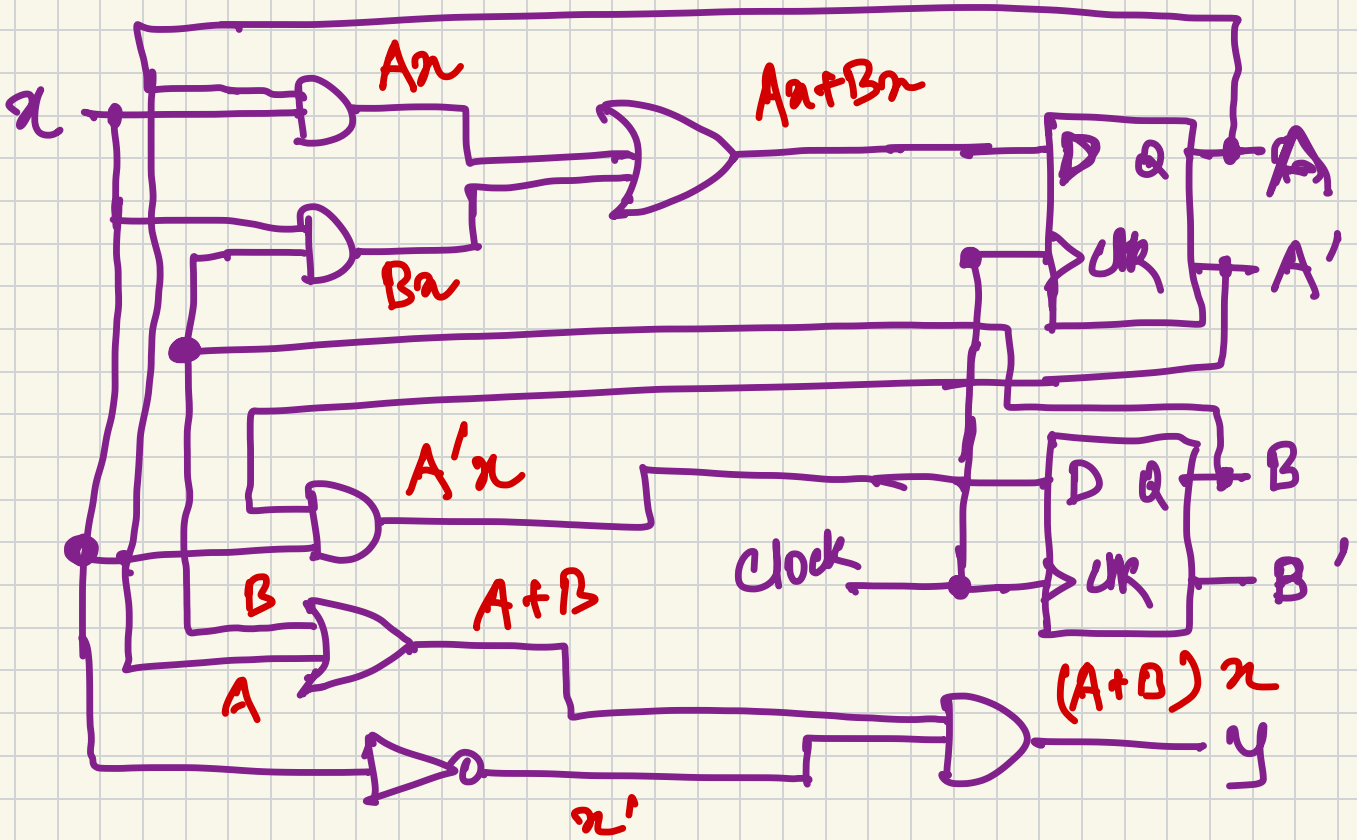
Rest	Clk	D	Q	Q'
1	↑	0	0	1
1	↑	1	1	0
0	x	x	0	1

Graphical symbol



D Positive edge triggered flip-flop with active low reset

Analysis of clocked sequential circuits



$Ax + Bx$

$$A(t+1) = A(t)\,x(t) + B(t)\,x(t)$$

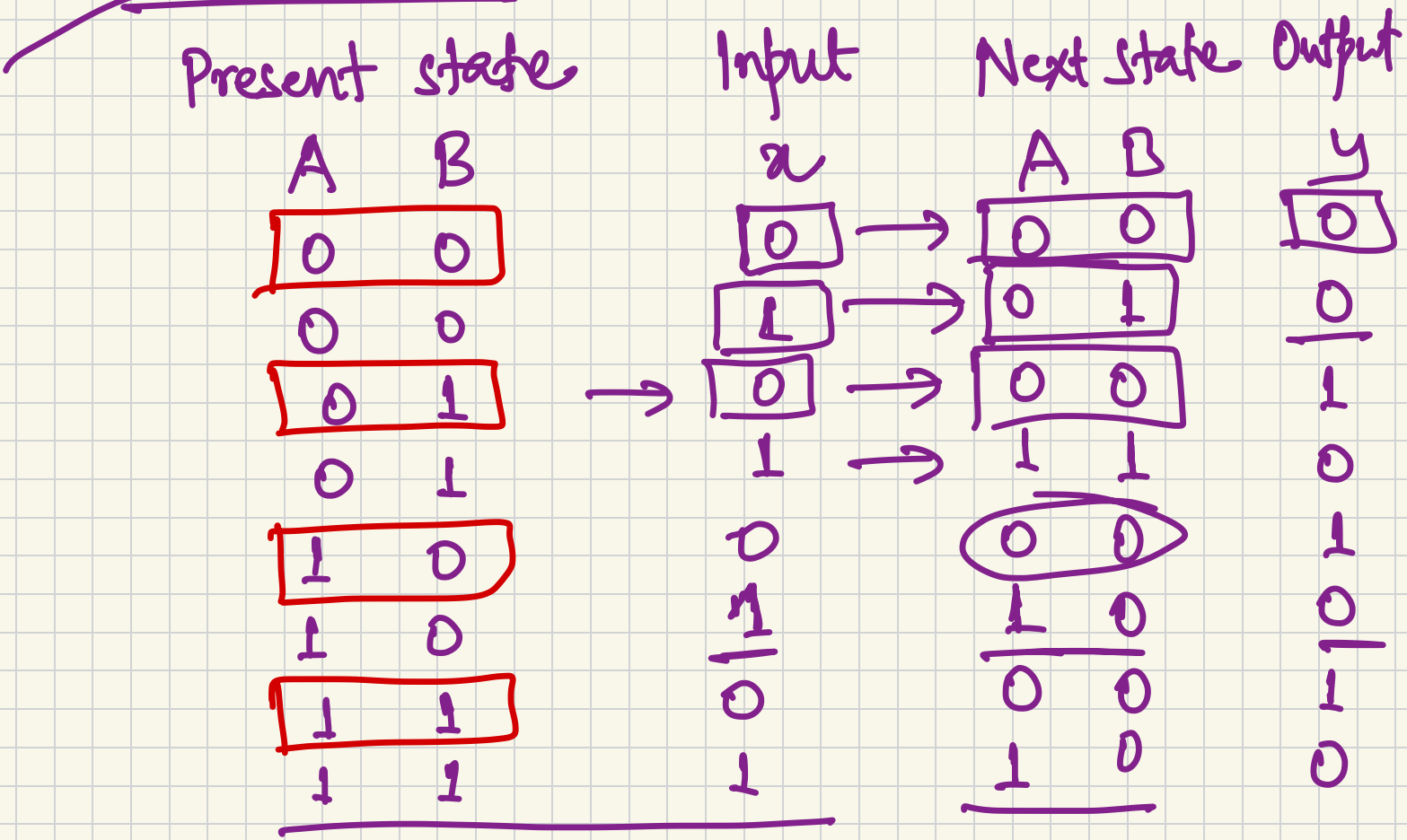
$$B(t+1) = A'(t)\,x(t) \qquad A'x$$

$$y(t) = \big(A(t) + B(t)\big)\,x'(t)$$

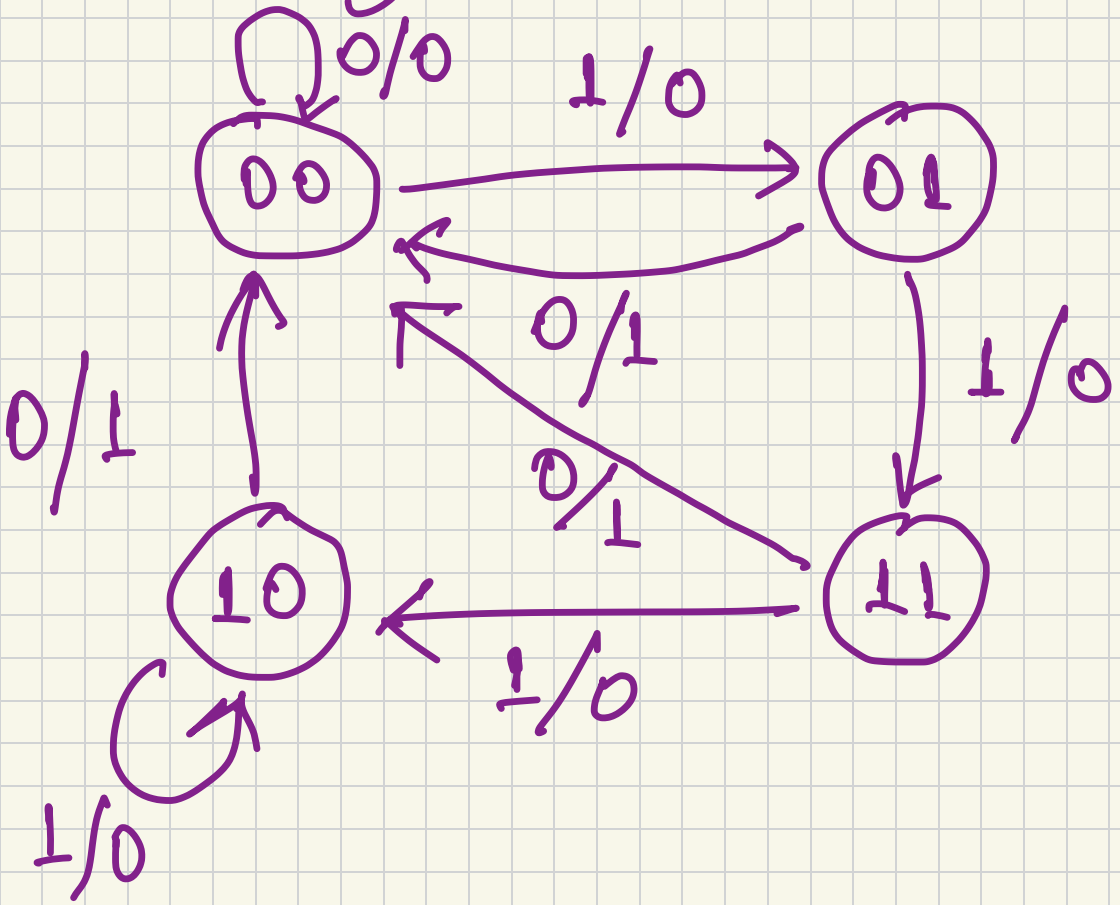
$$= (A+B)\,x'$$

$$= Ax' + Bx'$$

State table


Present state
Input
Next state
Output
A B
x
A B
y
0 0
0 0
0
0 1
0 1
0
1 0
0 0
1
1 1
1 1
0
1 0
1
1 0
1 0
0
1 1
0 0
1
1 1
1 0
0
0 0
1 0
1 0

State diagram



Alternate form (of the state table)

Present state		Next state				Output	
		$x=0$		$x=1$		$x=0$	$x=1$
A	B	A	B	A	B	y	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

Flip-flop input equations (also called excitation equations)

Flip-flop input eqns

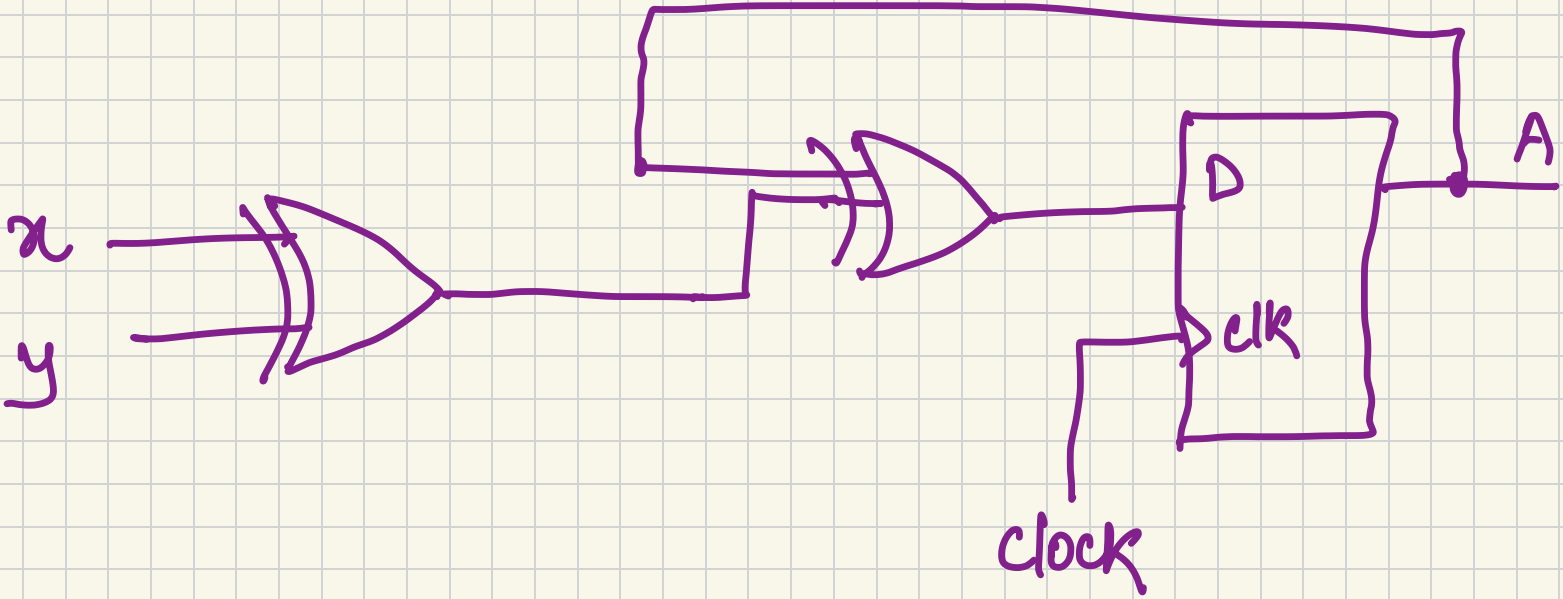
$$D_A = Ax + Bx$$

$$D_B = A'x$$

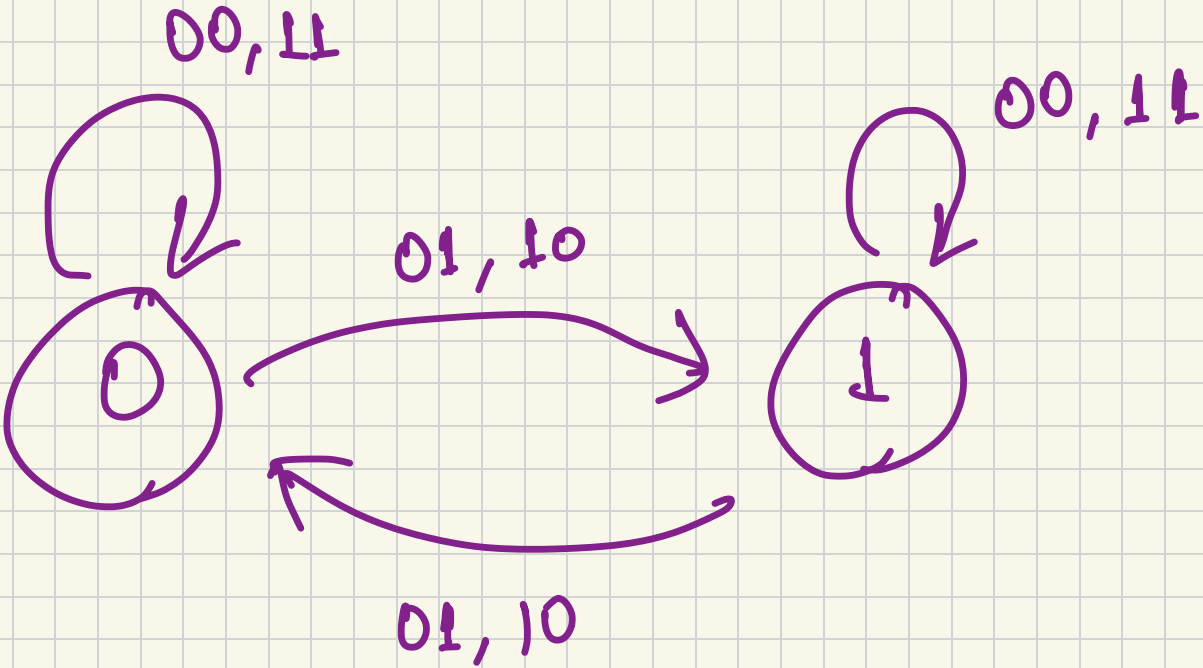
output eqn

$$y = (A+B)x'$$

$$D_A = A \oplus x \oplus y$$



Present State	Inputs		Next state
A	x	y	A
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1


00, 11
00, 11
01, 10
0
1
01, 10