COMPUTER SCIENCE & IT

DIGITAL LOGIC

Lecture No: 07

Miscellaneous Topics

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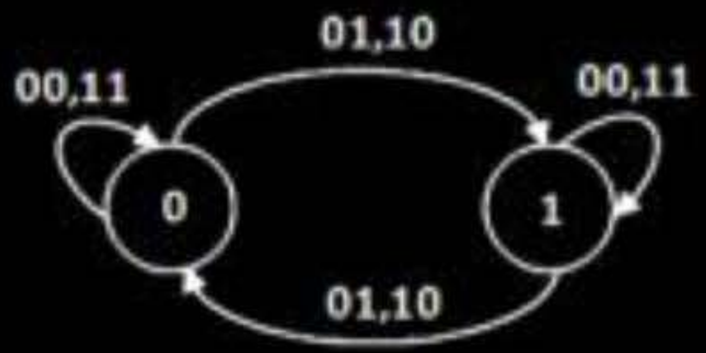
Recap of Previous Lecture

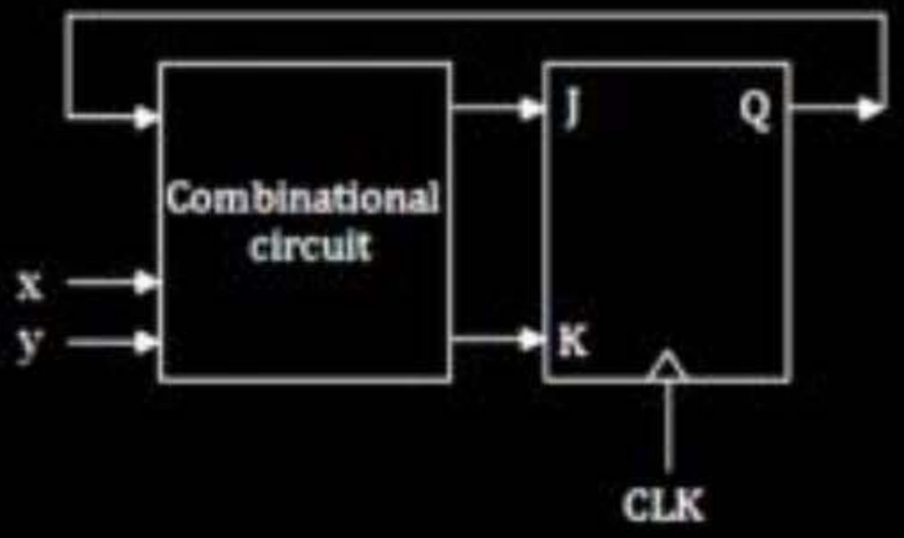
State transition Diagram

Concept Delay

[MCQ]

Consider the following state diagram and its realization by a JK flip flop :
The combinational circuit generates J and K in terms of x, y and Q. The Boolean expressions for J and K are :





(A) $(x \oplus y)'$ and $(x \oplus y)'$

(B) $(x \oplus y)'$ and $x \oplus y$

(C) $x \oplus y$ and $(x \oplus y)'$

(D) $x \oplus y$ and $x \oplus y$

x	y	$Q(n)$	$Q(n+1)$	J	K
0	0	0	0	0	X
0	0	1	1	X	0
0	1	0	1	1	X
0	1	1	0	X	1
1	0	0	1	1	X
1	0	1	0	X	1
1	1	0	0	0	X
1	1	1	1	X	0

$$Q(n+1) = P\bar{Q}(n) + \bar{P}Q(n)$$

$$Q(n+1) = P \oplus Q(n) = \underline{\underline{x \oplus y}} \oplus Q(n)$$

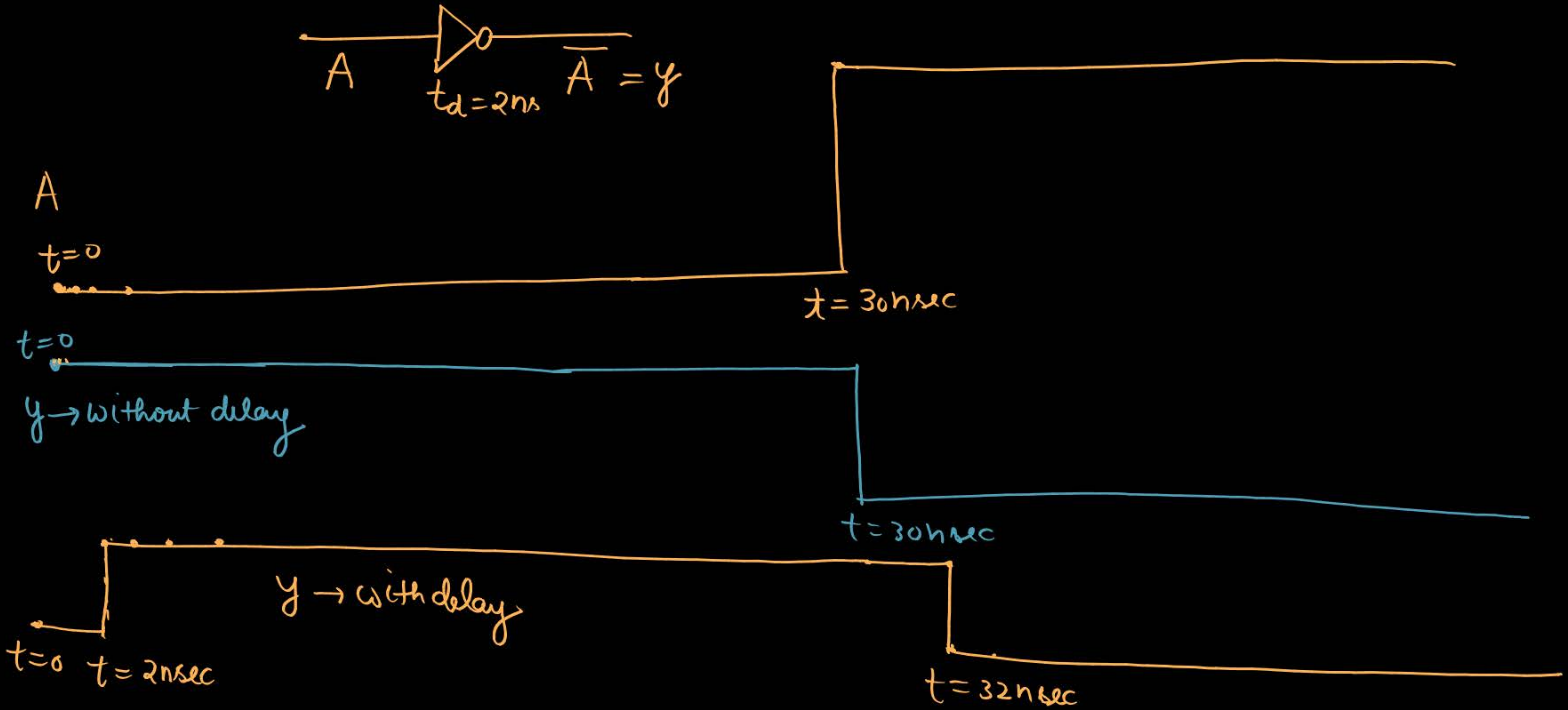
	$\bar{y}\bar{Q}$	$\bar{y}Q$	yQ	$y\bar{Q}$
$\bar{x}$		1		1
x	1		1	

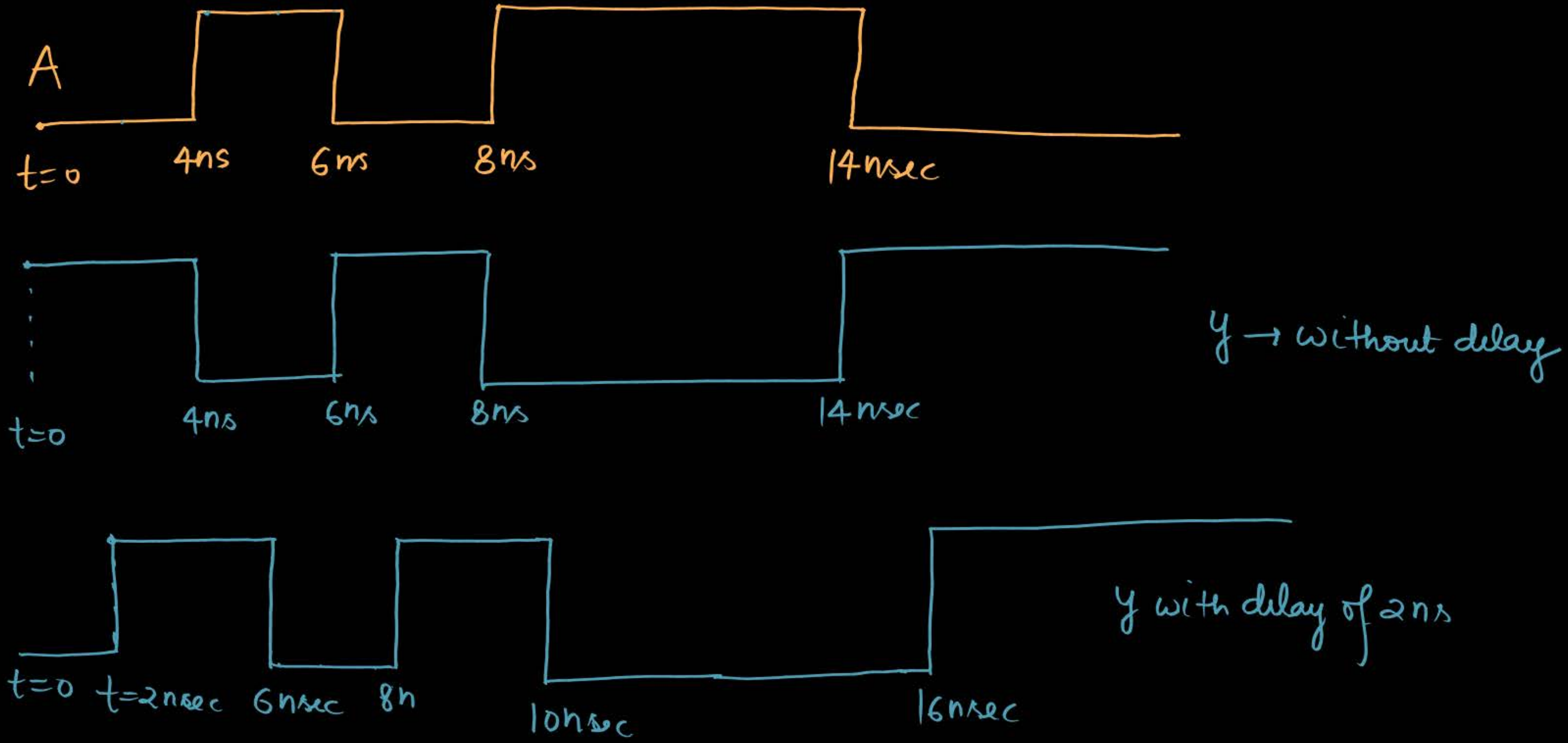
$$= \bar{x}\bar{y}Q(n) + \bar{x}y\bar{Q}(n) + x\bar{y}\bar{Q}(n) + xyQ(n)$$

$$= (\bar{x}y + x\bar{y})\bar{Q}(n) + (\bar{x}\bar{y} + xy)Q(n)$$

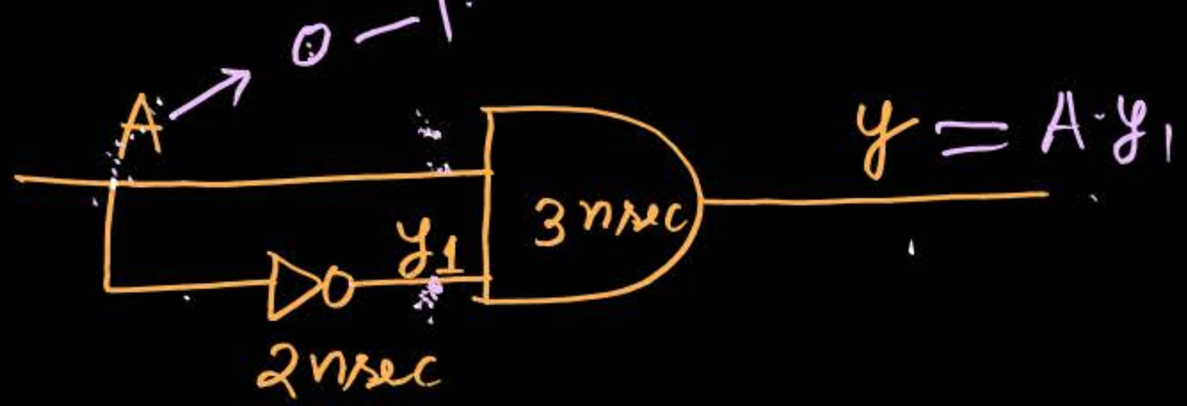
$$Q(n+1) = \underline{\underline{(x \oplus y)}}\,\bar{Q}(n) + \underline{\underline{(x \odot y)}}\,Q(n)$$

Concept of Delay:




A
t=0
4ns
6ns
8ns
14nsec
t=0
4ns
6ns
8ns
14nsec
y → without delay
t=0
t=2nsec
6nsec
8n
10nsec
16nsec
y with delay of 2ns

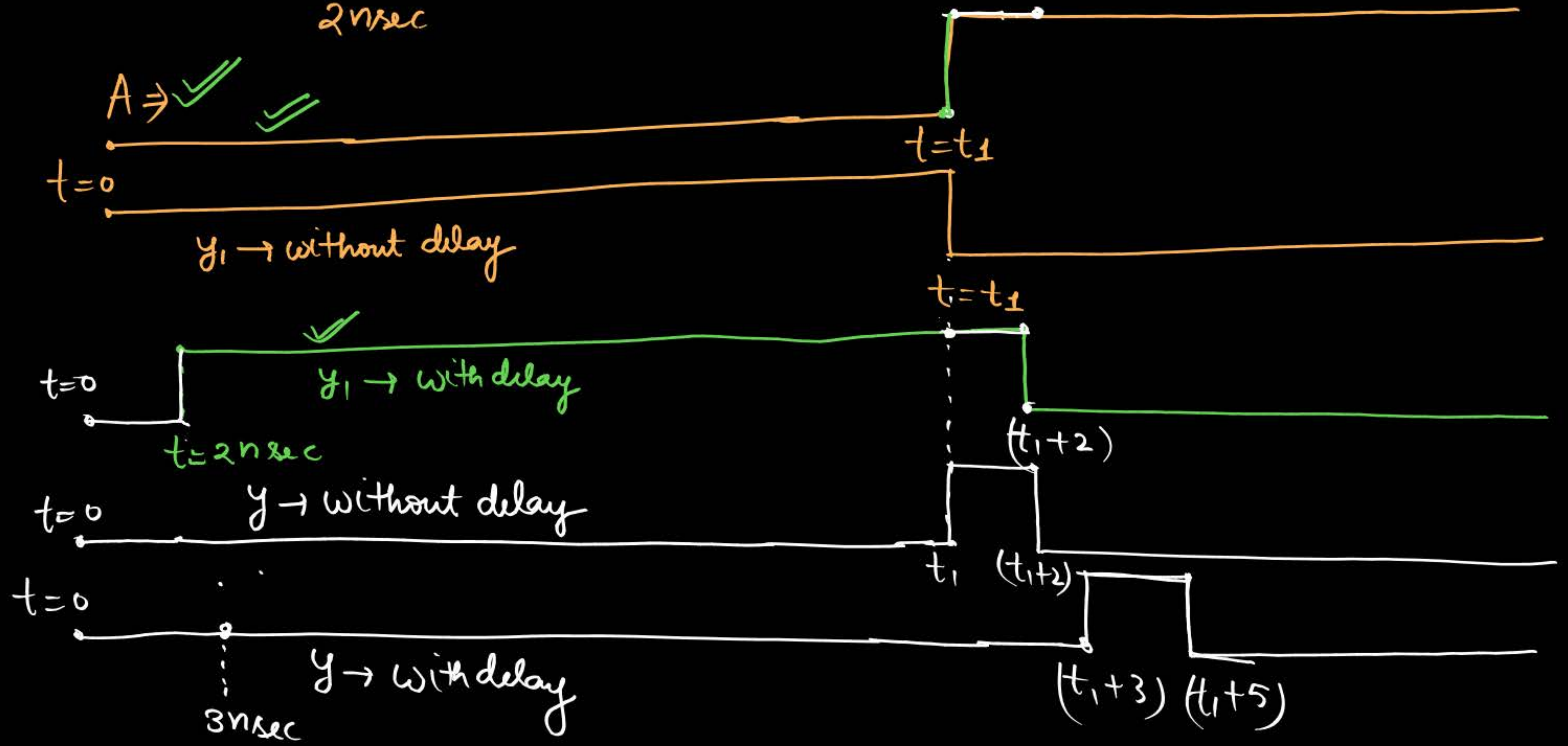
#

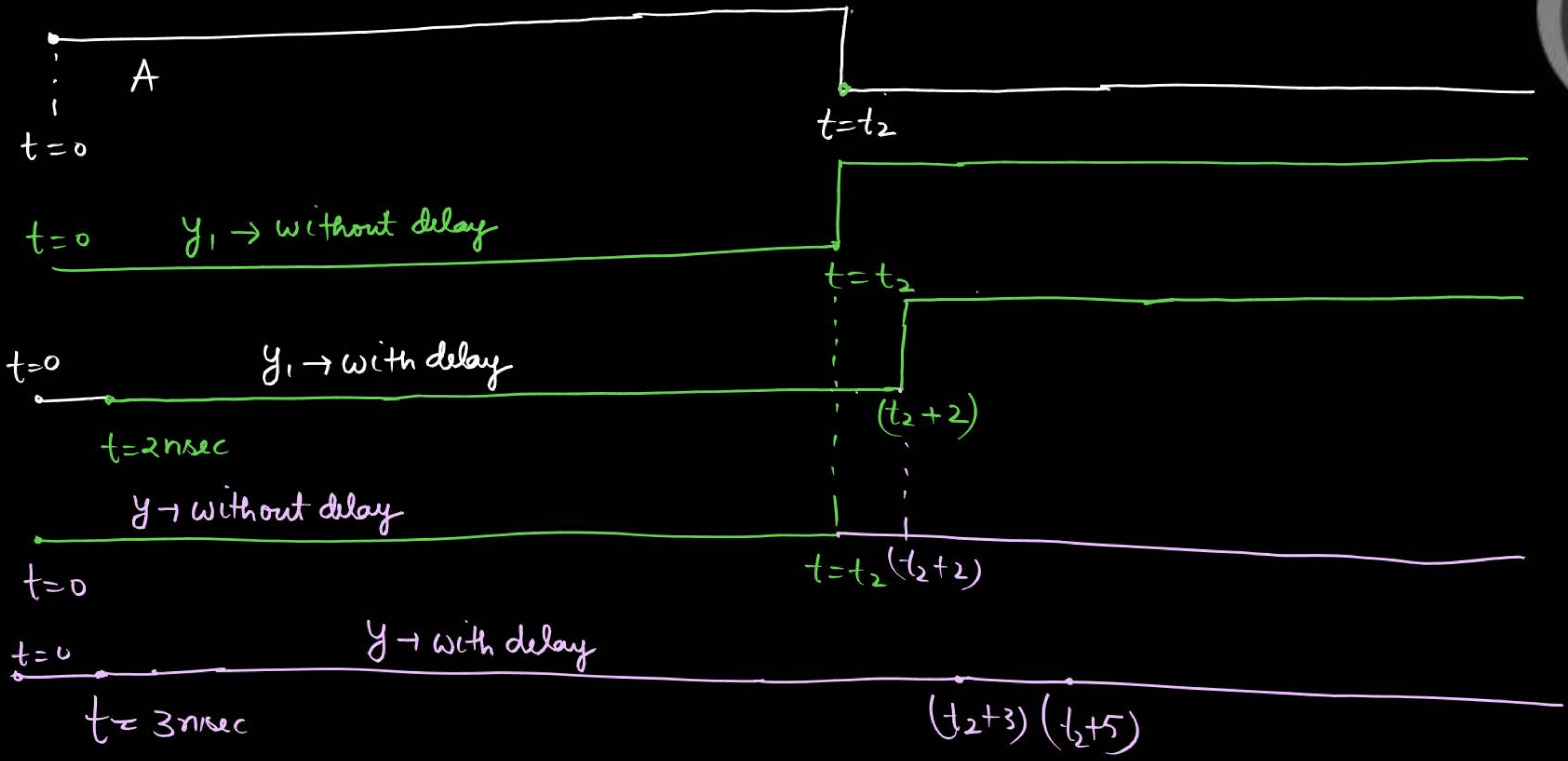


$$y_1 = \overline{A}$$

$$y = A \cdot \overline{A} = 0$$

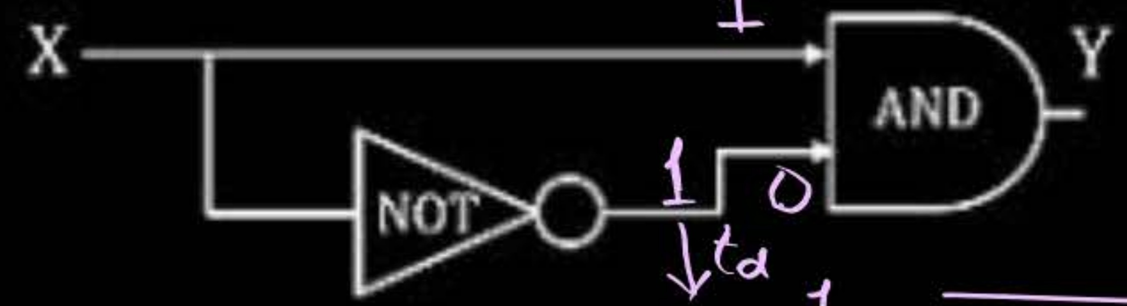
take O/P AND gate to be NAND gate and plot the waveform




A
t=0
t=t2
t=0
y1 → without delay
t=t2
t=0
y1 → with delay
(t2+2)
t=2nsec
y → without delay
t=0
t=t2
(t2+2)
t=0
y → with delay
t= 3nsec
(t2+3)
(t2+5)

[MCQ]

Consider the circuit shown below where the gates may have propagation delays. Assume that all signal transitions occur instantaneously and that wires have no delays. Which of the following statements about the circuit is/are CORRECT?



$Y = X \cdot \overline{X} = 0$

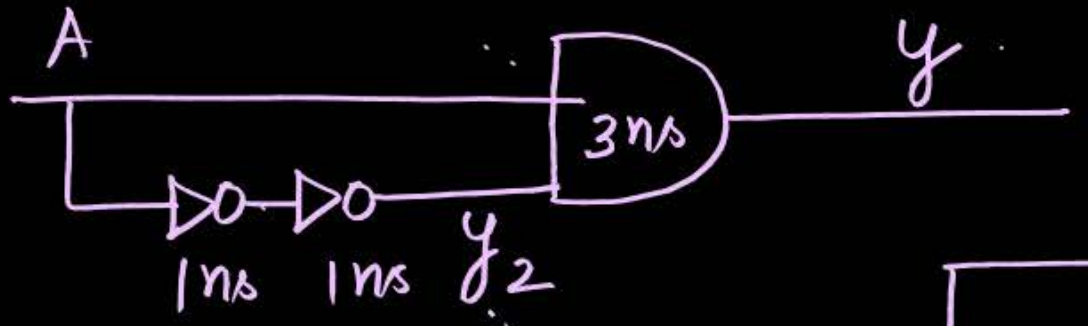
$\overline{X \cdot \overline{X}} = 1$

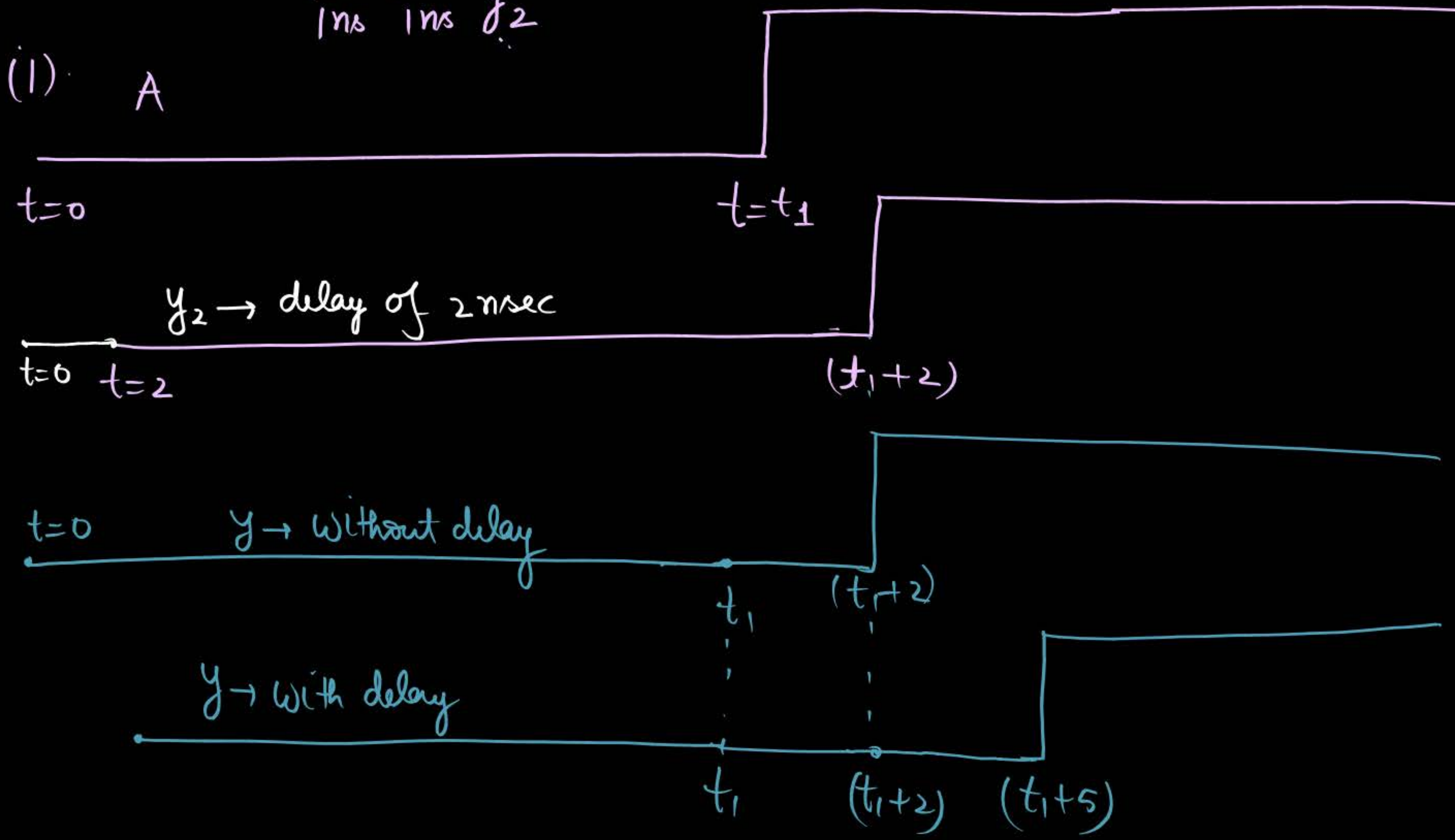
(A) With propagation delays, the output Y can have a transient logic ~~Zero~~ after X transitions from logic One to logic Zero

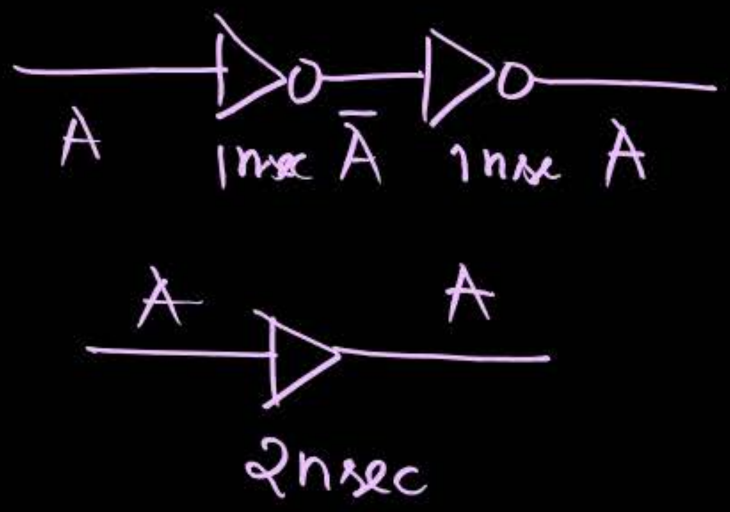
(B) With no propagation delays, the output Y is always logic One

(C) With no propagation delays, the output Y is always logic Zero

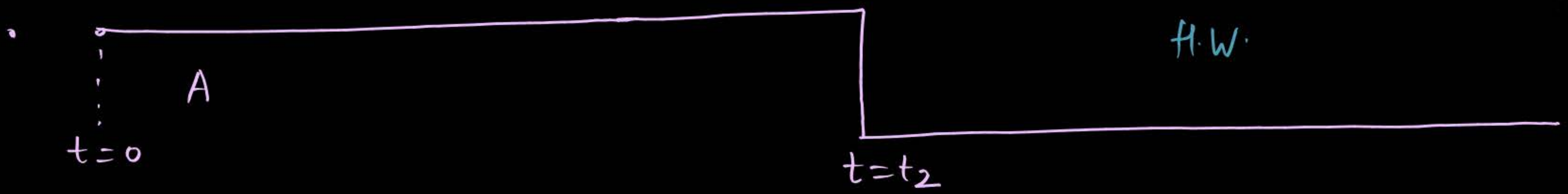
(D) With propagation delays, the output Y can have a transient logic One after X transitions from logic Zero to logic One


A
3ns
y
1ns
1ns
y_2

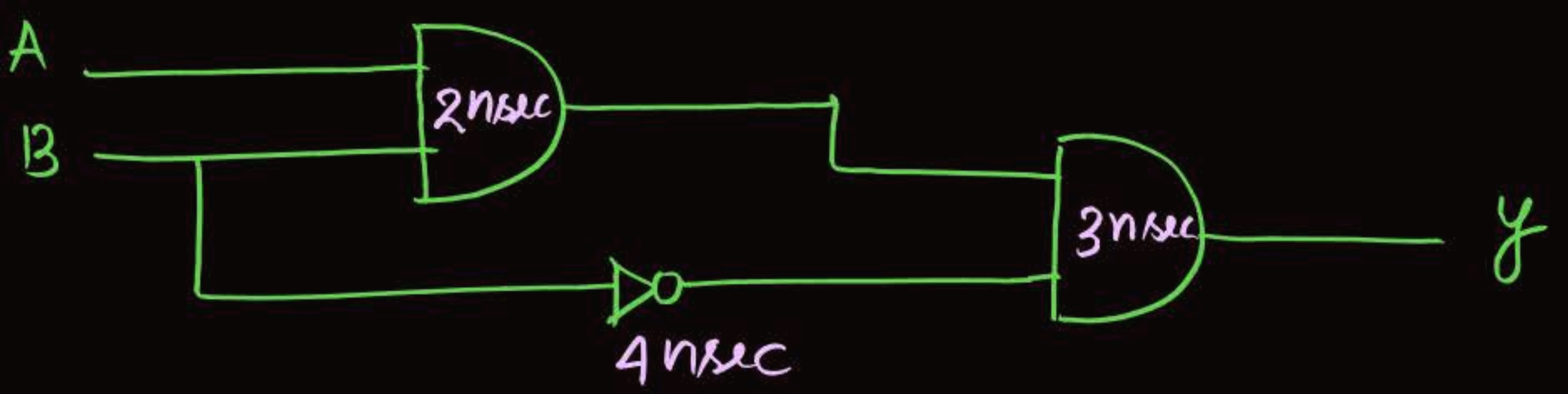

(1)
A
t=0
$t=t_1$
$y_2 \rightarrow$ delay of 2 nsec
t=0
t=2
(t_1+2)
t=0
$y \rightarrow$ without delay
t_1
(t_1+2)
$y \rightarrow$ with delay
t_1
(t_1+2)
(t_1+5)


A
1nsec
$\bar{A}$
1nsec
A
A
A
2nsec

H.W.



Q.



H.W.

Initially $A=0$, $B=0$ for a long time and then A and B are changed to $(1,1)$ then O/P y will go '1' for a duration t_1 nsec after changing A & B from $(0,0)$ to $(1,1)$ then value of t_1 ________ nsec.

Functionally Complete Function

- $f = \overline{A \cdot B} = \sum(0,1,2) = \{\underset{f_1}{\text{AND}}, \underset{f_2}{\text{NOT}}\}$

- Total-0 preserving function: $[T_0]$

$$f(A,B,C) \Rightarrow f(0,0,0) = 0 \longrightarrow T_0$$

$$= 1 \longrightarrow \text{it is not a total 0 preserving function.}$$

$$\hookrightarrow f(A,B,\overline{C}) \qquad f(0,0,0) = 0 \longrightarrow T_0$$

$A = 0$, $\overline{C} = 0$
$B = 0$,

$$1 \rightarrow \text{it is not a } T_0.$$

Total – 1 preserving function :→ T_1 :

$f(A, B, C) \Rightarrow f(1,1,1) = 1 \longrightarrow T_1$

$= 0 \longrightarrow$ it is not a T_1

$f(A, \bar{B}, \bar{C})$

$A = 1$
$\bar{B} = 1$
$\bar{C} = 1$

$\longrightarrow f(1,1,1) = 1 \rightarrow T_1$

$= 0 \longrightarrow$ It is not a T_1

- **Linear function:** L:

$f(A,B,C) \rightarrow$ is said to be linear if for all even no. of 1's combination output is 1 & for all odd no. of 1's combination o/p is zero and vice versa.

$\Sigma(\quad)$

A	B	y_1	y_2	y_3	y_4	y_5
0	0	0	0	0	0	1
0	1	1	1	1	0	0
1	0	1	0	1	0	0
1	1	0	1	1	1	1

$y_1 \rightarrow$ linear

$y_2 \rightarrow$ non linear

$y_3 \rightarrow$ non linear

$y_4 \rightarrow$ non linear

$y_5 \rightarrow$ linear

Monotonic function M:

if any i/p is changed from 0 — 1 then if o/p is not decreasing then it is said to be monotonic function.

		M	M	NM	NM	NM	NM
A	B	y_1	y_2	y_3	y_4	y_5	y_6
0	0	0	0	1	1	0	1
0	1	1	0	1	0	1	0
1	0	1	0	1	0	1	0
1	1	1	1	0	0	0	1

Self Dual Boolean functions:

$$\boxed{f^D = f}$$

$\boxed{H \cdot W}$

\# 1. $f(A,B,C) = A + \bar{B}\bar{C} \longrightarrow T_0, T_1, L, M, S$

\# 2. $f(A,B,\bar{C}) = \bar{A} + \bar{B}C \longrightarrow T_0, T_1, L, M, S$

\# 3. $f(A,B,C) = AB + BC + CA \longrightarrow T_0, T_1, L, M, S$

\# 4. $f(A,B) = \bar{A} \cdot \bar{B}$

\# 5. $f(A,\bar{B}) = \bar{A}B$

\# Q. 6. $f(A,B) = \bar{A}B$

\# Q 7. $f(A,B) = A + \bar{B}$

\# Q. 8 $f(\bar{A},B) = \bar{A} + B$

\# Q. 9. $f(\bar{A},B) = A + \bar{B}$

\# Q. 10. $f(A,\bar{B}) = A\bar{B}$

Topic : 2 Min Summary

- Concept of Delay
- Class of functions (boolean)

Thank you

GW

Soldiers !