Paper 7, TDC Part-3
Chapter– 1, Fundamental Concept of Digital Electronics
Lecture - 1

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Fundamental Concepts of Digital Electronics

Today science has made lots of progress and mostly in the field of Electronics and communication.

One of the main cause behind this development is the advent of integrated circuits (ICs).

We see many applications around us which are based on the electronics systems like mobile, calculator, computer, digital display etc. The operation of these systems also called digital systems, is based on principles of digital techniques

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Digital technology become the most powerful techniques for all innovations, whether it is in the field of computers, communication systems, information systems, entertainment, business, banking and finance, office machines, education, industrial control systems, scientific and medical equipment, defense equipment etc.

Principal reason for the wide spread of digital systems and digital techniques are:-

1. Digital circuits used in the digital systems, generally operate in one of the two states ON or OFF.

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2. Only few basic operations are in digital circuits.
3. The techniques require Boolean algebra.
4. Digital circuits requires basic concepts of electric network analysis.
5. Highly reliable, accurate, speed of operation and small in size.
6. Design and development of digital systems are very simple and also reduces interfacing problems.
7. Effect in the characteristic of the components, ageing of the component, temperature, and noise etc is very small in digital circuits.

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8. Digital circuits have capability of memory which makes these circuits highly useful for computers, calculators, watches, mobiles etc.
9. The display of data and other information is very convenient, accurate and elegant.

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Digital Signal : -

Unlike analog signal which can take any real values a digital signal has two discrete values or level. The two values are referred as “Low and High” Level depending on the logic system.

There are two logic system :-

(a) Positive logic (b) Negative Logic

In positive logic system, the signal with low voltage value is referred as “Low Level” while the signal with high voltage value is referred as “High Level”

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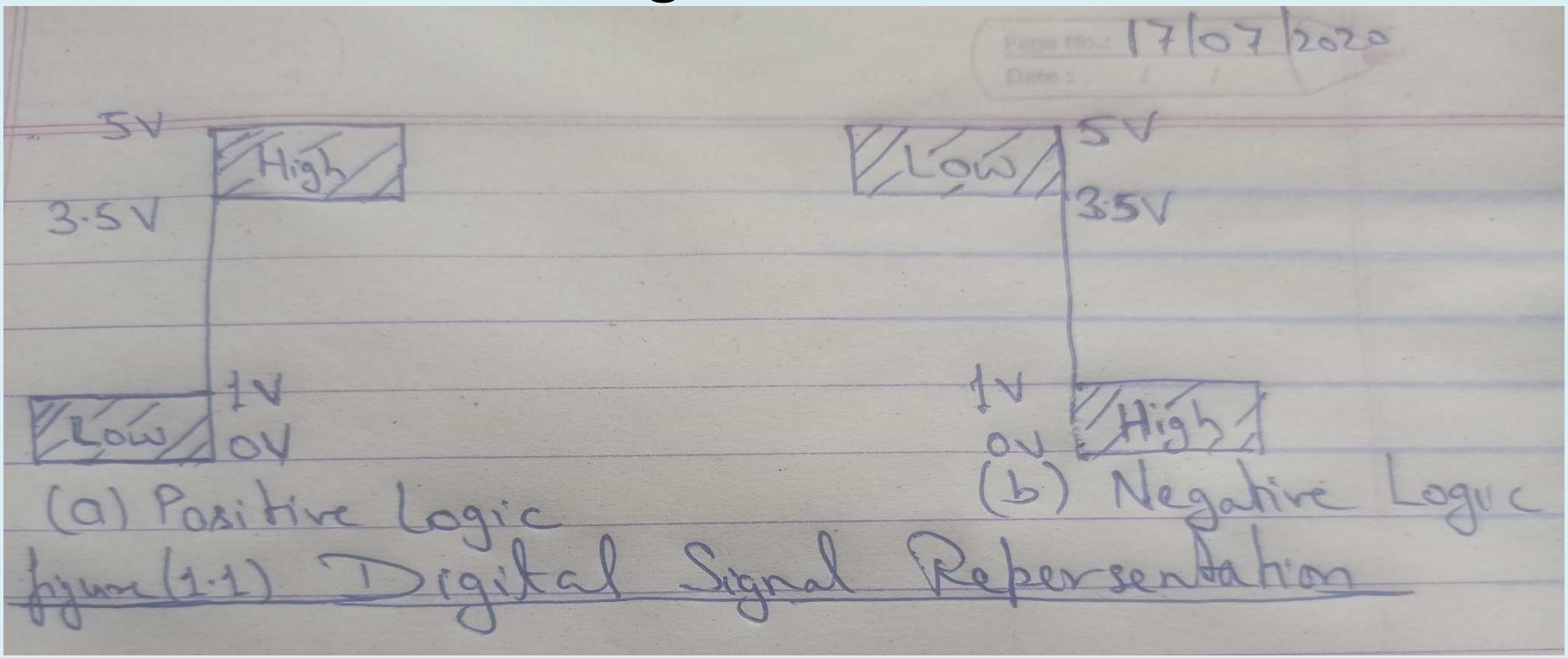
While in negative logic system, the signal with low voltage value is referred as “High Level” while the signal with high voltage value is referred as “Low Level”. As shown in figure below:-



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From fig 1.1 we can also understand that for positive logic voltage in a limited range is designated as a Level, that is any voltage in the range of 0 to 1V is Low level (OFF) and any voltage in the range of 3.5 to 5 V is High Level (ON).

For negative logic any voltage in the range of 0 to 1V is High level (ON) and any voltage in the range of 3.5 to 5 V is Low Level (OFF).

The two discrete signal level High and Low is usually represented by the binary digits 1 and 0 respectively

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The two levels can also be designated as True or False.

Since the digital signal can have only one of the two levels 1 or 0, the binary number system is used for the analysis and design of digital systems.

George Boole introduced the concept of binary number system. Algebra associated with binary number system is known as Boolean Algebra.

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Basic Digital Circuits : -

In a digital system there are few basic operation performed. Depending one the complexities of the system these operation are performed number of times.

The basic operations are NOT, OR, AND and FLIP-FLOP.

Using these basic operation some other operations like NAND, NOR, Exclusive-OR, Exclusive-NOR have also been derived.

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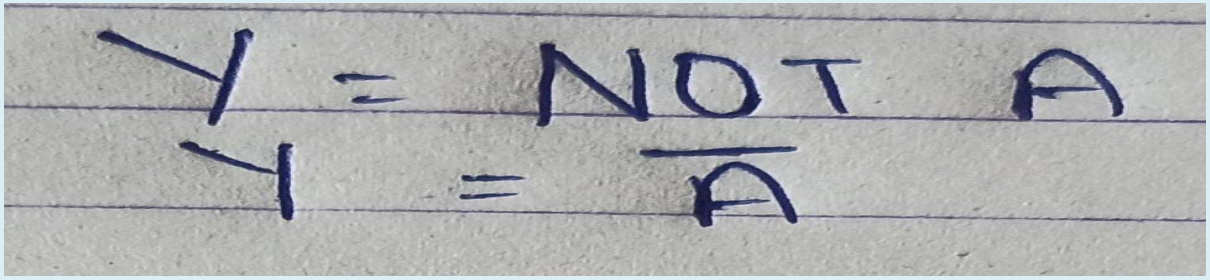
NOT GATE : -

A NOT Gate is also known as an inverter. A NOT Gate invert the signal applied at the input of the NOT Gate. This means the output of the NOT GATE is invert of the signal applied at the input of the NOT Gate.

The NOT Gate has only one input (A) and one output (Y). Its logic Equation is written as,



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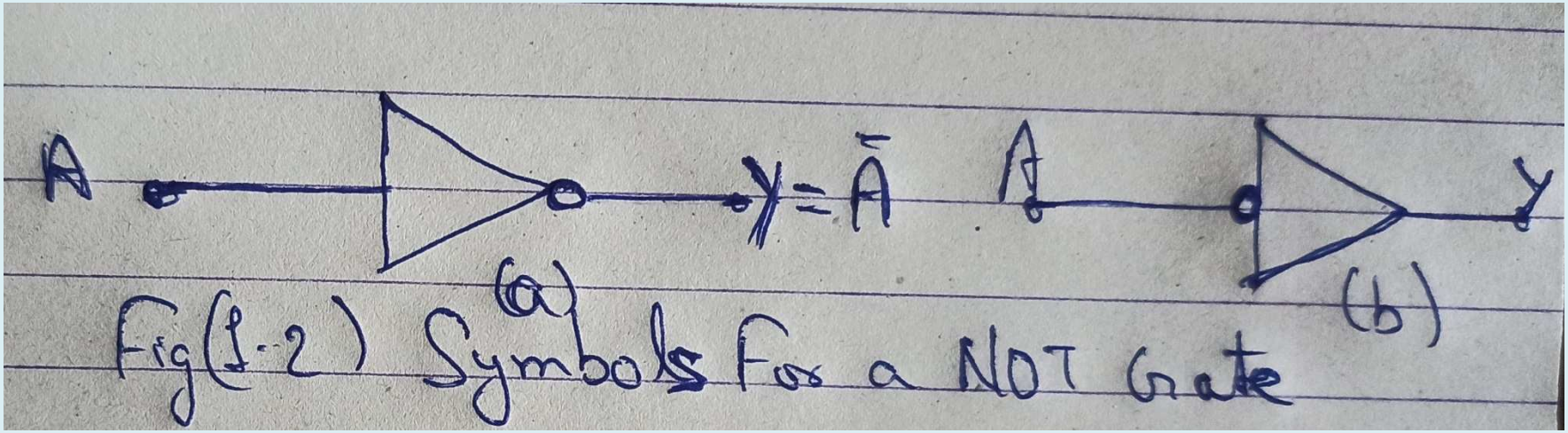
Symbol for NOT GATE : -



The presence of a small circle (bubble) denotes inversion in digital circuits.

The operation of a NOT gate can be written and understand from the truth table in the next slide.

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Truth Table for NOT GATE : -

A	Y
0	1
1	0

When the input signal is at level “Low” then the output signal is at level “High” and vice-versa.

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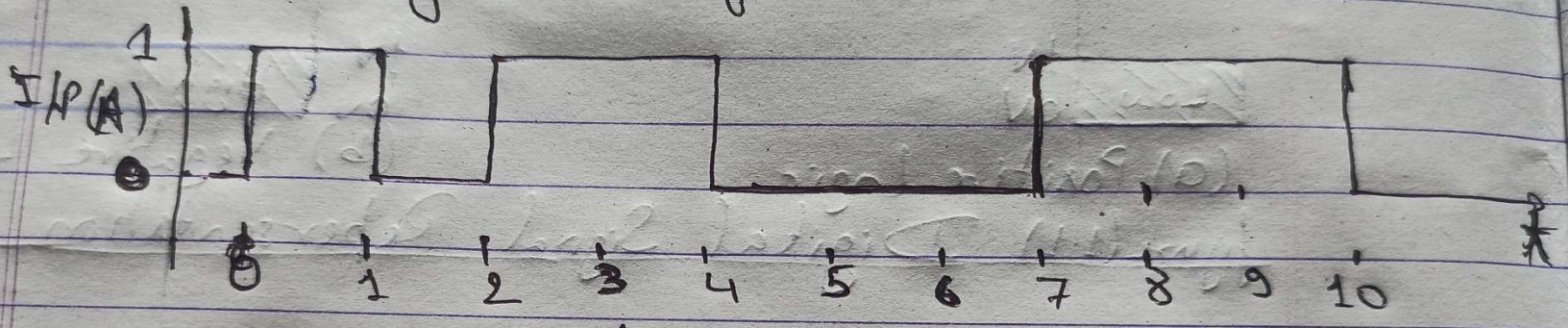
Eg 1.0 If the waveform shown in fig (1.3) is applied as the input signal to a NOT Gate, find the output signal waveform.



Input Signal A, Waveform.

Solution: From $t = 0$ to $t = 1$, $A = 1$ (High)

Therefore : $t = 0$ to $t = 1$, $Y = \overline{A} = \overline{1} = 0$ (Low)

Now, From $t = 1$ to $t = 2$, $A = 0$ (Low)

Therefore : $t = 1$ to $t = 2$, $Y = \overline{A} = \overline{0} = 1$ (High)

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Now from $t=2$ to $t=4$, $A = 1$ (High)
Therfore, from $t=2$ to $t=4$, $Y = \bar{A} = \bar{1} = 0$ (Low)

Now, from $t=4$ to $t=7$, $A = 0$ (low)
Therfore, from $t=4$ to $t=7$, $Y = \bar{A} = \bar{0} = 1$ (High)

Now from $t=7$ to $t=10$, $A = 1$ (High)
therfore, from $t=7$ to $t=10$, $Y = \bar{A} = \bar{1} = 0$ (low)

For $t > 10$, $A = 0$ (Low)
So, for $t > 10$, $Y = \bar{A} = \bar{0} = 1$ (High).