

Motilal Nehru National Institute of Technology Allahabad, Prayagraj.



Analog & Digital Electronics (EC 13103)

by

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ANALOG & DIGITAL ELECTRONICS (EC-13103)

UNIT 1: Introduction to semiconductor physics. Diode, Zener Diode, Diode as a switch, Rectifier, Clipping and Clamping Circuits

UNIT 2: Bipolar Junction Transistor, Biasing of Transistor, Transistor configurations, Transistor as an Amplifier, Transistor as a Switch.

UNIT 3: Introduction to FET, MOSFET, Operational Amplifier



UNIT4: Number System, Introduction to Boolean Algebra and fundamental theorems, Basic Logic Gates, Realization of combinational circuits using universal gates, Gate level minimization

UNIT 5: Important Digital Circuits Decoder, Multiplexer, PLA, ROM, RAM

UNIT 6: Flip Flops, Design of Sequential Circuits, Registers, Counters

Text/ Reference books

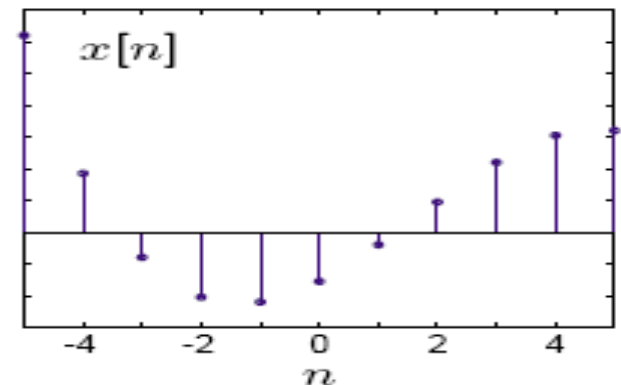
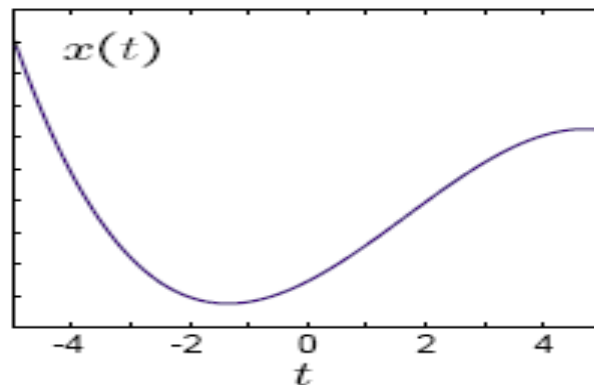
- Digital design by M. Morris Mano
- Electronic Devices and Circuit Theory by Robert L.Boylested

What is Signal

- **Signal:** A function of one or more independent variables that carries information of the nature of a physical phenomenon.

Example : Voice, Electrical Signal, Electromagnetic Waves, Heartbeat, Blood pressure, Temperature, Vibration.

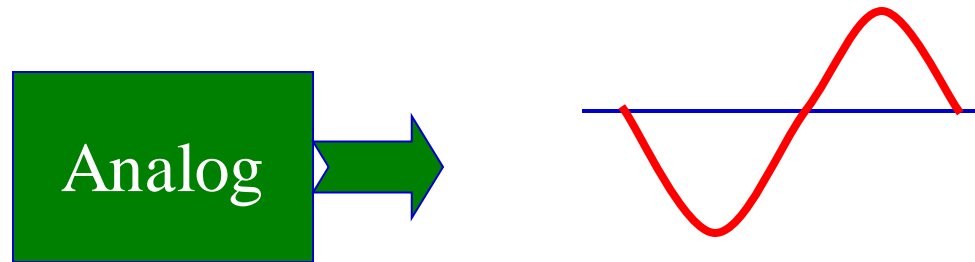
- **Continuous time signal:** A signal which is defined for all values of t . Where t is an independent variable $x(t)$
- **Discrete time signal:** A signal which is defined for discrete values of t i.e. $x(nT_s) = x(n)$ where T_s is the sampling time



Analog vs. Digital

Analog signal- Continuous time signal with finite amplitude.

Example: 230 V supply voltage at home, 12V , 9V for charging



Digital signal- A signal which is discrete in both time and amplitude commonly called HIGH or LOW (1 or 0).

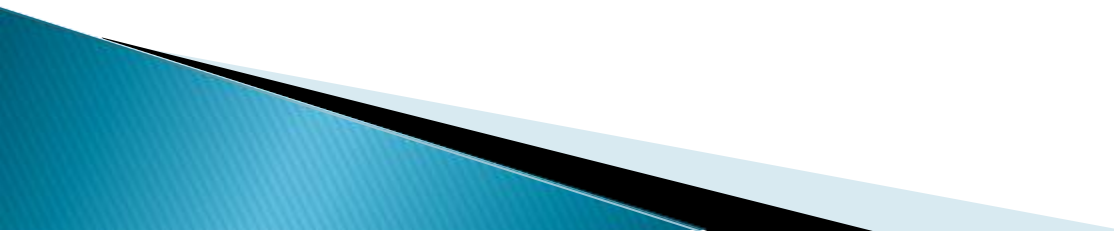
Example: Binary signal used in all digital process



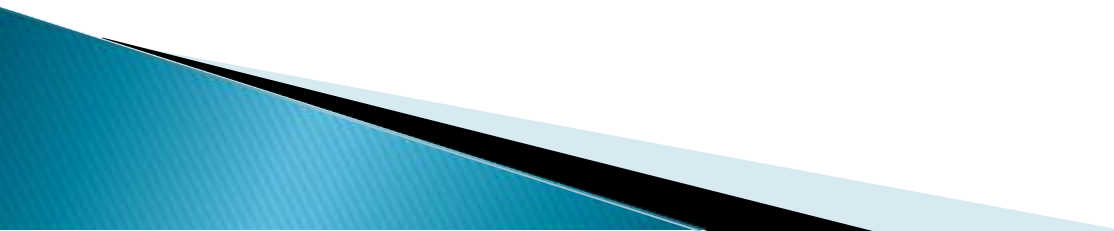
Why Analog ?

- Most “real-world” events are analog in nature.
- Analog processing is usually simpler..
- Traditional electronic systems were mostly analog in nature.

Why Digital?

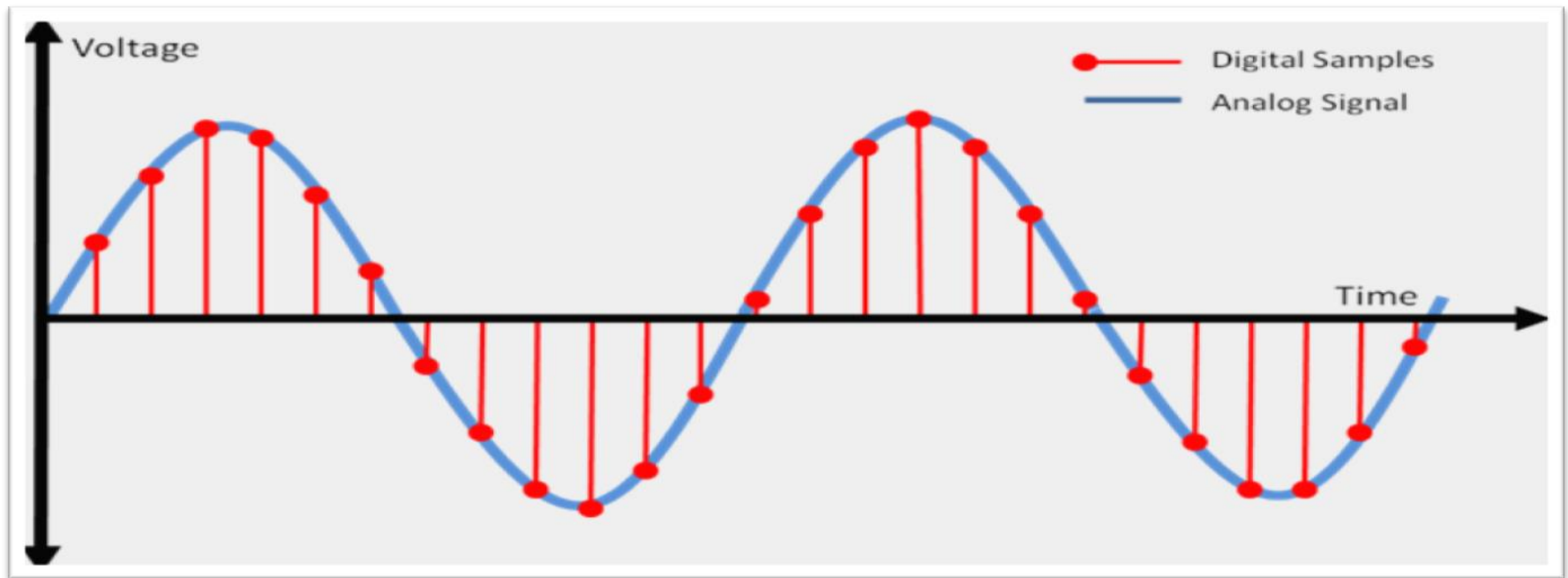
- Data can be stored .
 - Data can be used in calculations.
 - Compatible with display technologies.
 - Compatible with computer technologies.
 - Systems can be programmed.
 - Digital IC families make design easier.
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Benefits of Digital over Analog

- Reproducibility
 - Not effected by noise means quality
 - Ease of design
 - Data protection
 - Programmable
 - Speed
 - Economy
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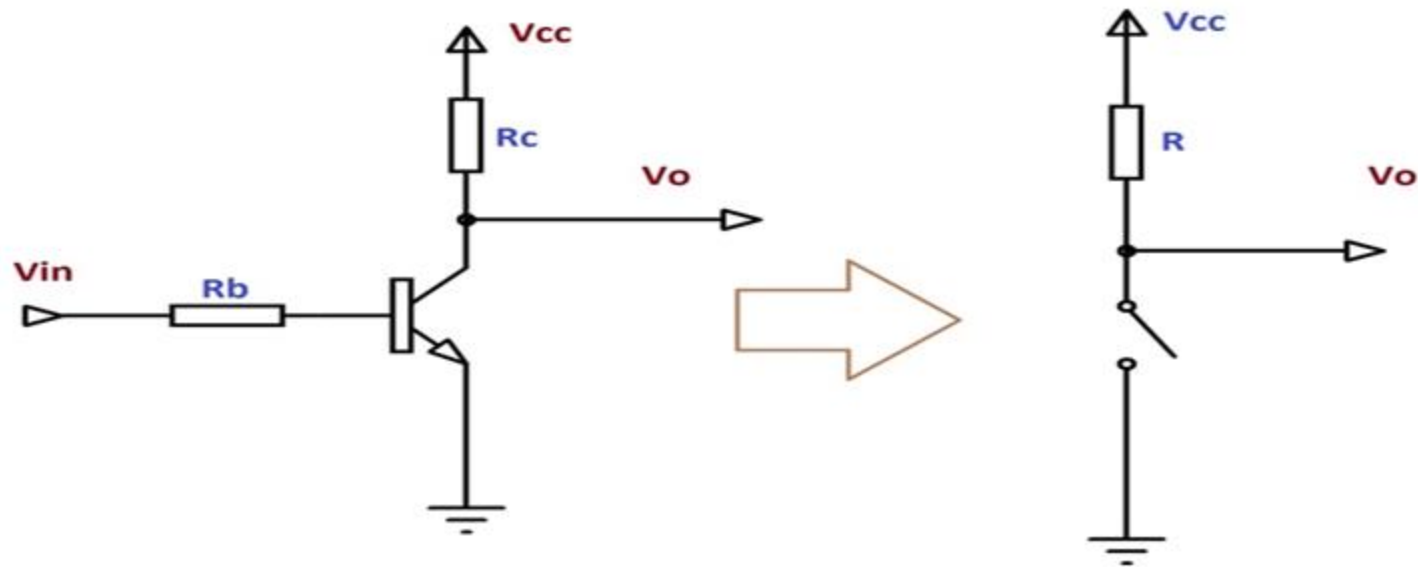
How to get Digital from Analog?

- SAMPLING (Discrete in time)
- QUANTIZATION (Discrete in amplitude)



Meaning of binary digital signal

- At any point in the circuit, only two Voltage states are present- HIGH or LOW.
- Also sometimes called TRUE or FALSE. In Boolean Logic, 0 and 1.
- Generally, +5V (roughly) considered high, while 0V (ground) is considered low for TTL logic



➤ *Transistor as a switch in saturation mode*

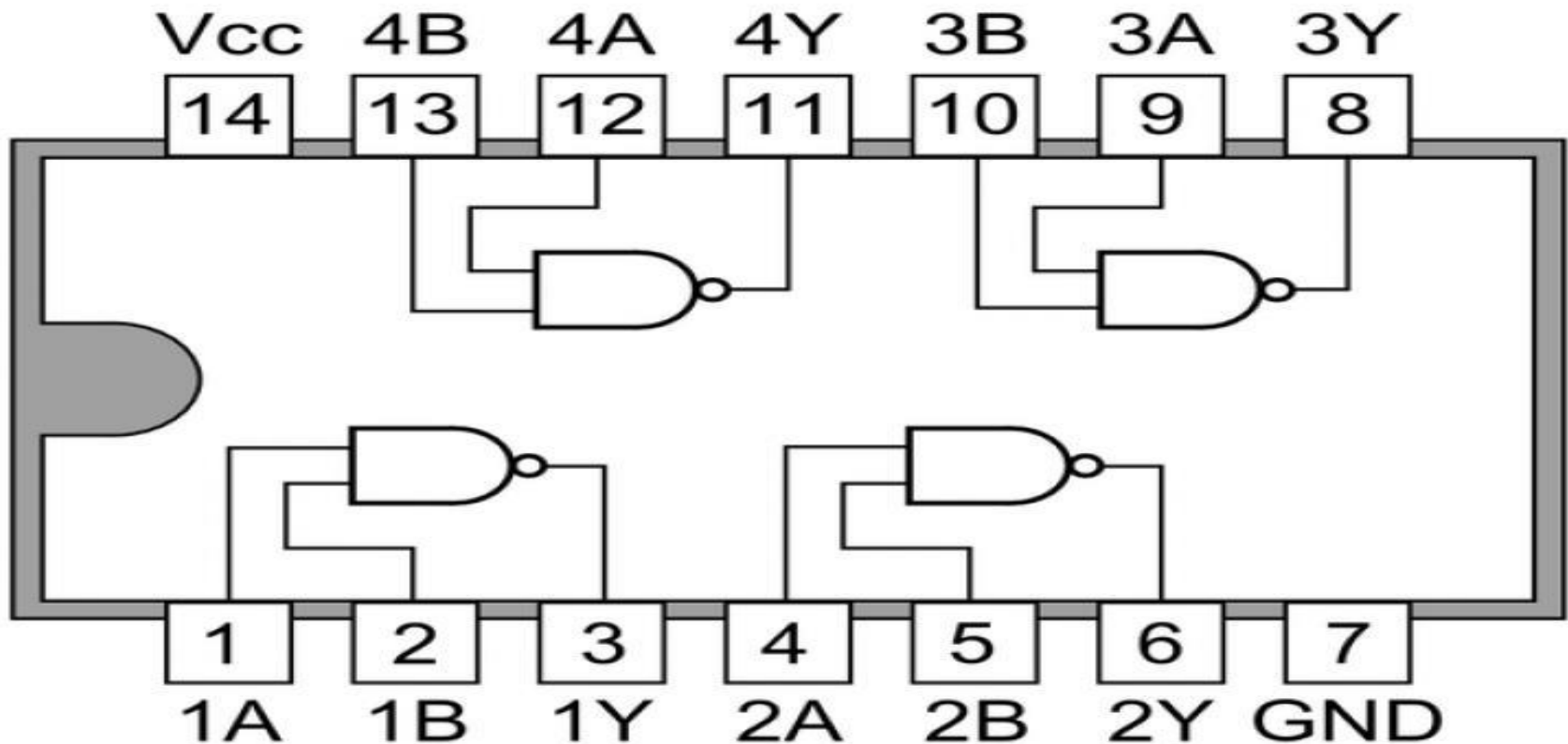
How do they look?



View of integrated circuit (IC)

What's Inside?

7400 Quad 2-input NAND Gates



Pin Diagram of SN74LS00 NAND IC

Levels of Integration of IC's

➤ Integration levels

➤ SSI (small scale integration)

➤ 1-10 gates (previous examples)

➤ MSI (medium scale integration)

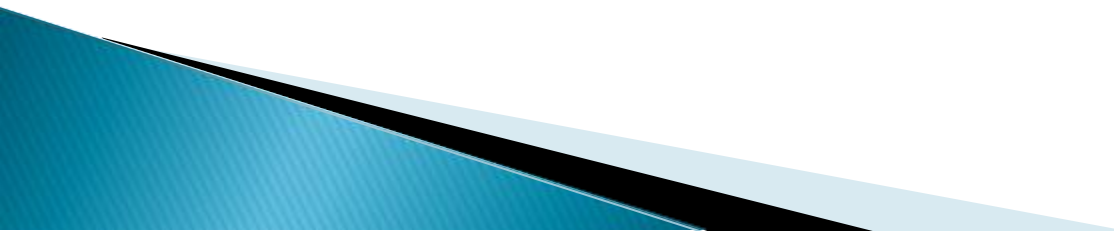
➤ 10-100 gates

➤ LSI (large scale integration)

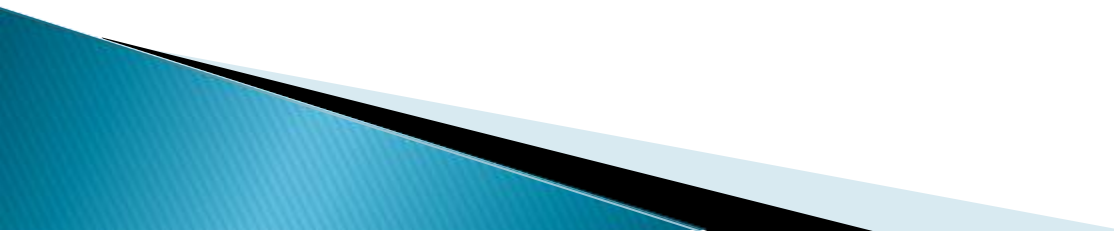
➤ 100-10,000 gates

➤ VLSI (very large scale integration)

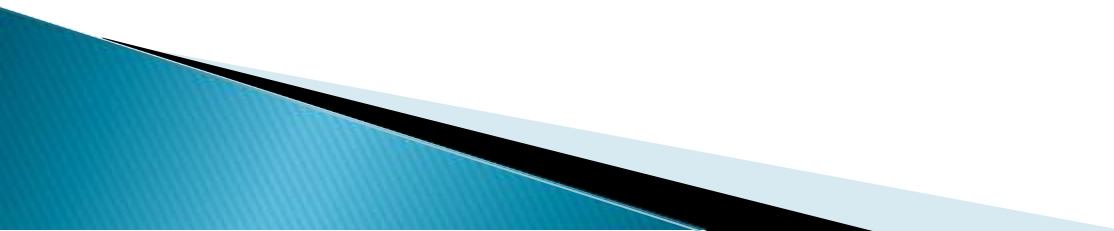
➤ More than 10,000 gates



Digital Circuits

- A **digital circuit** is often constructed from small **electronic circuits** called **logic gates** that can be used to create **combinational logic**. Each logic gate represents a function of **boolean logic**.
 - A logic gate is an arrangement of electrically controlled switches, better known as **transistors**.
 - The output of a logic gate is an electrical flow or voltage, that can, in turn, control more logic gates.
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Application of logic circuits

- Computers: The brain, body and limbs of computer systems—everything in it except peripherals
 - Embedded Systems: The brains that control the system (e.g. avionics, auto electronics, VCRs, microwaves, etc.)
 - Digital Signal Processing (DSP): E.g. in digital cellular phones, digital TV
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Thank You