Unit 1
Introduction

Digital

- Concerned with the interconnection among digital components and modules.
  >> Best digital system example is General Purpose computer.

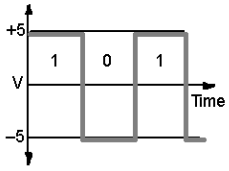
Logic Design

- Deals with the basic concepts and tools used to design digital hardware consisting of logic circuits.
  >> Circuits to perform arithmetic operations (+, -, x, /)

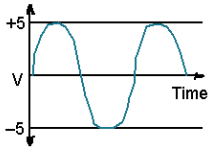
Digital Signals

- Decimals values are difficult to represent in electrical systems. It is easier to use two voltage values than ten.
- Digital signals have two basic states:
  1 (logic "high", or H, or "on")
  0 (logic "low", or L, or "off)
- Digital values are in a binary format. Binary means 2 states.

Digital vs Analog Waveforms



Digital:
only assumes discrete values



Analog:
values vary over a broad range continuously

	Analog	Digital
Technology:	Analog technology records waveforms as they are.	Converts analog waveforms into set of numbers and records them. The numbers are converted into voltage stream for representation.
Uses:	Can be used in various computing platforms and under operating systems like Linux, Unix, Mac OS and Windows.	Computing and electronics
Signal:	Analog signal is a continuous signal which transmits information as a response to changes in physical phenomenon.	Digital signals are discrete time signals generated by digital modulation.
Representation:	Uses continuous range of values to represent information.	Uses discrete or discontinuous values to represent information.
Memory unit:	not required	required
applications:	Thermometer	PCs, PDAs
Data transmissions:	not of high quality	high quality
Result:	not very accurate	accurate
Storage capacity:	limited	high
Process:	processed using OPAMP which uses electronic circuits	using microprocessor which uses logic circuits
Respose to Noise:	More likely to get affected reducing accuracy	Less affected since noise response are analog in nature
Waves:	Denoted by sine waves	Denoted by square waves

Digital Computer

A digital computer is a programmable machine which read the binary instruction and processes the data which are presented in binary form.
The digital computer takes the binary data at input, processes according to the set of instructions called program and produces the digital output.

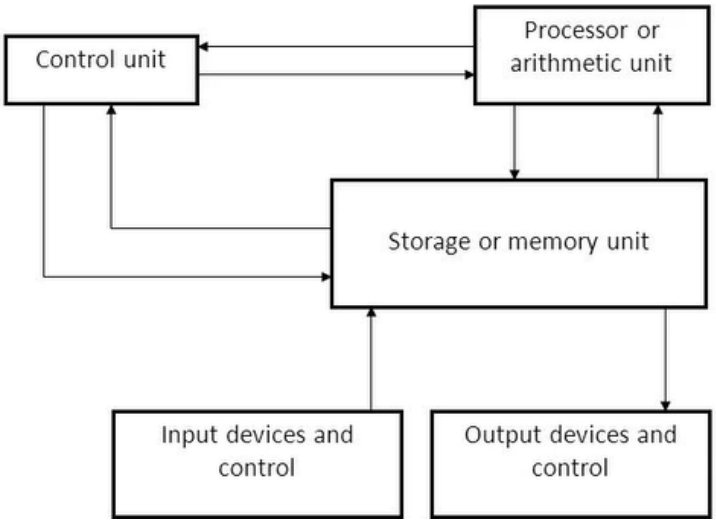


Fig: Block diagram of a Digital Computer

Working principles of digital computer:

1. Memory unit stores programs as well as input, output and intermediate data.
2. The control unit supervises the flow of information between various units and retrieve the instructions stored in memory unit.
3. After getting control signal memory unit sends the data to the processor.
4. For each instruction control unit informs the processor to execute the operation according to the instruction.
5. After getting control signal processor sends the process information to memory unit and memory unit sends those information to the output unit.

Advantages of digital system

- In case of digital system large number of ICs are available for performing various operations hence digital systems are highly reliable, accurate, small in size and speed of operation is very high.
- Computer controls digital system can be controlled by software that allows new function to be added without changing hardware.
- Less expensive
- Easy to manipulate

Disadvantages of digital system

- It is difficult to install digital system because it required many more complex electronic circuits and ICs.
- In digital systems, if a single piece of data lost, large blocks of related data can completely change.

Integrated Circuits (ICs)

An Integrated circuit is an association (or connection) of various electronic devices such as resistors, capacitors and transistors etched (or fabricated) to a semiconductor material such as silicon or germanium. It is also called as a **chip** or **microchip**. An IC can function as an amplifier, rectifier, oscillator, counter, timer and memory. Sometime ICs are connected to various other systems to perform complex functions.

Types of ICs

ICs can be categorized into two types

- Analog or Linear ICs
- Digital or logic ICs

Further there are certain ICs which can perform as a combination of both analog and digital functions.

Analog or Linear ICs: They produce continuous output depending on the input signal. From the name of the IC we can deduce that the output is a linear function of the input signal. Op-amp (operational amplifier) is one of the types of linear ICs which are used in amplifiers, timers and counters, oscillators etc.

Digital or Logic ICs: Unlike Analog ICs, Digital ICs never give a continuous output signal. Instead it operates only during defined states. Digital ICs are used mostly in microprocessor and various memory applications. Logic gates are the building blocks of Digital ICs which operate either at 0 or 1.

Advantages of ICs

- In consumer electronics, ICs have made possible the development of many new products, including personal calculators and computers, digital watches, and video games.
- They have also been used to improve or lower the cost of many existing products, such as appliances, televisions, radios, and high-fidelity equipment.
- The logic and arithmetic functions of a small computer can now be performed on a single VLSI chip called a microprocessor.
- Complete logic, arithmetic, and memory functions of a small computer can be packaged on a single printed circuit board, or even on a single chip.

Levels of Integration

Integrated circuits are often classified by the number of transistors and other electronic components they contain:

- **SSI (small-scale integration):** Up to 100 electronic components per chip
- **MSI (medium-scale integration):** From 100 to 3,000 electronic components per chip
- **LSI (large-scale integration):** From 3,000 to 100,000 electronic components per chip
- **VLSI (very large-scale integration):** From 100,000 to 1,000,000 electronic components per chip
- **ULSI (ultra large-scale integration):** More than 1 million electronic components per chip

For more topics see your textbook.