SCR 1013 : Digital Logic

Module 1:

DIGITAL LOGIC PRELIMINARIES

Digital and Analog Quantities

Binary Digits, Logic Levels and Digital Waveform

Introduction to Logic Operations

Overview of Logic Functions

Fixed-Function IC

Programmable Logic Devices (PLD)

Digital and Analog Quantities

Definition: Analog & Digital Quantities

- **Analog**
  - Varies over a continuous range of values
  - Examples of analog quantities : time, pressure, sound.

- **Digital**
  - A discrete (that is, discontinuous) set of values.
  - Varies in discrete (separate) steps.

Analog vs Digital

Analog

- Use base 10 (decimal)
- Represented by 10 different level: 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9.
- Analog system: A combination of devices that manipulate values represented in analog form

Digital

- Use base 2 (binary)
- Represented by 2 different level: 0 and 1 or low and high.
- Digital system: A combination of devices that manipulate values represented in digital form.

Digital systems in real world

- Digital technology is relatively new compared to analog technology, but a lot of analog systems has been changed to a digital systems, Examples:
  - Computers
  - Manufacturing systems
  - Medical Science
  - Transportation
  - Entertainment
  - Telecommunications

The Digital Advantages

- Real world quantities are mostly analog, but why change to a digital systems?
  - Because, digital systems has a lot of advantages
    - Ease of design
    - Ease of storage
    - Accuracy and precision are easier to maintain
    - Programmable operation
    - Less affected by noise
    - Ease of fabrication on IC chips

- Thus, the digital systems is more efficient and reliable for:
  - Data Processing
  - Data Transmission
  - Data Storage

Digital Disadvantages

- But digital systems also has a disadvantages:
  - Greater bandwidth (although compression changing this)
  - Sampling error
  - Compatibility with existing analog systems
  - Short product half life

- *But it advantages is a lot more compared to the disadvantages*

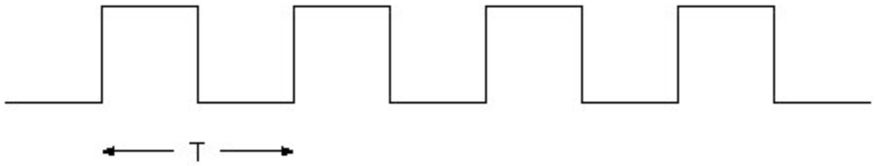
Digits, Logic Levels and Digital Waveform

Representing Digital Information

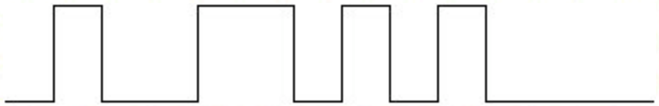
- The smallest information that can be represented in digital systems is <u>**b**</u>inary <u>**d**</u>igit (bit), it can have two value
  - HIGH (bit 1)
  - LOW (bit 0)
- This information is represented through electrical voltage. commonly higher voltage represents HIGH and lower voltage represents LOW.

Digital Waveform

- Digital systems usually uses a square wave
  - Because square wave represent a binary value (HIGH or LOW)
- 2 types of squarewave
  - Periodic
    - The signal keep on repeating after a period of time, T



  - Non Periodic
    - Doesn't have a period



Periodic Signal Parameter

- Frequency (f) is the rate at which the signal repeat itself at a fixed interval. The frequency is measured in cycles per second or Hertz (Hz) units.

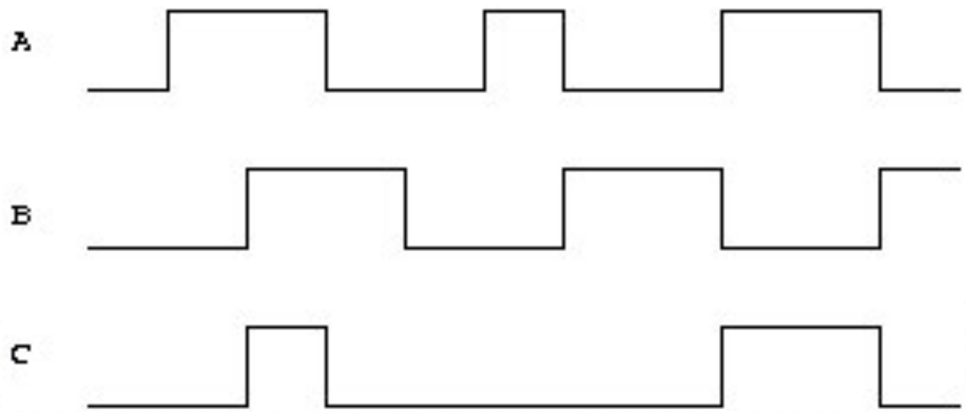
$$f = \frac{1}{T} \text{ Hz}$$

- Period (T) is the time from the edge of one pulse to the corresponding edge of the next pulse. The period is measured in second unit.

- Example:
  - clock frequency : f = 100Hz,
    so, period : T = 1/100Hz = 0.01s = 10x 10^{-3} = 10 ms

Timing Diagram

- Is a graph of digital waveform showing the actual time relationship of two or more waveform and how each waveform changes in relation to the others.
- In digital systems, the emphasis usually the timing not the amplitude because amplitude to represent a bit is predefined.



Example of a timing diagram that shows the relation between A, B and C waveforms, where C = A AND B