Digital Logic Design

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Syllabus

- Unit one
  - Introduction Number Systems and Conversion
  - Digital Systems and Switching Circuits
  - Number systems
  - Binary arithmetic.
  - Representation of negative numbers
  - Representation of Negative Numbers
  - Addition of 2’s complements Numbers
  - Addition of 1’s complements Numbers
  - Binary code

- Unit2: Boolean Algabra
  - Introduction
  - Basic Operations
  - Boolean Expressions and Truth Tables
  - Basic Theorems.
  - Commutative, Associative and Distributed Law
  - Simplification Theorems.
  - Multiplying and Factoring.
  - DeMorgan’s Laws.
  - Multiplying and Factoring Expressions.

- Unit 3: Boolean Algebra (Continued)
  - Multiplying Out and Factoring Expressions.
  - Exclusive-OR and Equivalence Operations.
  - The Consensus Theorem.
  - Algebraic Simplification of Switching Expressions.
  - Proving Validity of an Equation.

- Unit 4: Applications of Boolean Algebra Conversion of English Sentences to Boolean Equations.
  - Combinational Logic Design Using a Truth Table.
  - Minterm and Maxterm Expansions.
  - General Minterm and Maxterm Expansions.
  - Incompletely Specified Functions.
  - Examples of Truth Table Construction.
  - Design of Binary Adders and Subtracters.

- Unit 5: Karnaugh Maps
  - Minimum Forms of Switching Functions.
  - Two- and Three-Variable Karnaugh Maps.
  - Four-Variable Karnaugh Maps.
  - Determination of Minimum Expressions Using Essential Prime Implicants.
  - Five-Variable Karnaugh Maps.
  - Other Uses of Karnaugh Maps.
  - Other Forms of Karnaugh Maps.

Today's Lecture

- Digital systems and Analog system
- The design of digital systems
- A switching circuit
- Number Systems and Conversion
- Example

Digital systems and Analog system

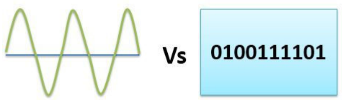
- Digital systems are used extensively in computation and data processing, control systems,communications,and measurement.Because digital systems are capable of greater accuracy and reliability than analog systems, many tasks formerly done by analog systems are now being performed digitally.

Digital systems and Analog system

- In a digital system, the physical quantities or signals can assume only discrete values, while in analog systems the physical quantities or signals may vary continuously over a specified range.

Digital systems and Analog system

- For example,the output voltage of a digital system might be constrained to take on **only two values such as 0 volts and 5 volts**, while the output voltage from an analog system might be allowed to assume **any value in the range 10 volts to 10 volts.**



Analog Signal **Digital Signal**

The design of digital systems

- The design of digital systems may be divided into three parts
  1. system design
  2. Logic design
  3. Circuit design

The design of digital systems

1. system design, breaking the overall system into subsystems and specifying the characteristics of each subsystem.
   - For example,the system design of a digital computer could involve specifying the number and type of memory units, arithmetic units, and input-output devices

The design of digital systems

2. logic design involves determining how to interconnect basic logic building blocks to perform a specific function.
   - An example of logic design is determining the interconnection of logic gates and flip-flops required to perform binary addition

The design of digital systems

3. Circuit design involves specifying the interconnection of specific components such as resistors,diodes,and transistors to form a gate, flip-flop, or other logic building block.

A switching circuit

- **Switching circuit** has one or more inputs and one or more outputs which take on discrete values. There are two types of switching circuits—combinational and sequential.
  1. **combinational circuit**, the output values depend only on the present value of the inputs and not on past values.
  2. **sequential circuit**, the outputs depend on both the present and past input values. (has a memory to store the past output

Number Systems and Conversion

- When we write decimal (base 10) numbers,we use a positional notation;each digit is multiplied by an appropriate power of 10 depending on its position in the number.
- For example,

$$953.78_{10} = 9 \times 10^2 + 5 \times 10^1 + 3 \times 10^0 + 7 \times 10^{-1} + 8 \times 10^{-2}$$

Number Systems and Conversion

- Similarly, for binary (base 2) numbers,each binary digit is multiplied by the appropriate power of 2.

$$1011.11_2 = 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0 + 1 \times 2^{-1} + 1 \times 2^{-2}$$
$$= 8 + 0 + 2 + 1 + \tfrac{1}{2} + \tfrac{1}{4} = 11\tfrac{3}{4} = 11.75_{10}$$

Number Systems and Conversion

$$N = (a_4a_3a_2a_1a_0.a_{-1}a_{-2}a_{-3})_R$$
$$= a_4 \times R^4 + a_3 \times R^3 + a_2 \times R^2 + a_1 \times R^1 + a_0 \times R^0$$
$$+ a_{-1} \times R^{-1} + a_{-2} \times R^{-2} + a_{-3} \times R^{-3}$$

where a_i is the coefficient of R^i and $0 \le a_i \le R-1$.

Example

$$147.3_8 = 1 \times 8^2 + 4 \times 8^1 + 7 \times 8^0 + 3 \times 8^{-1} = 64 + 32 + 7 +$$
$$= 103.375_{10}$$