1

The Computing Discipline

Introduction

This chapter attempts to evoke interest towards computer science in students. The important milestones in the evolution of computers and the different generations of computers are introduced here. Early computing techniques like Abacus, Napier's Bone, etc. are to be introduced in such a way that the learner too is encouraged to ponder over a new technique for computation. This unit should instill in them the feeling that each one has ample potential to contribute to this fast and continuously evolving discipline. Discussions and collections/ presentations about the evolution of computing techniques should be widely used to generate interest in the learner. Seminars may be given to students after supporting them with necessary inputs.

Values and Attitudes:

- Appreciate the contributions of pioneers in computer science.
- Realise that computer science is an evolving subject to which each student can contribute.

Unit Frame

Period : 10

Concepts/Process skills	Process/Activities with Assessments	Learning outcomes
• Counting and evolution of positional number system ✓Communicating and understanding	General discussion on importance of counting and evolution of positional number system.	Explains the evolution of counting and positional number system.
• Evolution of the concept of computing machines (Abacus, Napier's bone, Pascaline, Charles Babbage - Difference Engine and Analytical Machine, Hollerith's machine) ✓Observing ✓Communicating ✓Problem solving	Preparation of notes Slide presentation and discussion of features of various computing machines. Problem solving using Abacus and Napier's bones. Illustration, Preparation of notes. Assessment: o Model for Abacus o Model for Napier's Bones o Worksheet	Observes the features of some remarkable computing machines during the evolution of computers and demonstrates them
• Generation of Computers ✓Classifying ✓Communicating ✓Observing	Seminar on generation of computers Assessment: o Seminar Report	Lists the major developments in each generation.
• Evolution of Computing o Programming Languages ✓ Communicating and understanding ✓Inferring o Algorithm & Computer Programs ✓ Communicating and understanding ✓Inferring o Theory of Computing ✓ Communicating and understanding ✓Inferring	General discussion on evolution of programming languages using ICT tools. Preparation of notes General discussion on the importance of planning to solve problems. Preparation of notes General discussion on problem solving using Turing Machine. Preparation of notes Assessment: oWorksheet oAssignment on 'Pioneers of Computer Science'	Identifies how programming languages are evolved, need of algorithms and computation using Turing machine and explains them

Towards the Unit:

Counting and evolution of positional number system

(1 Period)

Suggested activity: Discussion and preparation of notes

- The teacher initiates the discussion by conducting a mock election for selecting the class leader. Two students are randomly selected as candidates. Students should vote for either of the candidates. Students who vote for one candidate stands up. The students who sit favour the other candidate.
  - o Teacher introduces the importance of the concept of 'more' or 'less' to find the leader and thereby the need of counting.
  - o Now, the teacher presents before them a situation where there was no numbers and there was a need to find which group is more and which is less in number.
  - o Students are encouraged to discover ways to find which group is the largest.
  - o Students present various techniques and teacher consolidates them by introducing the various counting methods developed by different civilizations and the evolution of positional number system.
- Provides learners an opportunity to think about it.
- The teacher concludes the discussion with the following points
  - o Importance of counting
  - o Evolution of positional number system
- Instructs the students to prepare notes

Evolution of the concept of computing machines

(2 Periods)

Suggested activity: Slide Presentation, Discussion, development of models and preparation of notes

- Teacher prepares an attractive presentation on the different computing machines along with their images and features.
  - o Discusses each computing machine in the class with the help of this presentation.
  - o The teacher directs the students to create a model of Abacus (with

4 positions) and Napier's Bones. (An Abacus can be easily created using a hardboard or rod to create the frame and twine with beads tied to it. Napier's Bones can be made by drawing Figure 1.3 in the text book on a paper and pasting on the hard cover of an old notebook. This can then be cut and separated to form the different bones of Napier's Bones.)

- Provides opportunity for peer evaluation, self-evaluation
- The teacher concludes the discussion with the following points
  - Working of each computing machine
- Instructs the students to prepare notes

Abacus and Napier's bones

(1 Period)

Suggested activity: Problem solving using model of Abacus and Napier's bones

- Teacher uses the model of an Abacus prepared by the students to demonstrate representation of a number in Abacus.
  - Demonstrates addition using abacus and Napier's Bones in the class.
  - Students perform the addition using the Abacus model they have developed in groups.
  - Selected students demonstrate the process of addition.
- This activity gives them a firsthand experience of the evolution of the computational process to the students and also motivates them to think of newer methods for computing.
- The teacher concludes the discussion with the following points
  - Working of Abacus and Napier's Bones
  - Use Assessment Worksheet No. 1.1

Generation of Computers

(2 Periods)

Suggested activity: Seminar, Slide Presentation, Discussion and Report preparation

- The teacher divides the students into 5 groups and each group is given the task of presenting a seminar on generations of computer.

- Each group has to prepare a presentation on the generation of computers by collecting data and images of major developments in each generation. Every student in the group has to get prepared for the seminar since the teacher will randomly choose a student to present it.
- After giving sufficient time for preparation, teacher randomly selects a student from a group to present the seminar of first generation. Other students in the group can supplement the presenter with additional facts, if necessary.
- The students in other group can clear their doubts after the seminar. The teacher can also support the presenter with additional information, if needed.
- All students are required to prepare a note on the seminar.
- The teacher then calls another student from another group to present the second generation computers and so on.

- This activity ensures the involvement of every student in the activity and enables teachers to evaluate the performance of each student in the group for process assessment.
- The teacher concludes the seminar with the following point:
  - Major developments in each generation
- Each student in a group has to submit the seminar report for the portfolio.

Evolution of Computing - Programming Languages

(1 Period)

Suggested activity: Slide Presentation, Discussion and preparation of notes

- Teacher asks the students to compare a calculator and a computer.
  - Teacher consolidates that calculator can perform a single task where as computers can perform any task given as instructions/ programs.
- The teacher recollects the concept of stored program by Von Neumann which was already discussed.
  - The need for instructions/programs to run the computer is introduced.
  - The method for giving instructions to computers using strings of binary digits 0 and 1 is introduced.

- The difficulty in writing instructions and removing errors is discussed.
- The evolution of assembly language and then need for high level language programs are introduced.
- The teacher can use ICT tools to demonstrate a sample code in machine, assembly and high level languages.
- The notable personalities who contributed to computing during the period can also be presented using ICT tools.

- This activity makes the students aware of the growth and issues that led to the development of computing.
- Teacher concludes the discussion with the following
  - Status of initial computing machines
  - Developments after stored program concept
  - Machine, assembly and high level languages and their features

Evolution of Computing - Algorithm & Computer Programs

(1 Period)

Suggested activity: Discussion and preparation of notes

- Teacher creates a situation: Suppose one of the students forgot to bring his/her pen to the class. He needs to buy a pen from the shop nearby during the interval.
  - Teacher asks the students to plan and write down the steps required for buying a pen from the shop.
  - The steps written by the students are consolidated and the teacher introduces the need for planning before performing a task.
  - Teacher consolidates the process by introducing the steps to be planned before performing a task in computer – algorithm.
- Through this activity students are made familiar with the need of finding a step by step solution for solving a problem.
- Teacher consolidates the discussion with the following
  - Algorithm and its need.
  - Augusta Ada King and her contributions.

Evolution of Computing - Theory of Computing

(1 Period)

Suggested activity: Discussion and preparation of notes

- Teacher asks the students to write about their dream about a computer and what all it is expected to perform.
  - The teacher consolidates the expectations/dreams of the students and brings in the point that the dreams of several people/scientists have led to the development of today's computer.
  - Teacher introduces the contributions of Alan Turing and his idea of a Turing Machine.
  - Teacher can use the 5 minute video from the following link to give the students a better idea about the working of Turing Machine.

  http://www.youtube.com/watch?v=E3keLeMwfHY
- Through this activity students are made familiar with the theory of computing and the contributions of Alan Turing.
- Teacher consolidates the discussion with the following
  - Theory of computing.
  - Alan Turing and his contributions.

Evolution of the concept of computing machines

(1 Period)

Suggested activity: Assignment

- Teacher asks the students to prepare an assignment on the scientists who have made significant contributions to the development of computer science.
  - The assignment should have a photo of the personality, dates of his birth and death and his significant contributions in bulleted points.
  - All the personalities in the chapter, and those about whom they have learned or heard can be included.
- Through this activity students will be more familiar with the legends of computer science and their contributions.
- Teacher consolidates
  - Pioneers in Computer Science.
  - Use Assessment Worksheet No. 1.2

Assessment Worksheet – 1.1

1. The number system that used space for representing the number 'zero' is _____.
   a. Sumerian b. Egyptian c. Chinese d. Greek
2. The symbol for zero was first used in the number system developed in _____ .
3. The number of beads on each wire in a Chinese Abacus is _____.
4. Napier's Bones helped to simplify a _____ calculation.

a. Multiplication b. Addition c. Subtraction d. Division

5. What is the use of punched cards in a loom?
6. Mention the difference between Difference Engine and Analytical Engine.
7. The person who started Tabulating Machine Corporation which later became IBM Corporation is _____.

Assessment Worksheet – 1.2

1. The first general purpose programmable electronic computer is _____.
   a. EDVAC b. ENIAC c. EDVAC d. Mark I
2. Name the different units of John Von Neumann architecture.
3. Match the following

a.	BASIC	i.	Fourth Generation computers
b.	Vaccum tubes	ii.	Third Generation computers
c.	Prolog	iii.	First Generation computers
d.	IBM PC	iv.	Fifth Generation computers
e.	Transistors	v.	Second Generation computers

4. Who developed integrated circuits?
5. VLSI is _____.
6. _____ is popularly known as world's first computer programmer.
7. Who is regarded as the father of modern computer science?
8. What was the limitation of assembly language?

Teacher Planner (A sample)

Name of the Chapter	:	The Computing Discipline
Date	:	14/07/2014 to 19-07-2014
No. of Periods	:	5
Learning Outcomes	:	Explains the evolution of counting and positional number system. Observes the features of some remarkable computing machines during the evolution of computers and demonstrates them.
Concepts	:	Counting and evolution of positional number system, Evolution of the concept of computing machines (Abacus, Napier's bone, Pascaline, Charles Babbage – Difference Engine and Analytical Machine, Hollerith's machine)
Process Skills	:	Communicating and understanding, observing
Values and Attitudes	:	Appreciate the contributions of pioneers in Computer Science.
Learning Materials	:	Text book, Activity Log, Slides, model of Abacus and Napier's Bones, flash/presentation model of Abacus
Products	:	Notes in Activity Log, model of Abacus and Napier's Bones

Process Column	Response Column
Refer Activity for 'Counting and evolution of positional number system' Discussion on • Need of 'more' and 'less' • New techniques for finding the largest and the smallest group • Notes in Activity log	60% of the learners participated in the activity. Raju, Shaji, Joseph and Vinitha came up with innovative ideas for finding the largest group. Hari and Sujith had to be given support.
Refer Activity for 'Evolution of the concept of computing machines'. Slide presentation on • Observes the features of some remarkable computing machines during the evolution of computers • Learns the working of Abacus and Napier's Bones • Notes in Activity log • Model of Abacus, Napier's Bones for Portfolio	80% of the learners got familiarised with the computing machines and the working of Abacus and Napier's Bones. Tomy, Joy and Manoj had to be given extra support to understand the working.
Refer Activity for 'Abacus and Napier's Bones' Problem solving using Abacus and Napier's Bones • Uses model of Abacus • Sets numbers on Abacus • Simple addition using Abacus • Uses model of Napier's Bones • Multiplication using Napier's Bones	60% of the learners are familiarised with placing numbers in Abacus and addition using it. They were also able to multiply using model of Napier's Bones. Philip, Binu and Susha had to be given special support to understand the working.

Process Assessment

- ✓ Model of Abacus and Napier's Bones
- ✓ Problem solving using Abacus and Napier's Bones
- ✓ Seminar on 'Generations of Computers'
- ✓ Assignment on 'Pioneers in Computer Science'

Portfolio Assessment

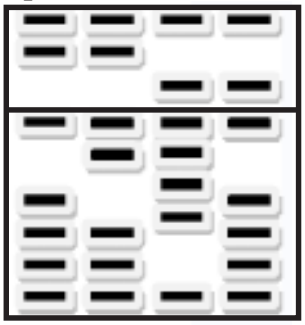
- ✓ Activity log book
- ✓ Model of Abacus and Napier's bones
- ✓ Assignment on 'Pioneers in Computer Science'
- ✓ Seminar report on 'Generations of Computers'
- ✓ Worksheets

Unit-wise Assessment

1. Written tests may be conducted with questions similar to those given in worksheets.
2. Group Quiz may be conducted by the learners themselves as follows:
   a. The learners are divided into 4 groups (adjacent benches)
   b. Each group prepares questions. Group leader ensures that all the members in the group participate in preparing questions and their answers. The questions are consolidated within the group.
   c. The quiz is conducted by ensuring the participation of all the learners. Teacher should intervene in time for ensuring the unit-wise assessment of all the learners.
3. Remediation may be planned, if needed, for the topics for which the learning outcome(s) are not attained.

TE Questions

1. Write the number represented in the abacus given below.



2. (A) Observe the following pair and identify the relationship between them.

Blaise Pascal : Pascaline

Now, select the pair from the following that has the same relationship as in the above pair.

a. Joseph Jacquard : Mark I
b. Analytical Engine : Charles Babbage
c. Howard Aiken : Difference Engine
d. John Napier : Napier's Bones

(B) Similarly identify the relationship in the pair given below and select the correct pair from the following four options.

First Generation computers : Vaccum tubes

a. First Generation computers : machine language
b. Second Generation computers : COBOL
c. Third Generation computers : integrated circuits
d. Fourth Generation computers : high level languages

3. Read the following statements.

i. Napier's Bones makes multiplication problems easy
ii. Pascaline uses punched cards
iii. Herman Hollerith developed the first electro mechanical punched card calculator
iv. Joseph Jacquard developed difference engine

Choose the most appropriate answer from the options below.

a. Statements i and ii are correct
b. Statement i and iii are correct
c. All statements are correct
d. All statements are wrong

4. Observe the following statements:

i. Stored program concept was developed by John Von Neumann
ii. Jack Kilby developed integrated circuits
iii. Transistors were developed at Bell Laboratories
iv. Prolog is an artificial intelligence programming language

Choose the most appropriate answer from the options below.

a. Statements i and ii are correct
b. Statement i and iv are correct
c. All statements are correct
d. All statements are wrong

5. State whether the following statements are true or false. If false, write the correct statement.
   A. Augusta Ada King is known as the first programmer in the world
   B. High level programming language was introduced in the third generation computers
   C. John Napier invented logarithm tables
   D. Integrated circuits was developed at Bell Laboratories
6. _____ and _____ are the contributions of Charles Babbage in the evolution of computers for which he is known as _____ .
7. From the first generation computers to the fifth generation computers the _____ of the computers increased and the _____ of the computers decreased.
8. What were the improvements made by Leibniz in his machine when compared to Pascaline?
9. State the significance of Jacquard's loom in the development of computers.
10. Write the structure of a vaccum tube.
11. Explain the significant developments during the fourth generation of computers.
12. What were the limitations in using machine language?

Scoring Indicators

1. 1296
2. A. John Napier : Napier's bones
   B. Third Generation computers : integrated circuits
3. Statement i and iii are correct
4. All statements are correct
5. A. True
   B. False (High level programming language was introduced in the second generation computers)
   C. True
   D. False (Integrated circuits was developed at Texas Instruments)
6. Analytical Engine, Difference Engine, Father of computer

7. Power/efficiency/reliability, cost/size
8. Multiplication and division
9. Ability to store information
10. Device controlling electric current through vaccum in a sealed container
11. CPU on single chip, VLSI, size reduced to a palm, less costly, more user friendly, highly popular
12. Machine dependency, difficulty in error correction, good knowledge of computer architecture.

2

Data representation and Boolean algebra

Introduction

In this chapter different number systems and their characteristics are presented. Different methods for representing numbers and characters in computer memory are explained in detail. Different file formats of images, sounds and videos are mentioned. After familiarizing decimal, binary octal and hexadecimal number system the learner should be able to understand formation of different number system. Though different standard data representation methods are used in today's computers, here we discuss only the fundamental data representation methods. For simplicity, the integer data representation is explained in 8 bit word length. The importance of complement representation for integers must be explained very clearly. The data representation of floating point number and character is to be discussed in brief. The concept of Boolean algebra must be provided to the learners by focusing on binary number system and their operations. After the completion of this chapter, the learner must have an idea on how to design a logic circuit for a simple logical expression. The learner must know the importance of binary number system in designing a logic circuit. The concept may be transacted through learning activities such as discussion, illustration, problem solving, demonstration etc. Teacher should ensure active participation of every student in all learning activities.

Values and Attitudes

- Creates enthusiasm in the fundamental aspects of hardware design of computers.
- Encourages to experiment with various circuits which will result in designing new electronic devices.

Unit Frame

Period : 30

Concepts/Process skills	Process/Activities with Assessments	Learning outcomes
Number systems ✓Communicating and understanding ✓Classifying ✓Comparing	General discussion on different number systems Table preparation of each number system , their base and symbols used	Distinguishes different number systems.
Number Conversions ✓Observing ✓applying ✓communicating ✓problem solving	Notes preparation Illustration of number conversions Assessment: Problem solving	Converts numbers from one system to another.
Binary arithmetic (addition, subtraction, complements) ✓observing ✓problem solving	General discussion on binary arithmetic Assessment: Problem solving	Performs binary arithmetic operations.
Representation of integers and floating point numbers ✓applying ✓ communicating and understanding ✓problem solving	General discussion on number representation Table preparation to distinguish different integer representation Notes Preparation	Represents numbers in computer memory and compares different methods.
Character representation ✓ communicating and understanding ✓charting	Slide presentation and discussion about different character representation methods Note preparation	Identifies various methods for representing characters in computer.
Representation of sound, image and video ✓identifying ✓presenting	Discussion on file formats. Prepare a table of file formats of sound, image and video Note preparation	Lists file formats for sounds, images and videos.
Introduction to Boolean algebra ✓ communicating and understanding	General Discussion about Boolean algebra Notes preparation	Explains the concept of Boolean algebra.

Concepts/Process skills	Process/Activities with Assessments	Learning outcomes
Logic operators and logic gates ✓Observing ✓Communicating	Illustration of logical operators and demonstration of logic gates Notes preparation	Explains logical operators and corresponding logic gates.
Basic postulates and laws of Boolean algebra ✓Identifying ✓Charting ✓Problem solving	Discussion on various Boolean laws and preparation of table by listing important laws. Assessment: Truth tables	Lists basic postulates and laws of Boolean algebra.
Circuit designing for simple Boolean expression ✓Applying ✓Problem solving	Drawing circuit diagram for simple Boolean expressions Assessment: Logic circuits	Designs circuits for simple Boolean expressions.
Universal gates ✓Applying ✓Problem solving	General discussion about importance of universal gates in circuit designing. Demonstrating the implementation of basic gates using universal gates Assessment: Logic circuits	Implements basic gates using universal gates.

Towards the Unit:

Number system

(1 Period)

Suggested activity: Group discussion on different number systems

- Teacher asks the students to write decimal numbers upto 30 downwards. After this they write a new series downwards with same numbers but avoiding symbols 8 and 9 as the next column. (i.e., numbers 8,9,18,19, etc. are avoided.). Now they write a new series in the next column downwards ignoring symbols 2, 3, 4, 5, 6, 7, 8 and 9. (i.e., using symbols 0 and 1 only). Similarly in the next column, a new series with new symbols A, B, C, D, E and F after symbol 9 are written.
  - Students individually write this series.
  - Teacher's intervention and support may be necessary as students may find it difficult to write series for octal and binary.
  - Once most students have finished they are grouped in benches and all students complete the task.
- Teacher consolidates the number series presented by students as decimal, octal, binary and hexadecimal respectively after presentation by students.
- The teacher concludes the discussion with the following points
  - Different number systems
  - Features of each number system
  - Construction of number series in each number system
  - Equivalent values for a number in one number system in other number systems. (can be easily found from each row of the table prepared.)
- Instructs the students to prepare notes

Importance of binary numbers

(1 Period)

Suggested activity: General discussion on the importance of binary numbers

- Teacher introduces computer as an electronic device and asks the students about the main feature of all electronic devices.

- Students identify that it has two states on and off.
- Teacher connects that binary numbers can be used to represent the on and off positions.

- Teacher consolidates that data can be represented using binary.
- The teacher concludes the discussion with the following points
  - On and off states of an electronic computer can be represented using binary numbers.
  - Data can be represented in binary form.
- Instructs the students to prepare notes

Importance of octal and hexadecimal number systems

(1 Period)

Suggested activity: General discussion on the importance of octal and hexadecimal numbers

- Teacher discusses the difficulty in representing data as binary (1's and 0's).
  - Students identify chances of errors and problems with debugging.
  - Teacher connects that binary numbers can be converted as octal or hexadecimal as they are powers of 2.
- Teacher consolidates that data can be easily represented using octal or hexadecimal than binary from.
- The teacher concludes the discussion with the following points
  - Data representation using binary is difficult
  - Data can be easily represented using octal or hexadecimal number systems.
- Instructs the students to prepare notes

Number conversions

(5 Periods)

Suggested activity: Problem solving on conversion of numbers from one number system to another

- Teacher introduces the importance of base in number conversions and performs decimal to other number systems by continuously dividing the number by the base to which the number is to be converted. The numbers after the decimal part will the continuously multiplied by the base.

- Students perform number conversions from decimal number system.

- The conversion to decimal number system from other number system is done by multiplying each number by their positional values.
  - Students perform number conversions to decimal number system.
- Teacher introduces the conversions betweenoctal, hexadecimaland binary number systems.
  - Teacher notes that these conversions are very easy and connects this with the reason for using octal and hexadecimal number system for representing data in computers.
- The teacher concludes the discussion with the following points
  - Number conversions steps
- Instructs the students to prepare notes

Representation of numbers

(3 Periods)

Suggested activity: General discussion on the different types of data and the different ways to represent numbers internally in computer

- Teacher asks the students to list different types of data that can be stored in a computer.
  - Students identify them as numbers(integers & floating poinit), characters, images, audio and video.
- Teacher reminds the students that data is stored internally in binary form and so all integers have to stored in that form.
  - Teacher makes the student feel the need for a common format (number of bits) for representing numbers otherwise which we cannot locate where a number starts and ends.
  - Teacher introduces the concept of a word and word length.
- Teacher introduces the different formats for representing integers.
  - Students identify sign and magnitude representation, 1's complement representation and 2's complement representation.
  - The logic behind using 1's compliment and 2's compliment can be demonstrated to students using a simple binary subtraction (101 – 011). This problem can be converted to an addition problem using the above two methods. (2's compliment as 101+101 (2's comp. of 011) which gives 010 as the answer.

- Teacher introduces the format for representing floating point numbers.
- The teacher concludes the discussion with the following points
  - The different number representation techniques
- Instructs the students to prepare notes

Representation of characters

(1 Period)

Suggested activity: General discussion on the different coding systems to represent characters

- Teacher initiates a discussion by asking the students how the character 'A' can be stored in a computer.
  - Students identify the need to convert these symbols as binary, as computers store data in binary format.
  - They understand the need for coding characters into binary.
- The different character coding formats are introduced by the teacher along with its features.
  - The teacher demonstrates the codes for some commonly used characters in ASCII, EBCDIC and Unicode.
- The teacher concludes the discussion with the following points
  - Different character coding formats
- Instructs the students to prepare notes

Representation of images, audio and video

(1 Period)

Suggested activity: General discussion on the different methods to represent images, audio and video internally in computer

- Teacher initiates a discussion by asking the students how images, audio and video can be stored in a computer.
  - Students identify the need to convert them as binary,since computers store data as binary.
- The different formats for storing images, audio and video are introduced by the teacher along with its features.
- The teacher concludes the discussion with the following points
  - Different images, audio and video coding formats
- Instructs the students to prepare notes

Introduction to Boolean Algebra

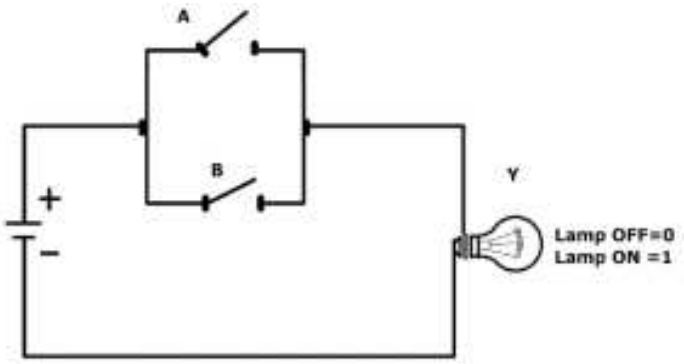
(3 Periods)

Suggested activity: Discussion and Notes preparation

- Initiate the discussion by posing some questions that give Yes/No answers and descriptive answers as given below:
  - Should I take an umbrella?
  - Will you give me your pen?
  - George Boole was a British mathematician. Say true or false.
  - Kerala is the biggest state in India. Say true or false.
  - Why were you absent yesterday?
  - What is your opinion about Boolean algebra?
- The responses from the learners are collected and introduce the term logical constant for identifying the values Yes/No (True/False).
- The discussion continues with the following questions:
  - What are the two states of an electronic circuit? (*Expected responses: Open and Closed OR High or Low*)
  - How can these states be expressed numerically? (*Expected responses: 1 and 0*)
  - What is meant by variable? How is it expressed in Mathematics? (*Expected responses: Value that changes. Using English letters*)
  - What is algebra in Mathematics? (*Expected responses: Study of operations on variables and constants*)
- Clues or hints may be given to introduce the concept of Boolean variable, the possible values it can have and Boolean algebra.
- Discussion on Boolean operations and logic gates
- The following question (or a similar one) is posed and responses are invited:
  - When do you use an umbrella? (*Response: When it rains or When it is too sunny*)
  - Make a sentence to combine these conditions to take the decision. (*Response: If it is raining or sunny take umbrella*)
- Now provide the following table and ask the learners to furnish it with YES or NO entries. (Refer textbook for the expected response – Section 2.5.2)

Raining	Sunny	Need Umbrella

- Ask them to replace YES and NO by TRUE and FALSE respectively and then by 1 and 0 respectively.
- Introduce the Logical OR operation and present the OR gate symbol.
- Provide the following circuit diagram (Fig. 2.6 in the textbook) and ask the learners to construct a table with A, B and Y as column headings and fill the boxes with 1s and 0s properly.
- Using the table constructed, introduce the concept of Truth Table and establish the relationship between logical operations and electronics.
- Ensure that the learners note down the Truth table of OR operation and draw the gate symbol.



- As described above introduce logical AND and logical NOT operators. (Use the questions given in the textbook for discussion or develop suitable questions to construct the concepts by the learners themselves.)

Basic Postulates of Boolean Algebra

(1 Period)

Suggested activity: Discussion and Notes preparation

- Discussion points:
  - o What are the Boolean quantities?

- What is a Boolean variable?
- Which values can be taken by a variable?

- Introduce postulate 1.
- Ask the learners to write all the entries in the Truth tables OR operation, AND operation and then NOT operation.
- Introduce the postulates 2, 3 and 4 one after the other.
- Learners note down these postulates in the Activity Log Book.
- Write the postulates 2 and 3 in pairs as given below:
  0+0=0 & 1.1=1 0+1=1 & 1.0=0 1+0=1 & 0.1=0 1+1=0 & 0.0=0
- Ask the learners to identify the common difference (or change) in the statements in each pair.
- Introduce the concept of "Principle of Duality".

Basic Theorems of Boolean Algebra

(3 Periods)

Suggested activity: Discussion and Notes preparation

- The theorems (for example associative law) may be introduced as follows:
  - A table with 7 columns are drawn and column headings are provided

A	B	C	A + B	(A + B) + C	B + C	A + (B + C)

  - Let the learners say number rows required for three input variables.
  - Ask the learners to draw the rows and fill all the entries as per the operation specified in each column.
  - Let them identify the columns that have the same values and introduce the statement of the law.
- Ensure that the learners note down the law and the correct truth table.

While transacting the contents in this chapter, teachers are expected to provide opportunities to construct the ideas themselves. While deriving the proof of De Morgan's theorems, let us point out the laws to be applied for derivation and let them try applying to prove the theorem. Similarly in the case of drawing circuits, let them try using the gates for designing the circuits.

Process Assessment

Discussions, Activity Log preparation, Truth table construction, Circuit designing, Worksheet completion, etc. are to be considered with the specified indicators and reflections are to be recorded in Teacher Planner and Activity Log.

Portfolio Assessment

Activity Log, Truth tables and circuits are assessed based on the specified indicators

Unit-wise Assessment

(2 Periods)

1. Boolean expressions may be given to find the output using truth tables.
2. Written tests may be conducted with questions similar to those given in worksheets, Check Yourself and Let us do boxes in the textbook.
3. Remediation may be planned, if needed, for the topics for which the learning outcome(s) are not attained.

TE Questions

1. What is the relevance of hexadecimal system in computers?
2. Fill in the blanks

   $(123)_8$, $(\_\_\_\_)_8$, $(133)_8$, $(137)_8$
3. Arrange the following numbers in the ascending order of their value in decimal number system.

   $(23)_8$, $(67)_{10}$, $(16)_{16}$, $(10010)_2$
4. Write the following decimal number in binary, sign and magnitude form, one's compliment and 2's compliment form.

   a. $(25)_{10}$ b. $(-40)_{10}$
5. Consider that you are filling the application for higher secondary admissions and you are entering your name as part of it. What is the method that computer uses to represent your name internally? Explain.
6. Given below are a few numbers whose number systems are not known. Write all the possible number systems each number can belong to.

   a. 1011 b. 649 c. 567 d. 989

7. Consider the number 25.45. write the mantissa and exponent part of this number when written in floating point notation.
8. a. Name the encoding scheme for encoding characters that was developed by Department of Electronics, Govt. of India.

   b. What was the purpose of this encoding scheme? Write its features.
9. NOR and NAND gates are known as universal gates. Justify this statement with proper illustration.
10. Prove that: $A\ (\overline{A}+\overline{B})+\overline{B}\ (A+B)=A$

    (a) Using truth table

    (b) Using algebraic method
11. Write down the output of each of the operations in the following logic circuit:
12. Three NAND gates are given. Which of the following Boolean operations can be realized using all the three NAND gates?

    (a) AND only (b) OR only

    (c) AND and OR (d) AND, OR and NOT
13. Name the logic gate that can represent the following circuit diagram?
14. How many rows are required in a truth table if the Boolean expression has 3 input variables?

    (a) 3 (b) 6 (c) 8 (d) 9
15. One of the statements of distributive law in Boolean algebra is A (B+C) = AB + AC. What is the other statement of this law?
16. Expand the De Morgan's theorem for three variables A, B and C.
17. NOR gate is the inverted OR gate. Prove this diagrammatically.
18. Which logic gate can accept only one input?

Scoring Indicators

1. Representing numbers and operations in binary form requires too many bits and needs lot of effort. Binary can be easily converted to hexa. Therefore this short-hand notation is widely used in the design and operations of electronic circuits.
2. $(127)_8$
3. $(10010)_{2,}$ $(23)_8$, $(16)_{16}$, $(67)_{10}$,

4. a. $(11001)_2$, $(00011001)_2$, $(00011001)_2$, $(00011001)_2$
   b. $(101000)_2$, $(10101000)_2$, $(11010111)_2$, $11011000)_2$
5. Unicode, features
6. a. binary, octal, decimal, hexa
   b. decimal, hexa
   c. octal, decimal, hexa
   d. decimal, hexa
7. mantissa: 0.2545, exponent: 2
8. a. ISCII
   b. encoding scheme for representing various writing systems of India. uses 8-bits, adopted by the Bureau of Indian Standards (BIS).Now replaced by Unicode.
9. Credit is given to the realization of basic gates using NAND and NOR.
10. (a) Credit is given for setting the columns with proper values and specifying the correct output for each operation.
    (b) Scores are awarded for the proper use of laws to prove the statement.
11. Scores awarded to specify the Boolean expression at the output line of each gate.
12. (b) OR only
13. AND gate
14. (c) 8
15. A +BC = (A+B)(A+C)
16. = and = ++
17. Credit is given to proper diagram (NOT gate at the output of OR gate)
18. NOT gate

Assessment Worksheet - 2.1

1. All number systems have ____ and ____ digits.
2. Calculations and comparisons are happening in the _____ unit of CPU.
3. The MSD of the binary number 1000.010 is_____.
4. The number system which uses the letter 'F' as one of its symbols is _____.

Assessment Worksheet – 2.2

1. What is Boolean variable?
2. Name the Boolean operation with only one input.
3. Which gate represents logical multiplication?
4. Draw an AND gate with three inputs.
5. What is principle of duality?

Assessment Worksheet – 2.3

1. What is Boolean variable?
2. Name the Boolean operation with only one input.
3. Which gate represents logical multiplication?
4. Draw an AND gate with three inputs.
5. What is principle of duality?