

**Welcome to the Session**  
**Presented By**  
**Mr. Nitish Kumar**  
**(Assistant Professor)**

# About Me

- **BTECH in CSE** from J. C. Bose University of Science and Technology
- **GATE 2024 Qualified**
- **MTECH in Artificial Intelligence** from Defence Institute of Advanced Technology (**DIAT-DRDO**) Pune.
- Worked as a **Project Researcher** in Technocraft Center for Applied Artificial Intelligence (**TCA2I**) , **VAJRA LAB** , Indian Institute of Technology (**IIT-Bombay**)
- Published a **conference paper** (Automation of Natural Language to SQL Query conversion for OSQuery to detect the threats) in an international conference **COMSNETS 2026** (Bangalore)

# Syllabus

## Course Objectives: -

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1	Understand the fundamental concepts of Data Structures and their applications.
2	Develop problem-solving skills using Data Structures.
3	Implement Data Structures using C programming language.

Unit	Course Content	Hours	PO	Cognitive Level
I	<b>Introduction and Overview:</b> Definition, Classification and Operations of Data Structures. Algorithms: Complexity, Time-Space Tradeoff. <b>Arrays:</b> Definition and Classification of Arrays, Representation of Linear Arrays in Memory, Operations on Linear <b>Arrays:</b> Traversing, Inserting, Deleting, Searching, Sorting and Merging. <b>Searching:</b> Linear Search and Binary Search, Comparison of Methods. <b>Sorting:</b> Bubble Sort, Selection Sort, and Insertion Sort. Two-Dimensional Arrays, Representation of TwoDimensional Arrays in Memory, Matrices and Sparse Matrices, Multi-Dimensional Arrays.	12	PO1, PO2, PO5, PO7	K1, K2, K3
II	<b>Linked Lists:</b> Definition, Comparison with Arrays, Representation, Types of Linked lists, Traversing, Inserting, Deleting and Searching in Singly Linked List, Doubly Linked List and Circular Linked List. Applications of Linked Lists: Addition of Polynomials. <b>Hashing and Collision:</b> Hashing, Hash Tables, Types of Hash Functions, Collision, Collision Resolution with Open Addressing and Chaining.	12	PO1, PO2, PO5, PO3	K1, K2, K3
III	<b>Stacks:</b> Definition, Representation of Stacks using Arrays and Linked List, Operations on Stacks using Arrays and Linked List, Application of Stacks: Arithmetic Expressions, Polish Notation, Conversion of Infix Expression to Postfix Expression, Evaluation of Postfix Expression. <b>Recursion:</b> Definition, Recursive Notation, Runtime Stack, Applications of Recursion: Factorial of Number, GCD,	12	PO1, PO2, PO3, PO4	K1, K2, K3, K4

# Syllabus

	Fibonacci Series and Towers of Hanoi. <b>Queues:</b> Definition, Representation of Queues using Array and Linked List, Types of Queue: Simple Queue, Circular Queue, Double-Ended queue, Priority Queue, Operations on Simple Queues and Circular Queues using Array and Linked List, Applications of Queues.			
<b>IV</b>	<b>Graphs:</b> Definition, Terminology, Representation, Traversal. <b>Trees:</b> Definition, Terminology, Binary Trees, Traversal of Binary Tree, Binary Search Tree, Inserting, Deleting and Searching in Binary Search Tree, Height Balanced Trees: AVL Trees, Insertion and Deletion in AVL Tree.	<b>12</b>	<b>PO1, PO2, PO4</b>	<b>K1, K2, K3, K4</b>
<b>Total Hours</b>		<b>30</b>		

## Text Books

1. R.B. Patel, "Expert Data Structures with C", Khanna Book Publishing Company, 2023 (AICTE Recommended Textbook)
2. Seymour Lipschutz, "Data Structures with C", Schaum's Outlines, Tata McGraw-Hill, 2011.
3. Yashavant Kanetkar, "Data Structures Through C", 4th Edition, BPB Publications, 2022.

## Reference Books

1. Reema Thareja, "Data Structures Using C", Second Edition, Oxford University Press, 2014.
2. Ellis Horowitz, Sartaj Sahni, and Susan Anderson-Freed, "Fundamentals of Data Structures in C", Second Edition, Universities Press, 2007.

# Syllabus

## **UNIT I: Basics of Data Structures**

1. What is data, structure, and data structure
2. Types of data structures (linear & non-linear)
3. Basic operations on data structures
4. Introduction to algorithms and their efficiency
5. Arrays and how data is stored in memory
6. Searching and sorting techniques
7. Two-dimensional and multi-dimensional arrays
8. Matrices and sparse matrices

# Syllabus

## **UNIT II: Linked Lists & Hashing**

1. Limitations of arrays
2. What is a linked list and why we use it
3. Types of linked lists:
  - I. Singly
  - II. Doubly
  - III. Circular
4. Basic operations on linked lists
5. Applications of linked lists (polynomial addition)
6. Hashing concepts and hash tables
7. Collision and collision handling techniques

# Syllabus

## **UNIT III: Stacks, Queues & Recursion**

1. Stack data structure and its operations
2. Applications of stacks (expressions & notations)
3. Recursion and how function calls work
4. Queue data structure and its types
5. Applications of queues in real life and systems

# Syllabus

## **UNIT IV: Trees & Graphs**

1. Tree structure and terminology
2. Binary trees, binary search trees and AVL trees
3. Tree traversal methods
4. Insertion, deletion, and searching in trees
5. Graphs and their representations
6. Graph traversal techniques

# What is Data?

- Data refers to **raw facts and figures**
- Data has **no meaning** when it is not processed
- Data can be numbers, characters, symbols, or values

## Examples of Data

- ✓ 25
- ✓ A
- ✓ 78.5
- ✓ Roll Number
- ✓ Phone Number

# What is Structure?

- Structure means **organizing and arranging things in a systematic way**
- It helps in managing and accessing items easily

## Examples

- ✓ Books arranged on shelves
- ✓ Files stored in folders
- ✓ Students arranged by roll number

# What is Data Structure?

- A Data Structure is a way of organizing data so that it can be used efficiently for **processing**, **searching**, and **updating**.

**Data + Structure + Operations = Data Structure**

- ❖ Data → **What we store**
- ❖ Structure → **How we store**
- ❖ Operations → **What we do (search, insert, delete)**

# Examples of Data Structure

## 1. Mobile Contact List

Names and phone numbers → **Data**

Saved alphabetically → **Structure**

Searching a name instantly → **Operation**

## 2: Library System

Thousands of books → **Data**

Books arranged by subject and code → **Structure**

Finding a book quickly → **Operation**

# Class Question

**Suppose you are given the marks of 1000 students.**

**Your task is to design a system (DS) such that we can:**

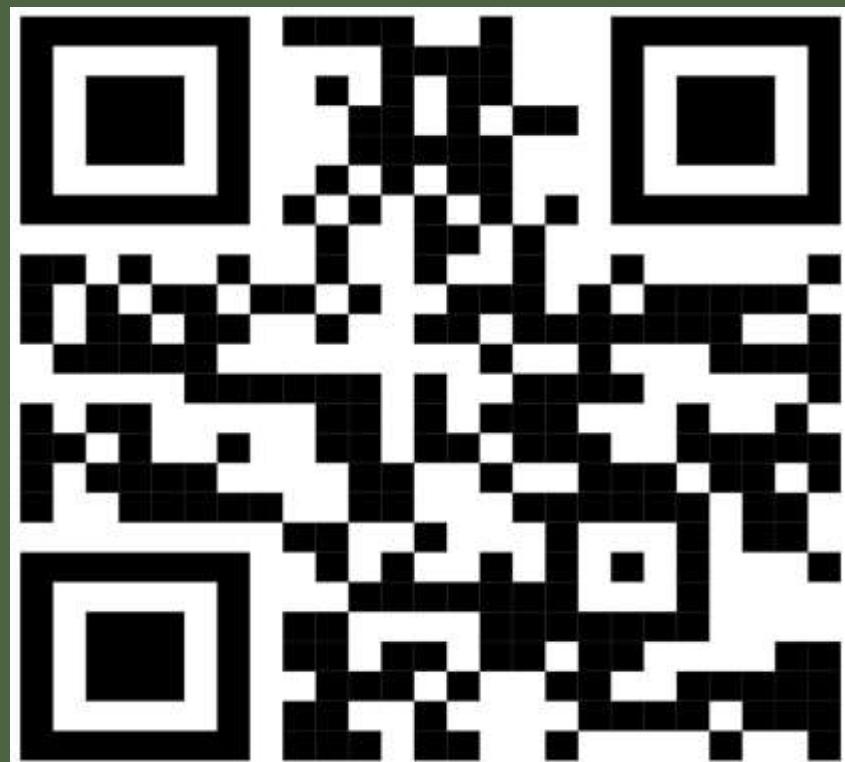
- Insert new student marks
- Update existing student marks
- Access any student's marks easily and quickly

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