

# COURSE STRUCTURE

**15CSE201**

**Data Structures and Algorithms**

**3-0-1-4**

## 1. COURSE OVERVIEW

This course aims to provide the students an in-depth understanding of structure and implementation of the common data structures used in computer science.

It imparts the ability to solve problems by choosing and applying the right data structures.

It also imparts the ability to improve the efficiency of programs by applying the right data structures.

## 2. COURSE OUTCOMES

1. Understand the concept and functionalities of Data Structures
2. Identify and apply appropriate data structures to solve problems and improve their efficiency
3. Analyze the complexity of data structures and associated Algorithms
4. Analyze the impact of various implementation and design choices on the data structure performance
5. Conceptualize and build data structures based on application needs

### 3. SYLLABUS

#### Unit 1

Introduction: Overview of Data Structures – A Philosophy of Data Structures - The Need for Data Structures – Cost and Benefits - Abstract Data Types and Data Structures - Principles, and Patterns. Basic complexity analysis – Best, Worst, and Average Cases - Asymptotic Analysis -Analyzing Programs – Space Bounds, Arrays, Linked Lists and Recursion: Using Arrays - Lists - Array based List Implementation – Linked Lists – LL ADT – Singly Linked List – Doubly Linked List – Circular Linked List - recursion- linear, binary, and multiple recursions. Stacks and Queues: Stack ADT - Array based Stacks, Linked Stacks – Implementing Recursion using Stacks, Queues - ADT, Array based Queue, Linked Queue, Double-ended queue, Circular queue.

#### Unit 2

Trees: Tree Definition and Properties – Tree ADT - Basic tree traversals - Binary tree - Data structure for representing trees – Linked Structure for Binary Tree – Array based implementation. Priority queues: ADT – Implementing Priority Queue using List – Heaps. Maps and Dictionaries: Map ADT – List based Implementation – Hash Tables - Dictionary ADT - Skip List – Complexity.

#### Unit 3

Search trees – Binary search tree, AVL tree, Trees – K-D Trees - B-Trees. Sorting and Selection – Linear Sorting – Heap Sort - Divide and Conquer Strategy – Analysis using Recurrence Tree based Method - Merge Sort - Quick Sort - Studying Sorting through an Algorithmic Lens – Selection – External Memory Sorting and Searching. Graphs: ADT- Data structure for graphs - Graph traversal- Transitive Closure- Directed Acyclic graphs - Weighted graphs – Shortest Paths - Minimum spanning tree – Greedy Methods for MST.

#### TEXT BOOKS:

1. Michael T Goodrich and Roberto Tamassia and Michael H Goldwsasser, “Data Structures and Algorithms in Java”, Fifth edition, John Wiley publication, 2010.
2. Clifford A. Shaffer, “Data Structures and Algorithm Analysis”, Third Edition, Dover Publications, 2012.

#### REFERENCES:

1. Michael T Goodrich and Roberto Tamassia and Michael H Goldwsasser, “Data Structures and Algorithms in Python++”, John Wiley publication, 2013.
2. Tremblay J P and Sorenson P G, “An Introduction to Data Structures with Applications”, Second Edition, Tata McGraw-Hill, 2002.

## 4. COURSE MODULES and TOPICS

### 1.Introduction to Data Structures

Need for Data Structures

Abstract Data Types

### 2. Complexity Analysis

Basic Complexity Analysis – Primitives based analysis

Worst Case, Best Case and Average Case

Asymptotic Analysis – Big Oh

### 3. Stacks and Queues

Using Arrays and Array based List Implementation

Stack ADT

Array based Stacks

Recursion

Linear, Binary and Multiple Recursion

Merge Sort and Quick Sort

Implementing Recursion using Stacks

Queues – ADT and Array based Queue

Double-ended queue and Circular queue.

### 4. Linked List

Linked Lists ADT

Singly Linked List

Doubly Linked List

Circular Linked List

Linked Stacks and Queue

## 5. Trees and Heaps

Tree basics, Definitions

Binary Tree Traversals

Binary Tree ADT

Priority Queues and Heaps

## 6. Search Trees

Binary Search Trees

AVL Trees

2-4 Trees

## 7. Graphs

Graph ADT

Data structure for graphs

Graph traversals and applications and Transitive Closure

Directed Acyclic graphs

Weighted graphs

Graph Algorithms (Shortest Paths, Minimum spanning tree )

## 8. Dictionaries and Hash Tables

Maps and Dictionaries

Hash Tables

External Memory Sorting (Bucket Sort)

## 9. Other Data Structures

Skip Lists

K-D trees