



## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA – 533 003, Andhra Pradesh, India

### DEPARTMENT OF INFORMATION TECHNOLOGY

III Year – I Semester		L	T	P	C
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<b>ADVANCED DATA STRUCTURES</b>					

#### Course Objectives:

- Describe and implement a variety of advanced data structures (hash tables, priority queues, balanced search trees, graphs)
- Analyze the space and time complexity of the algorithms studied in the course
- Identify different solutions for a given problem; analyze advantages and disadvantages to different solutions
- Demonstrate an understanding of Amortization
- Demonstrate an understanding of various search trees

#### Course Outcomes:

Upon completion of the course, graduates will be able to

- Illustrate several sub-quadratic sorting algorithms.
- Demonstrate recursive methods
- Apply advanced data structures such as balanced search trees, hash tables, priority queues and the disjoint set union/find data structure

#### UNIT I

Sorting: Medians and order statistics, External Sorting, Introduction, K-way Merging, Buffer Handling for parallel Operation, Run Generation, Optimal Merging of Runs.

Hashing: Introduction, Static Hashing, Hash Table, Hash Functions, Secure Hash Function, Overflow Handling, Theoretical Evaluation of Overflow Techniques, Dynamic Hashing- Motivation for Dynamic Hashing, Dynamic Hashing Using Directories, Directory less Dynamic Hashing, Alternate hash functions (mid-square, folding, digit analysis), Double Hashing

#### UNIT II

Priority Queues and Advance Heaps: Double Ended Priority queues, Leftist Trees: Height Biased, Weight Biased. Binomial Heaps: Cost Amortization, Definition of Binomial Heaps, Insertion, Melding two Binomial Heaps, deletion of min element. Fibonacci Heaps: Definition, Deletion from an F-heap, Decrease key, Cascading Cut.

#### UNIT III

Advanced and Efficient Binary Search Trees: Optimal Binary Search Trees, AVL Trees- rotations, insertion, deletion operations, Red-Black Trees, Definition, Representation of a Red-Black Tree, Searching a Red-Black Tree, Inserting into a Red Black Tree, Deletion from a Red-Black Tree, Joining Red-Black Trees, Splitting a Red-Black tree.

#### UNIT IV

Multi-way Search Trees: M-Way Search Trees, Definition and Properties, Searching an M-Way Search Tree, B-Trees, Definition and Properties, Number of Elements in a B-tree, Insertion into B-Tree, Deletion from a B-Tree, B+-Tree Definition, Searching a B+-Tree, Insertion into B+-tree, Deletion from a B+-Tree.



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**UNIT V**

Digital Search Structures: Digital Search Trees: Definition, Search, Insert and Delete. Binary Tries, Compressed Binary Tries. Multi-way Tries: Definition, searching a Trie, sampling strategies, Insertion, Deletion, Height of a Trie. Prefix Search and applications. Suffix Trees.

**Text Books:**

- 1) Fundamentals of Data Structures in C: 2<sup>nd</sup> ed, , Horowitz , Sahani, Anderson-freed, Universities Press
- 2) Data Structures, a Pseudo code Approach, Richard F Gilberg, Behrouz A Forouzan, Cengage.

**Reference Books:**

- 1) Data structures and Algorithm Analysis in C, 2<sup>nd</sup> edition, Mark Allen Weiss, Pearson
- 2) “Introduction to Algorithms”, T. Cormen, R.Rivest, C. Stein, C. Leiserson, PHI publication, Second Edition, 2004, ISBN 81-203-2141-3.

**e-Resources:**

- 1) <http://lcm.csa.iisc.ernet.in/dsa/dsa.html>
- 2) [http://utubersity.com/?page\\_id=878](http://utubersity.com/?page_id=878)
- 3) <http://freevidelectures.com/Course/2519/C-Programming-and-Data-Structures>
- 4) <http://freevidelectures.com/Course/2279/Data-Structures-And-Algorithms>