B. Tech. in COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)

III Year I Semester Syllabus (KR23)
ALGORITHM DESIGN AND ANALYSIS (23DI502PC)
Common for CSE (DATA SCIENCE) and IT

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Pre-requisites/ Co-requisites:

1. 23CS103ES-Programming for Problem Solving
2. 23CC402PC-Data Structures
3. 23CC305PC- Object Oriented Programming through Java

Course Objectives: The course will help to

1. Introduce the notations for analysis of the performance of algorithms and recursion.
2. Relate major algorithmic techniques (divide-and-conquer, greedy) and mention problems for which each technique is appropriate.
3. Introduce the applications of graphs and trees.
4. Understand dynamic programming with applications.
5. Understand Branch and Bound technique and introduce P, NP problems.

Course Outcomes: After learning the concepts of the course, the student is able to

1. Analyse the performance of algorithms and illustrate the use of divide and conquer in applications.
2. Illustrate the use of greedy method and binary search in real world applications.
3. Apply BFS, DFS and backtracking in different applications.
4. Develop different applications using dynamic programming.
5. Design different applications of branch and bound and understand P, NP problems.

UNIT - I
Introduction: Algorithm, Performance Analysis-Space Complexity, Time complexity, Asymptotic Notations- Big oh notation, Omega notation, Theta notation and Little oh notation.
Recursion: Introduction, Fibonacci sequence, Climbing Stairs, Reverse String, Happy Number, Greatest Common Divisor, Strobogrammatic Number II.
Divide and Conquer: General method, Master Theorem, Applications: Quick sort, Merge sort, Majority Element, Calculate pow(x,n).

UNIT - II
Binary Search- Introduction, Applications: Median of two sorted arrays, Find the fixed point in a given array, Find Smallest Common Element in All Rows, Longest Common Prefix, Koko Eating Bananas.
Greedy Method: General method – Applications –Minimum product subset of an array, Best Time to Buy and Sell Stock, Knapsack problem, Minimum cost spanning trees, Single source shortest path problem.

UNIT - III

Breadth First Traversal and Depth First Traversal: BFS Introduction, Applications: Find All The Lonely Nodes, Max Area of Island, Number of Distinct Islands. DFS Introduction, Applications: The Maze, Boundary of Binary Tree.

Trees: Binary Tree Introduction, Applications: Symmetric Tree, Balanced Binary Tree, Average of Levels in Binary Tree, Find Largest Value in Each Tree Row, Binary Tree Right Side View.

Backtracking: General method, Applications: N Queens Problem, Hamiltonian Cycle, Brace Expansion, Gray Code, Path with Maximum Gold, Generalized Abbreviation, Campus Bikes II.

UNIT - IV

Dynamic Programming: Introduction, DP Techniques, Applications – Matrix Chain Multiplication, Optimal Binary Search Tree, All Pairs Shortest Paths, Traveling Salesperson Problem, Climbing Stairs, Min Cost Climbing Stairs, Maximum Sub Array, Number of Corner Rectangles, 0/1 Knapsack Problem.

Strings Problems: Introduction, Count Substrings with Only One Distinct Letter, Valid Word Abbreviation, Longest Repeating Substring, Longest Common Subsequence, Longest Increasing Subsequence.

UNIT - V

Branch and Bound: General Method, FIFO Branch and Bound, LC Branch and Bound, Applications: 0/1 knapsack Problem, Traveling Salesperson Problem.

NP-Hard and NP-Complete problems: Basic concepts, non-deterministic algorithms, NP-Hard and NP-Complete classes, Cook's theorem.

TEXT BOOKS:

1. Fundamentals of Computer Algorithms, Ellis Horowitz, Satraj Sahni and Raja sekharan, University Press.
2. Introduction to Algorithms, Thomas H Coremen, Charles E. Leiser, Ronald L. Rivest, Clifford Stein, 3rd edition, 2009.
3. Design and Analysis of Algorithms: A Contemporary Perspective, Cambridge University Press, Sandeep Sen, Amit Kumar, 2019

REFERENCE BOOKS: