INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY								
IV Semester: CSE / IT / CSE (CS)								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ACSD16	**Core**	-	-	2	1	40	60	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 45**				**Total Classes: 45**		
Prerequisites: There are no prerequisites to take this course.								

I. COURSE OVERVIEW:
Design and analysis of algorithm lab provides hands on experience in implementing different algorithmic paradigms and develops competence in choosing appropriate data structure to improve efficiency of technique used. This laboratory implements sorting techniques using divide and conquer strategy, shortest distance algorithms based on Greedy, Dynamic programming techniques, Minimum spanning tree construction and applications of Backtracking, Branch and Bound. This is essential for developing software in areas Information storage and retrieval, Transportation through networks, Graph theory and Optimization problems.

II. COURSE OBJECTIVES
The students will try to learn:

I. The selection of Algorithmic technique and Data structures required for efficient development of technical and engineering applications.
II. The algorithmic design paradigms and methods for identifying solutions of optimization problems.
III. Implementation of different algorithms for the similar problems to compare their performance.

III. COURSE OUTCOMES:
At the end of the course students should be able to:

CO1 Apply divide and conquer strategy to organize the data in ascending or descending order
CO2 Make use of algorithmic design paradigms to determine shortest distance and transitive closure of directed or undirected graphs
CO3 Utilize greedy technique for generating minimum cost spanning tree of a graph.
CO4 Compare the efficiencies of traversal problems using different tree and graph traversal algorithms.
CO5 Utilize backtracking method for solving puzzles involving building solutions incrementally.
CO6 Examine branch and bound approach for solving combinatorial optimization problems.

IV. COURSE CONTENT:

Week-l: QUICK SORT and MERGE SORT

a. Sort a given set of elements using the quick sort method and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the 1st to be sorted and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.
b. Implement merge sort algorithm to sort a given set of elements and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted

and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.

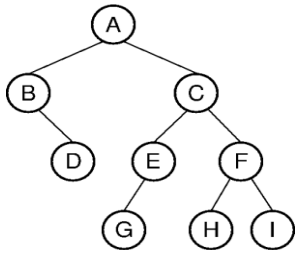
Week-2: DIVIDE AND CONQUER

a. Given two binary strings that represent value of two integers, find the product of two strings using Karatsuba algorithm for fast multiplication. For example, if the first bit string is "1100" and second bit string is "1010", output should be 120. For simplicity, let the length of two strings be same and be n.

b. Strassen's Matrix Multiplication is the divide and conquer approach to solve the matrix multiplication problems. The usual matrix multiplication method multiplies each row with each column to achieve the product matrix. The time complexity taken by this approach is $O(n^3)$, since it takes two loops to multiply. Strassen's method was introduced to reduce the time complexity from $O(n^3)$ to $O(n^{\log 7})$.

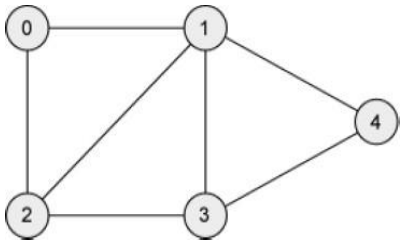
Week-3:TREE TRAVERSAL ALGORITHMS

Perform various tree traversal algorithms for a given tree using Recursive and Non Recursive techniques.



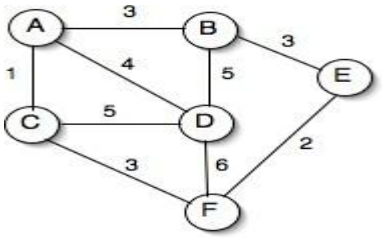
Week-4:GRAPH TRAVERSALS TECHNIQUES

a.Print all the nodes reachable from a given starting node in a digraph using BFS method.
b.Check whether a given graph is connected or not using DFS method



Week-5: MINIMUM COST SPANNING TREE

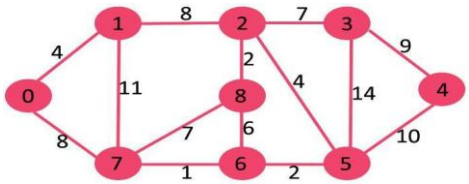
a.Find Minimum Cost Spanning Tree of a following undirected graph using Kruskal‘s algorithm.



b.Find Minimum Cost Spanning Tree of a given undirected graph above using Prims Algorithm.

Week-6: SHORTEST PATHS ALGORITHM

From a given vertex in a weighted connected graph, find shortest paths from 0 to other vertices using Dijkstra‘s algorithm.



Week-7: JOB SEQUENCING WITH DEADLINES AND OPTIMAL STORAGE ON TAPES

Implement in python for obtaining optimal solution using Greedy approach for the following problems

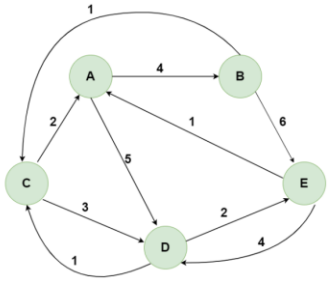
a. Optimal Storage on Tapes is one of the applications in the Greedy Method. The objective of this algorithm is to find the Optimal retrieval time for accessing programs that are stored on tape. There are 'n' programs that are to be stored on a computer tape of length (L). Associated with each program (i) is a length (l)

Let the programs are stored in the order (I = i1, i2, i3, ...) such that all programs are retrieved equally That is their expected or Mean Retrieval Time (MRT) will be same.

b. Job scheduling algorithm is applied to schedule the jobs on a single processor to maximize the profits. The problem states that, “Given ‘n’ number of jobs with a starting time and ending time, they need to be scheduled in such a way that maximum profit is received within the maximum deadline”.

Week-8:ALL PAIRS SHORTEST PATHS and 0/1 KNAPSACK PROBLEMS

a.Implement All-Pairs Shortest Paths Problem using Floyd's algorithm



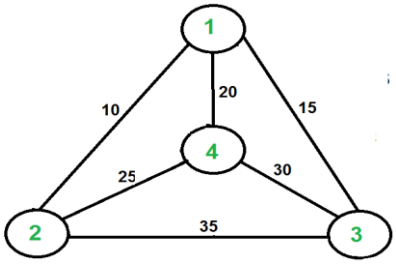
b.Find Optimal solution for 0/1 knapsack problem using Dynamic Programming Technique

Week-9: OPTIMAL BINARY SEARCH TREE

Write a Program to Construct optimal binary search for
(a1, a2, a3, a4) = (do, if, int, while),
p(1 : 4) = (3,3,1,1)
q(0 : 4)= (2,3,1,1,1)

Week-10: TRAVELLING SALES PERSON PROBLEM

Implement any scheme to find the optimal solution for the Traveling Sales Person problem and then solve the same problem instance using any approximation algorithm and determine the error in the approximation



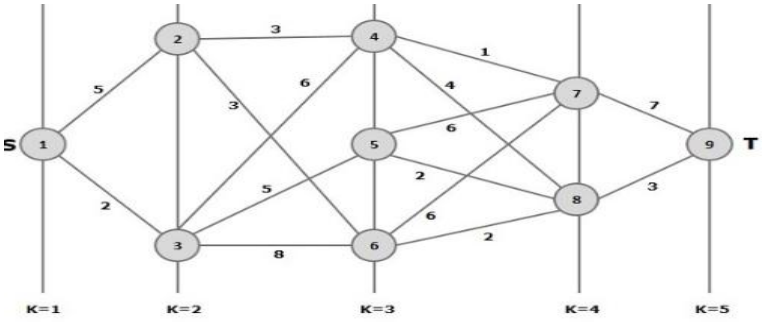
Week-11: SUM OF SUBSETS PROBLEM AND GRAPH COLORING PROBLEM

a. Find a subset of a given set S = {sl, s2,. , sn} of n positive integers whose sum is equal to a given positive integer d. For example, if S= {1, 2, 5, 6, 8} and d = 9 there are two solutions {1, 2, 6} and {1,8}.A suitable message is to be displayed if the given problem instance doesn't have a solution.

b. Implement a program to find Chromatic Number of Given Graph

Week-12:N MULTISTAGE GRAPH

Given a multistage graph, a source and a destination, find shortest path from source to destination (Forward Approach) and Destination to Source (Backward Approach). By convention, consider source at stage 1 and destination as last stage.



Week-13:N QUEENS PROBLEM and 8-PUZZLE PROBLEM

Implement N Queens Problem and 8-Puzzle problem in python using Branch and Bound Technique

V.TEXT BOOKS:

1. Karin R Saoub, *Graph Theory: An Introduction to Proofs, Algorithms, and Applications*, 1st edition, Chapman and Hall, 2021.
2. S S Sastry, *Introductory Methods of Numerical Analysis*, 5th edition, 2012.

VI.REFERENCE BOOKS:

1. Levitin A, "Introduction to the Design and Analysis of Algorithms", Pearson Education, 2008.

2. Goodrich, M.T. R Tomassia, “Algorithm Design foundations Analysis and Internet Examples”, John Wiley and Sons, 2006.
3. Base Sara, Allen Van Gelder, “Computer Algorithms Introduction to Design and Analysis”, Pearson, 3rd edition, 1999.

VII. ELECTRONIC RESOURCES

1. http://www.personal.kent.edu/~rmuhamma/Algorithms/algorithm.html
2. http://openclassroom.stanford.edu/MainFolder/CoursePage.php?course=IntroToAlgorithms
3. http://www.facweb.iitkgp.ernet.in/~sourav/daa.html

VIII. MATERIALS ONLINE

1. Course template
2. Lab Manual