

Time: 3 Hrs.

Max. Marks: 75

Subject: **Design and Analysis of Algorithms**

Sub. Code: U3CSE502 / U3SWE502 / U3BCE502

**Part A - (10 x 2 = 20)**  
**Answer ALL the Questions**

- How an algorithm's time efficiency is measured.
- Give expressions for Space and Time analysis of algorithms
- List the basic steps involved in the Divide-and Conquer strategy.
- Write the control abstraction of Divide and Conquer strategy.
- Find the optimal solution and maximum profit of the knapsack problem
- What is a feasible solution and an optimal solution ?
- How does dynamic programming differ from divide and conquer?
- What do you mean by Principle of Optimality?

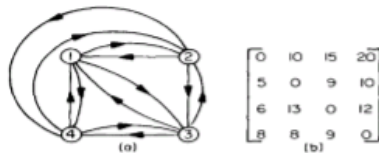
(Or)

(b) Given a directed, weighted graph G write an algorithm identify the shortest path from a given source vertex to remaining vertices of the graph.

- (a) Cost of insertion is 1, deletion is 1, change is 2 find the minimum cost of edit sequence convert X into Y

(Or)

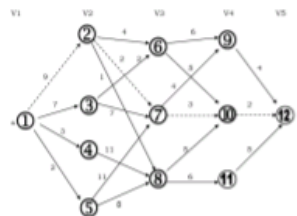
(b) Find minimum cost tour from vertex 1 of the following graph



- (a) What is m-colourability problem . Draw state space tree for a 4 node graph with 3 colours.

(Or)

(b) Bring out basic traversal techniques for a tree



- Design a backtracking algorithm that inputs a natural number C, and outputs all the ways that a group of ascending positive numbers can be summed to give C. For example, if C = 6, the output should be 1 + 2 + 3, 1 + 5, 2 + 4, and 6.

- How two queens in a chess board checked for not being in the same diagonal?

- Give an algorithm for BFS of graph.

**Part B (5 x 5 = 25)**  
**Answer ALL the Questions**

- (a) Write on specifications of Algorithm.  
(OR)  
(b) Describe Randomized algorithms
- (a) Write an algorithm based on D and Q to find maximum and minimum of numbers in an array. Find its best, worst and average case complexities  
(OR)  
(b) Write an algorithm based on D and Q to Quick sort numbers in an array. Find its best, worst and average case complexities
- (a) Given n sorted files write an algorithm to merge them into a single sorted file, such that record movement is minimised.

**Part C (3 x 10 = 30 Marks)**  
**Answer any THREE Questions**

- Explain asymptotic notations in detail with suitable examples
- (a) Write an algorithm to perform binary search on a sorted array. Find its best, worst and average case complexities  
(b) Write an algorithm to multiply two square matrices with reduced operations.
- Explain the greedy based algorithm for the fractional knapsack problem, and prove that this algorithm always yields the optimal solution.
- Give an algorithm to find shortest path from a source vertex s to sink vertex t in a multistaged graph G and hence solve the following graph

**PART - A (10 X 2 = 20)****Answer ALL Questions**

1. What do you mean by Amortized Analysis?
2. Give the two major phases of performance evaluation.
3. Give computing time for binary search?
4. What is Merge sort? Is insertion sort better than the merge sort?
5. Write the control abstraction for greedy method.
6. Specify the algorithms used for constructing Minimum cost spanning tree.
7. What are the drawbacks of dynamic programming?
8. State the time efficiency of floyd's algorithm.
9. Define state space of the problem.
10. Define chromatic number of the graph.

**PART - B (5 X 5 = 25)****Answer ALL the Questions**

11. (a) Define an algorithm. What are the characteristics of an algorithm?

(OR)

(b) Analyze the time complexity of the following segment  
 for ( $i=0; i<n; i++$ )  
 for ( $j=0; j<n; j++$ )  
 Sum=Sum+1;

12. (a) Explain divide and conquer design technique.

(OR)

(b) If  $T(n)=T(n/2)+b$ , then prove that  $T(n) = O(\log_2 n)$

13. (a) Explain optimal storage on tapes. Give an example.

(OR)

(b) Write Dijkstra algorithm.

14. (a) Write an algorithm for multistage graph using forward approach.

(OR)

(b) Explain all pairs shortest path problem.

15. (a) Write an algorithm for breath-first search.

(OR)

(b) Explain how backtracking is used to solve sum of subsets problem.

**PART - C (3 X 10 = 30)****Answer any THREE Questions**

16. Write an algorithm to find the greatest number among the group. Explain its time and space complexity.

17. Write Quick sort algorithm using divide and conquer design technique and analyze its time complexity.
18. Explain Job Sequencing with deadlines with example..
19. Solve the following knapsack problem in dynamic programming.  
 $M=4, n=3, P=(31,47,14), W=(2,3,1)$
20. What is Hamiltonian cycle? Develop an algorithm for finding minimum cost Hamiltonian cycle using backtracking principle.

**ISLAMIAH COLLEGE [AUTONOMOUS], VANIAMBADEI  
ARREAR EXAMINATIONS, OCTOBER - 2018**

Time: 3 Hrs

Max Marks : 75

Subject: **Design & Analysis of Algorithms**

Sub. Code: U5SW5001 / U5CS5001 / U5BC5001

**PART – A (10 X 2 = 20)**

**Answer ALL Questions**

1. What is an Algorithm?
2. Define the term 'Space Complexity'.
3. Define divide-and-conquer strategy.
4. What is the worst case complexity of Merge sort?
5. What is an optimal assignment?
6. What are weighted trees?
7. What is dynamic programming?
8. Define the term principle of optimality.
9. Define Binary Tree.
10. Define Solution state.

**PART– B (5 X 5=25)**

**Answer ALL Questions**

11. a. Explain the distinct areas of study of an algorithm.  
Or  
b. Write a Recursive algorithm to generate Fibonacci series.
12. a. Explain Binary search algorithm with an example.  
Or  
b. Explain about straightforward algorithm to find maximum and minimum items in a set of 'n' elements.

13. a. Explain about Prim's minimum-cost spanning tree algorithm with an example.

Or

- b. Write short notes on Optimal storage on tapes.

14. a. Write short notes on Multistage graphs.

Or

- b. Write short notes on string editing.

15. a. Explain about Hamiltonian cycles.

Or

- b. Write short notes on graph coloring.

**PART – C (3 X 10=30)**

**Answer any THREE Questions**

16. Explain in detail about Randomized algorithms with an example.
17. Explain Merge Sort with an example
18. Explain the steps to solve the Knapsack problem using Greedy algorithm.
19. How will you solve Travelling Salesman Problem? Explain the procedure involved in it.
20. Explain the 8-queens problem with an example. Also develop an algorithm for the same.

Sub. Code: U5CC5001  
 Subject Name: Design and Analysis of Algorithms

**PART-A (10 X 2 = 20 MARKS)**  
 Answer ALL Questions

1. Differentiate time complexity and space complexity.
2. How does randomized algorithm differ from normal algorithm
3. What is binary search problem?
4. Why is it necessary to have the auxiliary array  $b$  [low: high] in function Merge?
5. Find an optimal solution to the Knapsack instance  $n=3$ ,  $m=20$ ,  $(P_1, P_2, P_3) = (25, 24, 15)$  and  $(W_1, W_2, W_3) = (18, 15, 10)$ .
6. State optimal merge pattern problem with its greedy selection.
7. Give an expression that finds shortest path between two vertices  $i$  and  $j$  passing through index  $K$  having highest index of a graph.
8. Give the recurrence equation that find the minimum cost edit sequence one string to another.
9. Give pseudo code for BFS and DFS of a graph.
10. Define Backtracking? What are its constraints? List the applications of Backtracking.

**PART-B (5 X 5 = 25 MARKS)**  
 Answer ALL Questions

11. (a) If  $S$  is a set of  $n$  elements, the powerset of  $S$  is the set of all possible subsets of  $S$ . For example, if  $S = \{a, b, c\}$ , then  $\text{powerset}(S) = \{\{\}, \{a\}, \{b\}, \{c\}, \{a, b\}, \{a, c\}, \{b, c\}, \{a, b, c\}\}$ . Write a recursive algorithm to compute  $\text{powerset}(S)$ .



(Or)

- (b) Explain reliability design problem with suitable example.

15. (a) Give backtracking algorithm for N-queen problem

(Or)

- (b) State the subset – sum problem and complete state – space tree of backtracking algorithm applied to the instance  $A = \{3, 5, 6, 7\}$  and  $d=15$  of the subset – sum problem.

**PART-C (3 X 10 = 30 MARK)**  
 Answer any THREE Questions

16. Explain how algorithms are specified with pseudocode conventions
17. Explain the problem of finding the maximum and minimum items in a set of  $n$  elements.
18. (a). Explain Prim's Minimum cost spanning tree algorithm and hence find MCST of the graph below.



- (b). Explain Prim's Minimum cost spanning tree algorithm and hence find MCST of the graph below.

(Or)

- (b) Given a 2-sided coin. Using this coin, how will you simulate an  $n$ -sided coin  
 (i) when  $n$  is a power of 2? (ii) when  $n$  is not a power of 2?

12. (a) Show how divide and conquer technique can be used to compute the product of two  $n$ -digit integers. If  $n$  is a power of 2, obtain a recurrence relation for  $M(n)$ , the number of multiplications and solve it.  
 (Or)  
 (b) Briefly discuss the procedure used in Strassen multiplication and analyze its efficiency. Use Strassen's algorithm to compute the matrix product

$$\begin{pmatrix} 1 & 3 \\ 7 & 5 \end{pmatrix} \begin{pmatrix} 6 & 8 \\ 4 & 2 \end{pmatrix}$$

13. (a) Compute the minimum cost spanning tree for the following graph using (i) Prim's (ii) Kruskal's algorithm.

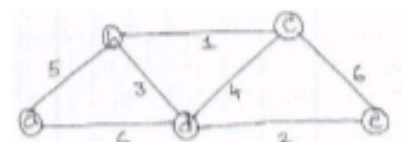


(Or)

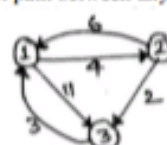
- (b) Write the Kruskal's algorithm to find the minimum cost spanning tree. Also trace the algorithm for the graph



14. (a) Find in multistage graph given below the minimum cost path from  $s$  to  $t$  and its minimum cost



19. Give an algorithm for All Pairs Shortest Path problem and hence find shortest path between any two vertices of the following graph



20. State and explain  $m$ -coloring problem with its algorithm. Solve it for a 4 node 3 color graph with its state space tree



**PART-A (10 X 2 = 20 MARKS)****Answer ALL Questions**

1. Differentiate time complexity and space complexity
2. What are the advantages and limitations of randomized algorithm?
3. What is the difference between Quick sort and merge sort
4. What are the improvements that can be made to quick sort?
5. State tree vertex splitting problem with its control abstraction and greedy selection
6. State the applications of Dijkstra's shortest path algorithm.
7. Define Principle of Optimality.
8. Give an expression that finds shortest path between two vertices i and j passing through index K having highest index of a graph.
9. Give a recursive formulation for Inorder, Preorder and Post order traversal of a Binary tree
10. Define promising node and non-promising node.

**PART-B (5 X 5 = 25 MARKS)****Answer ALL Questions**

11. (a). Explain the general plan for analyzing the efficiency of a recursive algorithm. Suggest a recursive algorithm to find the factorial of a number. Derive its efficiency.

(Or)

- (b). Consider the following algorithm

Algorithm GUESS ( $a[ ] [ ]$ )for  $i \leftarrow 0$  to  $n-1$ for  $j \leftarrow 0$  to  $i$  $a[i][j] \leftarrow 0$ 

- i) What does the algorithm compute?
- ii) What is basic operation?
- iii) What is the efficiency of this algorithm?

12. (a) Sort the letters of the word 'EXAMPLE' in alphabetical order using selection sort.

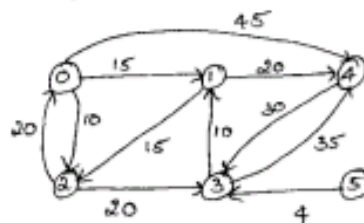
(Or)

- (b) Solve the recurrence  $T(n) = 2T(n-1) + 1$  if  $n > 1$ ;  $T(1) = 0$  if  $n = 1$

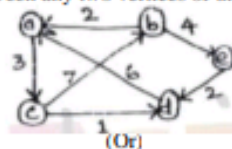
13. (a) Write an algorithm to find the shortest path from every a node to every other node in a graph G. What is the strategy you followed?

(Or)

- (b) Find shortest paths from vertex 5 to all other vertices of the graph.



14. (a) Give an algorithm for All Pairs Shortest Path problem and hence find shortest path between any two vertices of the following graph



(Or)

- (b). Solve the following travelling sales person problem for the graph whose cost matrix is given below

0	7	3	12	8
3	0	6	14	9
5	8	0	6	18
9	3	5	0	11
18	14	9	8	0

0	3	∞	7	∞
3	0	4	2	∞
∞	4	0	5	6
7	2	5	0	4
∞	∞	6	4	0

15. (a) State the subset – sum problem and complete state – space tree of backtracking algorithm applied to the instance  $A = \{3, 5, 6, 7\}$  and  $d=15$  of the subset – sum problem.

(Or)

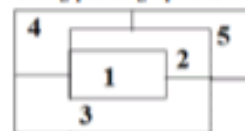
- (b) Write an algorithm to determine the Hamiltonian cycle in a given graph using backtracking.

**PART-C (3 X 10 = 30 MARKS)****Answer any THREE Questions**

16. Explain the analysis framework of algorithms. Explain the worst case, best case and average case efficiencies, with an algorithm.
17. Explain the problem of finding the maximum and minimum items in a set of  $n$  elements.
18. Explain the concept of greedy technique for prim's algorithm. Obtain minimum cost spanning tree for the graph whose weight matrix is given below.

19. Explain how dynamic programming is applied to transform one string to another string and hence transform  $X = a,a,b,a,a,b,a,b,a,a$  into  $Y = b,a,b,a,a,b,a,b$  with insertion and deletion cost 1 unit and change cost 2

20. What is graph coloring problem? Describe the back tracking technique to  $m$ -coloring with following planar graph show in figure.



ISLAMIAH COLLEGE [AUTONOMOUS] VANIYAMBADI  
END SEMESTER EXAMINATIONS, FEBRUARY - 2022

Time: 3 Hrs

Max. Marks: 75

Subject: **Design & Analysis of Algorithms**

Sub. Code: U3BCE502

**PART - A (10 X 2 = 20)**  
**Answer ALL the Questions**

1. What is an algorithm?
2. What is randomized algorithm?
3. Give computing time for binary search?
4. What is the use of Strassen's matrix multiplication?
5. State the general principle of greedy algorithm.
6. What is meant by Tree vertex splitting?
7. What are the drawbacks of dynamic programming?
8. State the time efficiency of Floyd's algorithm.
9. Define state space of the problem.
10. Define chromatic number of the graph.

**PART - B (5 X 5 = 25)**  
**Answer ALL the Questions**

11. (a) Explain in detail about Performance Analysis.  
(Or)  
(b) Briefly explain about algorithm Specification.
12. (a) Explain divide and conquer design technique.  
(Or)  
(b) Explain in detail about Quick Sort with an example.
13. (a) Write Dijkstra algorithm  
(Or)  
(b) Explain about Optimal Storage on Tapes.

14. (a) For the following graph having 4 nodes represented by the matrix given below determine the all pairs shortest path

1	$\infty$	3	$\infty$
2	0	$\infty$	$\infty$
$\infty$	7	0	1
6	$\infty$	$\infty$	0

(Or)

- (b) Write a note on reliability design.

15. For the following graph determine the Hamiltonian Cycle

(Or)

- (b) Write an algorithm for breath-first search.

**PART - C (3 X 10 = 30)**  
**Answer any THREE Questions**

16. Briefly explain the time complexity & space complexity estimation.
17. Distinguish between Quick Sort and Merge Sort and arrange the following numbers in increasing order using Merge Sort.
18. Define spanning tree. Discuss the design steps in Kruskal algorithm to construct minimum spanning tree with example?
19. Solve the following knapsack problem in dynamic programming.  
 $M=4, n=3, P=(31,47,14), W=(2,3,1)$
20. How backtracking works on the 8 Queen problem with suitable