

Govt. of Karnataka, Department of Technical Education
Diploma in Information Science & Engineering
Third Semester
Subject: ANALYSIS AND DESIGN OF ALGORITHM

Contact Hrs / week: 04

Total hrs: 64

Topic Analysis

Chapter No.	Contents	No. of Hours
PART-A		
1	Algorithm Analysis	03
2	Methodologies for Analyzing algorithm	05
3	Asymptotic Notations	06
PART-B		
4	Graphs	04
5	Optimization Problems	03
6	Brute Force Methods	04
PART-C		
7	Divide and Conquer	06
8	Decrease and Conquer	03
9	Dynamic Programming	06
PART-D		
10	Greedy Technique	06
11	Backtracking	06
12	Branch and Bound	04
13	Tests and Assignments	05
14	Industry innovation	03
Total		64

DETAILS OF THE CONTENTS

PART I

1. Introduction	03
1.1 Algorithm Definitions	
1.2 Fundamentals of algorithm problem solving	
1.3 The efficiency of algorithms	
1.4 Best, Average and worst case analysis	
2. Methodologies for Analyzing algorithm	05
2.1 Pseudo code	
2.2 The Random Access Machine	
2.3 Counting the primitive operations	
2.3 Analyzing Recursive Algorithms	
2.4 Algorithm Complexities	
2.4.1 Space Complexity	
2.4.1.1 Analysis of space complexity	
2.4.1.2 How to calculate Space complexity?	
2.4.2 Time Complexity	
3. Asymptotic Notations	06
3.1 The Big-oh Notation	
3.2 The Big-omega Notation	
3.3 The big-theta notation	
3.4 Ordering functions by their Growth rates	
3.5 A quick Mathematical Review	
3.5.1 Summations	
3.5.2 Logarithms and Exponents	
3.6 Case Studies in Algorithm Analysis	
3.6.1 A Quadratic Time Prefix Averages Algorithm	
3.6.1 A Linear Time Prefix Averages Algorithm	

PART II

4. Graphs	04
4.1 Definitions and Representations	
4.2 Different types of graph	
4.3 Searching Methods: DFS and BFS	

- 4.4 Introduction to Trees
- 4.5 Applications

5. Optimization Problems	03
5.1 Feasible Solutions	
5.2 Optimal Solutions	
5.3 Important problem types: Sorting, Searching, string processing, graph problems, combinatorial problems, Geometric problems, Numeric problems.	
6. Brute Force method	04
6.1 Selection Sort	
6.2 Bubble Sort	
6.3 Sequential Search	
6.4 Exhaustive Search	
6.4.1 Traveling Salesman problem	
6.4.2 0/1 Knapsack Problem	

PART III

7. Divide and Conquer	06
7.1 Merge Sort	
7.2 Quick Sort	
7.3 Strassen's Matrix Multiplication	
8. Decrease and Conquer	03
8.1 Insertion Sort	
8.1.1 Analysis of Insertion sort	
8.1.2 Implementation	
8.2 Topological Sorting	
9. Dynamic Programming	06
9.1 Warshall's algorithm	
9.2 Floyd's Algorithm	
9.3 0/1 Knapsack problem	

PART IV

10. Greedy Technique	06
10.1 Prim's Algorithm	
10.2 Kruskal's Algorithm	
10.3 Dijkstra's Algorithm	
10.4 Huffman Trees	
11. Backtracking	06
11.1 The method	
11.2 Explicit and Implicit constraints	
11.3 Solution Space	
11.4 n-queens problem	
11.5 Traveling Salesman problem	
12. Branch and Bound	04
12.1 Assignment problem	
12.2 0/1 Knapsack Problem	
12.3 Traveling Salesman problem	
13. Tests and Assignment	05
14. Case Studies	03

GENERAL EDUCATIONAL OBJECTIVES:

- 1 Understand the concepts of designing and analysis of an algorithm
- 2 Comprehend to evaluate the algorithm performance
- 3 Understand the different methods of analyzing algorithm
- 4 Understand the various algorithm design methods

SPECIFIC INSTRUCTIONAL OBJECTIVES:

PART I

1. Define algorithm and the fundamental problem solving steps.
Analysis the efficiency of Algorithm
Learn to analyze an algorithm using average & worst-case
Learn Average case analysis
2. Learn the Pseudo code
Analyze space complexities & time complexity of algorithm.
Know the different methods to find the time Complexity.
Analyze recursive algorithms.
3. Learn the asymptotic notations
Learn ordering of Functions by their growth rate.
Review the basic mathematical concepts of summation , logarithms and
Exponents
Analyze the Case Studies

PART II

4. Understand the definition and representation of Graph.
Learn the Different searching methods in graph.
Define trees
Understand the Applications
5. Learn the Basic Algorithm solving method: Brute force,
Some examples
Learn The different problem types,
6. Learn the concept of Brute Force method
Implement
The Brute Force Method
Analyze the applications

PART III

7. Learn the concept of Divide & conquer method
Implement
The Divide & conquer Method
Analyze the applications
8. Learn the concept of Decrease & conquer method
Implement
The Decrease & conquer Method
Analyze the applications
9. Learn the concept of Dynamic programming method
Implement
The Dynamic programming Method
Analyze the applications

PART IV

10. Learn the concept of Greedy method
Implement
The Greedy Method
Analyze the applications
11. Learn the concept of Backtracking method
Implement
The Backtracking Method
Analyze the applications
12. Learn the concept of Branch & Bound method
Implement
The Branch & Bound Method
Analyze the applications

TEXT BOOKS:

1. Algorithms Design by Michael T. Good Rich and Roberto Tamassia, WILEY INDIA EDITION 2009(for chapter 2.1-2.3, 3.4-3.6)
2. Introduction to the design & Analysis of Algorithms by Anany Levitin(for chapters 1.3,1.4,3.1- 3.3)
4. Analysis And Design of Algorithms by Nandagopalan, **Sapna Publications** (for Chapters 1.1-1.2,2.4)

Note: for other chapters refer any book mentioned here.

REFERENCE BOOKS:

2. Fundamentals of computer Algorithms by Ellis Horowitz
Sartaj Sahani Sanguthevar Rajasekaran.
4. Design and Analysis of Algorithm by prabhakar gupta,vineet agarwal,
monish varshney.
5. Design Methods and Analysis of Algorithms by S.K.Basu by PHI .

WEIGHTAGE OF MARKS IN EACH TOPIC

Unit No.	Chapter No.	Contents	No. of Hours	Marks
Unit 1	1	Algorithm Analysis	03	15
	2	Methodologies for Analyzing algorithm	05	10
	3	Asymptotic Notations	06	10
Unit 2	4	Graphs	04	15
	5	Optimization Problems	03	10
	6	Brute Force Methods	04	15
Unit 3	7	Divide and Conquer	06	15
	8	Decrease and Conquer	03	08
	9	Dynamic Programming	06	12
Unit 4	10	Greedy Technique	06	15
	11	Backtracking	06	10
	12	Branch and Bound	04	10
		Total	56	145

**DEPARTMENT OF TECHNICAL EDUCATION
INFORMATION SCIENCE
MODEL QUESTION PAPER**

Note: Question No 1 is compulsory. Answer any two full questions in each section.

Q No 1(a) Fill in the blanks

- i. _____ Provides asymptotic lower bound.
 - ii. A Sub graph of a Graph Without any Cycle is called as _____
 - iii. _____ is the time complexity of bubble sort
 - iv. In Quick sort we assume the first element as _____
 - v. _____ is a systematic approach to solve a problem
- (b) Write a short note on brute force method.

Section 1

- | | |
|--|---|
| Q No 2 a) Define algorithm and the fundamental problem solving steps | 7 |
| b) Define time and space complexities. | 5 |
| c) Write a pseudo code on selection sort | 4 |
|
 | |
| 3 a) Define Asymptotic notations? Explain its types | 6 |
| b) Explain with an example how to analyze Recursive algorithms | 4 |
| c) Explain Random Access Machine with an Example | 5 |
| 4 a) Define Graphs and its Representations | 4 |
| b) Analyze the best, average and the worst cases of Sequential Search. | 5 |
| c) What are Spanning trees explain with an example. | 6 |

Section 2

- | | |
|--|---|
| 5 a) Explain the following. | 4 |
| 1) Bipartite graph | |
| 2) Directed Acyclic Graph | |
| b) What are optimization problems? Define the feasible and optimal solutions. | 6 |
| c) What are combinatorial, geometrical and numerical problems | 5 |
|
 | |
| 6 a) Apply bubble sort to the following instance of an array: [45, 23, 89, 11, 27, 38] | 5 |
| b) Write a recursive algorithm to search for a key element in an | 4 |

array of size n.

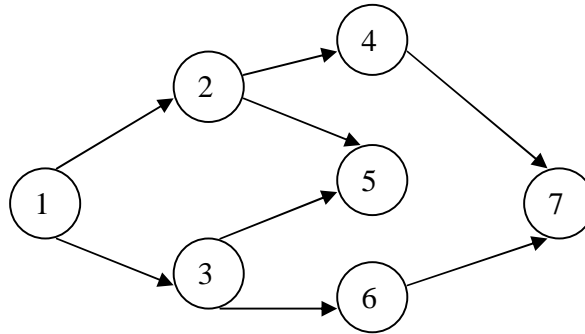
c) Apply Strassen's method to multiply the following two matrices: 6

$$\begin{array}{cccc} 1 & 2 & 3 & 4 \\ 5 & 2 & 7 & 1 \\ 2 & 7 & 0 & 5 \\ 4 & 3 & 2 & 1 \end{array} \quad \text{and} \quad \begin{array}{cccc} 5 & 6 & 7 & 8 \\ 1 & 0 & 3 & 4 \\ 6 & 2 & 7 & 0 \\ 8 & 1 & 6 & 5 \end{array}$$

7 a) what is divide and conquer? Explain with an example 5

b) Discuss the different ways to select the pivot element in an array for Quick sort. 4

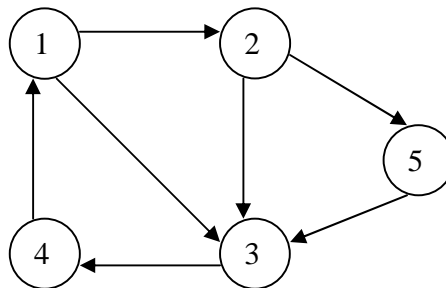
c) Find the topological ordering of the following graph 6



8 a) what is dynamic programming? Explain with an example. 4

b) Write the Warshall's algorithm to find the transitive closure of a graph. 5

c) Find all pairs shortest path for the following graph using Floyd's algorithm. 6



- 9 a) Write the greedy solution to illustrate Kruskal's algorithm 5
- b) What are Huffman codes and trees? Discuss the advantages of Huffman code. 6
- c) Write Prim's algorithm to find the minimum cost spanning tree 4
- 10 a) Draw the solution space tree for a 4-Queen problem. 5
- b) Explain Branch and Bound Method with an example 5
- c) Find the solution for the following 0/1 knapsack instance using backtracking Method. 5
- $n = 4, p = [4, 2, 1, 8] w = [3, 1, 7, 9] M=10$