VASIREDDY VENKATADRI INSTITUTE OF TECHNOLOGY NAMBUR-522508 ANDHRA

YEAR : III B.Tech **SEMESTER:** II

COURSE NAME: DESIGN AND ANALYSIS OF ALGORITHMS

COURSE CODE: XXXXXXXX

BRANCH: CSM

PREREQUISITE: Basic Knowledge on Algorithms and Data Structures

COURSE OBJECTIVE:

- To familiarize students with various notations to represent Algorithms.
- To understand various asymptotic notations.
- To familiarize with various design methodologies.
- To learn solving problems by choosing appropriate design methodology.

COURSE OUTCOMES: Students will be able to:

SN	OUTCOME	Cognitive Levels as per Bloom's Taxonomy	Weightage (%)
CO1	Infer the divide-and-conquer paradigm and its context. Recite algorithms that employ this paradigm. Apply this paradigm to design algorithms for apt problems. Derive and solve recurrences describing the performance of divide-and-conquer algorithms.	L1, L2	20
CO2	Infer the greedy paradigm and its context. Recite algorithms that employ this paradigm. Apply this paradigm to design algorithms for apt problems.	L2, L3, L4	20
CO3	Infer the dynamic-programming paradigm and its context. Recite algorithms that employ this paradigm. Apply this paradigm to design algorithms for apt problems.	L1, L2, L3, L4	20
CO4	Infer the backtracking paradigm and its context. Recite algorithms that employ this paradigm. Apply this paradigm to design algorithms for apt problems.	L1, L2, L3, L4	20
CO5	Infer the branch and bound paradigm and its context. Recite algorithms that employ this paradigm. Apply this paradigm to design algorithms for apt problems	L1, L2, L3, L4	20

WEIGHTAGE OF BLOOM'S LEGENDS & PERCENTAGE OF QUESTIONS IN EXAMINATIONS:

L1 (Remembering) = 30 - 40%, L2 (Understanding) = 30 - 40%,

L3 (Applying) = 10 - 20 %, L4 (Analysing) = 10 - 20%,

Easy (%) = 15%-20%, Average (%) = 60% - 70%, Difficult (%) = 15% - 20%

TOTAL = L1 + L2 + L3 + L4 = 100% (on an average about 2 minutes per mark)

Note: This specification weightage in above shall be treated as a general guideline for students, teachers and paper setters. The actual distribution of marks in the question paper may vary slightly.

DETAILED SYLLABUS:

UNIT - I **9 Hrs**

Introduction: Algorithm Definition, Algorithm Specification, Performance Analysis, Performance Measurement, Asymptotic notations. Divide and Conquer: General Method, Binary Search, Finding the Maximum and Minimum, Quick Sort.

UNIT - II **10 Hrs**

The Greedy Method: The General Method, Knapsack Problem, Optimal Storage on Tapes Problem, Single Source Shortest Path Problem, Optimal Merge Patterns Problem.

UNIT - III **12 Hrs**

Dynamic Programming: The General Method, 0/1 Knapsack Problem, Single Source Shortest Path – General Weights, All Pairs-Shortest Paths Problem, Traveling Salesperson Problem, String Editing Problem.

UNIT – IV **10 Hrs**

Backtracking: The General Method, The N-Queens Problem, Sum of Subsets Problem, Graph Coloring Problem, Hamiltonian Cycles Problem.

UNIT - V **10 Hrs**

Branch and Bound: The General Method, FIFO Branch-and-Bound, LC Branch-and-Bound, 0/1 Knapsack Problem, Traveling Salesperson Problem. NP-Hard and NP-Complete problems: Basic concepts, Cook's Theorem.

TEXT BOOKS:

1. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", 2nd Edition, Universities Press.

Reference Books:

1. Harsh Bhasin, "Algorithms Design & Analysis", Oxford University Press.
   S. Sridhar, "Design and Analysis of Algorithms", Oxford University Press.

Web Resources:

1. https://www.geeksforgeeks.org/fundamentals-of-algorithms/
2. https://www.javatpoint.com/daa-tutorial
3. https://nptel.ac.in/courses/106106131
4. https://www.tutorialspoint.com/design_and_analysis_of_algorithms/index.htm

MICRO-SYLLABUS:

UNIT I: **9 Hrs**

Introduction: Algorithm Definition, Algorithm Specification, Performance Analysis, Performance Measurement, Asymptotic notation. Divide and Conquer: General Method, Binary Search, Finding the Maximum and Minimum, Quick Sort.

Unit	Module	Micro content	No of Hrs
I	Algorithm Analysis	Definition of Algorithm, Properties of algorithm	1
		Algorithm Specification – Pseudo code Conventions	1
		Performance Analysis – time and space complexity	1
		Performance Measurement – step count and frequency count	1
		Asymptotic Notations – Big Oh, Omega, Theta	1
	Divide and conquer	General Method	1
		Binary Search – Procedure, Example, Algorithm and Computing Time Complexity	1
		Finding the Maximum and Minimum - Procedure, Example, Algorithm and Computing Time Complexity	1
		Quick Sort - Procedure, Example, Algorithm and Computing Time Complexity	1

UNIT–II: **10 Hrs**

The Greedy Method: The General Method, Knapsack Problem, Job Sequencing with Deadlines Problem, Single Source Shortest Path Problem, Optimal Merge Patterns Problem.

Unit	Module	Micro content	No of Hrs
II	Greedy Method	General Method	1
		Knapsack Problem - Description, Example, Algorithm.	2
		Single Source Shortest Path Problem - Description, Example, Algorithm.	2
		Optimal Storage on Tapes Problem - Description, Example, Algorithm.	3
		Optimal Merge Patterns Problem - Description, Example, Algorithm.	2

UNIT – III: **12 Hrs**

Dynamic Programming: The General Method, 0/1 Knapsack Problem, Traveling Salesperson Problem, All Pairs-Shortest Paths Problem, Traveling Salesperson Problem, String Editing Problem.

Unit	Module	Micro content	No of Hrs
III	Dynamic	The General Method	1
		0/1 Knapsack Problem - Description, Example.	2
		Single Source Shortest Path – General Weights - Description, Example.	2

	Programming	All Pairs-Shortest Paths Problem - Description, Example.	2
		Travelling Salesperson Problem - Description, Example.	2
		String Editing Problem - Description, Example.	3

UNIT – IV: **10 Hrs**

Backtracking: The General Method, The N-Queens Problem, Sum of Subsets Problem, Graph Coloring Problem, Hamiltonian cycles Problem.

Unit	Module	Micro content	No of Hrs
IV	Backtracking	The General Method	1
		The N-Queens Problem - Description, State Space Tree, Algorithm.	2
		Sum of Subsets Problem - Description, Example, State Space Tree, Algorithm	2
		Graph Coloring Problem - Description, Example, State Space Tree, Algorithm.	3
		Hamiltonian Cycles Problem - Description, Example, State Space Tree, Algorithm.	2

UNIT V: **10 Hrs**

Branch and Bound: The General Method, FIFO Branch-and-Bound, LC Branch-and-Bound, 0/1 Knapsack Problem, Traveling Salesperson Problem. NP-Hard and NP-Complete problems: Basic concepts, Cook's Theorem.

Unit	Module	Micro content	No of Hrs
V	Branch and bound	The General Method	1
		FIFO Branch and Bound	1
		LC Branch and Bound	2
		0/1 Knapsack Problem - Description, Example	2
		Traveling Salesperson Problem - Description, Example	2
	NP-Hard and NP Complete problems	Basics Concepts	1
		Cook's Theorem	1

III B. TECH II SEMESTER REGULAR EXAMINATION MODEL PAPER
DESIGN AND ANALYSIS OF ALGORITHMS

(CSM)

Time : 3 Hours **Max. Marks : 70**

Note : Answer **ONE** question from each unit **(5 × 14 = 70 Marks)**

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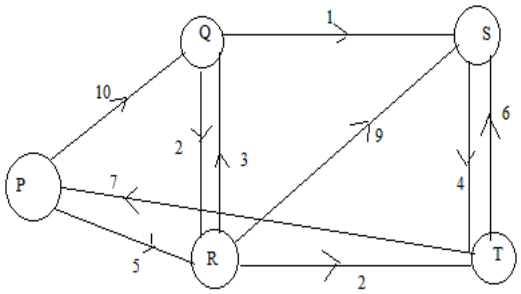
<table>
<tr><td colspan="4">UNIT-I</td><td>CO</td><td>BL</td></tr>
<tr><td rowspan="2">1.</td><td>a)</td><td>Explain performance Analysis of algorithm.</td><td>[7M]</td><td>CO1</td><td>L2</td></tr>
<tr><td>b)</td><td>Explain Big-O Notation, Thetha Notation, Omega Notation with an example.</td><td>[7M]</td><td>CO1</td><td>L2</td></tr>
<tr><td colspan="4">(OR)</td><td></td><td></td></tr>
<tr><td rowspan="2">2.</td><td>a)</td><td>What is Searching? Summarize different types of Searching with examples.</td><td>[7M]</td><td>CO1</td><td>L2</td></tr>
<tr><td>b)</td><td>What is Quick sort? Write an algorithm for Quick sort and find the time complixity.Illustrate the process of Quick Sort for elements 9,7,8,3,2,1.</td><td>[7M]</td><td>CO1</td><td>L3</td></tr>
<tr><td colspan="4">UNIT-II</td><td></td><td></td></tr>
<tr><td rowspan="2">3.</td><td>a)</td><td>Explain the knapsack problem. Assume that we have a knapsack with max weight capacity, W = 16. Our objective is to fill the knapsack with items such that the benefit (value or profit) is maximum. Consider the following items and their associated weight and value
<table>
<tr><th>ITEM</th><th>WEIGHT</th><th>VALUE</th></tr>
<tr><td>i1</td><td>6</td><td>6</td></tr>
<tr><td>i2</td><td>10</td><td>2</td></tr>
<tr><td>i3</td><td>3</td><td>1</td></tr>
<tr><td>i4</td><td>5</td><td>8</td></tr>
<tr><td>i5</td><td>1</td><td>3</td></tr>
<tr><td>i6</td><td>3</td><td>5</td></tr>
</table></td><td>[7M]</td><td>CO2</td><td>L3</td></tr>
<tr><td>b)</td><td>Discuss the Dijkstra’s single source shortest path algorithm and derive its time complexity. Find shortest paths in the following graph using Dijkstra’s algorithm?

</td><td>[7M]</td><td>CO2</td><td>L3</td></tr>
<tr><td colspan="4">(OR)</td><td></td><td></td></tr>
<tr><td rowspan="2">4.</td><td>a)</td><td>Explain the Optimal storage on Tapes problem. Consider n=3 and lengths are (l1,l2,l3)=(5,10,3) find the optimal storage order.</td><td>[7M]</td><td>CO2</td><td>L2</td></tr>
<tr><td>b)</td><td>Explain the Optimal Merge Patterns Problem. Find optimal merge pattern for merging the following files
F1 with 13 values</td><td>[7M]</td><td>CO2</td><td>L2</td></tr>
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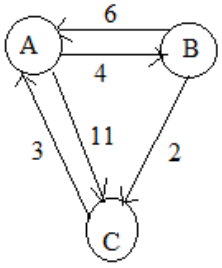
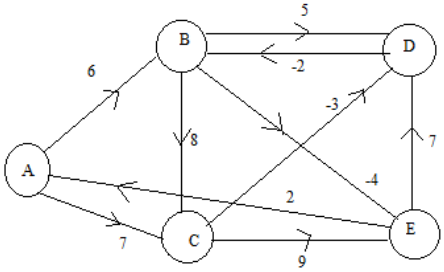
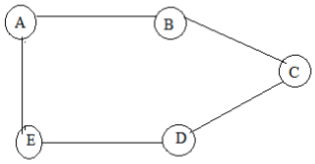
		F2 with 3 values F3 with 9 values F4 with 15 values F5 with 8 values F6 with 2 values			
		UNIT-III			
5.	a)	Explain the All pairs shortest paths problem. Find out the all pairs shortest paths for the given graph. 	[7M]	CO3	L2
	b)	Demonstrate pros and cons of 0/1 knapsack problem. Find the optimal solution for the 0/1 knapsack problem making use of dynamic programming approach. Consider n = 4,w = 5 kg,(w1, w2, w3, w4) = (2, 3, 4, 5),(p1, p2, p3, p4) = (3, 4, 5, 6)	[7M]	CO3	L2
		(OR)			
6.	a)	Discuss the single-source shortest paths algorithm with a suitable example. Find shortest paths in the following weighted graph using Bellman Ford algorithm? 	[7M]	CO3	L2
	b)	Explain the travelling sales person problem. Find the shortest path by using travelling sales person problem for the given matrix. $\begin{bmatrix} 0 & 10 & 15 & 20 \\ 5 & 0 & 9 & 10 \\ 6 & 13 & 0 & 12 \\ 8 & 8 & 9 & 0 \end{bmatrix}$	[7M]	CO3	L3
		UNIT-IV			
7.	a)	Explain the Graph–coloring problem. And draw the state space tree for m= 3 colors n=4 vertices graph. Discuss the time and space complexity.	[7M]	CO4	L3
	b)	Give difference between knapsack and 0/1 knapsack problem.	[7M]	CO4	L2
		(OR)			
8.	a)	Write an algorithm to determine the Hamiltonian Cycle in a given graph using backtracking. Find out the Hamiltonian paths for the given Graph.	[7M]	CO4	L3

					
	b)	Explain the sum of subsets problem. Consider n=7,(w1,w2,w3,w4,w5,w6,w7)=(1,2,3,4,5,6,7) and sum m=10.find out the sum of subsets.	[7M]	CO4	L3
		UNIT-V			
9.	a)	Describe the Travelling sales person problem and discuss how to solve it using branch and bound.	[7M]	CO5	L3
	b)	Develop an algorithm for 0/1 knapsack and write its advantages and dis-advantages with time complexity.	[7M]	CO5	L3
		(OR)			
10.	a)	Categorize the NP Problem. Explain NP-Hard and NP-Complete problem.	[7M]	CO5	L4
	b)	Find the optimal solution using 0/1 knapsack problem using FIFO Branch and Bound. consider n=4,(p1,p2,p3,p4)=(10,10,12,12,8),(w1,w2,w3,w4,w5)=(2,4,6,9) and m=15 find the optimal solution.	[7M]	CO5	L3

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THE ABOVE MODEL PAPER ATTAINMENTS OF BLOOM'S TEXONOMY AS FOLLOWS

L1: 7*7 = 49 = 35%
L2: 6*7 = 42 = 30%
L3: 5*7 = 35 = 25%
L4: 2*7 = 14 = 10%

SIGNATURES OF
COURSE COORDINATER MODULE COORDINATER HOD