U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

February 2025 Semester End Main Examinations

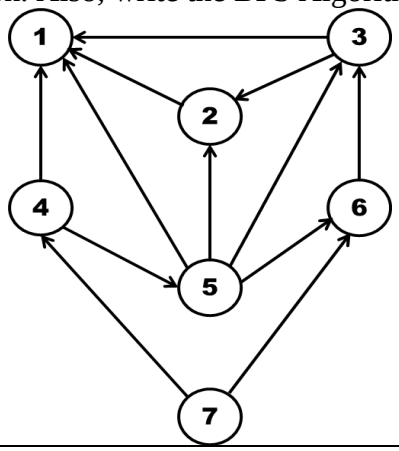
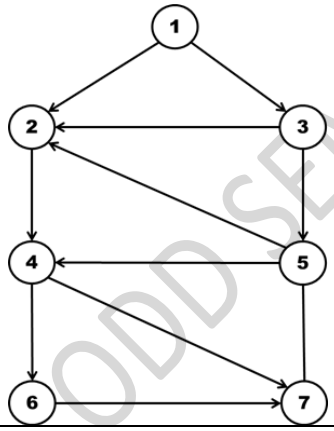
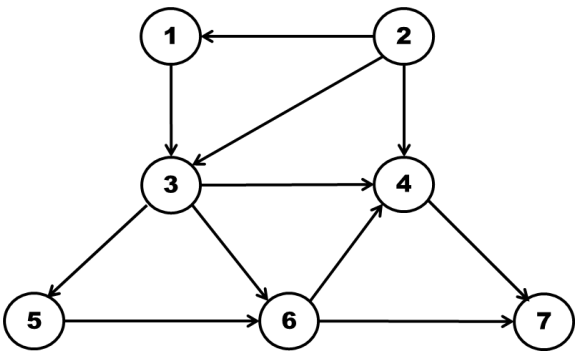
Programme: B.E. **Semester: IV**
Branch: Information Science and Engineering **Duration: 3 hrs.**
Course Code: 23IS4PCADA **Max Marks: 100**
Course: Analysis and Design of Algorithms

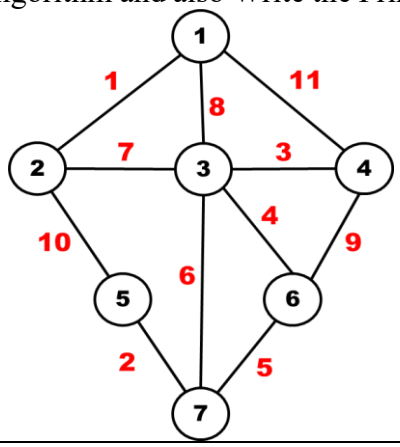
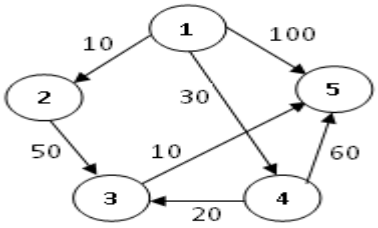
Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - 1	CO	PO	Marks
1	a)	Discuss the Asymptotic Notations with their definitions.	*CO2*	*PO1*	**6**
	b)	Find the Time Complexity for the following Algorithms: (i) Factorial of a given number (ii) Tower of Hanoi	*CO2*	*PO1*	**8**
	c)	Compare Bubble Sort and Selection Sort in the Best and Worst cases.	*CO2*	*PO2*	**6**
		OR			
2	a)	Design a recursive algorithm for computing 2^n for a non-negative integer n, based on the formula $2^n = 2^{n-1} + 2^{n-1}$. Setup a recurrence relation for the number of additions made by the algorithm and solve it.	*CO3*	*PO3*	**8**

	b)	Find algorithm efficiency with respect to time for the following algorithms:
		1.
		Algo_X(n)
		{
		x=0;
		for(i=0; x<=n; i++)
		x= x+i;
		}
		2.
		Algo_Hanoi (disk, source, dest, aux)
		{
		IF disk == 1, THEN
		move disk from source to dest
		ELSE
		Hanoi (disk - 1, source, aux, dest)
		move disk from source to dest
		Hanoi (disk - 1, aux, dest, source)
		END IF
		}
			CO2	*PO1*	**8**

	c)	Use recursion tree to solve T(n) = 2T(n/2) + cn, where c > 0 is constant.	*CO2*	*PO1*	**4**
		UNIT - 2			
3	a)	Show how the following numbers gets sorted using Merge Sort:	*CO1*	*PO2*	**8**

			72 46 24 57 12 68 07 18 Also, write the Merge sort Algorithm.			
		b)	Find the BFS traversals starting from vertex 7 for the following Graph. Also, write the BFS Algorithm. 	*CO3*	*PO3*	**7**
		c)	Find the Topological Sequence for the following Graph [using any method]. 	*CO3*	*PO3*	**5**
			OR			
	4	a)	Show how the following numbers gets sorted using Quick Sort: 84 23 68 09 96 66 05 25 Also, write the Quick Sort Algorithm.	*CO1*	*PO1*	**12**
		b)	Find the DFS traversal starting from vertex 2 for the following Graph. Also, write the DFS Algorithm. 	*CO3*	*PO3*	**8**

			UNIT - 3			
	5	a)	Find the Minimum Spanning Tree for the following Graph using Prim's Algorithm and also Write the Prim's Algorithm.  	*CO3*	*PO3*	**10**
		b)	Solve the following 0/1 Knapsack problem using dynamic programming: **P= (11, 7, 9, 14) W= (1, 5, 4, 6) C=10 n=4**	*CO2*	*PO1*	**10**
			OR			
	6	a)	Apply Dijkstra's algorithm to find shortest path from the vertex 1 to all other vertices for the following graph:  	*CO3*	*PO3*	**6**
		b)	Construct a Huffman tree and find the Huffman code for each character shown below: **Character / Frequency** **A 10** **B 15** **C 12** **D 3** **E 4** **F 13** **G 1**	*CO1*	*PO1*	**7**
		c)	Apply Floyd's Algorithm to find the All-Pair Shortest Path for the following: **1: 0, 5, ∞, ∞** **2: 50, 0, 15, 5** **3: 30, ∞, 0, 15** **4: 15, ∞, 5, 0**	*CO3*	*PO3*	**7**

<table>
<tr><td></td><td></td><td></td><td>UNIT - 4</td><td></td><td></td><td></td></tr>
<tr><td></td><td>7</td><td>a)</td><td>Apply Boyer Moore algorithm to search the given substring in the main string. Also, write the number of shifts required during searching.
Main String = “MISS MISS IN MISSISSIPPI”
Substring = “MISSI”</td><td>CO3</td><td>PO3</td><td>8</td></tr>
<tr><td></td><td></td><td>b)</td><td>Show how the following numbers are sorted by Heap Sort.
23 74 06 68 12 66 10 16</td><td>CO1</td><td>PO1</td><td>6</td></tr>
<tr><td></td><td></td><td>c)</td><td>Construct a Hash Table by Linear Probing/Closed Hashing for the following words. Consider the size and the hash table as 10.
WHERE, IS, NOW, THIS, AN, THAT, HOW, AND</td><td>CO1</td><td>PO1</td><td>6</td></tr>
<tr><td></td><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td></td><td>8</td><td>a)</td><td>Construct an AVL tree for the list: {6, 5, 4, 3, 2, 1} by inserting their elements successively, starting with an empty tree.</td><td>CO2</td><td>PO1</td><td>6</td></tr>
<tr><td></td><td></td><td>b)</td><td>Differentiate between open hashing and separate chaining.</td><td>CO1</td><td>PO2</td><td>6</td></tr>
<tr><td></td><td></td><td>c)</td><td>Given the input {30, 20, 56, 75, 31, 19} and hash function h(K) = K mod 11, answer the following questions:
i) Construct the open hash table.
ii) Find the largest number of key comparisons in a successful search in this table.
iii) Find the average number of key comparisons in a successful search in this table.</td><td>CO1</td><td>PO1</td><td>8</td></tr>
<tr><td></td><td></td><td></td><td>UNIT - 5</td><td></td><td></td><td></td></tr>
<tr><td></td><td>9</td><td>a)</td><td>Show the solution for 4-Queens problem using Backtracking and write an algorithm for n-Queens problem using Backtracking.</td><td>CO3</td><td>PO3</td><td>8</td></tr>
<tr><td></td><td></td><td>b)</td><td>Solve the following Job Assignment Problem using the branch-and-bound technique:
<table><tr><th></th><th>Job 1</th><th>Job 2</th><th>Job 3</th><th>Job 4</th></tr><tr><td>Person 1</td><td>5</td><td>6</td><td>9</td><td>7</td></tr><tr><td>Person 2</td><td>8</td><td>4</td><td>2</td><td>6</td></tr><tr><td>Person 3</td><td>1</td><td>3</td><td>7</td><td>9</td></tr><tr><td>Person 4</td><td>9</td><td>6</td><td>7</td><td>4</td></tr></table></td><td>CO3</td><td>PO3</td><td>7</td></tr>
<tr><td></td><td></td><td>c)</td><td>Discuss the concept of P, NP, NP-Complete and NP-Hard Problems.</td><td>CO2</td><td>PO2</td><td>5</td></tr>
<tr><td></td><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td></td><td>10</td><td>a)</td><td>Apply backtracking to solve the following instance of the subset-sum problem S = {3, 5, 6, 7} and d =15.</td><td>CO2</td><td>PO1</td><td>8</td></tr>
<tr><td></td><td></td><td>b)</td><td>With the help of a state space tree, solve the following instance of Knapsack problem by the branch and bound algorithm. Knapsack Capacity W = 10
<table><tr><th>Item No.</th><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>Weight</td><td>4</td><td>7</td><td>5</td><td>3</td></tr><tr><td>Value</td><td>40</td><td>42</td><td>25</td><td>12</td></tr></table></td><td>CO1</td><td>PO1</td><td>8</td></tr>
<tr><td></td><td></td><td>c)</td><td>Distinguish between P, NP and NP-Complete problems. Give example for each category.</td><td>CO1</td><td>PO2</td><td>4</td></tr>
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