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: CSE (ICB), AI&DS, CSE (DS) **Duration: 3 hrs.**
Course Code: 23DC4PCDAA **Max Marks: 100**
Course: Design and Analysis of Algorithms

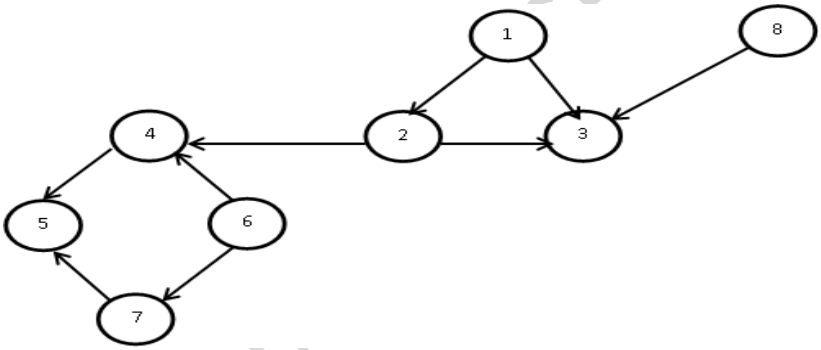
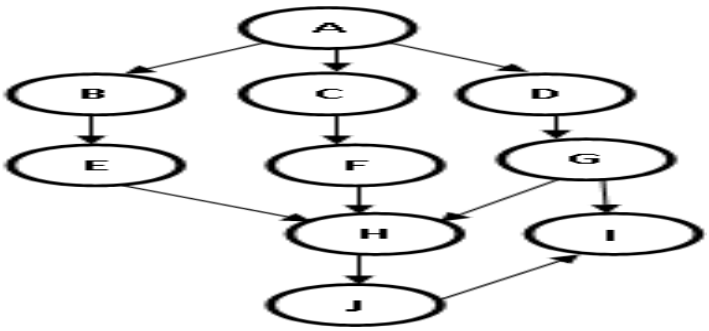
Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

		UNIT - I	CO	PO	Marks
1.	a)	Explain with formal notations the various asymptotic notations used in algorithm analysis.	CO1	PO1	**06**
	b)	Develop recursive algorithm for computing Tower of Hanoi and obtain its recurrence relation and solve using backward substitution.	CO3	PO3	**08**

	c)	Determine time complexity of the below non-recursive algorithms. Provide justification for your answer.
		
		i)
		`function(int n)`
		`{`
		`  if (n==1)`
		`  return;`
		`  for (int i=1; i<=n; i++)`
		`  {`
		`  for (int j=1; j<=n; j++)`
		`  {`
		`  printf("*");`
		`  break;`
		`  }`
		`  }`
		`}`
		
		ii)
		`int i, j, k = 0;`
		`for (i = n / 2; i <= n; i++)`
		`  {`
		`  for (j = 2; j <= n; j = j * 2)`
		`  {`
		`  k = k + n / 2;`
		`  }`
		`  }`
			CO2	PO2	**06**

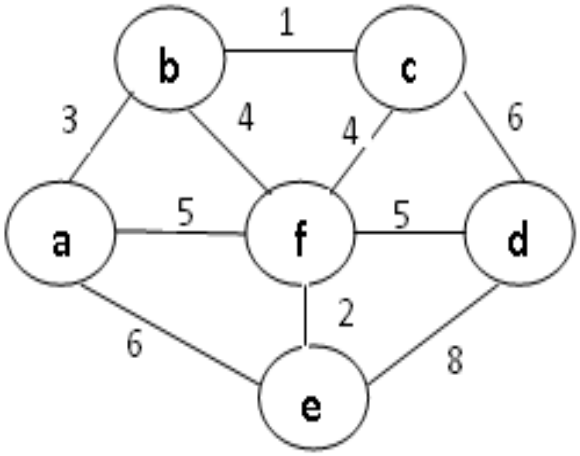
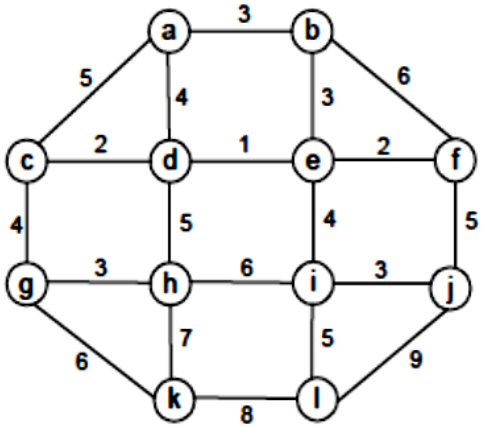
		OR			
2.	a)	For the given Non-Negative number 543 Perform the following operations. i) Extract the First digit of the Number (i.e. 5) by devising a suitable algorithm. ii) Find the Fibonacci series for this Digit. Devise a general Recursive Algorithm for finding Fibonacci(n). iii) Show the recursive Tree calls of Fibonacci algorithm made for the first digit extracted of the above number.	CO2	PO2	**10**

		b)	Consider the following algorithm:
			Algorithm guess(n,a)
			//Input :An array of a[0: n-1] of n integer numbers
			minval←maxval← a[0]
			for i<- 1 to n-1 do
			if (a[i]< minval)
			minval<-a[i]
			else if(a[i]> maxval)
			maxval<-a[i]
			return maxval – minval
			
			a) What does this Algorithm compute?
			b) What is the basic operation?
			c) Check for best case and worst case for the above algorithm and derive the appropriate efficiency class using Time complexity of the algorithm.
						10

			UNIT - II			
	3	a)	Apply Decrease and Conquer technique to find Topological order for the following graph using DFS method and Source Removal method with the source vertex '1'.  	*CO1*	*PO1*	**08**
		b)	Describe how the Johnson Trotter algorithm is used to generate permutations.	*CO1*	*PO1*	**04**
		c)	Differentiate between DFS and BFS tree traversals. Show step by step process in finding BFS traversal for the following graph with source vertex 'A'. Mention the traversal time of BFS if the input graph is represented as adjacency matrix and as adjacency list.  	*CO2*	*PO2*	**08**
			OR			

	4	a)	Design a brute force algorithm to obtain the position of the all occurrences of the pattern in a given string/text and return the position. Obtain the Time complexity of the algorithm.	*CO3*		**10**
		b)	Apply Exhaustive Knapsack problem Search technique to solve the following instance of Number of objects N=4, weights of 4 objects= {10,20,16,24) and profits= {85,40,35,30} with the capacity of Knapsack M=50.	*CO1*		**05**
		c)	Solve 128 * 56 using Russian Peasant method (Multiplication a la Russe).	*CO1*		**05**
			UNIT - III			
	5	a)	i) State the different variations of transform and conquer technique? Describe under which type does the Horner's rule for Polynomial Evaluation fall? ii) Apply Horner's rule to evaluate the polynomial to find the quotient and remainder. $f(x) = x^4 + 3x^3 + 5x^2 + 7x + 9$ at $x = 2$	*CO1*	*PO1*	**08**
		b)	Develop an algorithm for quick sort by considering the first element as the pivot element and also obtain the best case and worst-case time complexity. Apply the quick sort algorithm developed above to sort the following numbers: 54, 26, 93, 17, 77, 31, 44, 55, 20.	*CO3*	*PO3*	**12**
			OR			
	6	a)	Design pseudocode/program to for string matching using Horspool's technique. Apply the same to search for P="ACAGTA" in T="GCATCGCAGAGAGTATACAGTA"	*CO3*	*PO3*	**10**
		b)	Create a max heap tree for the following list of elements. Show step-by-step construction of tree using top-down approach and sorting of the elements. Also, design an algorithm for the same. {55, 28, 35, 78, 110, 48, 88}	*CO1*	*PO1*	**10**
			UNIT - IV			
	7	a)	i. Write the bottom-up dynamic programming algorithm for the knapsack problem. ii. Solve the following instance of knapsack problem by applying the dynamic programming algorithm. iii. Will applying Greedy technique give a better result?	*CO2*	*PO2*	**12**

Capacity = 5		
Item	Weight	Value
1	2	12
2	1	10
3	3	20
4	2	15

		b)	Apply Kruskal's algorithm to find the minimum spanning tree for the following graph using Greedy Technique and write algorithm for the same.  	*CO1*	*PO1*	**08**
			OR			
	8	a)	Apply Prim's algorithm to find minimum spanning tree (MST) for the following graph. Show the complete step by step process of generating the solution.  	*CO1*	*PO1*	**10**
		b)	Determine the Huffman codes for the character a, b, c, d, e and f whose frequencies are given as 0.1, 0.2, 0.13, 0.09, 0.4 and 0.08 respectively. Also write the algorithm for Huffman codes.	*CO1*	*PO1*	**10**
			UNIT - V			
	9	a)	Apply Branch and Bound approach to solve the below 0/1 Knapsack problem. Show the calculations of the upper bounds at each node and the state- space tree. Capacity of knapsack = 10 Item | Weight | Value 1 | 7 | 42 2 | 3 | 12 3 | 4 | 40 4 | 5 | 25	*CO1*	*PO1*	**08**

		b)	What is a clique? Convert below 3CNF to clique problem and also find solution for the same. CNF=(x1 V $\overline{x2}$ V $\overline{x3}$) ^ ($\overline{x1}$ V x2 V $\overline{x3}$) ^ (x1 V x2 V x3)	*CO2*	*PO2*	**06**
		c)	Distinguish between N, NP, NP-Hard and NP Complete problems.	*CO1*	*PO1*	**06**
			OR			
	10	a)	Define Vertex Cover. Write the algorithm to find the vertex cover.	*CO1*	*PO1*	**05**
		b)	Define Clique of a graph? Find maximum clique in the below graph.	*CO2*	*PO2*	**05**
		c)	Compare and contrast the backtracking and branch & bound techniques for solving combinatorial problems. Discuss the main principles of each method. Apply Sum of Subsets backtracking technique and draw a State Space Tree for a set S={11,13,24,7} and M=31.	*CO2*	*PO2*	**10**

****