U.S.N.										

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

Autonomous Institute Affiliated to VTU

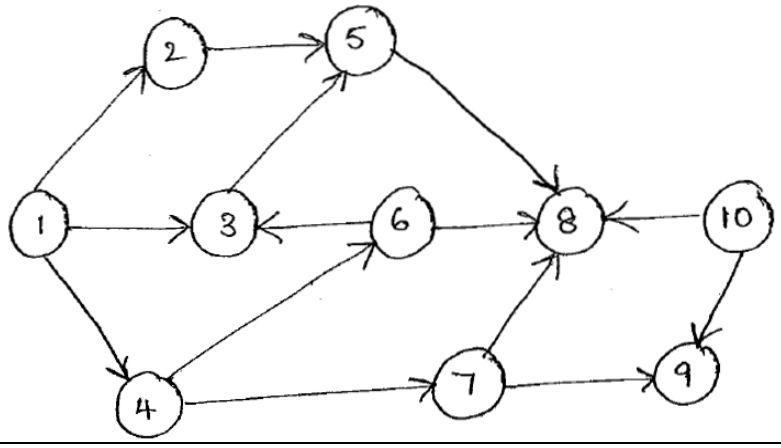
December 2023 Supplementary Examinations

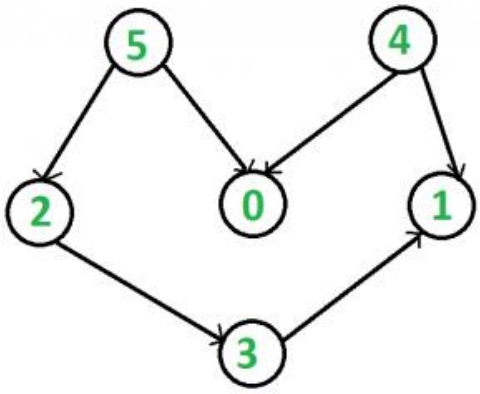
Programme: B.E. **Semester: IV**
Branch: Computer Science & Engineering **Duration: 3 hrs.**
Course Code: 22CS4PCADA **Max Marks: 100**
Course: Analysis and Design of Algorithms

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

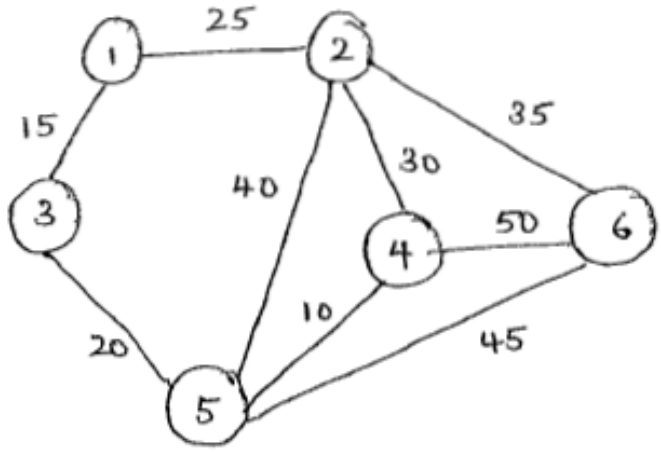
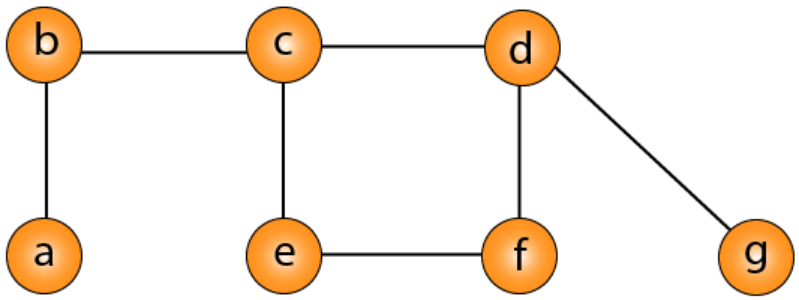
		UNIT - I	CO	PO	Marks

1	a)	Analyze the code given below and find the time complexity:
		void function (int n)
		{
		int count = 0;
		for (int i=n/2; i<=n; i++)
		for (int j=1; j<=n; j = 2 * j)
		for (int k=1; k<=n; k = k * 2)
		count++;
		}
			CO1	*PO2*	**06**

	b)	Write an algorithm/pseudocode to find the first digit of the factorial of a given non-negative number. Also, show the recursive calls made by factorial function to find the factorial of 5.	*CO2*	*PO1*	**08**
	c)	Solve the following recurrence relation by substitution method: a) T(n)=n*T(n-1) if n>1, 1 if n=1 b) T(n)=2T(n/2)+n if n>1, 1 if n=1	*CO1*	*PO2*	**06**
		UNIT - II			
2	a)	Obtain DFS and BFS traversal for the following graph. Show the steps clearly. 	*CO2*	*PO1*	**08**

		b)	Solve the following instance of Job assignment problem using Exhaustive search technique to find the optimal solution: **J1 J2 J3 J4** **P1 5 8 3 2** **P2 10 9 6 4** **P3 2 4 7 5** **P4 8 7 4 12**	*CO2*	*PO1*	**06**
		c)	Develop an algorithm for Brute-force string matching and also derive the time complexity for the same.	*CO2*	*PO1*	**06**
			OR			
	3	a)	Design an algorithm for the following scenario: Given a connected graph, check if the graph is bipartite or not. A Bipartite Graph is a graph whose vertices can be divided into two independent sets, U and V such that every edge (u, v) either connects a vertex from U to V or a vertex from V to U. In other words, for every edge (u, v), either u belongs to U and v to V, or u belongs to V and v to U. We can also say that there is no edge that connects vertices of same set. A bipartite graph is possible if the graph coloring is possible using two colors such that vertices in a set are colored with the same color. Also, obtain the time complexity for the same.	*CO2*	*PO1*	**10**
		b)	Given a directed graph with N vertices and M edges that may contain cycles, design an algorithm to find the lexicographically smallest topological ordering of the graph if it exists otherwise print -1 (if the graph has cycles). Lexicographically smallest topological ordering means that if two vertices in a graph do not have any incoming edge then the vertex with the smaller number should appear first in the ordering. For Example, in the image below many topological orderings are possible such as 5 2 3 4 0 1, 5 0 2 4 3 1, etc. But the smallest ordering is 4 5 0 2 3 1. 	*CO2*	*PO1*	**10**

			UNIT - III			
	4	a)	Analyze and derive the time complexity for Quick sort algorithm for the following scenario: The array is already sorted and the first element in the array is chosen as the pivot element.	*CO1*	*PO2*	**05**
		b)	Apply Horspool's string matching algorithm to search for the Pattern string: "LEADER" in the Text string: "JIMY_HAILED_THE_LEADER_ TO _STOP". Clearly demonstrate all the steps. Also, develop an algorithm for the same.	*CO2*	*PO1*	**10**
		c)	Apply Horner's rule to evaluate the following polynomial: $5x^4 + 2x^3 - 3x^2 + x - 7$ at the point x=3.	*CO1*	*PO2*	**05**
			OR			
	5	a)	Write an algorithm to determine number of occurrences of each element in an array using the concept of presorting and analyze its time complexity.	***CO1***	***PO2***	**05**
		b)	Build a max heap and apply heap sort technique to sort the following numbers in ascending order: 25, 57, 48, 37, 12, 92, 86 33	*CO2*	*PO1*	**10**
		c)	Demonstrate in terms of time complexity, how multiplication of two large integers using Divide and Conquer technique is efficient.	*CO2*	*PO1*	**05**
			UNIT - IV			
	6	a)	Given a rod of length 'n' inches and an array of prices that contains prices of all pieces of size smaller than 'n'. Determine the maximum value obtainable by cutting up the rod and selling the pieces. For example, if length of the rod is 8 and the values of different pieces are given as following, then the maximum obtainable value is 22 (by cutting in two pieces of lengths 2 and 6). length | 1 2 3 4 5 6 7 8 --- price | 1 5 8 9 10 17 17 20 And if the prices are as following, then the maximum obtainable value is 24 (by cutting in eight pieces of length 1) length | 1 2 3 4 5 6 7 8 --- price | 3 5 8 9 10 17 17 20	*CO2*	*PO1*	**06**

			Design an algorithm for the above scenario using Dynamic Programming.			
		b)	Apply Prim's algorithm to find the Minimum Spanning Tree for the following graph: 	*CO2*	*PO1*	**06**
		c)	Solve the following instances of Knapsack problem by Dynamic Programming technique. Assume Knapsack capacity as 10. Show the steps clearly for computation of the values. <table><tr><td>item</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>profit</td><td>30</td><td>20</td><td>40</td><td>70</td><td>60</td></tr><tr><td>weight</td><td>4</td><td>1</td><td>2</td><td>5</td><td>3</td></tr></table>	*CO2*	*PO1*	**08**
			UNIT - V			
	7	a)	Obtain the vertex cover for the following graph using approximation algorithm: 	*CO3*	*PO1*	**06**
		b)	With a neat diagram, explain the differences between P, NP-hard and NP-complete problems. Also, give an example for each.	*CO3*	*PO1*	**06**
		c)	Write the state-space tree for the following scenario: Given the set S={3,5,6,7} and the required sum value d=15. Find the possible subsets with sum value d using Backtracking. Also, write the pseudocode for the same.	*CO2*	*PO1*	**08**

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