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PES University, Bengaluru

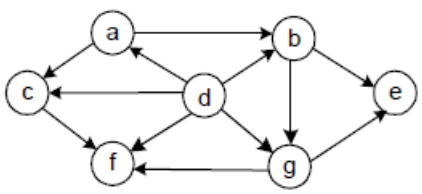
(Established under Karnataka Act 16 of 2013)

END SEMESTER ASSESSMENT(ESA) B. TECH 4th SEMESTER CSE

UE18CS251

Design and Analysis of Algorithms

Time: 3 Hrs | Answer All Questions | Max Marks: 100

1	a	Prove that if t1(n) ∈ Ω(g1(n)) and t2(n) ∈ Ω(g2(n)) then t1(n) + t2(n) ∈ Ω(max{g1(n), g2(n)})	4
	b	Explain the method of comparing the order of the growth of two functions using limits. Compare order of growth of (i) $\log_2 n$ and sqrt(n) ii) $(\log_2 n)^2$ and $\log_2 n^2$	2+4
	c	Solve the following recurrence relations using substitution method $f(n) = \begin{cases} f(n-1) + n & \text{for } n > 0 \\ 0 & \text{for } n = 0 \end{cases}$ x(n) = 3x(n-1) for n>1, x(1) = 4 x(n)= x(n/2) + n for n>1 , x(1) = 1, n = 2^k	6
	d	Rank the following functions in the order of increasing asymptotic growth(log base is 2) n^2, n!, (log n)!, nlogn, 2logn, e^n, 5	4
2	a	Design a Θ(n) algorithm to count the number of substrings that start with an A and end with a B in the given text. (For example, there are 9 such substrings in DAAXBABAGBD)	6
	b	Apply Insertion Sort to sort the list A L G O R I T H M S in alphabetical order.	4
	c	Analyze the best-case and worst-case time complexity of Insertion sort.	4
	d	Explain how to use DFS to solve topological sorting problem. Apply DFS to solve the topological sorting problem for the following directed graph 	3+3

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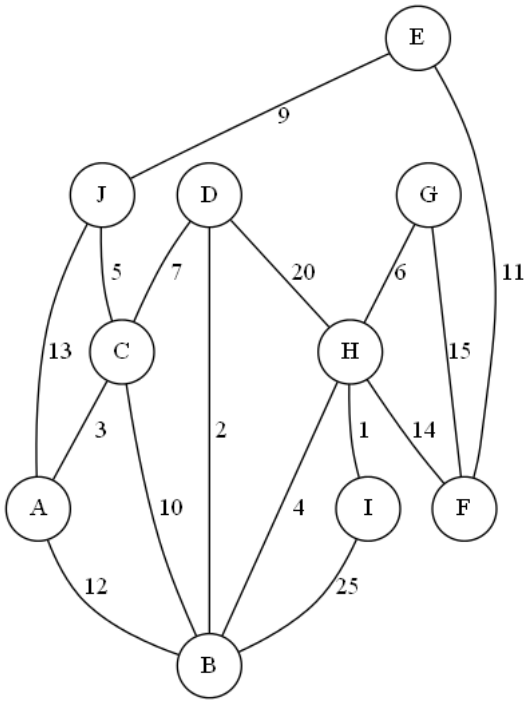
3	a	Develop a divide and conquer algorithm to find the position of the largest element in an array of n integers. Write the recurrence equation for the number of comparisons and hence derive the time complexity of the algorithm.	4+4
	b	Sort the array [1, 8, 6, 5, 3, 7, 4] using Heap sort (Use bottom up Heap construction and show all steps). What is time complexity of Heap Sort?	4+2
	c	Answer the following with respect to Quick Sort algorithm justify your answer i**.** Are strictly decreasing arrays the worst-case input, the best-case input, or neither? ii. if pivot element is chosen as the median of the first, last, and middle, are increasing arrays the worst-case input, the best-case input, or neither? iii. Is quicksort inplace sorting algorithm?	6
4	a	Explain Greedy technique based algorithm to solve single source shortest path problem. Analyse the run-time complexity of the algorithm	8
	b	Use Prim's algorithm starting at node A to compute the Minimum Spanning Tree (MST) of the given graph. Write down the edges of the MST in the order in which Prim's algorithm adds them to the MST.  	4
	c	How many character comparisons will the Boyer-Moore algorithm make in searching for each of the following patterns in the binary text of 1000 zeros? **a.** 00001 **b.** 10000	6
	d	What data structure would you use to keep track of live nodes in a best-first Branch and bound algorithm?	2

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5	a	What is the key difference between problems that can be solved efficiently by dynamic programming and the ones that can be solved efficiently by divide-and conquer strategy? What is the consequence of this difference for dynamic programming solutions?	2+4
	b	Compare the time complexities of the Dijkstra algorithm and the Floyd's algorithm to determine the minimum weight paths between all pairs of vertices for sparse graphs and dense graphs, and justify which algorithm you would use for each of these two types of graphs	2+4
	c	Write an algorithm to solve knapsack problem using bottom up dynamic programming. Apply the algorithm to solve the following instance of knapsack problem. objects | weights | Profits 1 | 2 | 3 2 | 3 | 4 3 | 4 | 5 4 | 5 | 6 Capacity of knapsack=5	4+4