VIT Reg. No.

Final Assessment Test (FAT) - November/December 2023

Programme	B.Tech.	Semester	FALL SEMESTER 2023 - 24
Course Title	DATA STRUCTURES AND ALGORITHMS	Course Code	BCSE202L
Faculty Name	Prof. T RAJA SREE	Slot	D2+TD2
		Class Nbr	CH2023240100849
Time	3 Hours	Max. Marks	100

- If any assumptions are required, assume the same and mention those assumptions in the answer script.
- Your answer should consist: logic to develop an algorithm, an illustration, the algorithm, and the running time of your algorithm.

Section-1 (10 X 10 Marks)
Answer all questions

01. Consider the following algorithm and compute its running time (5 Marks) [10]

Input: A is an array of n elements.

Output: return A

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Array_Modify(A[ ])

1. n← length(A)
2. i←1
3. while(i<= n)
4.       j← i
5.       For k ← 1 to j
6.           A[k] ← k+A[j]
7.           j ← j/2
8.       i← i+2
9. return A
```

(ii) Is $n^{4.22} + nlogn + 5 = O(n^{4.23})$? Justify your answer. (5 Marks)

02. There is a stack of 'n' dosas on a griddle (or tava), of distinct radii. Write an algorithm using stack data structure to serve the dosas of increasing radii. Use any sample input to illustrate your algorithm and also compute the running time of your algorithm. Your algorithm should use stack data structure operations only. [10]

03. Given a queue Q containing n positive integers, arrange the elements of Q in decreasing order based on a β comparison operator. The β comparison operator is defined on the two numbers x and y and denoted as x β y , when the sum of the digits of the number x should be greater than or equal to the sum of the digits of the second number y . If x β y is true then x will come first than y in the queue Q. For example, 122 β 11 is true because 5 (the sum of digits in 122) is greater than or equal to 2 (the sum of digits in 11). However, 31 β 425 is not true because 4 (the sum of digits in 31) is not greater than or equal to 11 (the sum of digits in 425). [10]

Let Q be a queue of n positive integers. Sort the elements of Q based on the β operator. For example, let Q = [122, 11, 31, 425]. The resultant output should be [425, 122, 31, 11]. Write an algorithm for β sorting and illustrate your algorithm for any sample input.

NOTE: you are supposed to use operations of the corresponding data structure strictly, without using any another data structure.

04. Consider the following table: [10]

ItemId (k)	Item Name	Price
18	Cotton T-Shirt	350
41	Branded T-Shirt	750
22	Basic Jeans	900
44	Designer Jeans	2000
59	Casual Dress	3000
32	Formal Gown	4500
31	Lehenga	12000
73	Belle Gown	8000

Form a hash table based on the hash function h(k) = k mod 13 and use the following collision resolution techniques during collisions occurs.

a. Separate chaining [3 marks]

b. Linear probing [3 marks]

c. Quadratic probing [4 marks]

05. Let T be a binary tree, r is the root node of T and L is the left subtree of r .Write an iterative algorithm to display the values of leaf nodes of the left subtree L. Compute the running time of your algorithm. Use any sample input to illustrate your algorithm. [10]

06. Given $f(x) = a_0+a_1x+a_2x^2+\ldots+a_nx^n$, where $a_0, a_1, a_2, \ldots a_n$ are coefficients(positive integers). Assume $f(x)$ is stored using linked list data structure and each node must contain only one data filed. Let k be a given positive integer. Write an algorithm to calculate the value of $f(k)$. Compute the running time of your algorithm. Use any sample input to illustrate your algorithm. [10]

07. Binary Search Tree is a binary tree in which each internal node 'x ' stores an element such that the values of the elements stored in the left subtree of ' x ' is less than or equal to the value of ' x ' and the values of the elements stored in the right subtree of ' x ' is greater than the value of ' x'. A ***full node*** is a node with two children. Write an iterative algorithm to find the sum of the values of the all full nodes to the given Binary Search Tree. Compute the time complexity of your algorithm. Use any sample input to illustrate your algorithm. [10]

08. Let $G = (V, E)$ be a graph where V is a vertex set and E is an edge set. Assume T is a spanning tree of G constructed using bread-first search. Let e_k be an edge from the edge set E. Write an algorithm to check whether the edge e_k is presenetd in the tree T or not. Compute the running time of your algorithm. Use any sample input to illustrate your algorithm. [10]

09. A ***maxiumum spanning tree*** of a connected weighted undirected graph is a spanning tree with the largest weight. Write an algorithm similar to ***Prim's algorithm*** for constructing a **maximum spanning tree** of a connected weighted graph. Compute the running time of your algorithm. Use any sample input to illustrate your algorithm. [10]

10. Let $L =< 50, 84, 72, 182, 276, 396, 380, 524, 556, 612 >$ be a list of keys. You are supposed to construct a binary search tree for a given set of keys in the same order as in L. The constructed binary search tree that guarantees the search operation in $O(logn)$ time. Then, delete keys '50' and '556' from the constrcuted binary search tree and show the resultant tree. [10]