

December 2024

B.Tech. (IT/CSE/CE/AI&ML/DS)

(Third Semester)

Data Structures and Algorithms (PCC-CS-301)

Time : 3 Hours]

[Maximum Marks : 75

Note : It is compulsory to answer all the questions (1.5 marks each) of Part A in short. Answer any *four* questions from Part B in detail. Different sub-parts of a question are to be attempted adjacent to each other.

Part A

1. (a) Consider the following function, **1.5**

```
int unknown(int n) {  
    int i, j, k = 0;  
    for (i = n/2; i <= n; i++)  
        for (j = 2; j <= n; j = j * 2)  
            k = k + n/2;  
    return k;  
}
```

What is the time complexity of the function ?

- (b) In quick sort, for sorting n elements, the $(n/4)$ th smallest element is selected as a pivot using an $O(n)$ time algorithm. What is the worst-case time complexity of the quick sort ? 1.5
- (c) What is the disadvantage of simple queue over circular queue in array implementation of queue ? 1.5
- (d) What are AVL Trees ? How are they different from Binary Search Tree ? 1.5
- (e) Define complete graph and strongly connected graph. 1.5
- (f) Give adjacency list and adjacency matrix representations of a graph data structure. 1.5
- (g) Give one advantage and one disadvantage of using Binary Search over Linear Search. 1.5
- (h) The in-order and pre-order traversal of a binary tree are **d b e a f c g** and **a b d e c f g**, respectively. What is the post-order traversal of the binary tree ? 1.5

- (i) What do you mean by minimum spanning tree ? 1.5
- (j) The keys 12, 18, 13, 2, 3, 23, 5 and 15 are inserted into an initially empty hash table of length 10 using open addressing with hash function $h(k) = k \bmod 10$ and linear probing. What is the resultant hash table ? 1.5

Part B

- ~~2.~~ (a) Given an array $\text{arr}[1 \dots 10][1 \dots 15]$ with a base value of 100 and the size of each element is 1 Byte in memory find the address of $\text{arr}[8][6]$ with the help of column-major order (CMO). 10
- (b) Define ADT (Abstract Data Type). Mention the features of ADT. 5
3. (a) Inspect, why we need an Asymptotic notation ? Explain the different Asymptotic notations with definition and example. 5
- (b) Write an algorithm to delete all occurrences of a given key in a linked list. 10

4. Write and Explain the algorithm to sort the given data using Merge Sort. Apply the merge sort on the following data to show the sorting process step-by-step :

87, 88, ~~25~~, ~~11~~, ~~22~~, ~~56~~, 99, ~~66~~, ~~77~~, ~~33~~.

Also analyze the time and space complexity.

15

5. (a) Explain operations of a stack with an example. 5

- (b) Write an algorithm to convert infix to postfix for $a + b * (c^d - e)^{(f + g * h)} - i$. 10

6. (a) What do you mean by Depth First Search (DFS) and Breadth First Search (BFS) ? Compare them. 10

- (b) Explain hashing, hash table and a hash function. Explain with an example. 5

7. (a) Write an algorithm to perform insertion and deletion in the circular queue. 10

- (b) What do you mean by priority queue ? Explain the different applications of priority queue. 5