

# GUJARAT TECHNOLOGICAL UNIVERSITY

DI -3 SEMESTER – OLD PAPER – S23 TO S25 – QUESTION BANK(English)

**Subject Name & Code:**

**Data structure and algorithms- 4330704**

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## Unit I: Basic Concepts of Data Structures

### Repeated Questions:

1. **Define an Algorithm. List/Specify/Explain the features of an algorithm.**
  - **Appeared in:** SUM 24 (Q1a, 03 marks), WIN 24 (Q1a, 03 marks), SUM 25 (Q1a, 03 marks)
2. **Define/What is Data Structure? Give the classification of Data Structure.**
  - **Appeared in:** WIN 22 (Q1a, 03 marks), SUM 23 (Q1a, 03 marks)
3. **Explain primitive and non-primitive data types/data structures.**
  - **Appeared in:** SUM 23 (Q1b, 03 marks)
4. **Define Time complexity, Space complexity and Big-Oh notation.**
  - **Appeared in:** WIN 23 (Q1a, 03 marks)

### Other Important Questions:

5. List out types of data structures. (SUM 23 - Q1a, 03 marks)
6. Define an Array. (SUM 23 - Q1b, 04 marks)
7. Write an algorithm to reverse a given string. (SUM 24 - Q1b, 04 marks)
8. Define array. Write an algorithm to insert an element in an array at the beginning. (SUM 24 - Q1c, 07 marks)
9. Write an algorithm to implement binary search and linear search in an array. (SUM 24 - Q1c(OR), 07 marks)
10. Write a C program to find the length of the string without using string function. (WIN 22 - Q1b, 04 marks)
11. Develop a C program to concatenate two strings into third one. (WIN 23 - Q1b, 04 marks)
12. Write an algorithm for array insertion operation. (SUM 25 - Q1b, 04 marks)
13. Write an algorithm for binary search operation on an array and also explain binary search with the help of an example. (SUM 25 - Q1c, 07 marks)
14. Write an algorithm for string concatenate and string copy operation. (SUM 25 - Q1c(OR), 07 marks)

15. Write an algorithm to copy a given string. (WIN 24 - Q1b, 04 marks)
16. Define array. Explain row major and column major array with the help of an example. (WIN 24 - Q1c, 07 marks)
17. Write an algorithm to implement binary search and linear search in an array. (WIN 24 - Q1c(OR), 07 marks)

## Unit II: Strings

### Repeated Questions:

1. **List out operations on string data structure.**
  - **Appeared in:** SUM 23 (Q1c, 02 marks), SUM 23 (Q1c(OR), 02 marks)
2. **Develop an algorithm to find the length of a string.**
  - **Appeared in:** SUM 23 (Q1c, 03 marks)
3. **Explain the significance of the NULL character in a string.**
  - **Appeared in:** SUM 23 (Q1c(OR), 02 marks)
4. **List out different string operations. Explain any two string operations using an algorithm.**
  - **Appeared in:** WIN 23 (Q1c(OR), 07 marks)

### Other Important Questions:

5. List out all string operations. Explain any two. (WIN 22 - Q1c, 07 marks)
6. Develop an algorithm to traverse an array. (SUM 23 - Q1c(OR), 03 marks)
7. Explain multidimensional array. (SUM 23 - Q1c, 02 marks)
8. List out operations on array data structure. (SUM 23 - Q1c(OR), 02 marks)
9. Explain Binary search method of an array with a suitable example. Write down the Binary search algorithm. (WIN 23 - Q1c, 07 marks)

## Unit III: Stack and Queues

### Repeated Questions:

1. **Define Stack. Write characteristics of stack / Write an algorithm to push/pop an element.**
  - **Appeared in:** WIN 22 (Q1g, 03 marks), WIN 23 (Q2a, 03 marks), WIN 24 (Q2a, 03 marks), SUM 24 (Q2a, 03 marks), SUM 25 (Q2a, 03 marks)
2. **Define Queue. Differentiate between Simple Queue and Circular Queue.**
  - **Appeared in:** WIN 24 (Q2a(OR), 03 marks), SUM 24 (Q2a(OR), 03 marks), SUM 25 (Q2a, 03 marks)
3. **Convert Infix expression to Postfix expression.**
  - **Appeared in:** WIN 22 (Q2a(OR), 03 marks), WIN 23 (Q2b(OR), 04 marks), WIN 24 (Q2b(OR), 04 marks), SUM 24 (Q2b(OR), 04 marks), SUM 25 (Q2c, 07 marks)
4. **Write an algorithm for PUSH and POP operations of stack.**
  - **Appeared in:** SUM 23 (Q2c(OR), 06 marks), WIN 23 (Q2c, 07 marks), SUM 25 (Q2b, 04 marks)
5. **Write an algorithm for insert and delete operations on Queue.**
  - **Appeared in:** SUM 23 (Q2c, 06 marks), WIN 22 (Q2c(OR), 07 marks)
6. **Explain Infix to Postfix conversion / Evaluation of Postfix expression using stack.**
  - **Appeared in:** SUM 23 (Q2a, 03 marks), SUM 23 (Q2a(OR), 03 marks)
7. **Write applications of stack.**
  - **Appeared in:** WIN 24 (Q2c(OR), 07 marks), SUM 24 (Q2c(OR), 07 marks)

### Other Important Questions:

8. Differentiate between stack and queue. (WIN 22 - Q2b(OR), 04 marks)
9. Write a short note on circular queue. (WIN 22 - Q1h, 04 marks)
10. Explain stack with a real-life example. (SUM 23 - Q2b, 03 marks)
11. Define Circular Queue. Explain Simple Queue with a real-life example. (SUM 23 - Q2b(OR), 04 marks)
12. Which data structure is called LIFO? Develop an algorithm for PUSH and POP operations of stack. (SUM 23 - Q2c(OR), 07 marks)
13. Evaluate  $(4+9) * (3+6)$  using stack. (WIN 23 - Q2b, 04 marks)
14. Define Queue. How to Insert and Delete an element in Queue. (WIN 23 - Q2a(OR), 03 marks)
15. Develop a C program that finds GCD of two numbers using recursion. (WIN 23 - Q2c(OR), 07 marks)

16. Consider maximum size of stack is 5. Perform operations (PUSH, POP) and show the status of stack and top pointer after each operation. (WIN 24 - Q2c, 07 marks), (SUM 24 - Q2c, 07 marks)
17. Write an algorithm to delete an element from a simple queue. (SUM 24 - Q2b, 04 marks)
18. Explain recursion with the help of an example. (SUM 24 - Q2c(OR), 07 marks)

## Unit IV: Linked List

### Repeated Questions:

1. **Differentiate between Singly linked list and Doubly linked list.**
  - **Appeared in:** WIN 22 (Q3a, 03 marks), WIN 24 (Q3b(OR), 04 marks), SUM 24 (Q3b(OR), 04 marks)
2. **Differentiate between Circular linked list and Doubly linked list.**
  - **Appeared in:** WIN 24 (Q3b, 04 marks), SUM 24 (Q3b, 04 marks)
3. **Define Linked list. Write an algorithm to insert an element at the end of the linked list/singly linked list.**
  - **Appeared in:** WIN 24 (Q3c, 07 marks), SUM 24 (Q3c(OR), 07 marks)
4. **Write an algorithm to insert an element at the start/beginning of the singly linked list/doubly linked list.**
  - **Appeared in:** WIN 22 (Q3c(OR), 07 marks), WIN 24 (Q3c(OR), 07 marks), SUM 25 (Q3b, 04 marks)
5. **Write an algorithm to delete a node from the end of the singly linked list.**
  - **Appeared in:** WIN 23 (Q3c, 07 marks), SUM 24 (Q3c, 07 marks)
6. **Explain Circular linked list.**
  - **Appeared in:** SUM 23 (Q3a, 03 marks), WIN 22 (Q3a(OR), 03 marks), WIN 23 (Q3b(OR), 04 marks)
7. **Write a short note on application of linked list.**
  - **Appeared in:** WIN 22 (Q3b(OR), 04 marks), WIN 24 (Q3a(OR), 03 marks), SUM 24 (Q3a(OR), 03 marks)
8. **Differentiate between Array and Linked list.**
  - **Appeared in:** WIN 23 (Q3a, 03 marks), SUM 25 (Q3b(OR), 04 marks)

### Other Important Questions:

9. Justify the statement "Linked list is a linear data structure". (WIN 24 - Q3a, 03 marks), (SUM 24 - Q3a, 03 marks)
10. Define pointer and linked list. List out different types of linked lists. (SUM 23 - Q3b, 04 marks)
11. Explain operation for inserting a node at beginning and at the end of the singly linked list. Develop an algorithm to traverse singly linked list. (SUM 23 - Q3c, 07 marks)
12. Explain doubly linked list. (SUM 23 - Q3a(OR), 03 marks)
13. Which are the components of a node of singly linked list? (SUM 23 - Q3b(OR), 04 marks)
14. Explain operation for deleting a node from beginning and at the end of the singly linked list. Develop an algorithm to delete first node from singly linked list. (SUM 23 - Q3c(OR), 07 marks)

15. What is linked list? Give the difference between array and linked list. (WIN 22 - Q3b, 04 marks)
16. Write an algorithm to insert an element at the end of the linked list. (WIN 22 - Q3c, 07 marks)
17. Write advantages and disadvantages of Linked list. (WIN 23 - Q3a(OR), 03 marks)
18. Explain Dynamic memory allocation (DMA). (WIN 23 - Q3b, 04 marks)
19. Write an algorithm to INSERT a node before a given node of the singly Linked list. (WIN 23 - Q3c(OR), 07 marks)
20. Write algorithms to delete last element of the singly linked list and first node of singly linked list. (SUM 25 - Q3c, 07 marks)
21. Write advantages of Dynamic memory allocation. (SUM 25 - Q3a(OR), 03 marks)
22. Write an algorithm to search a particular element from singly linked list. Write an algorithm to count number nodes in singly linked list. (SUM 25 - Q3c(OR), 07 marks)

## Unit V: Trees

### Repeated Questions:

1. **List the applications of a binary tree.**
  - **Appeared in:** WIN 24 (Q4a, 03 marks), SUM 24 (Q4a, 03 marks)
2. **Define Binary Search Tree (BST). Write applications of Binary Tree.**
  - **Appeared in:** WIN 23 (Q4a(OR), 03 marks)
3. **Explain with example inorder and preorder traversal.**
  - **Appeared in:** WIN 24 (Q4b(OR), 04 marks), SUM 24 (Q4b(OR), 04 marks)
4. **Generate a Binary Search Tree (BST) for given data and give preorder, inorder, postorder traversal.**
  - **Appeared in:** WIN 22 (Q4c(OR), 07 marks), WIN 23 (Q4c, 07 marks), WIN 24 (Q4c(OR), 07 marks), SUM 24 (Q4c(OR), 07 marks), SUM 25 (Q4c, 07 marks)
5. **Explain Insertion and Deletion operation on Binary Search Tree.**
  - **Appeared in:** WIN 24 (Q4c, 07 marks), WIN 23 (Q4c(OR), 07 marks), SUM 24 (Q4c, 07 marks)
6. **Write an algorithm for PREORDER / INORDER traversal of binary tree.**
  - **Appeared in:** SUM 23 (Q4c(OR), 06 marks), WIN 22 (Q4b, 04 marks), WIN 23 (Q4b(OR), 04 marks), SUM 25 (Q4b(OR), 04 marks)

### Other Important Questions:

7. Define following terms regarding Tree data structure: Root Node, Leaf Node, Degree, Path, Ancestor node, Descendant node, In-Degree, Out-degree, Complete binary tree, Siblings, Depth, Height, Sub tree. (SUM 23 - Q4a, 03 marks), (SUM 23 - Q4a(OR), 03 marks), (WIN 22 - Q4a, 03 marks), (WIN 23 - Q4a, 03 marks), (WIN 24 - Q4a(OR), 03 marks), (SUM 24 - Q4a(OR), 03 marks), (SUM 25 - Q4a, 03 marks), (SUM 25 - Q4a(OR), 03 marks)
8. Explain in-order traversal of binary tree with example. (SUM 23 - Q4b, 04 marks)
9. Define Sub tree. Develop an algorithm for post order traversal of binary tree. (SUM 23 - Q4c, 07 marks)
10. Explain pre-order traversal of binary tree with example. (SUM 23 - Q4b(OR), 04 marks)
11. Which binary tree traversal is known as Node-Left-Right traversal? Develop an algorithm for pre-order traversal of binary tree. (SUM 23 - Q4c(OR), 07 marks)
12. Define Tree. Explain applications of tree. (WIN 22 - Q4a(OR), 03 marks)
13. How a node is deleted in binary search tree. Explain it with example. (WIN 22 - Q4b(OR), 04 marks)
14. List tree traversal technique and explain any two with example. (WIN 22 - Q4c, 07 marks)
15. Write an algorithm of searching a node in Binary Search Tree. (WIN 23 - Q4b, 04 marks)
16. Write short note on application of trees. (SUM 25 - Q4b, 04 marks)

17. Draw BST for given data. Insert and delete nodes and redraw tree after each operation. (SUM 25 - Q4c, 07 marks)
18. Create BST for given data. Write inorder and preorder traversal sequence. (SUM 25 - Q4c(OR), 07 marks)

## Unit VI: Sorting and Hashing

### Repeated Questions:

1. **Define Sorting. List various sorting techniques.**
  - **Appeared in:** WIN 24 (Q5a, 03 marks), SUM 24 (Q5a, 03 marks)
2. **Define Hashing. List various hashing techniques.**
  - **Appeared in:** WIN 24 (Q5a(OR), 03 marks), SUM 24 (Q5a(OR), 03 marks)
3. **Differentiate between Insertion Sort and Bubble Sort / Quick Sort / Selection Sort / Merge Sort.**
  - **Appeared in:** WIN 24 (Q5b, 04 marks), SUM 24 (Q5b, 04 marks), SUM 24 (Q5b(OR), 04 marks)
4. **Explain the working of Quick Sort with the help of an example.**
  - **Appeared in:** WIN 24 (Q5c, 07 marks), SUM 24 (Q5c, 07 marks)
5. **Explain the working of Bubble Sort with the help of an example.**
  - **Appeared in:** WIN 22 (Q5c, 07 marks), WIN 24 (Q5c(OR), 07 marks)
6. **Explain the working of Selection Sort with the help of an example.**
  - **Appeared in:** SUM 24 (Q5c(OR), 07 marks)
7. **Develop an algorithm for Bubble Sort / Insertion Sort / Selection Sort / Merge Sort / Quick Sort.**
  - **Appeared in:** SUM 23 (Q5c, 07 marks), SUM 23 (Q5c(OR), 07 marks), WIN 23 (Q5b(OR), 04 marks), WIN 23 (Q5c(OR), 07 marks), SUM 25 (Q5a, 03 marks), SUM 25 (Q5a(OR), 03 marks)

### Other Important Questions:

8. Explain linear search method. (SUM 23 - Q5a, 03 marks)
9. List out any two collision resolution techniques. Explain hash table. (SUM 23 - Q5b, 04 marks)
10. Explain collision. (SUM 23 - Q5a(OR), 03 marks)
11. List out any two hash functions. Explain division method of hashing. (SUM 23 - Q5b(OR), 04 marks)
12. Give the average time complexity of Insertion Sort, Selection Sort, and Radix Sort. (WIN 22 - Q5a, 03 marks)
13. Explain Folding method of Hashing. (WIN 22 - Q5b, 04 marks)
14. What is hashing? List out hashing techniques. (WIN 22 - Q5a(OR), 03 marks)
15. Explain division method. (WIN 22 - Q5b(OR), 04 marks)
16. In what manner insertion sort algorithm works? Explain with suitable example. (WIN 22 - Q5c(OR), 07 marks)
17. Write an algorithm for Quick sort. (WIN 23 - Q5b, 04 marks)
18. Give Trace of numbers using bubble sort (Ascending Order). (WIN 23 - Q5c, 07 marks)
19. Define Hash table and Hash function. List out Hash table methods. (WIN 23 - Q5a(OR), 03 marks)
20. Write an algorithm for Merge sort. (WIN 23 - Q5b(OR), 04 marks)
21. Give Trace of numbers using Selection sort (Ascending Order). (WIN 23 - Q5c(OR), 07 marks)
22. Explain any two hash table methods. (SUM 25 - Q5b, 04 marks)
23. Give trace of quick sort algorithm using given data. (SUM 25 - Q5c, 07 marks)
24. Explain radix sort with the help of example. (SUM 25 - Q5b(OR), 04 marks)
25. Sort the given data using selection sort. (SUM 25 - Q5c(OR), 07 marks)

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