

- (v) If a queue is implemented with a linked list, keeping track of a front pointer and a rear pointer, which of these pointers will change during an insertion into a non-empty queue?
(a) neither of the pointers change (b) only front pointer changes
(c) only rear pointer changes (d) both the pointers change

Time Allowed: 3 hrs

Full Marks: 70

- (vi) The minimum number of nodes in a binary tree of depth d (root is at level 0) is
(a) $2^d - 1$ (b) $2^{d+1} - 1$ (c) $d + 1$ (d) d .
- (vii) Recursion is similar to which of the following?
(a) Switch Case (b) Loop
(c) if else (d) none of the mentioned.

- (viii) Given an array $\text{arr}[] = \{46, 89, 90, 94, 99, 100\}$ and $\text{key} = 99$; what are the mid elements in the first and second levels of recursion?

1. Choose the correct alternative for the following:
(a) 90 and 99 (b) 90 and 94
(c) 89 and 99 (d) 89 and 94.
- (ix) The most appropriate matching for the following pairs:
X: $m = \text{malloc}(5)$; $m = \text{NULL}$; 1. Using dangling pointers
Y: $\text{free}(n)$; $n \rightarrow \text{value} = 5$; 2. Using uninitialized pointers
Z: $\text{char} *p, *q, *r, *a$; 3. Lost memory
(a) X-1, Y-2, Z-1 (b) X-2, Y-1, Z-3
(c) X-3, Y-2, Z-1 (d) X-1, Y-2, Z-2.
- (x) QuickSort can be categorized into which of the following?
(a) data structure in which elements can be inserted or deleted at/from both the ends but not in the middle is (b) Divide and conquer
(c) Greedy algorithm (d) Dynamic programming.
(a) queue (b) circular queue
(c) dequeue (d) priority queue.

Group - B

2. (iii) Given a pointer to the first node of a singly linked list, which of the following operation can be implemented in $O(1)$ time?
(i) create the menu card
(ii) add new items at the end of the menu card
(iii) sort and display the items according to price (low to high)
(iv) display the tax added price (18% GST) of the past entered transaction. For e.g., if user enters Butter of Prawns, you must print Price = ₹ 212.5

No need to write the full program.

- (a) +, -, *, a, b, c, d
(c) a, b, c, d, -, *, +

- (d) -, a, (2 + 3 * 4) + 3 = 12

Multicuisine Restaurant- Menu Card	
1. French Fries Deep fried potato strips served with Tomato sauce	₹ 110
2. Corn Fritters Sweet corn kernels and spring onion fritters served with tomato sauce	₹ 130
3. Aloo Dhanya Tikki Deep fried potato, cheese and coriander pattice flavored with North Indian spices.	₹ 130
4. Fish Cube Masala Fry Deep fried fish cubes dusted with Kerala spices	₹ 170
5. Spicy Prawn Skewers Sweet and spicy prawns skewered with sweet chilly sauce	₹ 180
6. Squid/ Prawn Tempura Batter fried squid or prawns	₹ 180
7. Butterfly Prawns Crumb fried prawns	₹ 180
8. Shrimp Cocktail Combination of shrimps, salad and cocktail sauce	₹ 180
* Taxes as applicable	

3. (a) Find the maximum number of non-zero elements and work out the index function for the following matrices:
(i) Upper triangular and (ii) Tridiagonal
- (b) Represent the polynomial: $15x^4 + 40x^2 - 5x + 10$ with a linked list. Write an algorithm to read such a polynomial, integrate the polynomial within the range $[0, 1]$ and print the result.

$$6 + (1 + 2 + 3) = 12$$

Group - C

4. (a) With the help of stack convert the following infix expression to corresponding postfix expression (assume $^$ is the exponentiation operator); clearly mention each step involved.

$$(a * (b - c)) + d ^ e ^ f$$

- (b) Write recursive functions to find the nth Fibonacci number and derive its time complexity?

$$6 + 6 = 12$$

5. (a) What is a circular queue? What are the advantages of circular queue over linear queue? Write append and serve functions for a circular queue.
- (b) Write recursive functions to implement the binary search and derive the time complexity.

$$(2 + 2 + 4) + 4 = 12$$

Group - D

6. (a) Insert the keys, in the order shown, to build them into an AVL tree (lexicographic order). Clearly show the rotation(s) when required.
Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec
- (b) Prove that in a binary tree $n_0 = n_2 + 1$, where n_0 and n_2 are the number of nodes with zero children and two children respectively.
- (c) Draw all the possible non-similar binary trees with three nodes.

$$6 + 4 + 2 = 12$$

7. (a) Insert the following entries, in the order stated, into an initially empty B-tree of order 5

A G F B K D H M J E S I R X C L N T U P

- (b) Prove that the number of NULL links in a binary tree with n nodes is $(n + 1)$.

- (c) Consider the in-order and post-order traversals of a tree as given below:

In-order : J E N K O P B F A C L G M D H I

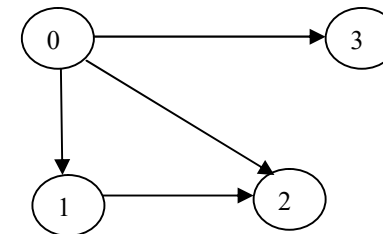
Post-order : J N O P K E F B C L M G H I D A

Draw the tree. What will be the pre-order traversal of the tree?

$$4 + 2 + (4 + 2) = 12$$

Group - E

8. (a) Write an algorithm for heap sort. Deduce the complexity of the algorithm.
- (b) Draw the adjacency matrix and adjacency list for the given graph.



$$(4 + 2) + 6 = 12$$

9. (a) What is hashing? What are the characteristics of a good hash function?
- (b) Sort the following list of 14 numbers using shell sort with increments: 7, 3, 1, 26, 55, 35, 29, 19, 12, 22, 44, 39, 16, 77, 61, 33, 27.
- (c) How is the idea of sentinel used to increase the efficiency of linear search?

$$4 + 5 + 3 = 12$$