DATA STRUCTURE
(ECEN 2102)
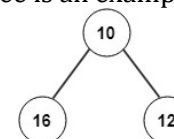
Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

   (i) Which is the best time complexity among the folowing?
   (a) $O(n\log n)$ (b) $O(n^2)$
   (c) $O(2^n)$ (d) $O(n^3)$.

   (ii) What are the advantages of arrays?
   (a) Elements are always sorted (b) Dynamic Size
   (c) Easier for storing same data type (d) Mixed data types can be stored.

   (iii) In a stack, if a user tries to remove an element from empty stack it is called _____.
   (a) Overflow (b) Empty collection
   (c) Underflow (d) Garbage Collection

   (iv) A normal queue, if implemented using an array of size MAX_SIZE, gets full when
   (a) Rear = MAX_SIZE – 1 (b) Front = rear + Stack
   (c) Front = (rear + 1)mod MAX_SIZE (d) Rear=Front.

   (v) In linked list each node contain minimum of two fields. One field is data field to store the data second field is
   (a) Pointer to character (b) Pointer to node
   (c) Pointer to integer (d) Pointer to Pointer.

   (vi) The following given Tree is an example for

   (a) Binary Search Tree (b) AVL Tree
   (c) B Tree (d) Binary Tree.

(b) Consider the following sequence of data: 10, 20, 3, 15, 8, 18, 25, 30, 6, 16, 45, 35, 7. Construct a Balanced Binary search tree.

(c) How graphs are represented by adjacency lists? Show the adjacency list for graph in 7 (a).

(2 + 3) + 5 + 2 = 12

Group – E

8. (a) Sort the following set of elements using Bubble sort techniques showing all intermediate steps, $2, 4, -11, -7, 31, 22, 56, 189, 47, 91$.

   (b) After comparing Binary and Linear search method, state which one is better?

   (c) Describe the methodology of Linear and Quadratic probing in Hashing and allocate the following sequence of data to the array with array of size 10;
   50, 10, 60, 80, 61, 15, 16, 20, 22, 25, 6 and 17.

   (d) How hashing is better than binary search?

   3 + 3 + 5 + 1 = 12

9. (a) Write the algorithm for Merge Sort. Compare the relative merits and demerits of Quick Sort and Merge Sort algorithms.

   (b) Which search procedure (Binary or Linear) is better if "199" is to be searched in the following array (set of positive integers up to 1542)? Why?
   $1, 2, 3, 4, .., 1542$.

   (c) Write the function Max_Heap for constructing a max heap.

   (5 + 2) + (1 + 1) + 3 = 12

(vii) The number of edges from the node to the deepest leaf is called _____ of the tree.
(a) length   (b) width
(c) height   (d) depth

(viii) The number of elements in the adjacency matrix of a graph having 7 vertices is _____.
(a) 14   (b) 49
(c) 7   (d) 36

(ix) After each iteration in bubble sort
(a) one element is sorted   (b) max and min elements sorted
(c) one less comparison is made   (d) minimum element is sorted.

(x) What is direct addressing?
(a) Fewer positions than keys   (b) Direct data no key
(c) Fewer keys than positions   (d) Distinct position for every key.

Group – B

2. (a) What is Big-O notation? Why is it needed? Graphically represent the common order of magnitude functions for big-O.

(b) Suppose L is a linked list with n items where each item is considered as an integer. Write a function/pseudo code to insert an item "t" after a specified integer present in L.

(c) What is ADT? Give example.

(2 + 1 + 4) + 3 + 2= 12

3. (a) A singly-linked list contains integer data. Write an algorithm or a pseudo-code to delete the node containing maximum value.

(b) In case of a linked list which method of searching is more suitable and why?

(c) Consider a matrix with order 500 × 500 having 194 negative integers and 200 positive integers. What amount of memory (in bytes) it will consume if stored as a 2D array? Propose an efficient mechanism to store it with less memory consumption.

(d) Critically comment on the following statement: STACK is a non-linear data structure.

4 + 2 + 3 + 3 = 12

Group – C

4. (a) Consider the following operations in Circular Queue:

(i) insert the following values 11,22,33,44,55,66
(ii) delete 11,22
(iii) insert 77,88,99
The Circular Queue can accommodate at max five elements. Front and Rear are set to zero at beginning. What will be the Front and Rear values after each operation?

(b) Convert the following infix expression to postfix form using a stack:
M + P * Q + (R * S + T) / U, [show all intermediate steps].

6 + 6 = 12

5. (a) Write an algorithm/function/ pseudo code for pop() operation in Stack.

(b) Insert the following elements in a queue : 214, 133, 137, 102 and do the following and show value of front and rear in each cases:
(i) Enqueue a new element 145
(ii) Dequeue 2 times.

(c) What are the relative merits and demerits of Recursion and Iteration?

(d) What are the time complexities of Enqueue and Dequeue operations on queue.

3 + (2 + 2) + 3 + 2 = 12

Group – D

6. (a) Construct a binary tree whose nodes in inorder and preorder are given as follows:
Inorder : 5, 10, 12, 13, 15, 20, 25, 30, 33, 35, 45
Preorder: 15, 10, 5, 13, 12, 25, 20, 35, 30, 33, 45
Show all intermediate steps.

(b) How trees can be represented using array? Give example.

(c) Write function/algorithm/pseudo code for inserting a node in a Binary tree.

(d) What is the time complexity of inserting a node into a Binary search Tree with height h.

4 + (1 + 2) + 4 + 1 = 12

7. (a) Create the adjacency list for the following graph. Perform a depth-first search on the following graph starting at vertex A. Whenever faced with a decision of which vertex to pick from a set of vertices, pick the one whose label occurs earliest in the alphabet. Show intermediate steps.