VIT

Vellore Institute of Technology

School of Information Technology and Engineering

Fall Semester 2022-2023

Continuous Assessment Test – I

Programme Name & Branch : MCA

Course Name & Code: ITA5002 – Problem Solving with Data Structures and Algorithms

Class Number (s): VL2022230105092, VL2022230105099, VL2022230105106.

Slot: C2 + TC2

Faculty Names: Dr. Chandra Mouliswaran S, Dr. Dharmendra Singh Rajput, Prof.Nagarajan B

Exam Duration: 90 Min. **Maximum Marks: 50**

General Instruction(s):

Answer ALL Questions (5 * 10 = 50 Marks)

1. a) Describe the various asymptotic notations that are used for algorithm analysis and explain with suitable examples. (6 Marks)

   b) Consider the following snippet and analyze the time complexity. (4 Marks)

```
fun()
  {
  for(i=1; i<=n; i++)
      for(j=1;j<=n; j=j+i)
          printf("hello");
  }
```

2. Develop the functions to insert an element into a circular queue and delete an element from the circular queue using array implementation.

3. a) Write the pseudo-code to represent the polynomial expression of the form $6X^3 + 9X^2 + 7X + 1$ using linked list. (5 Marks)

   b) Devise an algorithm to add two polynomial equations using linked list. (5 Marks)

4. a) Design an algorithm to convert the infix expression to postfix expression. Apply the algorithm and show the contents of stack during the conversion for the expression: a + b * c + (d + e + f) / g (6 Marks)

   b) Evaluate the given postfix expression using stack: 9 3 4 * 8 + 4 / - (4 Marks)

5. Develop an algorithm to create, insert and search an element in Binary search tree. Create Binary search tree for the following list of elements which are inserted into an empty binary search tree: 14, 15, 4, 9, 7, 18, 3,5,16, 20, 17, 9.

VIT

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act 1956)

School of Information Technology and Engineering

Fall Semester 2022-2023

Continuous Assessment Test – II

Programme Name & Branch: MCA

Course Name & Code: ITA5002 – Problem Solving with Data Structures and Algorithms.

Class Number (s): VL2022230105092, VL2022230105099, VL2022230105106.

Slot: C2+TC2

Faculty Name(s): Dr. Chandra Mouliswaran S, Dr. Dharmendra Singh Rajput, Dr. Krishnamoorthy N.

Exam Duration: 90 Min. **Maximum Marks: 50**

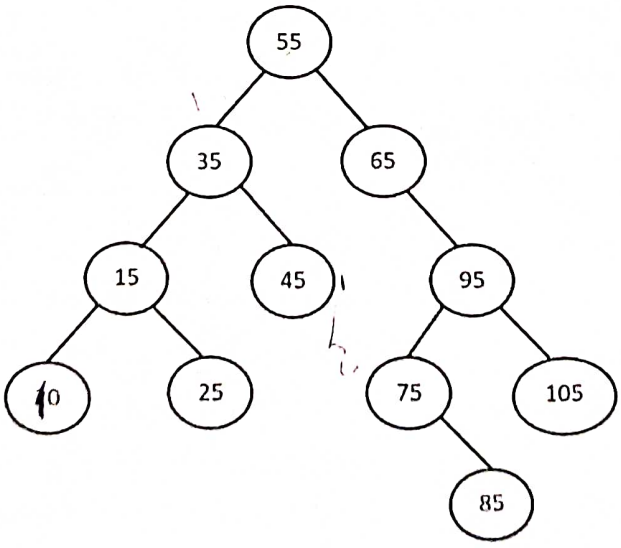
General instruction(s):

(i) Write the concrete and crisp answers instead of writing the answer in general.

(ii) Draw Diagrams and Tables wherever necessary.

(iii) Provide every step and iteration clearly while solving problems and derivings your solutions.

1. (i) Consider the splay tree given below and perform the operations such as ***Insert 32***, ***Search 75*** and ***Delete 65*** in sequence. Display your rotations and their types while performing the above operations. (6)



(ii) How many bits are required per node to store the height of a node in an "N" node AVL Tree? (2)

2. Construct a heap (MIN HEAP) for the following array structure. Check whether the heap property is maintained. If, it is violated, rearrange the heap so as to maintain the heap property. Sort the following elements using heap sort. (10)

24	18	17	36	72	54	11	44	45	33

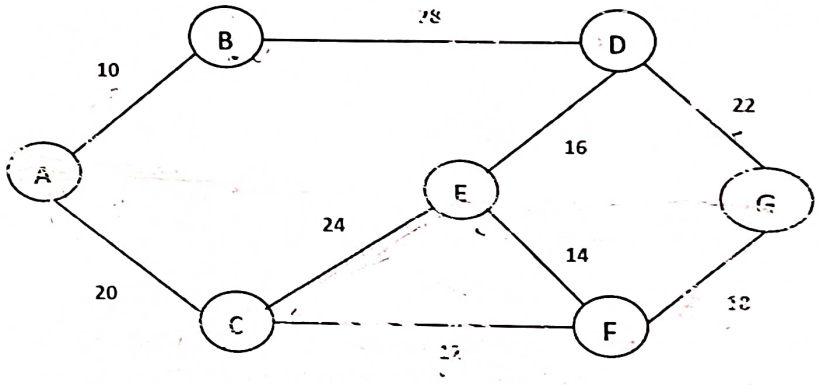
Here, each and every step in all of the iteration is needed to be illustrated clearly.

3. (i) Apply the Insertion Sort to sort the below elements in ascending order. Here, each and every step in all of the iteration is needed to be illustrated clearly. (7)

63	23	53	73	43	83	13	93	33

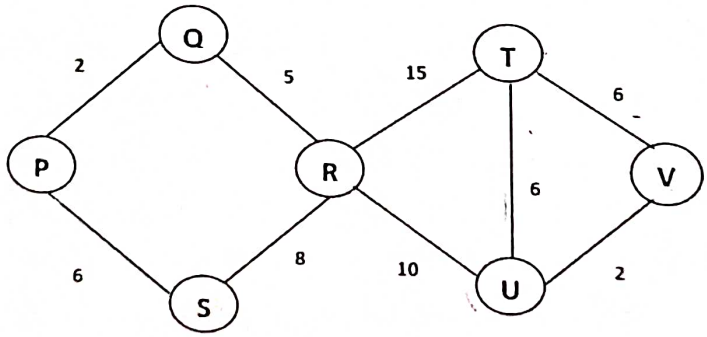
(ii) Find the minimum number of comparison required to sort 5 elements? Among the various sorting techniques known to you, which sorting technique provide it? Justify your answer with an example. (3)

4. (i) Develop the weighted matrix for the graph given below. (2)



(ii) Construct the Minimum Spanning Tree for the above Graph using Prim's and Kruskal's Algorithms and compare their results. (8)

5. By applying the Dijkstra's algorithm, illustrate how to find the shortest path from the node or vertex "P" to all other nodes or vertices in the below Graph. Provide the status of graph in each and every step clearly. (10)



Final Assessment Test – Jan / Feb 2023

VIT® Vellore Institute of Technology

Course: ITA5002 - Problem solving with Data structures and Algorithms

Class NBR(s): 5092 / 5099 / 5106 Slot: C2+TC2

Time: Three Hours Max. Marks: 100

KEEPING MOBILE PHONE/SMART WATCH, EVEN IN 'OFF' POSITION, IS TREATED AS EXAM MALPRACTICE

General Instructions:

I. Write the concrete and crisp answers. Draw Diagrams and Tables wherever necessary.

II. Provide every step and iteration clearly while solving problems and deriving solutions.

Answer ALL Questions

(10 X 10 = 100 Marks)

1. (i) Using the stack data structure, construct the algorithm or write the pseudocode to convert the given decimal number into the binary number and illustrate with suitable example. **[5]**

   (ii) Convert the infix expression ((A + B) / C) ↑ (D - E) into polish notation and show the steps in the format of Table given below. **[5]**

Input Symbol / Character	Operation (PUSH/POP)	Content of Stack	Result / Output

2. (i) Find the order of the following algorithmic functions such as **[4]**
   $f(n) = n^2 + 10n$ and $f(n) = 10n^2 + 4n + 2$.

   (ii) Develop an algorithm to solve Towers of Hanoi problem using recursion. Further, derive the recurrence relation for the same and analyse its time complexity. **[6]**

3. (i) Formalize an algorithm and write the pseudocode to insert and delete the given element in the existing sorted circular linked list. **[5]**

   (ii) Write the pseudocode to perform the enqueue and dequeue operation with the given Circular Queue. Further, define the constraint to verify the whether the given Circular Queue is Full or Empty. **[3]**

   (iii) You know that e-mail system is the highly used official messaging platform. Which data structure would be used to deliver the messages? Justify your answer. **[2]**

4. (i) How many different binary trees are possible with "n" nodes? Find the number of NULL nodes or branches in a binary tree when the binary tree contains "n" nodes? **[3]**

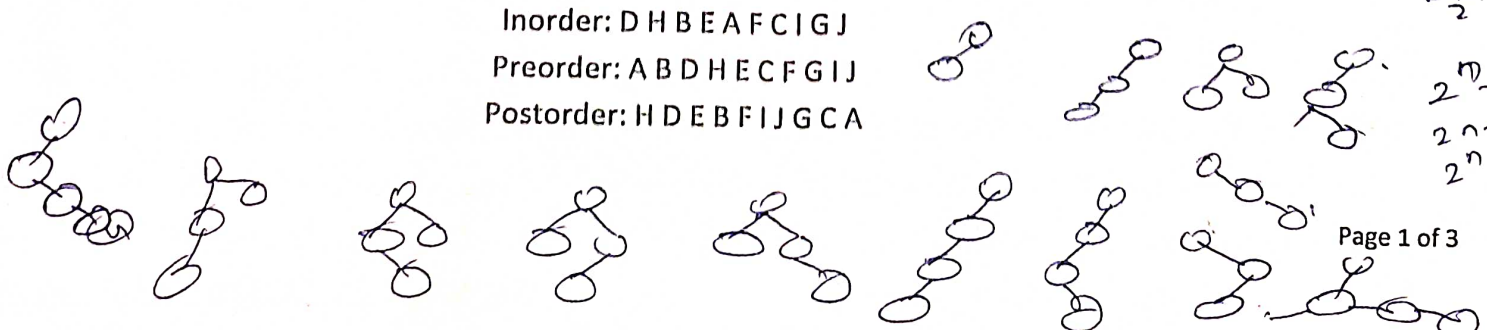
   (ii) Draw the binary tree for the algebraic expression ((a – 3b) (2x – y)³) and perform the preorder and postorder traversal of the same. **[4]**

   (iii) Find the tree which produces its inorder, preorder and postorder traversal as follows. **[3]**

   Inorder: D H B E A F C I G J

   Preorder: A B D H E C F G I J

   Postorder: H D E B F I J G C A



5. (i) How do you calculate the Balancing Factor of any node in the AVL Tree and how do you convert it as balanced in case if it is not? Give an example. **[3]**

(ii) Construct the AVL Tree by inserting the following elements one by one and perform the appropriate AVL rotation required while inserting each of the element. **[7]**

50	25	35	45	53	63	73	83	33

6. (i) Formalize an algorithm or write the pseudocode to perform the Merge Sort on the set of values given as the input and produce their result in ascending order. **[5]**

(ii) Using Radix Sort, arrange the list of elements given below in descending order and explain its steps with its pseudocode. **[5]**

645	212	90	181	514	2	389	21	786

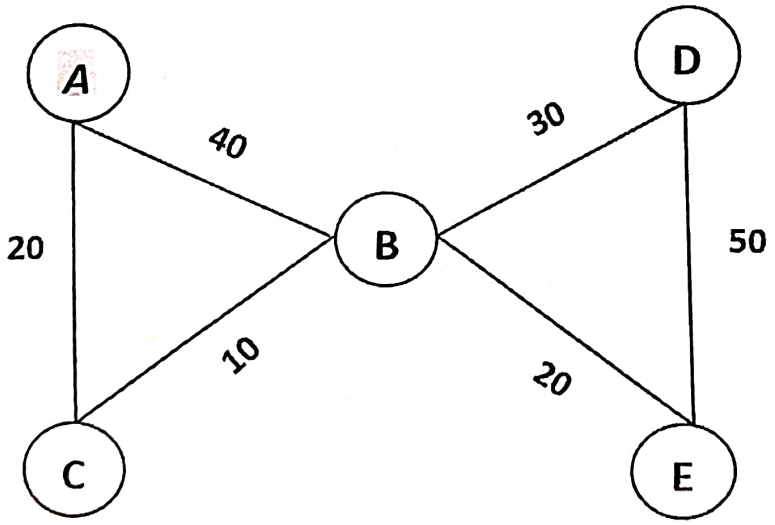
7. (i) Draw the undirected graph "G" of an incident matrix "M" given below and find its adjacency list. **[4]**

$$M = \begin{pmatrix} 0 & 0 & 1 & 0 & 0 & 1 & 1 & 1 \\ 0 & 1 & 0 & 1 & 0 & 0 & 1 & 0 \\ 1 & 0 & 1 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 1 \\ 1 & 1 & 0 & 0 & 1 & 1 & 0 & 0 \end{pmatrix}$$

(ii) Consider the same undirected Graph "G" mentioned above and perform the Breadth First Search (BFS) and Depth First Search (DFS) from the Vertex 1 i.e. "V_1" and find their search path. **[3]**

(iii) Which data structure supports Prim's and Kruskal's algorithm for finding the Minimum Spanning Tree (MST)? Further, compare and contrast both the algorithms with its functionality as well as complexity. **[3]**

8. Write down the Dijkstra's algorithm and find the shortest path of the Graph given below from the starting vertex "A". **[10]**



9. (i) Consider a text file contains 1000 characters and assume only six characters occurs repeatedly in the text file as follows. [5]

Chara-cter	a	b	c	d	e	f	Total
Freq-uency	350	160	120	90	230	50	1000

By applying the Huffman coding represent each character in the file in a compact way and calculate the approximate percentage of saving on the no. of bits in the compressed file.

(ii) Which algorithm design technique is followed by Quick Sort algorithm and describe how does it support? Why is it widely used as the default sorting technique while developing various applications in IT industry? List out the reasons and justify your answer. [5]

10. (i) How do the Dynamic Programming and Backtracking differ from each other? Identify which is best among the two approaches and justify your answer. [4]

(ii) Write Floyd's algorithm to solve all pairs shortest path problem and explain its steps. [6]

⇔⇔⇔