VIT
Vellore Institute of Technology

Final Assessment Test – Jan / Feb 2023

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 $f(n) = n^2 + 10n$ and $f(n) = 10n^2 + 4n + 2$. [4]

(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

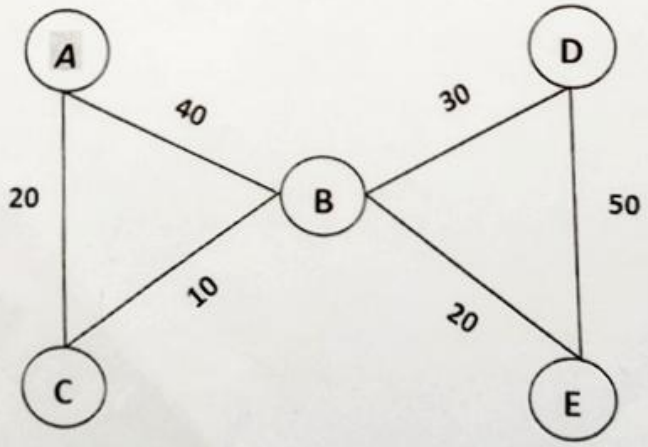
7. (i) Draw the undirected graph "G" of an incident matrix "M" given below and find its adjacency list. **[4]**

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

(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]

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