Unique Paper Code: 32341301

Name of the Course: B.Sc. (H) Computer Science

Name of the paper: Data Structures

Semester: III

Year of admission: 2019

Duration: 3 Hours Maximum Marks: 75

Instructions for Candidate

Attempt any four questions. All questions carry equal marks.

Q 1	Write a program to implement a ticket reservation system for a particular flight. The program should display a menu with the following options: 1. reserve a ticket. 2. cancel a reservation. 3. check whether a ticket is reserved for a particular person. 4. display the passenger list. Use singly linked list for storing information. Information is maintained in ascending order of names. Is there any disadvantage if information is not kept in a sorted way?
Q 2	a) Consider the intermediate configurations of an array being sorted. Which sorting algorithm is being used in each case? Justify your answer. (i) (10, 3, 14, 9, 8) (3, 10, 14, 9, 8) (3, 8, 14, 9, 10) (3, 8, 9, 14, 10), (3, 8, 9, 10, 14) (ii) (50 , 3, 20, 40, 10,) (3, 20, 40, 10, 50) (3, 20, 10, 40, 50) (3, 10, 20, 40, 50), (3, 10, 20, 40, 50)

b) Consider an n X n matrix A where

$$A[i,j] = 0 \text{ if } (i+j-n) \neq 0,1,2 \quad 1 \leq i, j \leq n$$

The non-zero elements of this matrix ie. the element A[i,j] where i+j-n >=0 and i+j-n<=2 , are stored in a single dimensional array. What will be the size of this 1-dimensional array B? How the elements of A are stored in B. Write the formula for accessing (i,j) th element of A?

The following 5X5 matrix of the above type is given. Store this a single dimensional array B using the above scheme. Calculate the address of A[3,3] if the base address of array B is 200.

0	0	0	10	20
0	0	5	6	9
0	11	25	29	0
30	90	12	0	0
52	19	0	0	0

Question 3

a) Shyam wants to evaluate the following expression. He doesn't know maths, so he seeks help from his friend Ram. Ram doesn't know how to evaluate infix expressions but he is an expert in solving postfix expressions. Help Ram by converting the following infix expression to postfix expression.

2 + (((30 - 10)*(10 -5) + 15) / 5) * (10 - 5)

Show the status of the stack at each step.

Also evaluate the above postfix expression using stack. Show the status of the stack at each step.

	b) What does the following function compute? *int function (int *array, int size)* *{* *int temp = 0;* *for (int i=0 ; i<size ; i++)* *temp += array[i];* *return temp;* *}* Write a recursive function that performs the same operation as performed by the function given above.Which data structure is used to implement recursion? Explain how recursion works with the help of the recursive function written above and an array containing the values 2, 6, 3, 4, 5, 9, 1.
Question 4	Suppose there is a circle. There are *n* petrol pumps on that circle. You are given two sets of data. 1. The amount of petrol that every petrol pump has. 2. Distance from that petrol pump to the next petrol pump. Calculate the first point from where a truck will be able to complete the circle (The truck will stop at each petrol pump and it has infinite capacity). Expected time complexity is O(n). Assume for 1-litre petrol, the truck can go 1 unit of distance. Suggest the appropriate data structure and give the implementation of the above function to calculate the first point. Further, trace your function on the given following data: 6 petrol pumps with amount of petrol and distance to next petrol pump are {3,5}, {6,7}, {4,1}, {2,6}, {8,3}, {4,5}
Question 5	a) An operating system uses the Non-Preemptive Priority scheduling (NPPS) algorithm to schedule processes, wherein, each process is assigned a priority. Process with the highest priority (priority 1 is highest priority) is to be executed first and so on. Ties are broken arbitrarily. For the NPPS scheduling algorithm, which of the following data structures:- linked list, binary search tree, Binary-Heap; is/are suitable

	to add a process in O(log n) time and schedule a process in O(log n) time. Justify your answer. For **the chosen** data structure show its contents as processes are added and scheduled as per the given sequence. (show results after each step) -Add process P1 (Priority 8) -Add process P2 (priority 4) -Add process P3 (priority 3) -Add process P4 (priority 5) -Add process P5 (priority 1) -Add process P6 (priority 6) -Retrieve a process for scheduling -Retrieve a process for scheduling b) In an empty B-tree of order 3 insert the following keys <10, 20, 30 ,40 , 50, 5, 15, 25, 1, 2, 7>. Show the B-tree diagrammatically after each key insertion. Next delete the key 40 from the constructed B-Tree.
Question 6	a) Reena wants to send a text file over the network. Before sending the file she wants to encode it using some algorithm which needs the frequency of all the letters in the file. Help Reena to find the frequency of each letter using an AVL tree. i) Give the structure of the node of the AVL tree. ii) You are given the sample file, draw an AVL tree for the same and print all the letters in alphabetical order along with their frequencies **Sample File** **so i said yes to thomas** iii) Argue that the time complexity of finding the frequency of letters in a text file is linear.(2 + 8 + 3)

	b) Specify which searching technique out of linear search and binary search needs a sorted array as input? What is its running time? Does Hashing guarantee search in O(1) running time? For a Hash table of size 11 that uses open addressing for collision resolution, h(k) = k modulo 11. Construct a sequence of 10 keys to be inserted into an empty hash table one by one such that for each of the first 5 keys there is no collision and for each of the last 5 keys there is at least one collision.