Unique Paper Code : 42347501 Name of the Paper : Data Structures Name of the Course : B.Sc. (Programme) DSE Semester : V Year of Admission : 2019 Duration : 3 Hours Maximum Marks : 75 Instructions for candidates: Attempt any FOUR questions out of six questions. All questions carry equal marks.

1. Use a stack to write a function that scans a singly linked list only once to determine whether data contained in its nodes forms the pattern $A^n B^m C^n$ where A^n indicates n consecutive occurrences of character A, B^m indicates m consecutive occurrences of character B and so on (n, $m \ge 0$). For example, for the following list, the program should print 'List Data is Correct'.



And for the following list, the program should print 'List Data is Incorrect'.



Provide your own implementation of the stack data structure .

Convert the infix expression A+(B*C)/(D-E) to prefix form using a stack. Show the stack contents at every step. What is the maximum number of symbols that appear on the stack at any point of time during the evaluation of this expression?

2. Six students (Arun, Vidit, Aditi, Nisha, Esha, Dilip) are enrolled in a dance class and their teacher wishes to keep a record of the student names in alphabetical order for attendance. The teacher uses a sorting technique where the last name in the alphabetical order gets to the correct position after each pass. Identify a sorting algorithm that the teacher could have used? Write an algorithm for the same and show its working after each pass.

In an office, employee records are stored in an array in ascending order of their employee ID. There are more than 10,000 records present. To get the details of an employee, the employee ID is specified. Write a program to help the office to retrieve the details of the employee in the most efficient manner.

3. A simulation program records the arrival times of male and female customers at a store in two queues Q1 and Q2. Write a program to combine the two queues in a new queue Q3 such that customers in this queue are placed in increasing order of arrival time. Provide your own implementation of the queue data structure.

Consider the following declarations in a program;:

```
int a[] = \{62, 45, 14, 33, 28, 71\};
```

```
priority_queue<int> pq(a,a+5);
```

In which order are elements from **pq** dequeued? Change the queue declaration to reverse the order in which the elements are dequeued. List the advantage of using a priority queue.

4. Consider the following binary search tree:



Determine the inorder, preorder, postorder, and breadth-first traversals for the given tree. What is the height of the above tree? Is the above tree a complete binary tree? Justify your answer.

A binary tree node contains fields for **data**, a pointer to the left child (**left**), and a pointer to the right child (**right**). Determine the functionality of the following function if it is invoked with the root of a binary tree. What will the function return, if the root of the binary search tree shown above is passed as an argument?

```
1 f(r)
2 if (r = = NULL)
3 return 0
4 else if (r->left = = NULL and r->right = = NULL)
5 return 1
6 else
7 return f(r->left) + f(r->right)
```

Determine the change in functionality when the statement in line 7 is replaced with the following statement:

```
return f(r \rightarrow left) + f(r \rightarrow right) + 1
```

5. Consider class SLL that implements a singly linked list and contains a single pointer head pointing to the first node of the list. Nodes of the list contain the fields: data and next (pointer to subsequent node in the list). Determine the functionality of following pseudocode:

1	check()
2	p1 = head
3	Stack s
4	while p1!= NULL
5	s.push(p1->data)
6	p1 = p1 - next
7	p1 = head
8	while p1!= NULL
9	t = s.top()
10	s.pop()
11	if p1->data != t
12	return false
13	p1 = p1 - next

Illustrate the execution steps of the pseudocode for the linked list consisting of data elements 12, 19, 5, 6, 19, 12 in sequence.

Write a function that takes a doubly linked list as input and swaps every two consecutive nodes only if the element in the first node is even and element in the second node is odd. Show the step by step execution of the code if the doubly linked list consists of elements 11, 10, 9, 6, 5, 3 in order.

6. Show the 2D array mat[3][4] constructed from the following 1D array arr using row major mapping and column major mapping.
arr[12] = [32 16 12 9 8 5 20 17 3 6 11 4]

Considering each integer element takes 2 bytes of storage and the first element is stored at memory address 3000, calculate the address of **mat[2][3]** for both row and column major mapping. How many bytes are required in total to store the 2D array **mat**?

What function of n does the following recursive code compute?

```
int fun(int i)
{
    if (i==0)
        return 1;
    else
        return (i+1)*fun(i-1);
}
```

What will be returned when fun(3) is called. When fun(-1) is called? Show the changes to the run-time stack during execution of fun(3).