Question Paper

Exam Date & Time: 08-Dec-2022 (09:30 AM - 12:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

THIRD SEMESTER B.TECH. (INFORMATION TECHNOLOGY) EXAMINATIONS - DECEMBER 2022
SUBJECT : ICT 2153 - DATA STRUCTURES

Marks: 50 **Duration: 180 mins.**

Answer all the questions.

1A) Write a user defined functions to perform the following: (5)
i) Create a singly linked list A with N nodes.
ii) Reverse the singly linked list A after the (N/2) th node.
For example: 1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → 10 → NULL becomes 1 → 2 → 3 → 4 → 5 → 10 → 9 → 8 → 7 → 6 → NULL

1B) Construct a min heap for the following data set: 11, 33, 55, 22, 77, 99, 88, 100, 120, 89, 90. Show each step. (3)

1C) Find the step count of the following code using tabular method. (2)

```
void display(int n)
{
int i=n;
while(i>=0){
cout< < i;
i=i-2;
}
}
```

2A) Write user defined functions to perform the following operations on circular singly linked list: (5)
i) Print repeated elements in the given list.
ii) Right shift the list A counter clockwise for a given value of k.
For example: 10 → 20 → 30 → 40 → 50 → 60 → NULL and k = 3, then 40 → 50 → 60 → 10 → 20 → 30 → NULL (Do not use array or stacks or queues)

2B) A book shop maintains the inventory of books that are being sold at the shop. The list includes details such as author, bookId, title, price, publisher, and stock position. Whenever a customer wants a book, the salesperson inputs the bookId and the system searches the list and displays whether it is available or not. If it is not available, appropriate message is displayed. If it is available, then the system displays the book details and requests for the number of copies required. If the requested copies are available, the total cost of the requested copies is displayed, otherwise the message "Required copies not in stock" is displayed. (3)
Write a suitable class definition with Book as class name with suitable data members and member functions.

2C) Illustrate the conversion of the below infix expression to postfix expression, clearly showing the stack operations. (2)
A/B+(C/D)*(E-F)*(H/J)/(K*L)

3A) Consider an array A[1...n] with size n. This array is used to implement multiple stacks of varying sizes s_1, s_2...s_k. The size of each stack is the user input. Write functions to perform the following operations: (5)

i) Implement PUSH operation on the stack whose number is an input from the user.
ii) Implement POP operation on the stack whose number is an input from the user.

3B) Identify and represent the graph shown in Figure Q.3B that is suitable for its traversal using DFS technique. Write a function to traverse the graph using DFS technique and count the total number of nodes that contain odd number as the data. (3)

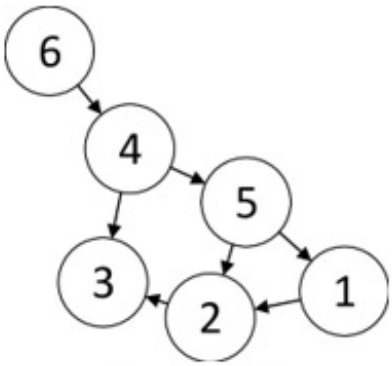

Figure Q.3B

3C) Write a user defined function to copy one binary tree to another. (2)

4A) i) Given the list of elements 15, 5, 20, 1, 17, 10, 30, 25, 20,35 develop the user defined function for construction of Max Heap and Min Heap using Heapification algorithm, also provide the hand tracing for the algorithm for the given list of elements? (5)
ii) Given the list of elements 100, 25, 150, 78, 85, -20, 125, 90. Develop the user defined function for binary search method using insertion sorting technique.

4B) Design the user defined function for Copying, testing for equality and searching element of the Binary trees? (3)

4C) Write a C++ Program using Class and Objects to perform the matrix multiplication, find the resultant product matrix is symmetric or not, and interchange the primary and secondary diagonal elements in the given resultant of product matrix. (2)

5A) i) Construct the Expression tree using the stack for the following and also describe the steps for implementing the same and traverse the tree and provide the infix, postfix and prefix order traversal of the constructed expression tree using stack for the following expressions. (5)
1. ((5 - z) / -8) * (4 ^ 2) also evaluate the expression tree when z = 20
2. ((true V false) ^ ~false) V (true V false)
3. a b + c d e + * *
4. (2a+5b) ^ 3 * (x-7y) ^ 4
ii) Construct the Binary search tree (BST) for the following and provide the Post-order, In-order, and Pre-order traversal of the following:
a) Given the post order A C E D B H I G F construct the BST and outline the In-order and Post order tree traversal.
b) Given the pre-order traversal order of the tree 20, 16, 5, 18,17, 19, 60, 85, 70 construct the BST and provide the In-order and Post order tree traversal.

5B) Outline the definition of sparse matrix. Implement the C++ User defined function to implement the Sparse matrix addition and multiplication? (3)

5C) Write the user defined functions to merge the 2 binary trees? What problems you will face if you merge two binary trees of numerical elements which are represented using A single array. (2)

-----End-----