



University of Engineering & Management, Kolkata

End Semester Examination, February 2021

Course: MCA

Semester: 1<sup>st</sup>

Paper Name: Data Structures with C

Paper Code: MCA103

Full Marks: 100

Time: 3 hours

Answer all the questions. Each question is of 10 marks.

1. A. What is Data Structure? Explain the positive attributes a good data structure design will contribute towards program development. List down few areas where data structures are widely used. 3+3+4

OR

- B. Design a data structure for a student information system where the maximum number of students is 100. Information to be stored about the student are student name, student address, student class, student mark in subject 1, student mark in subject 2, student mark in subject 3, student mark in subject 4.

2. A. Assume following are the contents of two sparse matrices  
Matrix A:

0 0 3 0 4  
0 0 5 7 0  
0 0 0 0 0  
0 2 6 0 0

Matrix B:

1 0 0 2 0  
0 0 0 0 0  
0 7 0 3 0  
5 0 0 0 8

Write a program to create compact matrices from these sparse matrices which will contain only the 3-tuple forms of non-zero elements {row, column and value} present in the sparse matrices and then add (A+B) the sparse matrices from the 3-tuple forms and create the resultant sparse matrix C.

OR

- B. Implement a single dimensional array called myarray with following elements:

Int myarray [10]= { 35, 33, 42, 10, 14, 19, 27, 44, 26, 31 }

Implement following basic operations supported by an array on the above array

3. A. Implement a stack using single dimensional array of integers called stack of MAXSIZE 10. Write an algorithm to PUSH following five elements into the stack and then POP two elements from the stack. Ensure to write accompanying algorithms like isfull() and isempty() as appropriate. 5+5

stack <- PUSH 35, 33, 42, 10, 14  
stack -> POP 14, 10

OR

- B. Implement a queue using single dimensional array of integers called queue of MAXSIZE 10. Write an algorithm to ENQUEUE following five elements into the queue and then DEQUEUE two elements from the queue. Ensure to write accompanying algorithms like isfull() and isempty() as appropriate. 5+5

queue <- ENQUEUE 45, 62, 71, 17, 38  
queue -> DEQUEUE 45, 62

4. A. There are two linked lists A and B containing the following data  
A : 13,17,10,15,26,19,32,27,42  
B : 26,13,19,25,47,19,20,27,38

Write a program to create a linked list C that contains only those elements that are not common in linked list A and linked list B.

OR

- B. There are two linked lists A and B containing following data

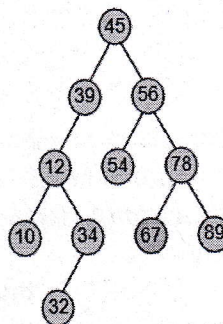
A : 17, 15, 13, 11, 30

B : 16, 35, 42, 21, 19

Write a C program to combine the two linked lists into a single linked list D so that linked list contains combined data in descending order.

5. A. Consider the following Binary Search Tree (BST).

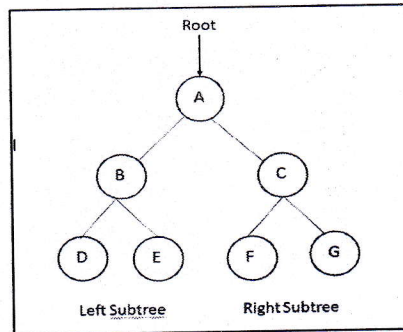
Write a C program to insert a node containing the value 70 in the given Binary Search Tree.



OR



B. Write a C program to implement In-Order Traversal of this tree.



6. A. Under what circumstance collisions occur in a hash table.  
Explain how the following technique is implemented to solve the problem of collision in a hash table (collision resolution technique)
- Linear Probing

OR

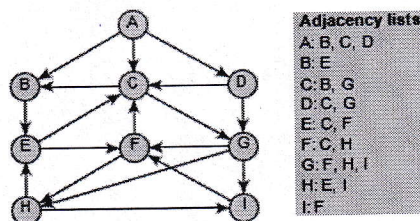
B. Explain what is main goal of hash function? Under what circumstances hash functions are used? If multiplication method is used for hash function, map the key 12345 to an appropriate location in the hash table for a hash table of size 1000.

7. A. Assume you have a single dimensional array of integers named A initialized with following data  
 $\text{Int } A[] = \{ 21, 25, 29, 32, 38, 43, 48, 60, 64, 67, 75 \}$   
 Assuming the above data in the array A, explain how binary search is performed on the above array to search for the value of 64.  
 Write down the algorithm for Binary Search operation on the above array. 5+5

OR

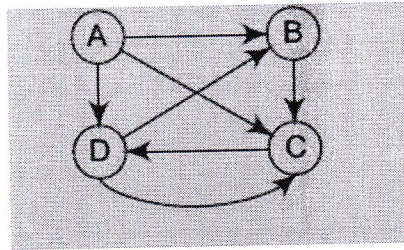
- B. Assume you have a single dimensional array of integers named A initialized with following data  
 $\text{Int } A[] = \{ 25, 29, 33, 36, 42, 47, 52, 64, 68, 71, 79 \}$   
 Assuming the above data in the array A, explain how interpolation search is performed on the above array to search for the value of 36.  
 Write down the algorithm for Interpolation Search operation on the above array. 5+5

8. A. Consider the graph G given below. The adjacency list of G is also given. Suppose we want to print all the nodes that can be reached from the node H (including H itself). Write the algorithm to use a breadth-first search of graph G starting at node A.



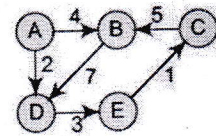
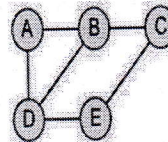
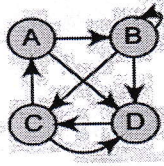
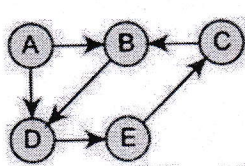
OR

- B. Consider the graph given below. State all the simple paths from A to D, B to D, and C to D. Also, find out the in-degree and out-degree of each node. Is there any source or sink in the graph?



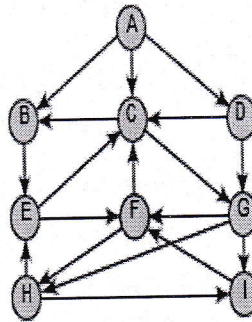
Draw a complete undirected graph having five nodes.

9. A. Find the adjacency Matrix of following graphs



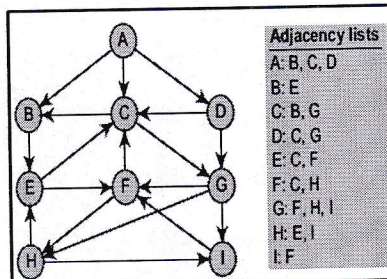
OR

- B. Consider the graph G given below. The adjacency list of G is also given. Suppose we want to print all the nodes that can be reached from the node H (including H itself). Write the algorithm to use a depth-first search of graph G starting at node A.



Adjacency lists  
 A: B, C, D  
 B: E  
 C: B, G  
 D: C, G  
 E: C, F  
 F: C, H  
 G: F, H, I  
 H: E, I  
 I: F

10. A. Consider the graph G given in the figure below. The adjacency list of G is also given. Assume that G represents the daily flights between different cities and we want to fly from city A to I with minimum stops. That is, find the minimum path P from A to I given that every edge has a length of 1.



Adjacency lists  
 A: B, C, D  
 B: E  
 C: B, G  
 D: C, G  
 E: C, F  
 F: C, H  
 G: F, H, I  
 H: E, I  
 I: F



OR

- B. What exactly you mean by sorting in Data Structure parlance? Indicate the typical types of sorting that you come across, under various circumstances?  
Write down the algorithm and explain the steps that are performed in SELECTION-SORT.

2+2+6

\*\*\*\*\*