Paper Code: CS-301/ECS-302	Roll No.									

B.Tech.
THIRD SEMESTER EXAMINATION, 2016-2017
DATA STRUCTURES USING C

[Time: 3 Hours] [Total Marks: 100]

Note: Attempt ***ALL*** questions. Assume suitable data, if required. All question carry equal marks.

1. Attempt any *four* parts of the following: -
(5x4=20)

(a) It is often seen that in linked list representation of a binary tree null links are more than actual pointers. How can you make use of these null links to make tree traversal more efficient?

(b) Formulate an algorithm to find the number of leaf nodes in a binary tree. What is the complexity of your algorithm?

(c) Write an efficient algorithm to find the k^{th} element in a sequence of n elements.

(d) At which location of memory you insert the $A[i][j]^{th}$ element of a row major matrix A. Given that the base address of A is B and element size is b.

(e) A student wants to implement the Factorial with recursive function. Which data structure will you suggest him? Explain the properties of suggested data structure.

(f) Write a program in C for binary search. What is the complexity of your program?

2. Attempt any *four* parts of the following: -
(5x4=20)

(a) Write the function to delete an element in queue in C language.

(b) Convert the string **((10 + (20- 30)) * 40) $ (50 + 60)** into postfix string.

(c) What do you mean by $\Theta(n)$? Explain with an example.

(d) How many real links are required to store a sparse matrix of 10 rows, 10 columns and 15 non-zero entries.

(e) Draw the tree given that in-order and pre-order traversals yield the following sequence of nodes:

In-order: D B E A F C, Pre-order: A B D E C F.

(f) Implement the Tower of Hanoi problem in C.

3. Attempt any *two* parts of the following: - **(10x2=20)**

(a) Find out the minimum spanning tree of the graph in **Fig. 1** using Kruskal's algorithm. What will be the cost of that spanning tree?

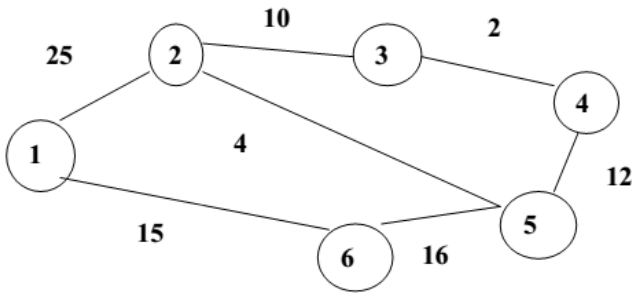

Fig. 1

(b) Derive the formula to find the number of distinct binary trees having n nodes.

(c) Sort the following sequence by using insertion sort with proper explanation :

60, 50, 80, 40, 30, 10

4. Attempt any *two* parts of the following: - **(10x2=20)**

(a) Let p be a pointer to the first node in a singly linked list and x be an arbitrary node in this list. Write an algorithm to delete the node x from the list. If x = p then p should be reset to point to the new first node in the list.

(b) Let G=(V,E) be a directed graph . Let n=|V| and e=|E|. Prove the following:

(i) $\sum_{i=1}^{n} d_i^{in} = \sum_{i=1}^{n} d_i^{out} = e$ where d_i is degree of vertex **i**.

(ii) $0 \leq e \leq n(n-1)$

(c) Write an algorithm to find All Pairs Shortest Paths in a given graph. Also apply the algorithm in following graph in **Fig. 2**:

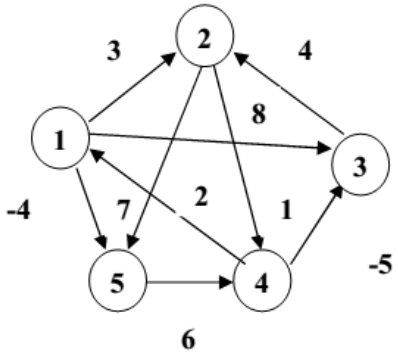

Fig. 2

5. Attempt any *two* parts of the following: - **(10x2=20)**

(a) Write short notes on the following:

(i) B^+ Tree (ii) AVL Tree

(b) A person wants to insert the sequence 72, 18, 43, 36, 6, 10, 5 and 15 in a hash table of size 8 by using division hash function. Further he decides to use linear probing. Show the positions of each element in the hash table.

(c) Design an algorithm to find the shortest path from Lucknow to all other cities of India.