**Code: CS21**     **Subject: DATA STRUCTURES & ALGORITHM DESIGN**

## ALCCS – OLD SCHEME

**Time: 3 Hours**     **FEBRUARY 2012**     **Max. Marks: 100**

*PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.*

**NOTE:**
- **Question 1 is compulsory and carries 28 marks. Answer any FOUR questions from the rest. Marks are indicated against each question.**
- **Parts of a question should be answered at the same place.**

**Q.1**   a.   Let n denote a positive integer. Suppose a function L is defined recursively as follows:

$$L(n) = \begin{cases} 0 & \text{if } n = 1 \\ L(\lfloor n/2 \rfloor + 1) & \text{if } n > 1 \end{cases}$$

Here $\lfloor k \rfloor$ denotes the "floor" of k, i.e., the greatest integer which does not exceed k.  Find the value of L(25). Approximate L(n) as a function of n.

b.   What are stacks? List 6 different applications of stacks in a computer system.

c.   Define worst-case efficiency, best-case efficiency and average-case efficiency of an algorithm?

d.   Describe in brief, the Backtracking technique?

e.   What is the advantage of doubly linked list over singly linked list?

f.   Write a C function that will insert an element into linear array.

g.   Write a recursive code to compute the sum of squares as shown in the series
   $m^2 + (m+1)^2 + \dots + n^2$ for m, n integers, $1 \le m \le n$     **(7×4)**

**Q.2**   a.   Write an algorithm to insert a node in the beginning of the linked list.     **(8)**

b.   How stack helps in problem solving? Using stacks, write an algorithm to determine whether an infix expression has balanced parenthesis or not.     **(10)**

**Q.3**   a.   Assume the declaration of multidimensional arrays A and B to be,
   A (-2:2, 2:22) and B (1:8, -5:5, -10:5)
   (i)   Find the length of each dimension and the number of elements in A and B.     **(3)**
   (ii)   Consider the element B[3,3,3] in B. Find the effective indices $E_1, E_2, E_3$ and the address of the element, assuming Base (B) = 400 and there are W = 4 words per memory location.     **(4)**

b. Given an array A that contains 14 elements as follows:
66, 33, 40, 22, 55, 88, 60, 11, 80, 20, 50, 44, 77, 30
Apply merge sort algorithm to sort the array A in ascending order. Show each pass.
Also discuss the complexity of the algorithm.                                    **(8+3)**

**Q.4** a. Apply Quick sort algorithm for the following array and sort the elements (Take first
element of the list to be sorted as the pivot element)
24, 56, 47, 35, 10, 90, 82, 31
Also discuss the complexity of the algorithm.                                    **(6+3)**

b. Write an algorithm to implement Depth-first search? How is Depth-first search
different from Breadth-first search?                                             **(6+3)**

**Q.5**  a. Write a function to sort the characters of the string passed to it as argument.      **(6)**

b. Write a C program that reads two strings str1 and str2 and finds the no of occurrence
of smaller strings in large string.                                             **(6)**

c.  Write an algorithm that will split a circularly linked list into two circularly linked
lists.                                                                          **(6)**

**Q.6**  a. Define Hashing. Discuss any two Hash functions?                                     **(6)**

b. Define the following:
(i)   Adjacency Matrix
(ii)  Path Matrix
(iii) Adjacency list representation
For the following graph find the adjacency matrix and adjacency list representation of
the graph.                                                                      **(6+6)**
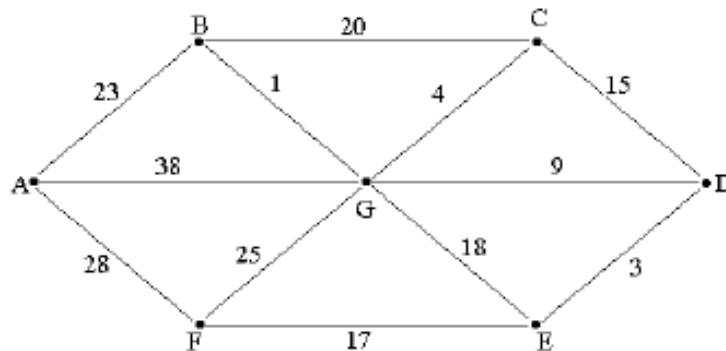


**Q.7**   a. Suppose the following list of numbers is inserted in order into an empty binary search
tree:   45, 32, 90, 34, 68, 72, 15, 24, 30, 66, 11, 50, 10
(i)   Construct the binary search tree.
(ii)  Find the in-order, pre-order and post-order traversal of BST created.     **(4+4)**

b. Write an algorithm to search a key in a B-tree? What is the worst case of searching in
a B-tree? List the possible situations that can occur while inserting a key in a B-tree?
                                                                                **(5+2+3)**