PART I.

Data Structures

(1) Explain the following terminologies. Please explain with an example. (24%)

    (A) garbage collection

    (B) topological sort

    (C) abstract data type

    (D) m-way search tree

(2) By using Huffman encoding, please find the code for each character in the following message such that the total message length is minimum. What is the total length (in bits) of the encoded message ? You should show the steps in finding your answer. (13%)

    MESSAGE :   AAABBBBBCCCCCCDDDDDDDDD

    number of 'A' : 3
    number of 'B' : 5
    number of 'C' : 6
    number of 'D' : 9

(3) For the following graph, please find a spanning tree with minimum cost. The number shown along each edge is the cost of the edge. You should show the steps in finding your answer. (13%)
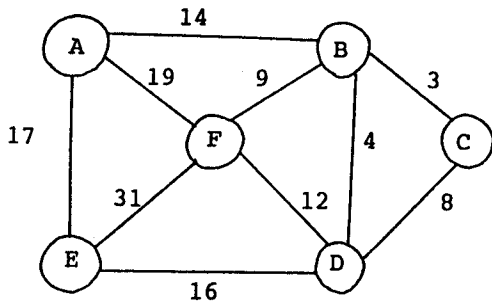
PART II.

[ALGORITHMS]    (50%)

1. The Fibonacci numbers are defined to be:
    $F_n = F_{n-1} + F_{n-2}$    for $n \geq 2$ with $F_0 = F_1 = 1$.
   a) write a recursive program to compute $F_n$, and
      analyze the time complexity of your program.
   b) write a nonrecursive program to compute $F_n$ in linear time.(13%)


2. Describe binary search algorithm, and prove that binary search
   never uses more than $\log_2 N + 1$ comparisons for either sucessful
   or unsucessfull search in a sorted array of N elements.(12%)


3. Suppose you are given an unsorted file containing N keys.
   Your problem is to find the $i$th smallest key where $1 \leq i \leq N$.
   Write a modified Quicksort algorithm called FINDiTH for this
   purpose.(12%)


4. Explain deterministic algorithm and nondeterministic algorithm
   briefly.  Give a nondeterministic polynomial-time algorithm to
   determine whether or not a set of integers can be divided into
   two sets whose sum is equal.(13%)