1. Explain the following terms (10%)
   (a) WWW Proxy Server
   (b) Language Semantics
   (c) Linker
   (d) Firewall
   (e) ATM network

2. (a) Explain what is the ambiguous grammar. (10%)
   (b) Prove the following grammar is ambiguous:
   
   \[
   S \rightarrow A \\
   A \rightarrow A + A | id \\
   id \rightarrow a | b | c
   \]

3. Please explain why Java programs can be executed on different computer platforms? (7%)

4. Please compare characteristics of the relational database and object-oriented database. (8%)
5. Design an algorithm using C language to check if a tree is a binary search tree or not. Figure 1 is the node structure of the binary tree. (10%)

![Binary Tree Node Structure]

Figure 1.

6. Show the algorithm of reversing a single linked list, for example, from (A, B, C, D) to (D, C, B, A). Figure 2 illustrates the single linked list (A, B, C, D). (10%)

![Single Linked List]

Figure 2

7. Write a recursive function GCD(n, m) using C language that returns the GCD (Greatest Common Denominator) of two integers n and m, (10%)

where \[ GCD(n, m) = \begin{cases} 
  m & \text{if } m \leq n \text{ and } n \mod m = 0, \\
  GCD(m, n) & \text{if } n < m, \\
  GCD(m, n \mod m) & \text{otherwise}
\]
8. The following questions are written in C language. (10%)
   a. \( \text{md} = -1; \)
      \[ \text{result} = \text{md} > 0 ? 1 : 0; \]
      now the value of result is ___
   b. \( \text{total} = 2; \text{amt} = 3; \)
      \[ \text{total} += \text{amt}; \]
      now the value of total is ___
   c. \( \text{result} = 25 \% 7; \)
      now the value of result is ___
   d. \( \text{total} = 0; \text{count} = 1; \)
      \[ \text{total} += ++\text{count}; \]
      now the value of total is ___
   e. \( \text{total} = 0; \text{count} = 1; \)
      \[ \text{total} += \text{count}++; \]
      now the value of total is ___

9.
   a. Write a C recursive function that calculates
      \[ n*(n-1)*(n-2)*...*1 \] (where \( n \) is a positive integer). (5%)
   b. Write a C function that performs the bubble sort for
      \( n \) unsorted integers stored in an array. (5%)
10. A double-linked list is an implementation of the ADT list defined as follows. Each cell has three fields, a data field, a pointer to the next cell, and a pointer to the previous cell. The position of a list element is a pointer to the cell that contains it. A list is implemented using a pointer to the first and last elements of the list.

a. Write C declarations for a cell, a list, and a position. (5%)

b. Write a C function which implements the delete operation. (10%)  
   (Do not do any error checking.)