1. Explain the following statements: (10 points)
   (a) Parity bit
   (b) Modem
   (c) Hash table
   (d) Stack and queue
   (e) Data encryption/decryption

2. Consider the following grammar:
   
   \[
   S \rightarrow a \ S c \ B | A | b \\
   A \rightarrow c \ A | c \\
   B \rightarrow d | A 
   \]

   Which of the following sentences are in the language generated by this grammar? Please write down the derivation process of each correct sentence. (10 points)
   (1) acccd  (2) abcd  (3) accecc  (4) acd  (5) accbce

3. Please explain the most significant characteristics of the Client-Server architecture. (5 points)

4. Please calculate the result of the following two binary equations with the 1'S complement representation. Use as much bits as you need and ignore overflow/underflow. (10 points)
   (a) 111001 + 001010
   (b) 101011 - 11010
Consider the following fragments of code: (9 points)

<table>
<thead>
<tr>
<th>Main program:</th>
<th>Subprogram S (x, y, z):</th>
</tr>
</thead>
<tbody>
<tr>
<td>integer a, b, c</td>
<td>integer p</td>
</tr>
<tr>
<td>a ← 1</td>
<td>y ← z</td>
</tr>
<tr>
<td>b ← 2</td>
<td>p ← x + z</td>
</tr>
<tr>
<td>c ← S(a, a, a+b)</td>
<td>Return(p)</td>
</tr>
</tbody>
</table>

Output c

1. Assuming the linkage is implemented by call-by-address, what is the value of c?
2. Assuming the linkage is implemented by call-by-name, what is the value of c?
3. Assuming the linkage is implemented by call-by-value, what is the value of c?

Determine the value of each variable after all statements are performed. Assume that all variables have the initial value 2. (6 points)

\[
\begin{align*}
\text{x} & = \text{x}++; \\
\text{z} & = \text{x}+++\text{y}; \\
\text{y} & = ++\text{x} - \text{x}++; \\
\end{align*}
\]

Using C language statement to answer the following. Assume that unsigned integers are stored in 2 bytes and the starting address of array A is 1002500₁₀ in memory. (10 points)

1. Declare an array of type unsigned int called A with 5 elements. Initialize the elements as even integers from 2 to 10. Assume the symbolic constant SIZE has been defined as 5.
2. Declare a pointer vPtr that points to an object of type unsigned int.
3. Give two separate statements that assign the starting address of array A to pointer variable vPtr.
4. Write a loop statement to print the elements of array A using pointer/offset notation.
5. What address is referenced by vPtr+3? What value is stored in that location?
3. The Fibonacci series

0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, ...

begins with the terms 0 and 1 and has the property that each succeeding term is the sum of the two preceding terms. (10 points)

(a) Write a nonrecursive function fibonacci(n) that calculates the nth Fibonacci number.

(b) Write a recursive function r_fibonacci(n) that calculates the nth Fibonacci number.

4. Reverse the content of stack S. (10 points)

(a) Using two additional stacks (S1, S2).

(b) Using one additional queue (Q).

5. Determine the complexity of the following algorithm for transposing matrix. (10 points)

for (i = 0; i < n-1; i++)
    for (j = i+1; j < n; j++) {
        tmp = a[i][j];
        a[i][j] = a[j][i];
        a[j][i] = tmp;
    }

6. Design an algorithm (pseudo code can be used possibly) to create a mirror image of a binary tree where all the left children become right children, and vice versa, for all nodes of the binary tree. (10 points)