Indian Institute of Engineering Science and Technology, Shibpur
B.Tech. 1st Semester Final Examinations, December, 2023
Introduction to Computing (CS - 1101)

Time: 3 hours

Full Marks: 50

Answer any five questions (not exceeding five).
All parts of the same question must be answered together.
For the programming problems use C language.

1. (a) Convert the following numbers from the given base to the desired base up to 3-digit accuracy.
   (i) $(501)_{10}$ to (Base 8)
   (ii) $(676.521)_8$ to (Base 16)
   (b) Perform the arithmetic operations $(+14)_{10} + (-10)_{10}$ in binary using the 2's complement representation.
   (c) Using minimum number of 2-input NAND gates realise a 2-input XOR gate.

   $[(2 \times 2) + 3 + 3 = 10]$

2. (a) Draw the block diagram of a computing system and describe each of the units.
   (b) Implement the following expression in digital logic circuit using basic logic gates. Consider NOT gate and 2-input logic gates (AND and OR) to desgin the circuit:

$$Y = f(A, B, C) = A.\overline{B}.C + \overline{A} + BC$$

   $[6 + 4 = 10]$

3. Define a structure representing a 2-D coordinate (X, Y). Then, define a structure representing a triangle having three coordinates (X_1, Y_1), (X_2, Y_2), and (X_3, Y_3). Finally, write a program to calculate the area of the triangle. The coordinates of the triangle are taken as input from the user.

   The following equation can be used to calculate the area of the triangle:

$$Area = \frac{1}{2}\left|(X_1 * (Y_2 - Y_3) + X_2 * (Y_3 - Y_1) + X_3 * (Y_1 - Y_2))\right|$$

   $[2 + 3 + 5 = 10]$

4. (a) Differentiate with suitable example between '*Call by value*' and '*Call by address*' mechanism in function call.
   (b) Write a recursive function to compute the factorial of a number n and also write the program to test the function, where n is the input given by the user.

   $[(3 + 3) + 4 = 10]$

5. (a) Write a function *int numberOfVowels* (*char myStr*[ ]) to calculate the number of vowels of a string. Also write the complete program to test the function.
   (b) Assume there is a string created as *char myStr*[20] = "*Life is beautiful*". Write a program to print each character of the string *myStr* strictly using a character pointer *char* * *ptr*.

   $[6 + 4 = 10]$

6. Write a program to create a 2-D *Integer* matrix of dimension $N \times M$, and then populate the matrix elements based on user input. Also, write a function to print the maximum element and its position among the matrix elements.

   $[5 + 5 = 10]$

7. (a) Write a function to evaluate the following series
   $S = 1 - 4 + 9 - 16 \ldots$ up to n^{th} term. Here n is a user input.
   (b) Write a program to input basic salary of an employee and calculate its gross salary (basic Salary + HRA + DA) according to following:
   Basic Salary $\leq$ 20000 : HRA = 20%, DA = 45%
   Basic Salary $>$ 20000 : HRA = 25%, DA = 35%

   $[6 + 4 = 10]$