Name of Course	: **CBCS B.Sc. (H) Mathematics**
Unique Paper Code	: **32357503**
Name of Paper	: **DSE-I C++ Programming for Mathematics**
Semester	: **V**
Duration	: **3 hours**
Maximum Marks	: **75 Marks**

Attempt any four questions. All questions carry equal marks.

1. Write C++ code to implement the mathematical *mod* function (name it *myMod*) without using the inbuilt operator % or any inbuilt function. The function must take two integers as inputs and must return the positive remainder when the large number is divided by the small number (ignoring the sign). Further, use this function *myMod* to find the gcd of two integers using the *While* loop **(8+10.75 Marks).**

2.

a. Describe passing arguments through call by value and call by reference to a function. Discuss the difference through examples **(6 Marks).**

b. Write a C++ program that takes a day, a month, and a year as input and calculate a date 25 days after the input date. Print this new date in the format dd/mm/yyyy **(12.75 Marks).**

3. Write a program to read 10 integers from the user and store them in an array named **intlist.** Pass this array to the following procedures:

a. **COUNT** that prints the total number of positive integers, negative integers and zeros in intlist **(8 Marks).**

b. **SORTLIST** that sorts the inlist elements by storing all positive integers, followed by zeros and finally all negative integers. For example if intlist originally consists of 1, -2, 5, 0, -6, 7, 0, -4, 0, 0 then after calling SORTLIST, intlist becomes -2, -6, -4, 0, 0, 0, 0, 1, 5, 7 **(10.75 Marks).**

4. Create a *Matrix* class to represent an element of the ring

$$M_2(\mathbb{R}) = \left\{ \begin{bmatrix} a & b \\ c & d \end{bmatrix} \;\middle|\; a, b, c, d \in \mathbb{R} \right\}$$

with respect to the usual matrix addition and multiplication.

The class should have the following features :

i. The *Matrix* class should have four private data elements:

a, b, c and *d* (of double type) to represent the 2×2 real matrix *A:*

$$A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

ii. The class should include the following constructors :

a. A default constructor to represent the 2×2 zero matrix.
b. A four argument constructor.

iii. Include get methods to inspect the values held in *a, b, c* and *d*.

iv. Include set methods to change the values held in *a, b, c* and *d*.

v. Include the operator + to add two *Matrix* objects.

vi. Include the operator * to multiply two *Matrix* objects.

vii. Include an operator << for printing a *Matrix* object in the form :

$$\begin{matrix} a & b \\ c & d \end{matrix}$$

Create any two objects of above class matrices and perform the addition(+) and multiplication (*) of these objects. Further display these two objects in matrix form **(18.75 Marks).**

5. Write a program to input a sentence from the user and pass it to the following two procedures:
   a. **COUNTCASE** that returns the total number of Uppercase and Lowercase alphabets in it and a procedure **(9.75 Marks).**
   b. **CHECKSPECIAL** that checks if special characters ! and ? are present and return TRUE/FALSE for both these characters **(9 Marks).**
6.
   a. Write a program in C++ to find 100! using a procedure with the help of GMP package **(9 Marks).**
   b. Write a C++ program to generate 50 numbers randomly from the set

      {1, 2, ... , 10}

      and write them to a file named **random.txt**. Then the same program must find the average of the 50 numbers from the file **random.txt** and write the average to a file named **average.txt (9.75 Marks).**