

<b>Unique Paper Code</b>	<b>: 32341101</b>
<b>Name/Title of the paper</b>	<b>: Programming Fundamentals using C++</b>
<b>Name of the Course</b>	<b>: B. Sc. (H) Computer Science</b>
<b>Semester</b>	<b>: I (DSC - 1)</b>
<b>Year of Admission</b>	<b>: 2021 onwards</b>
<b>Duration</b>	<b>: 3 Hours</b>
<b>Maximum Marks</b>	<b>: 75</b>

### **Instructions for Candidates**

1. Attempt any FOUR out of SIX questions.
2. All questions carry equal marks.

Q1 Write a program in C++ that defines a class named **StringOps**. Declare data members of this class as described below:

- variable **str** of data type string.
- variable **size** of data type integer which represents the length of the string **str**.

Define member functions in **StringOps** as given below:

- parameterless and parameterized constructors that initialize the string variable **str**.
- **void input()**: This function accepts a string as input from the user and stores it in **str**. The length of this string is computed and stored in the variable **size**.
- Overload **operator +** to create a new string obtained by concatenation of two **StringOps** class objects. The size of this new string should be appropriately set.
- Overload **operator []** to return the character present at the specific index of the string variable **str**. The index specified begins from 1 and can range upto **size**. Index can also receive a negative value in which case -1 means the last character of the string variable **str**. The range in the negative side would be from -1 to **-size**. For example, if **str = "hello"**; then index = 1 would correspond to character **'h'**; index = -1 would correspond to character **'o'**, index = -2 for character **'l'** and so on. Zero index would stand invalid.
- **int findMatch(char set[])**: This function searches the characters from the array **set** in the string **str** and returns the sum of frequency of matched characters in **str**. For example, if **str = "C++ programming"** and **set = {'p', 'm', '+', 'h'}**, then the value returned is  $1+2+2 = 5$ .
- **void display()**: This function should display the string object **str** and its size.

Q2 Write a program in C++ that defines a 2D array **A** of integers. The array has a size **m x n** where **m** is the number of rows and **n** is the number of columns. **m** and **n** should be declared as constants. Define the functions with the following prototypes in the program:

- **void read(int A[][n], int m, int n):** This function will input values from the user and store them in the array **A** column-wise. For example, for an array of size 2 x 2, if the user enters,

2  
4  
7  
6

then,  $\mathbf{A} = \begin{bmatrix} 2 & 7 \\ 4 & 6 \end{bmatrix}$ .

- **findSubtotals():** This function receives a single row **A1** from the array **A**. The function then replaces the content at each index say *i* with the sum of the elements in the original array from the left till the index *i*. For example, if **A1** = {5 2 9 3 6}. Then the resultant array should be: {5 7 16 19 25}.
- **int checkskewsymmetric(int A[][n],int m, int n):** A square matrix **A** is considered to be skew symmetric if the matrix **A** is equal to negative of its transpose. Define a function to check if the given array **A** is skew symmetric. It will return 1 if the array is skew symmetric and 0 otherwise. If the array received has unequal values of **m** and **n**, then an exception is thrown displaying the message "**Invalid array**". The exception should be handled in the main function.
- **void displayEven(int A[][n], int m, int n):**This function will display the even values stored in the array **A**.

Q3 Write a program in C++ that reads text from the keyboard and stores it in a file named "**File1.txt**".

Also, for each of the specified prototypes given below, write the function definitions.

- **void copyselc(ifstream& fp, ofstream& fp1):**This function reads the contents of the file "**File1.txt**" and copies those lines from the file that begin with the character '#' to the file named "**File2.txt**".
- **void checksize(ifstream& fp1,ifstream& fp2):**This function reads two files "**File1.txt**" and "**File2.txt**" and counts the number of characters in both the files. If the count of characters in both the files is same, then the function should print the message "**Both Files are of the same size**" else it should display "**Size of the files is not same**".
- **void dispNumNames(ifstream& fp):**Assuming that the file "**File2.txt**" may also contain numbers (1 to 5), this function will read the contents from the file and display the number names for any numbers encountered.

Q4 Write a program in C++ that defines a class named **Student** that represents a student. This class declares three variables – **name**, **stipend** and **course** of suitable data types. It also has a variable **intern\_status** that is set to 1 if the student is interning in some organization and 0 otherwise. This variable is initialized appropriately in the constructors of the class. The member functions of this class should be defined as given below:

- Parameterized constructor that initializes the values of all the members.
- An overloaded constructor that sets the stipend to zero for a non-interning student.
- Copy constructor for the class **Student**.
- Overload Operator **<<** as a friend function in the class **Student** for displaying the details of the student.
- Destructor for the class **Student**.

In the main() function, create two objects of this class; one for a student who is interning and another who is not; and show the invocation of the respective constructors. Use copy constructor to create a new object and display it using **<<** operator.

Q5 Define a class **Person** with data members – **Name**, **Age** and **Address**. In this class, define member functions as given below:

- parameterized constructor to initialize the data members - **Name**, **Age** and **Address**.
- A function **disp()** for displaying the **Name**, **Age** and **Address**.
- A pure virtual function **void print()**.

Derive the class **Teacher** from the **Person** class using public inheritance. In the **Teacher** class, declare data members: **Course**, **Salary** and **Qualification** of the appropriate data type and define a parameterized constructor for initializing these data members. Override the **print()** function in the **Teacher** class to display the **Course**, **Salary** and **Qualification** along with the person details.

Derive a class **Visiting\_Faculty** from the **Teacher** class using public inheritance. This derived class declares data members – **Specialization**, **Teaching\_hours** and **Institute** of the appropriate data type. Define the parameterized constructor of this class to initialize the values of **Specialization**, **Teaching\_hours** and **Institute**. Override the **print()** function in this class to display **Specialization**, **Teaching\_hours** and **Institute** along with the person details.

Define the **main()** function and declare one object each of **Teacher** class and **Visiting\_Faculty** class. Use run time polymorphism and display the details of **Teacher** and **Visiting\_Faculty** class objects. Consider the scenario when **Person** class is inherited privately in **Teacher** class. What effect will it have on the access of **Person** class data members in **Visiting\_Faculty** class?

Q6 Write C++ code for the following tasks:

- Write a prototype for the function named **fsum()** that accepts two parameters: an array **A** of integer pointers and a variable **x** of type double. The return type of this function is int.
- Store three integer values entered as command line arguments in an integer array **A**.
- Insert the string " **Offline**" after the first occurrence of character 'o' in the string **s1= "Hello World"**. Also, print the ASCII value of each character in this modified string after insertion.
- Define a function **replace()** that receives an integer number as parameter and replaces it with a number formed by rearranging the digits of the original number. The return type of the function is **void**.
- Define a class **A** that declares a static variable **count** of type integer. Initialize the value of **count** to zero. Use the variable **count** to count the number of objects of the class **A**.