Name of Course : CBCS B.Sc. (H) Mathematics

Unique Paper Code : 32357503

Name of Paper : DSE- I, C++ Programming

Semester : V

Duration : 3 hours

Maximum Marks : 75 Marks

Attempt any four questions. All questions carry equal marks

1. The electricity board charges the following rates to the domestic users for the consumption of electricity:

<table>
<thead>
<tr>
<th></th>
<th>Sanctioned load ≤ 2 K.W.</th>
<th>Sanctioned load &gt; 2 K.W.</th>
</tr>
</thead>
<tbody>
<tr>
<td>For the first 100 units</td>
<td>Rs. 3.0</td>
<td>Rs. 4.0</td>
</tr>
<tr>
<td>101-300 units</td>
<td>Rs. 3.5</td>
<td>Rs. 4.5</td>
</tr>
<tr>
<td>Beyond 300 units</td>
<td>Rs. 4.0</td>
<td>Rs. 5.0</td>
</tr>
</tbody>
</table>

All users charged a minimum of Rs. 200/- as meter charge. Write the appropriate code in C++ to calculate the Total charges based on units consumed and sanctioned load.

2. Write a function in C++ using the one dimensional array to calculate the following quantity:

$$\sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^3}{n - 2}}$$

where,

- $x_i$ denotes the data stored in the cells of array
- $\bar{x}$ denotes the average of the data stored in the array
- $n$ denotes the number of data stored in the array and $n > 2$.

3. Consider a system of linear equations

$$AX = B$$

where $A$ is a coefficient matrix of order $3 \times 3$, $X$ is a column vector of unknown variables of order $3 \times 1$ and $B$ is a known column vector of order $3 \times 1$. Write a program that performs following tasks

i. Check whether the given system of linear equations has a solution. If it has a solution then perform the next point otherwise print some messages and exit.

ii. Check the given system of linear equations has infinite solutions or unique solution. If the system has a unique solution, then perform point (c) otherwise print some messages and exit.
iii. Find the solution of the given system of linear equations using Cramer’s method.

4. Write a C++ program that performs the following tasks by defining functions
   i. Input a ten-digit integer, then separate all digits and store them in a one-dimensional array.
   ii. Then form a function `RemoveZero(array, sizeOfArray)` that identifies the cell location of all zeros and eliminates them from the array. Because this operation changes the effective size of the array, `RemoveZero`, should take the effective size as a reference parameter and adjust it accordingly.
   iii. After point (ii), reverse the position of all elements of the array and then find the cell position of the largest and smallest numbers.

5. Write a program to find the elements of $U(8)$, where $U(8)$ is the group under multiplication modulo 8 having elements less than and co-prime to 8. The program then displays the element of $U(8)$. Also the program has a function called Calay table which takes elements of $U(8)$ as argument in one dimensional array form and displays the Calay’s table for $U(8)$ in grid form.

6. Write a program that gives values of $n$ between 1 to 100 for which number of the type $3^{n-1} + 2$ is prime or the product of two prime numbers. Moreover, it should find and display the prime factorization of $3^{12-1} + 2$ and also checks if it is a palindrome or not.