VIT
Vellore Institute of Technology

Reg. No. :

Final Assessment Test (FAT) - JUNE/JULY 2023

Programme	**B.Tech.**	Semester	**Winter Semester 2022-23**
Course Title	**STRUCTURED AND OBJECT-ORIENTED PROGRAMMING**	Course Code	**BCSE102L**
Faculty Name	**Prof. PALANI THANARAJ K**	Slot	**G1**
		Class Nbr	**CH2022232300542**
Time	**3 Hours**	Max. Marks	**100**

Section A (10 X 10 Marks)
Answer All questions

01. In a library, **m** people are in waiting hall, each of whom should read **n** books sequentially(n is common for all). Reading each book requires one unit of time. Unfortunately, reading service is provided sequentially. **[10]**

There is only one reading table. So when someone reads, others have to wait in the waiting room. At first everybody chooses **n** books they want to read. Selection of **n** books by a single person takes **x** amount of time. People can choose books simultaneously. Then they enter the waiting room. After reading **n** books the person leaves the library immediately. As nothing is free, the cost of reading is also not free. If a person stays in the library **t** units of time, then the cost of reading is $\lfloor (t-n)/m \rfloor$ units of money.

So, the i^{th} person pays for time **x** he needs to choose books and the time **(i−1)∗n** he needs to wait for all the persons before him to complete reading. Note for every odd person will get 50% discount on their payment. Write a C Program to find the total amount collected in library.

02. Imagine you are given a set of N different coloured objects, represented by an array of integers. Each element in the array represents a unique colour. Write a C program that accepts this array as input and then forms the pair of colours using the combination of any two elements of the array. Determine the count of pairs of colours in the array where the colours in the pair are sorted in descending order. It should also print the pairs as space separated values on each line. For example, let's say you have an array {2, 8, 7, 4}. In this case, the program should find the pairs of colours in descending order. The pairs in this array are (8,2), (8,7), (8,4), (7,2), (7,4), and (4,2). So the count value of the pairs should be 6, indicating that there are six pairs of colours where the colours are sorted in descending order. **[10]**

03. John, a young farmer, successfully implemented precision farming techniques in turmeric cultivation, resulting in a productive yield. He demonstrated the turmeric rhizomes after thoroughly preparing the land. Additionally, he grew intercrops such as onions, coriander, chillies, and red gram, effectively utilizing water and fertilizers to achieve optimal results. **[10]**

With the profits obtained, John decided to invest in purchasing multiple fields and the maximum number of field is restricted to 10. Now, he plans to diversify his crop selection across these newly acquired fields. According to his district the maximum number of crop is restricted to 6. Develop a C program to validate the input and calculate the total number of different combinations in which he can plant the crops, he needs assistance in implementing a solution using function pointers. The desired outcome is to determine the total number of combinations for planting 'r' crops in 'n' purchased fields using the formula nCr = n!/r!(n-r)!

04. You are a software developer working on a Student Record Management System in C. The system is designed to store and manage information for N number of students in a class. The system should allow users to input and retrieve data related to each student, including their names, roll numbers, and marks obtained in five different subjects. Create a structure for student detail. Implement array of structure to read, write, and display the marks statistics of N students in a class. The system should calculate and display the average marks obtained by each student. It should also identify the highest and lowest marks scored by each student in a class. [10]

05. Consider there are two class rooms and each containing X number of boys and Y number of girls in it. Write a C++ program to display the total sum of boys and girls in both the classes keeping in view the following guidelines: [10]

a) The name of the class should be ClassRoom with data members NoOfBoys, NoOfGirls in it.

b) Parameterized constructor should be used for initializing the objects.

c) A method namely add(ClassRoom, ClassRoom) with objects as arguments should be used for performing the addition.

d) Total three objects of ClassRoom type should be created in the main method.

e) The first two objects should be used as arguments to add method and the third object is to store the result returned from add method and then display the total number of boys and girls in the resulting object.

06. Krishna wants to use a Product Inventory program using object-oriented programming concepts in his shop. So, the program should allow Krishna to manage a list of products, including adding products, displaying product details, and calculating the total value of the inventory. Write a C++ program that implements the following features to help Krishna: [10]

a. Create a **Product** class with the following attributes:

- **productId**: to store the unique ID of the product
- **productName**: to store the name of the product
- **price**: to store the price of the product
- **quantity**: to store the quantity of the product in stock

b. Implement a member variable **totalProducts** to keep track of the total number of products in the inventory.

c. Implement a constructor for the **Product** class that takes the **productId**, **productName**, **price**, and **quantity** as parameters. The constructor should initialize the attributes and increment the **totalProducts** count.

d. Implement member functions for the **Product** class as follows:

- **displayProductDetails()**: displays the details of the product, including the product ID, name, price, and quantity.
- **getTotalValue()**: returns the total value of the product inventory (price * quantity).

e. Use an inline function to implement the **getTotalValue()** member function.

f. Allow the user to input the number of products to add to the inventory and their details (product ID, name, price, and quantity) using appropriate user prompts.

After adding the products, display the details of all the products in the inventory, including the total products and total value of the inventory.

07. Design a Hospital Management System to manage different types of employees in a hospital. The hospital has various categories of staff, including doctors, nurses, and administrative staff. Each category of staff has specific attributes and functionalities. The doctors have specialties, the nurses have different shifts, and the administrative staff has specific roles such as receptionist, accountant, and human resources manager. [10]

Develop a C++ program that implements the following classes: **Employee, Doctor, Nurse**, and **AdministrativeStaff**. **Employee** class should serve as the base class for all staff members and contain member variables **name** and **employeeId**. Define a display method in the derived classes to display the employee details. The **Doctor** class should be derived from the **Employee** class and have an additional member variable **specialty**. The **Nurse** class should also be derived from the **Employee** class and have an additional member variable **shift**. The **AdministrativeStaff** class should be derived from the **Employee** class and have an additional member variable **role**.

In your **main()** function, create instances of a doctor, a nurse, and an administrative staff member. Use the chain of constructor to initialize the data members of derived class and base class. Identify the type of inheritance and sketch the various classes and methods used in the above scenario.

08. Develop a application program for a restaurant that offers both food and beverages. The program should allow the user to view the menu, add items to their order, and calculate the total bill. The restaurant offers both vegetarian and non-vegetarian food items, as well as alcoholic and non-alcoholic beverages. [10]

Design a C++ program that implements the following classes: Food, Beverage, VegetarianFood, NonVegetarianFood, AlcoholicBeverage, and NonAlcoholicBeverage. The Food class and Beverage class should serve as the base classes, containing member variables for the name and price then define the method to print the name and price of food class and beverage class.

In main program make use of parameterized constructor for each category of food and beverages to add the name and price of the item. The derived classes should inherit from the appropriate base class attributes like (Name and price of the food and beverage Item) specific to that category. Implement a menu-driven program that allows the user to view the menu which shows the list of food categories and beverage categories item name with price details. Provide separate options in the menu to order food item and beverage, finally calculate the total bill.

09. You have a base class called **Employee** with data members name, basic salary and inherit two derived classes **Manager** and **Developer**. Each derived class has its own implementation of a **calculateSalary()** method. [10]

Create a class hierarchy in c++ to handle salary calculation differently for each derived class (**Manager** and **Developer**) in the **Employee** class hierarchy, and make the **calculateSalary()** method as virtual function in base class and override the **calculateSalary()** method in each derived class. The user has to give the input value for name and basic salary. The formula for calculating salary is as follows: **Salary = Basic + HRA + Transport Allowance + DA.**

TA, DA and HRA details as follow:

For Manager DA is 12 % of basic pay, TA is 15 % of basic pay and HRA is 18% of basic salary.

For Developer DA is 10 % of basic pay, HRA is 14% of basic pay and no TA allowed.

10. You are working on a library management system that needs to handle different types of items, such as books, DVDs, and CDs. Each item has a unique ID, a title, and an author/artist. You decide to implement a class template called *LibraryItem* based on two different representations [10]

of unique ID. Unique ID may be in the form of String or Integer. The *LibraryItem* class should include member functions to get and set the ID, title, and author/artist of an item. Based on the given scenario, implement the *LibraryItem* class template. Develop a C++ program for the usage of ***LibraryItem*** class template to store and display information about a book and a DVD item.