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VIT

Reg. No. : 22BAI1014

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. Kiruthika S**	Slot	**C1**
		Class Nbr	**CH2022232300564**
Time	**3 Hours**	Max. Marks	**100**

Part 1 (7 X 10 Marks)
Answer All questions

01 A company must implement a tax calculation system. The system should calculate the tax amount for each employee based on their annual salary. The tax rates vary based on the following rules: [10]

- Employees with a salary up to Rs. 10,000 pay no tax.
- Employees who earn between Rs. 10,000 and Rs. 50,000 per year are subject to a 10% tax for the salary amount that is above Rs. 10,000.
- Employees who earn between Rs. 50,000 and Rs. 100,000 are subject to a 20% tax on the portion of their salary that exceeds Rs. 50,000 and a Rs. 4,000 fixed tax.
- Employees who earn above Rs. 100,000 pay a 30% tax on the portion of the salary exceeding Rs. 100,000, plus a fixed tax amount of Rs. 12,000.

Write a C program that takes each employee's annual salary as input and calculates the tax amount using the appropriate tax rules. Display the employee's salary, tax rate, and tax amount. The program should continue to prompt the user to input of employee salary until the user stops with a value of -1 for the input.

02. The voice message is stored in the system as a sequence of numbers. Write a C program to compute the sum of squares of the 1-D signal for the elements in the even positions of the voice message and the sum of the cubes of 1-D signal for the elements at the odd position of the message. Develop the program such that the above calculations are performed in different modules. The result of the module *even_square_sum()* is added to all the elements in the odd position of the array as a part of encryption. Similarly, the result of *odd_cube_sum()* is added to the elements in the even position of the array for the encryption process to be strong. [10]

03. A *Player* class represents the individual players in the game. The *Player* class has a static data member *total_players* to keep track of the total number of players currently active in the game. Implement the event handling mechanism to update the *total_players* count whenever a new player joins or leaves the game. In addition to the *Player* class, you have a *GameManager* class that manages the overall game progress. The *GameManager* class has a static member function *checkGameCompletion()* which checks the completion condition of all players reaching a specific score. Implement the event handling mechanism to call the *checkGameCompletion()*, whenever a player's score is updated. Write a C++ code for the above scenario. [10]

04. Create an employee database system in C++ with a class called *Employee* representing employee details. Implement a function called *UpdateSalary()* that is not a part of the Employee class, but allows the class named *HR_Department* to directly update the employee's salary which will be [10]

having the salary attribute that cannot be accessed outside the class *Employee*. Write a C++ code to implement the event handling mechanism of updating the employee salary using the static data member concept in C++.

05. Write a C++ program that gets the input for the student's basic and academic information to calculate the result. The program should be designed to display the students' information such as *name, ph.no, roll_no, course enrolled, marks* and *average*. The program should have three classes namely *Person, Student*, and *Exam*. *Person* is the base class which has the basic data members *name* and *ph.no*. The class *Student* has *roll_no* and *course* with limited access for its own class. Another class named *Exam* has attributes namely *marks (five subject marks)* and *average* with limited access for its own class. Identify an appropriate inheritance technique to implement these classes. What other object orientation concept is needed to implement the scenario that reads and displays the values through the methods namely *read() and show()* in the three classes *Person, Student* and *Exam*. The driver program should control the entire set of inherited classes and also invoke the method of class *Exam* named *cal()* which will calculate the total and the average marks obtained by the student. [10]

06. Develop C code to implement the following scenarios. [10]

a) There is a computerized word game that consists of n words in a word bag (1.....n). These words originate from the same stem. Example: grace, graceful, disgraceful, gracefully, etc.. Design the computerized game with the C program that has a module to find the original stem of the word. The stem is the longest consecutive substring that occurs in all the n words. If there are ties, we will choose the smallest one in the alphabetical (lexicographic) order. When the above example is given as input, the stem of the word bag namely *grace* has to be displayed as output.

b) Ravi Varma is a curious person. Once, he searched for various famous personalities on Google. When he searched about Neil Armstrong and to his wonder Armstrong's number link was recommended by Google. Now he wanted to know all Armstrong numbers that are less than his birth year number. Get his year of birth as input and prints all the Armstrong numbers up to that four-digit number (year of birth). Hint: An Armstrong number is a number that is equal to the sum of digits raised to the power total number of digits in the number.

07. N balls are to be transported through a tunnel. Each ball has 3 parameters namely: color, diameter (cm), and weight (g). One ball can be sent into the tunnel at a time. Store the three parameters for all the balls using an appropriate data structure in C. and Display whether the ball meets the required constraints or not in the main function. Use a function with a default parameter specified in the formula. [10]

Constraints:

I. If the ball is red, and the diameter is <41 cm, the ball can pass through the tunnel.

II. If the ball is black, and the weight is <3Kg, the ball can pass through the tunnel.

III. If the diameter of ball is having a diameter <100cm and weight<100g, the ball can pass through the tunnel.

Pass the data obtained from the user to a function named *check()*. The result of the check() is to be passed to another function named *findVolume(). Use pointers concept to avoid returning the volume from the function. Display the result in main().*

Formula for finding the volume of the sphere: $(4/3)\ \pi r^3$

[Note: If the constraints are satisfied, the volume is to be calculated, If not, display "Cannot be transported through the tunnel"]

PART B (2 X 15 Marks)

Answer All questions

08. The General Manager of the company wants to give a New Year bonus to his employees on 1/1/2023. The joining details (Name, Employee ID, and Joining Date) are maintained by the HR manager of the Company. He decides to give the bonus based upon the date of Joining (DOJ). If the DOJ is before 31/12/2000, the employee will be given Rs.10,000 as a bonus. If the DOJ is from 1/1/2001 to 31/12/2015, the employee will be given Rs.6,000 as a bonus. If the DOJ is from 1/1/2016 till date, the employee will be given Rs.4,000 as a bonus. According to numerology, the density number for 1/1/2023 is 9. In addition, if the employee's density number for the joining date is 9 (Adding up all the numbers present on the joining date), he decides to give Rs. 1000 extra. The program should accept the number of employees in the database as input and a loop has to be defined to get the employee joining details. Develop an algorithm and write a C program using structures to display the following: [15]

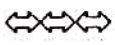
- name and eligible bonus amount of the employee queried by the Employee ID.
- List of employee names and the bonus amount obtained by the employees who come under the category of the same density number.
- List of employee details who joined in the queried year.

09. Imagine that you are developing a product review system for an online shopping platform. The system allows users to enter the name of a product and rate it on a scale of 1 to 10 (decimals not allowed). Each product review consists of the product name and the rating given by the user being stored together in an array. The array index in the product name. The company decides to give the product review based on the sales percentage of the product which is also stored in the same data structure as the above. Implement a generic function called *productReview()* that returns the following: [15]

a. product name and the position of the product in the store when queried with the rating

b. product name and position of the product when queried with the sales percentage.

Write an object-oriented generic program that allows the user to pass the values in any datatype. through which the name and the position of the product in the store could be obtained as the output.



VIT

Reg. No. : 22BRS 1143

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. Ilavendhan A**	Slot	**C2**
		Class Nbr	**CH2022232300567**
Time	**3 Hours**	Max. Marks	**100**

PART A (7 X 10 Marks)
Answer All questions

01. Write a C program to suggest whether the family can select any health insurance policy for their entire family's well-being or not. This suggestion has been taken after considering the following factors and their weightage to calculate the health index of the family. [10]

Family Size – 10%
Number of Salaried People – 20%
Percentage of Adults in the family – 25%
Percentage of Older Adults in the family – 45%

Read the number of family members and their detail such as age and salary income status. If age is more than 55 then they are older adults. If the age is between 25 to 54 then they are adults. Calculate the percentage of adults and older adults in the family. Calculate the family health index by the weighted sum of all four above-mentioned factors. If the family health index is greater than 1.10 then the system has to give a 'Strong Recommendation' to take health insurance for the family. If the index is in the range of 0.75 to 1.09, then the system can recommend 'Advisable' or if the index is less than 0.75 then the system can recommend 'Not Necessary' to take the health insurance for the entire family.

02. Write a C program to manage employee records for a company. Each employee record should contain the following information: employee ID (integer), name (string), age (integer), salary (floating - point number), department (string), and position (string). Decide an appropriate data structure to store each employee detail in a collective manner. Decide on a mechanism to access multiple employee records. Write the C program with different modules to perform the following tasks: [10]

- Display the details of the employee with the highest Gross Salary.
- Display the details of the youngest employee.
- Calculate and display the average salary of all employees.
- Find and display the employees in a specific department.
- Find and display the employees holding a specific position.

03. Given a non-negative integer, write a C program to count the number of 1's present in the number using recursion. For example, if the given integer is 15,then the output should be 8 as there are eight 1's considering every digit of the numbers from 1 to 15. [10]

04. Develop a system for managing a university course enrolment. The system needs to handle different types of courses, including lectures and lab courses. Each course has details such as the course code, title, and instructor. Lecture courses have an additional detail called lecture hall, while lab courses have a lab number. Develop a C++ program that implements the following classes: *Course*, *LectureCourse*, and *LabCourse*. The *Course* class should serve as the base class for all types of courses and contain member variables *courseCode*, *title*, and *instructor*. The *LectureCourse* class should have a constructor that accepts the *course code*, *title*, *instructor*, and *lecture_hall*. The *LabCourse* class should have a constructor that accepts the course *code*, *title*, *instructor*, and *lab_number*. Implement member functions *displayDetails()* in each class that displays the details of the course. In your *main()* function, create instances of a lecture course and a lab course. Using their respective constructors, initialize their attributes, and display their details using the *displayDetails()* function. Name the inheritance type that is used in the above scenario. [10]

05. In the IPL final match between MI and CSK, there is an exciting moment when a batsman from the Mumbai Indians team hits a six against a bowler from the Chennai Super Kings team. The batsman is a part of the *MumbaiIndians* class, and the bowler belongs to the *ChennaiSuperKings* class. Use an appropriate inheritance concept to represent this scenario. Justify your answer. Use base class called *Player* which contains common attributes and methods for all players and derived classes for specific roles: *Batsman*, *Bowler* and *AllRounder*. There are derived classes specific to each team as well namely: *MumbaiIndians*, *ChennaiSuperKings* and *RoyalChallengersBangalore*. If these classes inherit from the appropriate role classes, identify the type of inheritance in that scenario. [10]

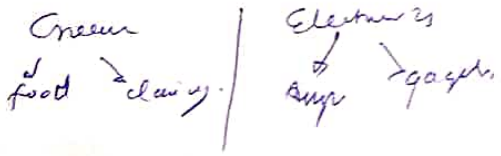
06. Write a C++ program to create a generic class for Subject with the member variables *Students' Identification* and *Value*. Assume that the number of registered students in the class is represented in the member variable count. The University web portal allows faculty to use any one of the two standard formats to maintain the details of the Subject. As the first method, the integer Roll Number can be used for *Students' Identification*, and the subject's Grade in character is used to represent the *Value*. In the Second format, the Student's name is for *Identification* and Mark is for *Value*. Write a program to create the objects under two given standards for the Student class. The class Student has *set_id* and *set_value* methods to initialize the data members. Also, it has a *put* method to display the names of the top 5 scorers in this subject. [10]

07. You are given a sorted array of integers 'Arr' which is in non-decreasing order and a target value 'X'. Display the value stored in the beginning of the array. Also display the position of the target element 'X'. If there are duplicated in the array for the target element, display only the first occurrence of the target element in the array. Write a C program for the above scenario and explain it with an example. [10]

PART B (2 X 15 Marks)

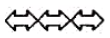
Answer All questions

08. The supermarket has two main categories of products: *Grocery* and *Electronics*. Under each category, there are further subcategories of products. For *Grocery*, *Food* and *Cleaning_Products* are the sub categories, and for *Electronics*, *Appliances* and *Gadgets* are the sub categories. There [15]



prints the grocery details available in that class. The *Electronics* class has a method called *GetInfo()* that gets the name of the electronic items from the admin user. Store those names in an array. There is a method called *DisplayInfo()* that prints the electronic items available in that class. Define the classes with their respective methods and inheritance relationships. Create objects for the derived classes and demonstrate the usage of the methods in the inheritance hierarchy. Implement the classes and write the necessary code to test the functionality.

09. Create a class called *BuyJewellery*. The cost of gold is Rs 5000 /-per gram and silver is Rs 80 /- and per gram of bronze is Rs 35 /-. Irrespective of the number of grams of purchase, if a customer buys gold, silver, and bronze as a combo he is given Rs 1000 /- flat discount on the net cost. If he buys only gold and bronze he is given Rs 750 as a discount and Rs 500 discount for silver and bronze combination, otherwise for any other combination there is no discount. Write a C++ program that has method named *discount()* to do all three categories of computations for every instance of purchase using an appropriate concept of object orientation. [15]



VIT
Vellore Institute of Technology

Reg. No. : 22BCE1351

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. SENDHIL R	Slot	G1
		Class Nbr	CH2022232300541
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. 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)! [10]

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.