Ref. No.: Ex/PG/DMC/T/116B/2024

M.Tech Distributed and Mobile Computing First Year First Semester Examination

Object Oriented Systems
Part: Full

Time: Three hours **Full Marks:** 100

Attempt any ***five*** from the following questions. Each question carries ***twenty marks***.
Make your answer brief and to-the-point. Use **illustrative diagrams** wherever it is necessary.

1.

a. What is **object**? Discuss various **mechanisms** of creating **objects** in **Java**.
b. What is **method overloading** in **object-oriented programming**? Illustrate it through suitable **java program**.

(2+6) + (2+10)

2.

a. What is ***abstract class***? Show how a **class** can be made **abstract** in **Java**.
b. What is ***polymorphism***? Why it is used in ***object-oriented programming***?
c. Write down a **java** program that has demonstrated ***polymorphism*** using ***abstract class***.

(2+3) + (2+3) + 10

3.

a. Define a class (*Stack*) for a **stack** that includes methods to push and pop **int** data item. In some situations, it is required to treat a pair of numbers as a unit. For example, each screen coordinate has an x component and a y component. Represent such a pair of numbers as a **structure** called **pair** comprising two **int** member variables.

Now, assume you want to store the **pair** variables on a stack. That means, you want to place a pair of two numbers onto a stack using a single call to a *push()* method with a **structure** of type **pair** as an argument, and retrieve a pair using a single call to a *pop()* method, which will return a **structure** of type **pair**. So, derive a new class called *pairStack* from the previously defined class *Stack* to meet the abovesaid requirements.

Write down a **main()** method to create an instance of *pairStack* and then to push several pairs of numbers onto it and also pop them off.

20

4.

a. Consider a **shared array** '**a**' that may contain at most 10 positive integers. A **producer thread** inserts random number into the vacant places of the array '**a**' whereas **consumer thread** prints the number already stored at some element of the array. Once the number stored into the index '**i**' of array '**a**' is printed, that element becomes vacant.
Define the classes '**SharedArray**', '**Producer**' and '**Consumer**'.

20

5.

a. State the **advantages** and **disadvantages** of using ***sequence diagram*** and ***collaboration diagram***. Show the differences between them with suitable example.

b. Specify the names of first five **GRASP patterns**. Write short notes on following three patterns.

   i. Information expert
   ii. High cohesion
   iii. Low coupling

(6+4) + (1+3x3)

6.

a. Imagine a **publishing company** that markets both **book** and **audiocassette** versions of its works. Create a class **publication** that stores the **title** (a string) and **price** (type float) of a publication. From this class derive two classes: **book**, which adds a **page count** (type int), and **tape**, which adds a **playing time in minutes** (type float). Each of these three classes should have a ***getdata()*** function to get its data from the user at the keyboard, and a ***putdata()*** function to display its data.

   Now assume that the publisher wants to distribute the books via some **computer disk**, for those who like to do their reading on their laptop. To meet the abovesaid requirement, add a **disk class** that, like book and tape, is derived from publication. The **disk class** should incorporate the same member functions as the other classes. The unique data item to this class is the **disk type:** either **CD** or **DVD**. Use appropriate data structure to store this item. The user could select the appropriate type by typing **c** or **d**.

   Write a program to test the **book**, **tape** and **disk classes** by creating instances of them, asking the user to fill in data with ***getdata()***, and then displaying the data with ***putdata()***.

b. Draw a **class diagram** for the above-mentioned description. Make sure to show **attributes, multiplicities** and **associations** where appropriate.

14+6

7.

a. Specify the **advantages** of using **design patterns** in **software engineering**? Name various kinds of **design patterns** used in software engineering

b. Provide the **UML** diagram of the **design patterns** suitable for the following problems and state their **consequences**.

   i. Ensure that a class has only **one instance** and provide a **global point of access** to it.
   ii. Define a **one-to-many dependency** between **objects** so that when one object changes **state**, all its **dependents** are notified and updated automatically.

(3+1) + (8+8)