

UNIVERSITY OF RUHUNA
BACHELOR OF SCIENCE (GENERAL) DEGREE
LEVEL II (SEMESTER I) EXAMINATION – JULY 2023

SUBJECT: Computer Science

COURSE UNIT: COM2113 – Object Oriented System Development

Time: 2 hours

Answer all four (04) questions.

1)

a.

- i. Name the **four (04)** basic principles of object orientation.
- ii. Briefly explain in simple words, what is **abstraction** in object-oriented programming paradigm?

b.

- i. Briefly explain the role of **access modifiers** in Java.
- ii. Consider the following Java classes below.

Connection.java

```
class Connection {  
    private static Connection conn;  
    private Connection() {}  
    public static Connection getConnection() {  
        if (conn == null)  
            conn = new Connection();  
        return conn;  
    }  
}
```

TestConnection.java

```
class TestConnection {  
    public static void main(String[] args) {  
        Connection dbConnection = new Connection();  
    }  
}
```

The above Java program has a compilation error.

- What is the **reason** for that compilation error?
- What is the change that you should make in the above code to avoid that compilation error?

c.

- i. Write **two (02)** duties of a **constructor** in Java.

- ii. Consider the following Java classes below.

LibraryItem.java

```
class LibraryItem {
    private String category;
    private boolean isRef;
    public LibraryItem(String category, boolean isRef) {
        setCategory(category);
        setIsRef(isRef);
    }
    // getters and setters are here
}
```

Book.java

```
class Book extends LibraryItem {
    private String isbn;
    public Book(String category, boolean isRef, String isbn) {
        setCategory(category);
        setIsRef(isRef);
        setIsbn(isbn);
    }
    // getter and setter are here
}
```

TestLibrary.java

```
class TestLibrary {
    public static void main(String[] args) {
        Book harryPotterGobletOfFire = new Book("Fiction", false, "123");
    }
}
```

The above Java program has a compilation error.

- What is the **reason** for that compilation error?
- What is the **Java statement** necessary to fix that compilation error?
- **Where exactly** should the above Java statement be written in the above Java program?

- d. Draw the activity diagram for the following scenario on **"Meeting a new client"**.

There are three people involved in the process of meeting a new client. They are salesperson, consultant, and corporate technician. The activities followed by each person are as follows:

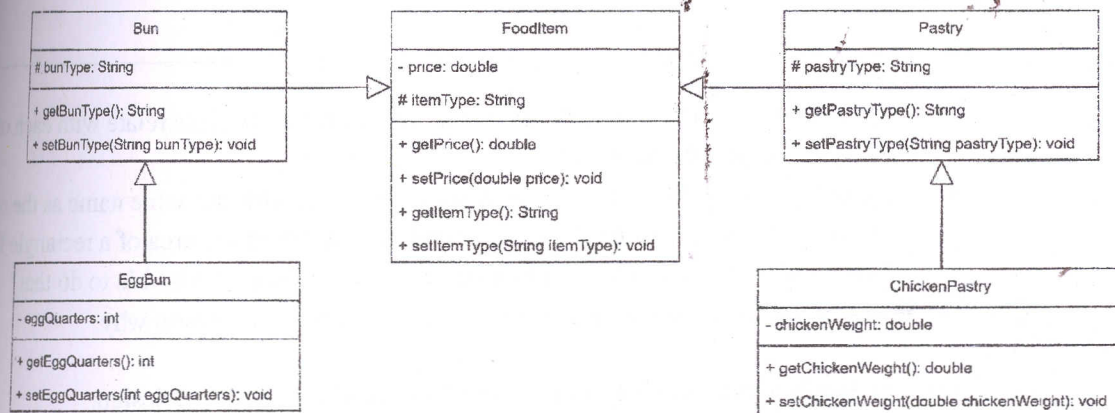
- A salesperson calls the client and sets up an appointment.
- If the appointment is onsite (in the consulting firm's office), corporate technicians prepare a conference room for a presentation.
- If the appointment is offsite (at the client's office), a consultant prepares a presentation on a laptop.
- The consultant and the salesperson meet with the client at the agreed-upon location and time.
- The salesperson follows up with a letter.
- If the meeting has resulted in a statement of a problem, the consultant creates a proposal and sends it to the client.
- If there was no problem occurred, meeting will be end successfully.

Note: Use swim lanes for your activity diagram.

2. Suppose that you are going to develop a hospital management system. Draw the **class diagram** for the following gathered requirements.

- A hospital has a unique name, an address, and a phone number.
- A ward is a division of a hospital shared by patients who need a similar kind of care.
- In a hospital, there are several wards, each of which may be empty or have on it one or more patients. Each ward has a unique name.
- Wards are differentiated by gender of its patients, i.e., male wards and female wards. A ward can only have patients of the gender admitted to it.
- Every ward has a fixed capacity, which is the maximum number of patients that can be on it at one time (i.e., the capacity is the number of beds in the ward).
- The doctors in the hospital are organized into teams. Each team has a unique name (e.g., Orthopedics or Pediatrics) and is led by a consultant doctor. A doctor can only serve for one team.
- There are two types of doctors: junior doctors and consultant doctors.
- Each patient is in a single ward and is under the care of a single team of doctors. A patient may be treated by any number of doctors, but they must all be in the team that cares for the patient.
- A patient has a unique identification number. The gender and age of a patient is important. Furthermore, accepted date, sickness, prescriptions, and allergies should be recorded in the system.

b. Consider the following class diagram and write the necessary Java code blocks according to the given introductions.



- Write the getter for the attribute *itemType* and the setter for the attribute *price* in class **FoodItem**.
- Write the code for the class definition of the **Pastry** class with the default constructor. (Assume that the attribute *pastryType* has been correctly declared, and its getter and setter has also been completely written in the **Pastry** class.)
- Write the code for the **EggBun** class with a public parameterized constructor with 3 parameters that sets values for the attributes *price*, *bunType*, and *eggQuarters*. (Assume that all variable declarations, getters, and setters of all the classes in the above class diagram are completely written.)

3)

a. Assume that you are going to develop a library management system for the university library. Consider the following requirements and **draw the use-case diagram**.

- Students and staff members are the main two types of users of the library. To use library facilities the user needs to first register with the system through filling in the register form and after successful registration the user will receive library card ID.
- Users can borrow books, return books, reserve books, renew books using the library management system. When returning the books if there are any delays or damage the user can pay the applicable fine through the system.
- Librarians can add books to the system, update existing books, issue books to the users, accept returning books and accept fines when returning books.

b.

i. Consider the following Java class.

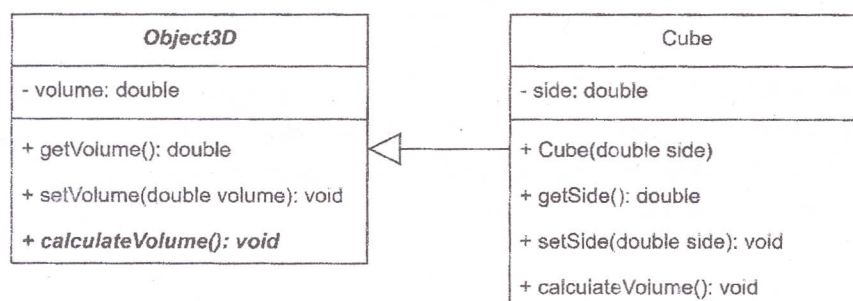
AreaCalculator.java

```
class AreaCalculator {
    // calc & return the area of a circle with given radius
    public double calculateArea(double radius) {
        return Math.PI * radius * radius;
    }
    // calc & return the area of a triangle with given base & height
    public double calculateArea(double base, double height) {
        return 0.5 * base * height;
    }
}
```

- How do the two instance methods in the **AreaCalculator** class relate with each other in terms of object orientation?
- Suppose you want to write another instance method with the same name as the other two, in the **AreaCalculator** class, to calculate and return the area of a rectangle for a given *width* of type *double* and *height* of type *double*. Is it possible to do that?
- If yes, write the code for that method. If not, mention the reason why.

ii. What is **Single Responsibility Principle (SRP)** in object-oriented design.

c. Write an OO solution using Java language to model basic 3D objects in mathematics and to calculate their volume by referring to the given class diagram. Assume that **bold** and *italic* identifiers in the class diagram as **abstract**. To test your OO solution, write a test class with a main method, create a **Cube** object with side length 4, calculate its volume, and print in the console. **Help:** Volume of a cube with side length x is x^3 .



4)

- a.
 - i. Name the **two (02)** types of **polymorphism** in object orientation.
 - ii. Name **two (02)** features / constructs provided in Java to implement the principle of **abstraction** in object orientation.
 - iii. What is the type of **polymorphism** that you need to successfully use any of the two features / constructs that you mention in (4)(a)(ii)?
- b.
 - i. List **three (03)** characteristics of a variable declared in a **Java interface**.
 - ii. State **two (02)** situations where an interface should be created instead of a superclass in Java.
- c. State **two (2)** advantages and **two (2)** disadvantages of following fact-finding techniques.
 - i. Prototyping
 - ii. Questionnaires
 - iii. Observation of work environment

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