VICTORIA UNIVERSITY
Kampala · Uganda

EXAMINATION

FACULTY OF SCIENCE AND TECHNOLOGY

PROGRAMME(S):

SESSION:DAY/EVENING

MODULE CODE AND TITLE: 2108,2101: Object Oriented Programming With Java	**LEVEL:** 2.1
DATE: JULY, 2025	**TIME:**
DURATION: **6Hrs**	**TOTALMARKS:** 100
EXAMINER/LECTURER: Mr. Bazigu Alex	**MODERATOR:** Dr. Lillian Tamale

INSTRUCTIONS TO THE CANDIDATE/STUDENT

1. V-class is the **ONLY** official examination platform.
2. Questions must be attempted in the answer booklet/sheet provided on V-class.
3. All queries should be directed to the examiner, Head of Department, or Dean.
4. You have **SIX HOURS** to complete this paper. No exam answer sheet shall be accepted after the 6 hours (the system has closed).
5. This is an **OPENBOOK (Online)** examination.
6. Attempt 4 Questions in total. All questions carry equal marks(25 marks each).
7. Read each question carefully before beginning to type/write your answers.
8. Review the grades assigned to each question of the examination and allocate your time accordingly.
9. Review your answers carefully before submitting your examination**.**
10. After submission of your exam answer sheet, Cross-Check to make sure your examination was attached and has been sent to V-class and received a confirmation message.

SECTION A

Attempt All Questions (2)

QUESTION ONE (25 Marks)

BALEXTRANIT (U) LTD, a transportation company operating in Kampala and surrounding districts operates individual taxis and shuttles. Taxis transport an individual or small group from one location to another, while shuttles pick up multiple passengers from different locations and transport them to their respective destinations. When a call is received from a passenger source (such as an individual, hotel, corporate company, or tourist organization), the company schedules an available vehicle for pickup depending on the number of seats required. If no vehicles are available, the request is lost without queuing. Drivers notify the company upon arriving at a pickup location and after dropping off passengers. To assess expansion profitability, the company needs to track lost fares and monitor how vehicles spend their time.

a) Identify five key classes from the case study and for each, list one primary responsibility and collaborator class (5 Marks).
b) Write a complete Java class named PassengerSource that meets the following specifications.
    (i) A constructor taking a Company object.
    (ii) A requestPickup() method that creates a new Passenger, generates random pickup and destination Location objects with x and y coordinates ranging from 0 to 100, and uses the company to schedule a vehicle; the method should return true if the company successfully schedules the pickup and false otherwise (10 Marks)
c) Write two JUnit tests for the Company class. (5 Marks)
d) Explain how encapsulation is applied in one class. (5 Marks)

QUESTION TWO (25 Marks)

The National Library of Uganda (NLU) has launched a new digital catalog system for managing book metadata, patron queries, and bibliographic indexing using Java.

a) Explain the concept of string immutability in Java and discuss how it aids in ensuring secure and efficient handling of frequently queried book titles and author names in NLU's system. (4 Marks)

b) Using relevant syntax, demonstrate two different ways to create empty string objects in Java within the context of book record initialization. (6 Marks)

c) Discuss how the methods equalsIgnoreCase() and to Lowercase() can be used to improve user search functionality when patrons query for books in various cases. (4 Marks)

d) Analyze the output of the following code and explain how object comparison works. (3 Marks)

```
String author1 = "Ainebyoona";

String author2 = "ainebyoona";

String author3 = new String("Ainebyoona");

System.out.println(author1 == author3);

System.out.println(author1.equalsIgnoreCase(author2));
```

e) Write a Java program that prompts a librarian to enter a book description and counts the number of times the word "Uganda" appears in it, regardless of case. (8 Marks)

SECTION B

Attempt Only Two Questions

QUESTION THREE (25 Marks)

a) Discuss the Concept of Java Exception and Exception Handling (4 Marks)

The Kampala Capital City Authority (KCCA) has recently contracted **AirQO** (https://airqo.net/) to develop a Java-based air quality monitoring dashboard for Kampala City under the Theme "Kampala -Smart City".

b) What exception is thrown when a Java program attempts to divide air pollutant levels by zero during average AQI calculation? Explain why this exception is triggered. (3 marks)

c) Distinguish between while and for loops in Java using code snippets to simulate how NEMA through AirQO Java System tracks daily PM2.5 levels for 30 days. (6 Marks)

d) Write a Java program that:

i) Generates 30 random air quality index (AQI) readings between 1 and 300.

ii) Computes and displays the median AQI value.

iii) Identifies and counts the number of "hazardous" days (AQI > 200). (12 Marks)

QUESTION FOUR (25 Marks)

a) With examples, compare constructors with Java's garbage collection mechanism used in place of destructors in C++. (5 Marks)

b) St. Mary's Hospital Lacor (https://www.lacorhospital.org/) in Gulu is transitioning to an electronic medical records (EMR) system powered by Java.

i) Illustrate how the ***this*** keyword can resolve variable naming conflicts within constructors while assigning a patient's ID and allergy notes. (2 marks)

ii) Define and explain the use of

(a) static method - for shared utilities like **calculateBMI()**

(b) Method overloading - for multiple patient report formats (4 marks)

c) Differentiate between final and finally in Java. Provide examples where a final class prevents further modification of medical constants, and a finally block ensures files are closed after report generation. (4 marks)

d) Write a Java program that reads the content of an existing File object **medicalLogFile** and displays it on the screen. The program should properly catch **FileNotFoundException** and **IOException** that might occur during the file read operation. (10 marks)

QUESTION FIVE (25 Marks)

The Uganda Revenue Authority (**URA**) implemented the Electronic Fiscal Receipting and Invoicing System (**EFRIS**) to enhance real-time monitoring of business transactions, automate tax processes, and improve compliance. The system is built using Object-Oriented Programming principles to ensure secure, flexible, and scalable implementation.

a) Briefly explain five core OOP principles and how each could be applied in the URA's EFRIS system (5 Marks)

b) Discuss how encapsulation is utilized in the EFRIS system to protect sensitive transaction details such as buyer TIN, seller TIN, invoice amount, and transaction timestamp. HINT: Illustrate your answer with a Java class named TransactionRecord that uses private fields with public getter and setter methods. (6 Marks)

c) Explain how polymorphism allows the EFRIS system to apply different VAT calculation logic for different taxpayer categories (Retailer, Wholesaler, Manufacturer, and Importer). (6 Marks)

d) Write a Java program segment that meets the following requirements:

   (i) Define a base class **TaxCategory** with a method **calculateVAT**(double amount)

   (ii) Create subclasses Retailer, Wholesaler, and Importer that override calculateVAT() based on different VAT rates (such as 18%, 15%, 10%)

   (iii) In the main method, create an array of TaxCategory objects and invoke calculateVAT() for various transaction amounts, demonstrating runtime polymorphism (dynamic method dispatch). (8 marks)

QUESTION SIX (25 Marks)

a) You are tasked with developing a Java program to determine whether a given number is a perfect number. A perfect number is a positive integer that is equal to the sum of its proper divisors (excluding itself). For example, 6 is a perfect number because 1 + 2 + 3 = 6. Write a complete Java program that:

   (i) Prompts the user to enter a positive integer and validate the input using exception handling.

   (ii) Calculates the sum of all proper divisors of the number

   (iii) Determines and displays whether the number is a perfect number (10 marks)

b) Victoria University through Faculty of Science and Technology is organizing an Innovation and Technology Exhibition aimed at showcasing student projects. The organizers require a simple Java-based desktop application to register participating students. The application should provide a user-friendly interface and store records in a Microsoft Access database.

   (i) Design a Java GUI using Swing or JavaFX that allows event organizers to input student registration details, including Registration ID, Student Name, Faculty,

Project Title, Contact Number, and Email Address. HINT: The interface should include appropriate labels, text fields, and buttons such as “Register”, “Clear”, and “Exit”. (4 marks)

(ii) Create an Access database named VUE_Exhibition.accdb with a table Participants having fields that match the above registration details. (3 Marks)

(iii) Write Java code to connect the application to the Access database using the UCanAccess JDBC driver. (3 marks)

(iv) Implement the functionality of the “Register” button to insert the entered details into the Participants table.(3 marks)

(v) Briefly explain how your program handles invalid inputs (e.g., empty fields, wrong formats) and ensures data integrity during the registration process. (2 marks)