



University of Ruhuna- Faculty of Technology

Bachelor of Information & Communication Technology Honours Degree

Level 2 (Semester I) Examination, June/July 2025

Academic year 2023/2024

Course Unit: ICT2142 Object Oriented Analysis and Design (Written)

Duration: 2 hours

.....

Instructions:

1. This is a **closed-book** examination. No reference materials, notes, or textbooks are permitted.
2. This question paper contains **seven (07) pages**, including this instruction page.
3. Answer **all four (04) questions**.
4. All questions carry **equal marks** unless otherwise stated.
5. Start a new question on a **new page**.
6. Clearly indicate your **student index number** on all additional papers.

1. A technology startup is developing a Smart City Traffic Management System to optimize vehicle flow, reduce accidents, and support emergency services using real-time sensor data, cameras, and communication between vehicles and traffic infrastructure.

Using the principles and concepts of Object-Oriented Analysis and Design (OOAD), answer the following questions.

- a. Using three (03) key points, explain why the object-oriented approach is more suitable than the traditional procedural approach for developing the Smart City Traffic Management System.

[15 marks]

- b. For each of the following object-oriented principles:

- Abstraction
- Encapsulation
- Inheritance
- Polymorphism

- i. Define and explain the above principles clearly in your own words.

[20 marks]

- ii. Provide one real-world example of how these principles can be applied in the Smart City Traffic Management System.

[12 marks]

- c. Differentiate between Object-Oriented Analysis (OOA) and Object-Oriented Design (OOD).

[08 marks]

Using the Smart City Traffic Management System example, describe:

- i. What types of information are focused on during the OOA phase?

[08 marks]

- ii. How is this information transformed during the OOD phase to prepare for implementation?

[07 marks]

- d. Define high cohesion and low coupling in the context of Object-Oriented design.

Explain how both characteristics can be achieved in the Smart City Traffic Management System.

[30 marks]

2.

- a. Rational Unified Process (RUP) is a process framework that is widely used in software development.

- i. Identify and explain three (03) best practices of RUP.

[12 marks]

- ii. A software development team is applying the RUP to build a complex enterprise application. During the four (4) major phases of the RUP lifecycle, the team encounters specific challenges.

Answer the following by explaining how each issue should be addressed within its respective phase:

- I. A client approaches with only a high-level idea of their software needs. How would you structure the inception phase using the project's vision and scope?

[12 marks]

- II. Why is risk assessment a critical focus during the elaboration phase in RUP?

[10 marks]

- III. New critical requirements are introduced during the construction phase. How should the development team respond to these without sabotaging the project?

[10 marks]

- IV. A major defect is discovered during deployment preparation. What steps should the team take to manage this defect and ensure successful delivery?

[10 marks]

- b. Based on the following description of "Allocate Truck to Driver", draw a UML communication diagram that models the interactions between the objects involved in the given scenario.

A logistics company is expanding its Transport Management System to support efficient truck assignment operations. In this scenario, a dispatcher initiates the allocation process by interacting with the system interface. The dispatcher begins by selecting a specific driver and a delivery schedule to be assigned. The system then verifies whether the selected driver is available for the given schedule by consulting with the driver management component. This step ensures that drivers are not double-booked or scheduled during unavailable times.

- If the driver is available, the system queries the truck management component to retrieve a list of trucks that are free and appropriate for the selected schedule.
- The dispatcher is presented with this list and chooses a suitable truck.
- The assignment service proceeds to carry out the allocation by associating the selected driver, truck, and schedule with the dispatcher.
- Once the assignment is successfully completed, the system sends a confirmation message back to the dispatcher to indicate success.

Note: Write relevant parameters when passing messages.

[46 marks]

3.

- a. Write a fully dressed use case for the course registration in an online university system based on the following scenario.

Kamal, a second-year undergraduate student at ABC University, intends to register for courses for the upcoming academic semester. The university has officially opened its online course registration portal, which allows enrolled students to manage their course selections within the specified registration period.

Kamal initiates the process by accessing the university's course registration portal. He logs in using his assigned student identification number and password. The system verifies his credentials and confirms that he is an active, enrolled student eligible to register for courses. Upon successful authentication, Kamal navigates to the "Course Registration" section of the portal.

The system displays a tailored list of available courses based on Kamal's academic program and year of study. It automatically filters out courses he has previously completed and presents only those for which he is eligible. Kamal proceeds to select his preferred courses for the semester.

Once selections are made, the system performs a validation check. This includes verifying whether Kamal satisfies the prerequisite requirements for each selected course, ensuring there are no timetable conflicts among the chosen courses, and confirming that his total credit load does not exceed the maximum credit hour limit stipulated by university regulations.

As all validations are successfully passed, the system registers Kamal for the selected courses. His academic record is updated accordingly, and a confirmation message listing the registered courses is generated and displayed. Kamal reviews the confirmation and logs out of the system, completing the registration process.

In the event of any registration issue, such as unmet prerequisites, schedule conflicts, or exceeding credit limits, the system is designed to alert the student immediately. It provides appropriate guidance or prompts the student to make necessary adjustments to resolve the issue before proceeding further.

Based on this scenario, include the following details in the fully dressed use case format:

- Use case name
- Primary actor
- Preconditions
- Postconditions
- Main success scenario
- Extensions (alternative flows or failure cases)

[28 marks]

- b. Consider the following scenario of a library management system and answer the questions.

A university is developing a Library Management System to automate the core functions of its library.

The following are the functionalities provided by the system:

- A user registers as either a staff member or a student in the system.
 - To register, users must complete a registration form.
 - The librarian issues a library card with a unique ID after registration.
- After receiving the library card, the user can request a new book.
- The user can reserve the book to ensure no one else can request it.
- The user can renew the book to extend the due date.
- If the book is not returned on time or not renewed, it becomes overdue, and the user will be charged a fine.
- Users can provide feedback by completing a feedback form.
- The librarian plays a critical role in the system. They:
 - Add user records to the library database when books are issued, returned, or fines are paid.
 - Delete user records when users leave the university or no longer need access to the library.
 - Delete records of books that are no longer available.
- The librarian is responsible for updating the library database.

- i. Based on the above scenario, draw a Use Case Diagram that represents the actors, use cases, and their relationships (e.g., include, extend, generalization).

[38 marks]

- ii. Draw a Class Diagram that models the key classes, appropriate relationships (such as associations, inheritance, and dependencies) with multiplicities relevant to the system described.

[34 marks]

4.

- a. In the context of an activity diagram, actions represent the fundamental components of behavior.

Identify and briefly describe three (03) key characteristics of actions.

[21 marks]

- b. The following **Figure 1** illustrates an activity diagram drawn for an Order Processing scenario.

Identify the elements labelled from **A to E** and briefly describe each of the identified elements.

[25 marks]

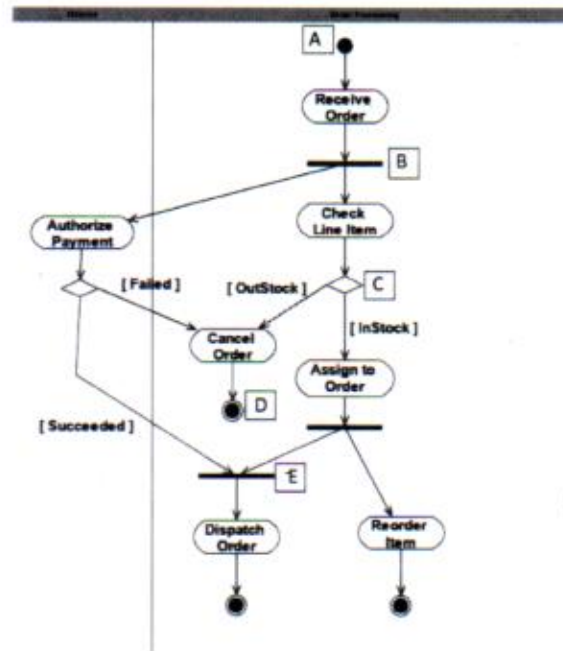


Figure 1: An activity diagram is drawn for an Order Processing

- c. Draw the corresponding activity diagram for the following use case narration, “Crop Disease Reporting”.

Use Case Name	Crop Disease Reporting
Goal in context	This use case describes the process by which a registered farmer reports a suspected crop disease through the mobile-based agriculture information system, uploads images, and receives automated preliminary feedback.
Primary Actor	Farmer
Pre-conditions	Farmer must be logged into the application. The dashboard is displayed after successful login.
Post-conditions	The system provides an acknowledgment and displays initial diagnosis or recommendation. The suspected disease report is submitted.
Triggers	This use case starts when the farmer selects the “Report Disease” option from the dashboard.

Typical Course of Events	
Step	Action
1	Farmer clicks on “Report Disease” option.
2	System displays the disease reporting form.
3	Farmer selects the crop type from a drop-down menu.
4	Farmer enters a short description of the issue and uploads 1–3 images of the affected crop.
5	System performs client-side validation of form fields and image format/size.
6	Farmer clicks on [Submit] button.
7	System uploads the information and images to the server.
8	System processes the submission and performs a basic image analysis and

	symptom matching.
9	System displays a summary page with preliminary diagnosis and suggested immediate actions.
10	Farmer clicks [Confirm] to acknowledge and return to the dashboard.
Alternative Courses	
5a	If any mandatory field is missing or images are not uploaded in the correct format/size: 5a1: System displays an error message. 5a2: Redirects farmer to step 4 for corrections.
8a	If the server upload fails: 8a1: System displays a connection error. 8a2: Offers options: [Retry] or [Save Offline]. 8a3: If [Retry] is selected, return to step 7. 8a4: If [Save Offline], the system saves report locally.

[54 marks]

**** End of the Paper****