



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 8 Examination in Engineering: December 2025

Module Number: EE8217 Module Name: Software Architecture (C-18)

[Three Hours]

[Answer all questions]

Q1 Answer the questions below based on the given scenario.

To overcome the poor scalability, limited real-time visibility, and operational inefficiencies in their traditional parking system, a leading private hospital decides to build a smart car parking system to efficiently manage the vehicle flow, minimize congestion, and ensure reliable revenue collection. Your company has been awarded this project, and your team is tasked with building this system. Business analysts in your team have already discussed and identified the functional requirements for this software application.

- When a vehicle is entering the car park, it should be detected at the entrance by scanning its number plate and assigned an available parking slot. This slot number should be displayed to the driver via an LED display at the entry gate. To scan and extract the vehicle registration number, a third-party service called “**AWS Textract**” can be used.
- Parking sensors should be used to detect the available parking slots, and these should be tracked in real-time.
- A web-based admin dashboard should be implemented for real-time monitoring of occupancy of parking slots, managing revenue reports, and notifying of any gate failures, payment failures etc.
- Parking fees calculation is based on the time a vehicle is parked in the parking lot. However, fee calculation should be able to support different pricing rules (hourly, flat rate etc.) set by the administration.
- Payments should be processed via KIOSK machines placed in the parking lot. Acceptable payment methods are either cash or a card. A well-known third-party payment gateway called “**SRI-PAY**” can be used for payment processing.
- Payment failures should be recorded and notified on the admin dashboard. Also, an email should be triggered to a designated admin user for payment failures. A third-party email service called “**Mailgun**” can be used for sending emails.

- When a vehicle is exiting the parking lot, it should be detected at the exit gate, and the payment status should be validated.
- The exit gate should be open only if the payment is confirmed. Otherwise, on-duty officers at the parking lot should be notified via a notification in the admin dashboard.
- The system must operate reliably under high peak-hour traffic and intermittent network connectivity.

Assume that the architects in your team have decided to build a separate backend application following the REST architecture and a separate frontend application for this use case.

- Draw a context diagram for the above system. [4 Marks]
- Draw a container diagram for the above system. [4 Marks]
- Draw a component diagram for the backend API container. [4 Marks]
- Event-Driven Architecture (EDA)** is an architectural style where systems communicate by producing and reacting to events (such as user action or system state change), rather than calling each other directly. Mention a scenario in this system where EDA can be effectively used. [4 Marks]
- Explain what is meant by the "**Cross-Cutting Concerns**" in a distributed system. Identify 3 cross-cutting concerns relevant to this system. [3 Marks]
- Draw a diagram illustrating a suitable deployment architecture for this system. [3 Marks]
- This system relies on external services, such as OCR providers, email services and payment gateways. Mention two advantages and one disadvantage of using these outside services in software implementation. [3 Marks]

- Q2
- Define what a component is in component-level design and list its key features. [2 Marks]
 - "In reality, maintainability of code is more important than reusability".* Would you agree with this statement? Express your views using component-cohesion principles. Clearly state the trade-offs you will have to account for. [5 Marks]

- c) Name three common design mistakes in pattern-based design and briefly explain how those mistakes can be avoided.

[3 Marks]

- d) Briefly explain how to apply the concept of separation of concerns in software design subtasks using a real-world software example to support your answer.

[3 Marks]

- Q3 a) Briefly explain the differences between Architectural design and Detailed design. In your answer, clearly state the purpose of each, the level of abstraction involved and the types of decisions made at each stage.

[3 Marks]

- b) Name two key properties of a microservice.

[1 Mark]

- c) Assume that you are being tasked with designing a microservices architecture for a complex requirement. Explain briefly what are the criteria/approach you can take to identify suitable functional candidates for microservices. Illustrate your answer with a suitable example.

[5 Marks]

- d) It is a commonly accepted best practice that each microservice should have its own database. Briefly explain why it is recommended to have a database per microservice and the advantages of doing so.

[3 Marks]