



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 8 Examination in Engineering: February 2020

Module Number: EE8205 Module Name: Principles of Software Architecture

[Three Hours]

[Answer all questions, the first question carries 20 marks and the rest of each carries 10 marks]

Q1 Answer the questions below based on the given scenario.

Fast-Shipping is a *cross-border shipping company* which has multiple warehouses in different countries. Customers can order products from online stores such as Amazon to these Fast-Shipping warehouses (by putting the address of the warehouse as the delivery address) and Fast-Shipping company delivers the products to the customers once the products are delivered to their warehouses. This service is being used by most of the users who are outside of the United States since the online e-commerce platforms like Amazon do not ship all their products to all the countries.

Fast-Shipping company has an existing online cloud-based customer portal which is being used by end customers to track the products after the products arrive at Fast-Shipping company's warehouses and to pay the shipping fees.

The Fast-Shipping company currently uses a mainframe-based warehouse management system to manage the warehouse operations such as parcel inbound handling, parcel shipping, etc. Whenever a new parcel is delivered to the warehouse, the warehouse operator records parcel details in the warehouse management system and it automatically updates the customer portal so that the customer can see that the parcel has arrived at the warehouse.

Once the parcels arrive in the warehouse, the warehouse operator packs parcels into one or more boxes. Once the packing process is completed, the warehouse operator should hand the boxes over to a courier service. This warehouse management system works with multiple courier service companies such as DHL. Once the warehouse operator selects the courier service, the warehouse management system talks to the relevant courier service API and gets a tracking number for the box and the warehouse operator places the tracking number on the box before handing it over to the courier service.

The warehouse administrators generate weekly and monthly reports to analyze the warehouse operations (inbound and outbound parcels) and the performances (the time taken to perform operations) of the warehouse operators. The customer service desk operator can see the status of each parcel and answer customer queries.

The management of the Fast-Shipping company has decided to migrate its existing warehouse management system to a more robust cloud-based warehouse management system.

Assume that you are the architect of the team which is responsible for developing the cloud-based warehouse management system from scratch.

- a) Explain why companies such as Fast-Shipping are moving away from mainframe-based systems and migrate their systems into cloud-based systems. Your answer should elaborate on the problems with mainframe-based systems and how cloud solutions can help to overcome those.
[3 marks]
- b) Explain how the **separation of concerns** helps to overcome the **complexity challenge** when designing the above software.
[3 marks]
- c) Draw a **context diagram** for the above-mentioned cloud-based warehouse management system.
[2 marks]
- d) Draw a **container diagram** for the above-mentioned cloud-based warehouse management system. Clearly mention the technology stack for each container. Briefly explain the reasons for selecting each technology.
[4 marks]
- e) Draw the **component diagram for one of the containers** that you mentioned in part d.
[4 marks]
- f) The November and December months are considered as the peak season for these types of shipping and warehousing systems since a lot of customers order products online due to black Friday and 11/11 sales. Assume that you have deployed the backend of this application in a single Amazon cloud server with a limited set of resources and the Fast-Shipping company is experiencing a slowness of the application only during the peak season. Explain a cost-effective and a reliable solution for this issue. Your answer should mention the names of technologies/products which you can use to solve this problem.
[4 Marks]

- Q2 a) Most software architects define the architecture of the software before the implementation of the system. Mention two (02) advantages of defining a proper architecture to a system before the development of the system.
- [2 Marks]
- b) Abstraction plays a major role in designing software architecture. Briefly explain how abstraction can be used to design better software architecture.
- [2 Marks]
- c) What is meant by “**Constraints**” in a software system? Give two (2) example constraints imposed on the design of a software system.
- [3 marks]
- d) Explain “Component”, “Connector” and “Allocation” structures in terms of software architecture.
- [3 marks]
- Q3 a) Briefly explain Service Oriented Architecture using a diagram.
- [2 Marks]
- b) Mention two(02) architectural benefits of Service-Oriented Architecture.
- [2 Marks]
- c) The Microservices Architecture pattern solves many of the common issues found in monolithic service architecture. State three (03) such issues and briefly explain how microservices architecture resolves each.
- [3 Marks]
- d) Show how to create an e-commerce application using Microservices architecture pattern using a simple diagram. Clearly mention the functionalities of each microservice.
- [3 Marks]
- Q4 a) Briefly explain the difference between a framework and a design pattern in software engineering.
- [1 mark]
- b) Explain how pattern-based design and thinking in patterns helps the software design process using a software-related example.
- [3 marks]
- c) Briefly describe any two features of a component in component-based architecture pattern.
- [2 Marks]

d) Explain the following design principles used in class-based component design. Provide one example for each.

i) The Release Reuse Equivalency Principle (REP)

ii) Dependency Inversion Principle (DIP)

[4 Marks]