FACULTY OF ENGINEERING AND TECHNOLOGY

FINAL EXAMINATION FOR THE BACHELOR OF SOFTWARE ENGINEERING (HONOURS)

ACADEMIC SESSION : APRIL 2025 SEMESTER

CSC3209: SOFTWARE ARCHITECTURE AND DESIGN PATTERNS

EXAMINATION : AUGUST 2025

TIME ALLOWED : 2 HOURS AND 10 MINUTES READING TIME

INSTRUCTIONS TO CANDIDATES

This exam contains FIVE questions.

Answer **ALL** questions.

All answers must be written in the answer booklets provided using blue or black INK.

IMPORTANT NOTES TO CANDIDATES

Materials Allowed

Standard Items: Pen, Pencil, Eraser or Correction Fluid, Ruler
Special Items : Non-Programmable Calculators, Computer, Tablet, Notes (Compiled in one Folder)

It is your responsibility to ensure that you do **NOT** have in your possession any unauthorized notes or any other means that would improperly help you in your work. If you have any unauthorized materials with you, hand it to the invigilator BEFORE reading any further.

DO NOT REMOVE THIS QUESTION PAPER FROM THE EXAMINATION HALL

[This paper contains **FIVE** questions printed on **THREE** pages, including cover page]

Question 1 **(Total: 17 marks)**

A healthcare insurance provider is developing a management system that must provide a wide range of functionalities including checking the insurance balance, personal details, and panel clinics. Consider yourself as a software architect in this system. You are required to address the following requirements:

First Requirement: Users can check a specific panel clinic map location using, for example, Google Maps, in the system itself directly without the need for browsing the location on Google Maps application separately.

Second Requirement: Allow the users to store and to track their insurance balance and claim details via the Internet.

Third Requirement: Users want to be notified whenever a claim process has been approved, or new promotions are available.

a) Present three suitable architectural patterns to be employed to address those three requirements with a detailed justification. (6 marks)

The four quality attribute scenarios are designed to ensure the system is reliable, fast, secure, and easy to use. The Availability scenario requires the Authentication Service to successfully authenticate a remote user during peak traffic. The Performance scenario demands the Data Retrieval Service display a logged-in user's balance within 500 milliseconds. For Security, the Claims Processing Service/API Gateway must block and log an external attacker's exploit attempt, ensuring zero records are accessed. Finally, the Usability scenario dictates a first-time user must locate a clinic using the map successfully in zero errors and less than 3 steps, concerning the UI/Map Integration Module.

b) For each of the selected architectural patterns:

i. Explain an advantage or a quality attribute enhanced by the selected pattern in the scenario. (3 marks)

The three selected patterns were Microservices, Client-Server, and PublishSubscribe. Microservices enhances Modifiability for Map Integration,

allowing the function to be updated or replaced independently. Client-Server improves Security for Data Tracking by centralizing sensitive data and controls on the server component. Publish-Subscribe boosts Performance/ Responsiveness for Notifications; the system publishes an event and instantly continues, preventing bottlenecks as a message broker handles distribution to all Subscribers.

ii. Explain a limitation or a quality attribute degraded by the selected pattern in this scenario. (3 marks)

Microservices increases Complexity, Client-Server degrades Availability Because the central server is a single point of failure. Finally, Publish-Subscribe reduces Testability.

c) Consider the following quality attributes: availability, performance, usability, and security. Answer with justification the following:

i. Which of these quality attributes are observable at run time? Explain why? (4 marks)

The quality attributes that are observable at run time are Availability and Performance.

ii. Provide one example of how to measure each of the quality attributes. (4 marks)

Availability is quantified by calculating the system's uptime percentage over a given period. Performance is measured by the average response time.

Question 2 **(Total: 13 marks)**

Assume you are an architect for the same management system stated in Question1. You are required to do the following:

a) Present four quality attribute scenarios and specifications (informally and formally) to address four quality attribute requirements for users. Consider the six parts in quality attribute specification (Source, Stimulus, Environment, Response, Response measure, Artifact). (8 marks)

The four quality attribute scenarios are designed to ensure the system is reliable, fast, secure, and easy to use. The Availability scenario requires the Authentication Service to successfully authenticate a remote user during peak

traffic. The Performance scenario demands the Data Retrieval Service display a logged-in user's balance within 500 milliseconds. For Security, the Claims Processing Service/API Gateway must block and log an external attacker's exploit attempt, ensuring zero records are accessed. Finally, the Usability scenario dictates a first-time user must locate a clinic using the map successfully in zero errors and less than 3 steps, concerning the UI/Map Integration Module.

b) Present a utility tree that captures the quality attribute scenarios presented in

i) The tree should present all the addressed quality attributes, their scenarios and their impact on business value and architecture. The tree should have node for quality attributes, quality attribute refinements, and leaf nodes for the specific quality attribute scenarios. (5 marks)

Testing one two three.

ii) What is the primary difference between a Microkernel and a Monolithic Kernel. (5 marks)

Testing one two thee four.