THE OPEN UNIVERSITY OF SRI LANKA
DEPARTMENT OF COMPUTER SCIENCE
B.Sc. in IT DEGREE PROGRAMME (Hons) 2024/2025
FINAL EXAMINATION
ITU6302: DISTRIBUTED SYSTEMS
DURATION: **TWO HOURS ONLY (2 HOURS)**

Date: 20th June 2025 **Time: 1.30 pm – 3.30 pm**

1. Answer any **04** questions only.
2. Clearly state your index number in your answer script.

Question 01 (25 Marks)

a. Define a distributed system and explain three (03) key characteristics that distinguish it from a centralized system. *(5 Marks)*

b. Provide two (02) real-world examples of distributed systems and explain how they benefit from distribution. *(5 Marks)*

c. Discuss two (02) major challenges faced in designing distributed systems and suggest possible solutions. *(5 Marks)*

d. Explain how transparency is achieved in distributed systems with an example. *(5 Marks)*

e. Analyze the importance of scalability in distributed systems with reference to a case study (e.g., Netflix, Amazon, or Google). *(5 Marks)*

Question 02 (25 Marks)

a. Compare client-server and peer-to-peer (P2P) architectures by highlighting three (03) key differences. Provide one real-world example for each. *(5 Marks)*

b. Explain how hybrid architectures combine the strengths of client-server and P2P models. Illustrate your answer with a case study (e.g., CDNs, edge computing, or IoT systems). *(5 Marks)*

c. Discuss two major challenges in designing distributed systems and suggest mitigation strategies. *(5 Marks)*

d. Analyze the role of scalability in distributed architectures with reference to one of the following: cloud platforms (AWS/Azure), blockchain (Bitcoin), or streaming services (Netflix). *(5 Marks)*

e. How does fault tolerance differ in client-server vs. P2P architectures? Use examples to support your answer. *(5 Marks)*

Question 03 (25 Marks)

In distributed systems, communication models play a crucial role in enabling seamless and secure transactions, such as those performed in Automated Teller Machine (ATM) systems. ATMs rely on efficient, fault-tolerant communication between clients (ATM terminals) and remote banking servers to execute operations like balance inquiries, cash withdrawals, and fund transfers. Different communication paradigms—such as message-passing, Remote Procedure Calls (RPC), and distributed object communication—offer distinct advantages and challenges in terms of reliability, synchronization, and security.

a. Explain how this model could be used for ATM operations like cash withdrawals and highlight one (01) advantage and one (01) limitation. *(5 Marks)*

b. Describe how RPC simplifies ATM-bank server interactions and identify a key challenge it faces. *(5 Marks)*

c. Briefly compare its approach with RPC in handling ATM transactions. *(5 Marks)*

d. Why is synchronization critical for ATM systems? Name one (01) technique (logical or physical) to achieve it. *(5 Marks)*

e. Propose one (01) mechanism to secure ATM communication against fraud. *(5 Marks)*

Question 4 (25 Marks)

a. Explain the challenges of managing shared data in distributed systems. Provide an example of how concurrent access to a shared bank account can lead to race conditions. *(5 Marks)*

b. Compare pessimistic and optimistic locking, highlighting their advantages and disadvantages. Under what scenarios would you prefer optimistic locking? *(5 Marks)*

c. How does timestamp ordering resolve conflicts in distributed transactions? Contrast it with Multiversion Concurrency Control (MVCC) in terms of performance and consistency. *(5 Marks)*

d. Discuss the trade-off between consistency and performance in distributed concurrency control. How does network latency impact protocols like Two-Phase Commit (2PC)? *(5 Marks)*

e. Explain how Google Spanner achieves strong consistency across distributed databases. Give another example (e.g., e-commerce, collaborative editing) where concurrency control is critical. *(5 Marks)*

Question 05 (25 Marks)

a. Define distributed systems and explain their key characteristics. *(5 Marks)*

b. Provide real-world examples of distributed systems and their applications. *(5 Marks)*

c. What are the main challenges in designing and managing distributed systems? *(5 Marks)*

d. Discuss the benefits of distributed systems, including scalability, fault tolerance, and resource sharing. *(5 Marks)*

e. Explain the key design goals of distributed systems. *(5 Marks)*

Question 06 (25 Marks)

a. Define layered architecture models and explain their advantages and disadvantages. *(5 Marks)*

b. Compare the OSI and TCP/IP models in terms of structure, layers, and real-world applicability. *(5 Marks)*

c. What are the key characteristics of modular architecture models, and how do they differ from layered architectures? *(5 Marks)*

d. Explain how microservices architecture improves scalability and maintainability in distributed systems. *(5 Marks)*

e. Discuss the advantages and challenges of cloud-based architectures in modern computing. *(5 Marks)*