



University of Ruhuna – Faculty of Technology
Bachelor of Information & Communication Technology Honours Degree
Level 3 (Semester II) Examination – November/December 2025
Academic Year: 2023/2024

Course Unit: ICT3263 – Distributed Systems and Cloud Computing (Written)

Answer all four (04) questions

Duration: 2 hours

IMPORTANT INSTRUCTIONS

- This paper contains **four (04) questions** on **five (05) pages**.
- The medium of this examination is **English**.
- This is a **closed-book** examination.
- Each question carries **100 marks**.

Question 01

[100 marks]

a) The Faculty of Engineering recently upgraded its product innovation laboratory, where students work on CAD simulations, 3D modelling, and performance analysis tasks. Each student is assigned a high-performance personal computer with a dedicated GPU and a large memory capacity. These computers are connected over the university's local area network (LAN). During project sessions, students use their assigned computers to complete their work. However, during peak hours, a common issue arises: when a student leaves the lab without logging out, their computer remains idle for long periods, while other students who need more processing power could make use of those idle machines.

i) Identify the most suitable Distributed Computing System Model for the above given scenario.

[10 marks]

ii) Justify your answer for the above Part (a)(i) by providing **three (03) reasons** for your selection.

[15 marks]

- b) To support collaborative projects, the laboratory has introduced a Service-Oriented Architecture (SOA). Instead of installing all tools locally, functionalities such as file versioning and thermal simulation modules are provided as reusable services hosted on centralized departmental servers.
- i) List down **four (04)** components of a Service-Oriented Architecture (SOA) and briefly explain each. [16 marks]
 - ii) State **two (02)** characteristics of a Service-Oriented Architecture (SOA). [08 marks]
 - iii) Define the term "**Enterprise Service Bus (ESB)**". [10 marks]
- c) During peak hours, the laboratory experiences problems with shared resources. Assume that computers **A**, **B**, and **C** are requesting resources **R1**, **R2**, and **R3** as follows:
 The computer **A** is requesting **R1** while holding **R2**.
 Simultaneously, the computer **B** is requesting **R3** while holding **R1**.
 Meanwhile, the computer **C** is requesting **R2** while holding **R3**.
- i) Draw a Wait-For Graph for the above scenario. [10 marks]
 - ii) Does the situation create a deadlock? Justify your answer using the Wait-For Graph in Part (c)(i). [11 marks]
 - iii) Define "**Mutual Exclusion**" in distributed systems. [10 marks]
 - iv) Briefly describe how the mutual exclusion problem is resolved in single-computer systems and distributed systems. [10 marks]

Question 02

[100 marks]

- a) "BookWorld Online" is an online bookstore selling books, e-books, and stationery. Its main distribution center is located in Colombo, with regional delivery hubs in major cities across the country. Some functionalities are implemented as reusable services hosted at the main distribution center. The owner plans to develop a RESTful web service to allow customers, sellers, and administrators to interact with the system.
- i) List the components of an HTTP request and briefly explain each. [20 marks]
 - ii) Define the terms "**Statelessness**" and "**Caching**" in the context of RESTful web services. [12 marks]
 - iii) Provide **two (02)** potential drawbacks of statelessness for this system. [08 marks]

b) To improve real-time operations, the owner of bookstore plans to implement socket-based communication among regional delivery hubs. It is a way of connecting two delivery hubs on a network to communicate with each other.

i) Distinguish **two (02)** differences between Stream Sockets and Datagram Sockets. [12 marks]

ii) Examine *Figure Q2 (Socket API)* and identify the correct system calls for blanks **A** to **M**, using the pool of system calls provided. [26 marks]

Pool of System Calls

bind(), close(), connect(), socket(), listen(), read(), write(), accept()

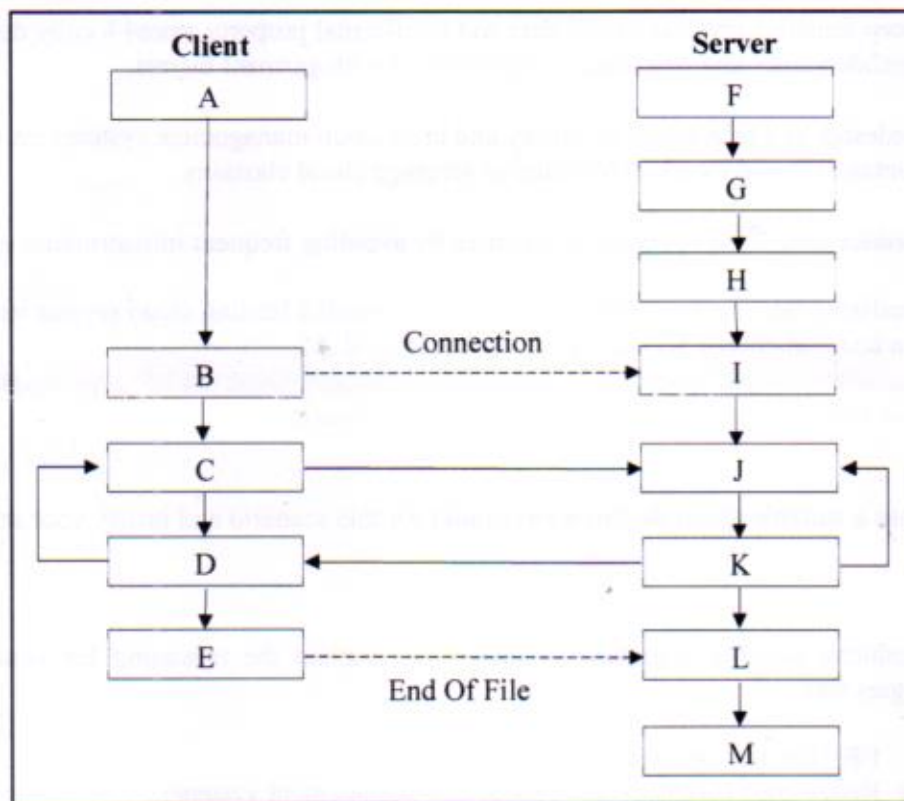


Figure Q2: Socket API

c) The owner of the bookstore plans to move to distributed databases for each regional delivery hub instead of maintaining a centralized database. Each delivery hub may use different database management system types (relational, hierarchical, object-oriented, etc.) with incompatible schemas, software and platforms. Also, each delivery hub may not be aware of other delivery hubs and there is limited co-operation between hubs.

i) Choose a suitable distributed database environment for the bookstore. [08 marks]

ii) Justify your answer for the above Part (c)(i) by explaining **three (03)** characteristics of the selected distributed database environment. [14 marks]

Question 03

[100 marks]

SilverFin Textiles PLC is an international apparel company operating from its headquarters in Kandy, Sri Lanka. The company uses on-premises servers for ERP, payroll, inventory, and product lifecycle management systems, but the infrastructure has not been upgraded for seven years. Due to operational growth, the IT department faces system slowdowns, storage shortages, and security concerns. The management is evaluating migrating systems to the cloud.

They expect to:

- Migrate ERP and payroll systems to the cloud to improve reliability and availability without making major architectural changes.
- Keep sensitive product design data and intellectual property stored locally due to confidentiality and compliance requirements with garment buyers.
- Redesign and migrate its inventory and production management systems into a container-based cloud architecture to leverage cloud elasticity.
- Reduce long-term operational expenses by avoiding frequent infrastructure upgrades.

Before finalizing the migration, the board plans to consult a leading cloud service vendor and establish a comprehensive Service Level Agreement (SLA).

Answer the following questions based on the above scenario:

- a) Propose a suitable **cloud deployment model** for this scenario and justify your selection. [16 marks]
- b) Recommend suitable migration strategies and explain the reasoning for your selected strategies for: [20 marks]
- i) ERP and payroll systems
 - ii) Redesigned inventory and production management systems
- c) Provide **four (04)** important recommendations that should be included in the **Service Level Agreement (SLA)** to ensure secure, reliable, and efficient cloud adoption. [32 marks]
- d) The cloud provider recommends adopting a multi-tenant architecture for cost efficiency and scalability. Evaluate: [32 marks]
- Two (02) advantages
 - Two (02) potential challenges

Question 04

[100 marks]

- a) Compare **Hybrid Cloud** and **Community Cloud** in terms of usage patterns, data ownership, reliability, scalability, and security considerations. [20 marks]
- b) Load balancing techniques fall into **two (02)** main categories. Describe these **two (02)** categories and provide two example algorithms under each. [20 marks]
- c) Explain the key steps involved in the **Live Migration** of a running virtual machine from one host to another without interruption. [30 marks]
- d) Cloud computing evolved through the convergence of multiple technologies. Identify and briefly describe any **three (03)** core technologies that enabled this evolution. [30 marks]

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