



**MASINDE MULIRO UNIVERSITY OF
SCIENCE AND TECHNOLOGY
(MMUST)**

UNIVERSITY EXAMINATIONS

MAIN CAMPUS

2021 / 2022 ACADEMIC YEAR

FOURTH YEAR SECOND SEMESTER EXAMINATIONS

**FOR THE DEGREE
OF**

BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY

COURSE CODE: BIT 422

COURSE TITLE: DISTRIBUTED SYSTEMS

DATE: 20/04/2022

TIME: 8:00-10:00AM

INSTRUCTIONS TO CANDIDATES

Answer questions ONE and any other TWO questions.

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 3 Printed Pages. Please Turn Over. ▶

Question 1 [COMPULSORY-30 MARKS]

- a) Suppose you want to build a simple chat system based on a client-server architecture. Establish whether there is a need for threading in the server and the client. (4marks)
- b) Identify and explain TWO main features the necessitate group communication. (4 marks)
- c) Using suitable examples distinguish between a name server and a directory server. (4 marks)
- d) Explain in detail how the Bully algorithm for electing a leader works. (3marks)
- e) Compare and contrast the concepts of a *message authentication code* and a *digital signature*. (4 marks)
- f) Using a suitable illustration explain what is meant by *Fault masking*. (4 marks)
- g) Identify the characteristics that distinguish *Location* and *Migration* transparency in a distributed system. (3marks)
- h) You know the maximum drift rate of the clocks on two processors and the maximum allowed skew between them. How do you determine the maximum interval between two successive synchronizations between the clocks? (4 marks)

Question 2: 20 MARKS

- a) Compare the following two possible semantics for remote procedure calls:
 i. At least once semantics (4 marks)
 ii. Exactly once semantics.
- b) Remote Method Invocation (RMI): trace the way of a request and of the reply from the client to a remote server and back. Illustrate with a figure. (6 marks)
- c) Demonstrate how connectionless communication between a client and a server proceeds when using sockets. (6marks)
- d) Show that transient synchronous communication has inherent scalability problems. (4 marks)

Question 3: 20 MARKS

- a) Distributed algorithms for solving coordination problems are required to have the properties of safeness and liveness. Explain what it means for a leader election algorithm to have these properties. (6 marks)
- b) In addition to leader election, organizing exclusive access to shared resources is another problem requiring distributed coordination. This problem is often specified as the problem of Mutual Exclusion. Justify this assertion. (4 marks)
- c) Using suitable examples, compare and contrast between external and internal synchronization of physical clocks? (4 marks)
- d) Illustrate how Cristian's algorithm for clock synchronization estimates the time at the receiver? (6 marks)

Question 4: 20 MARKS

- a) Explain why atomic multicast is needed when replication is used. (4 marks)
- b) With examples illustrate the difference between passive and active replication. (6 marks)
- c) Demonstrate how voting protocols for updating replicated data work. (4 marks)
- d) Describe a sender-based scheme for preventing replicated invocations. (6 marks)

Question 5: 20 MARKS

- a) Identify and justify TWO essential aspects of the triple modular redundancy model. (4 marks)
- b) Demonstrate whether or not the triple modular redundancy model can handle Byzantine failures. (4 marks)
- c) Provide any TWO examples of how and where *Fault Tolerance* is applied. (6 marks)
- d) Discuss whether at-least-once semantics or at most once semantics is suitable for the following applications.
- Reading and writing files from a file server.
 - Remote banking
- (6 marks)