



**NAMIBIA UNIVERSITY  
OF SCIENCE AND TECHNOLOGY**

**FACULTY OF COMPUTING AND INFORMATICS  
DEPARTMENT OF COMPUTER SCIENCE**

<b>QUALIFICATION: BACHELOR OF COMPUTER SCIENCE, SYSTEMS ADMINISTRATION</b>	
<b>QUALIFICATION CODE: 07BACS</b>	<b>LEVEL: 6</b>
<b>COURSE NAME: DISTRIBUTED SYSTEMS</b>	<b>COURSE CODE: DTS620S</b>
<b>DATE: November 2023</b>	<b>PAPER: THEORY</b>
<b>DURATION: 2 HOURS</b>	<b>MARKS: 70 (100%)</b>

<b>FIRST OPPORTUNITY EXAMINATION QUESTION PAPER</b>	
<b>EXAMINERS</b>	<b>MS ALBERTINA SHILONGO</b>
<b>MODERATOR</b>	<b>PROF. JOSE QUENUM</b>

<p style="text-align: center;"><b>INSTRUCTIONS</b></p> <ol style="list-style-type: none"><li>1) Answer ALL the questions on the answer scripts provided.</li><li>2) Be guided by the number of marks allocated when answering the questions.</li><li>3) Write clearly and neatly.</li><li>4) Show all your calculations/work.</li><li>5) Number your questions clearly.</li></ol>
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THIS QUESTION PAPER CONSISTS OF 3 PAGES (Including this front page)

### Question 1:

[26 Marks]

- a) Explain why the following systems can be classified as real-world applications of distributed systems? (4)
  - I. Web:
  - II. Civil Aviation:
- b) Why is clock synchronization a key feature in distributed systems? (2)
- c) List and explain various key challenges in designing and managing distributed systems. (8)
- d) Explain the role of middleware in supporting the development of distributed applications and services. (4)
- e) Explain the concept of fault tolerance in distributed systems and discuss various features designed within distributed systems to handle failures. (8)

### Question 2

[20 Marks]

- a) Explain the concept of independent failure in distributed systems. (3)
- b) Group Communication paradigm routes messages via multicast, using various communication protocols; at times the message sent is never received by the receiver; Explain the causes of such scenarios. (3)
- c) If a communication paradigm is asynchronous, is it also time and space uncoupled? motivate your answer with examples as appropriate. (4)
- d) Many of the information resources that are made available and maintained in distributed systems have a high intrinsic value to their users. Their security is therefore of considerable importance. List and explain the 3 security components of any distributed systems (6)
- e) Discuss how the following security challenges can be experienced in distributed systems. (4)
  - I. Denial of service attacks:
  - II. Security of Mobile code:

### Question 3

[24 Marks]

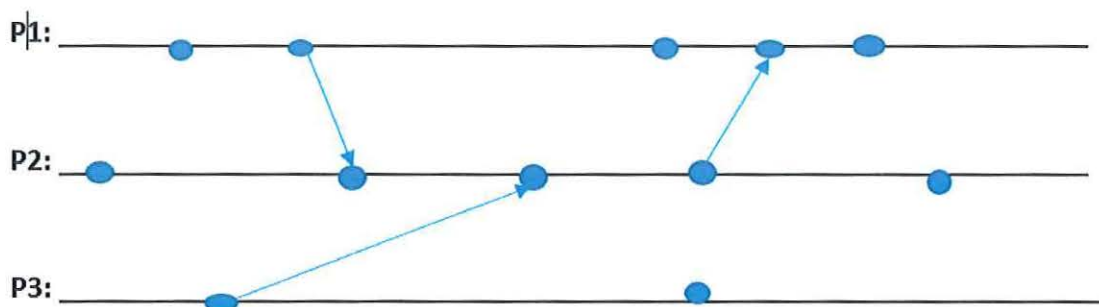
a) Using Java codes, create an application that creates a MulticastSocket class to create UDP multicast sockets to receive datagram packets sent to a multicast IP address and received by another process. The following instruction should guide you, only on the sender side.

(12)

- Objects (MulticastSender and MulticastReceiver)
- Connectionless oriented, the receiver needs to start first.
- On the Multicast receivers
- Specify Class D IP address starting from (225.1.2.3)
- Open any available multicast socket on the UDP port (3456)
- Call the join group method on the multicast socket to join the multicast group.
- Message to be received should be 150 bytes (create an array).
- Create a datagram socket for the expected packets.
- Create and call the receiver method on the Multicast socket to be able to receive the message.
- Display the message that was received.
- Close the socket.

b) Consider **figure 1** below that shows 3 processes (**P1, P2, and P3**) executing in a distributed System with various messages passing between the processes. Assume that initial logical clock values are all initialized to 0.

Using **Vector Clock**, for each event shown in the figure, list all the packet's logic clocks. (12)



*Exam Ends*

*Total 70 Marks*