



PAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF COMPUTING AND INFORMATICS

DEPARTMENT OF COMPUTER SCIENCE

QUALIFICATION: Bachelor of Computer Science	
QUALIFICATION CODE: 07BACS	LEVEL: 6
COURSE: Distributed Systems and Applications	COURSE CODE: DSA621S
DATE: January 2023	SESSION: 2
DURATION: 3 Hours	MARKS: 92

SECOND OPPORTUNITY/SUPPLEMENTARY EXAMINATION QUESTION PAPER	
EXAMINER:	Prof. José G. Quenum
MODERATOR:	Prof. Dharm Singh Jat

This paper consists of 1 page
(excluding this front page)

INSTRUCTIONS

1. This paper contains 5 questions.
2. Answer all questions on the exam paper.
3. Marks/scores are provided at the right end of each question
4. Do not use or bring into the examination venue books, mobile devices and other materials that may provide you with unfair advantage. Should you be in possession of one right now, draw the attention of the examiner officer or the invigilator.
5. NUST examination rules and regulations apply.

PERMISSIBLE MATERIALS

Calculator

Question 1 [12 points]

Consider the following Byzantine Generals problem with seven processes: $P_1, P_2, P_3, P_4, P_5, P_6$ and P_7 . P_1 is the commander and the rest of the processes are its lieutenants. P_1 sends the value 0 to P_2, P_3 and P_4 , while it communicates the value 1 to the other processes. Assuming that processes P_3 and P_6 were also faulty during the algorithm, what is the final decision?

Question 2 [20 points]

Consider a distributed system with twelve (12) processes P_1 to P_{12} . Note that a process with a higher identifier has better resources than one with a lower identifier. Consider the following scenarios during an election algorithm involving the processes:

1. the initiator of the election P_3 , using the ring algorithm 1, crashed during the election phase;
2. process P_{12} crashed after forwarding the election message using the ring algorithm 2.

For each scenario, discuss the outcome of the election

Question 3 [25 points]

Present the architecture of a Hadoop Distributed File System (HDFS) cluster. Discuss in detail the read and write operations using HDFS.

Question 4 [20 points]

- (a) Discuss in detail the read operation in Network File System (NFS) [8]
- (b) Most distributed file systems involve a remote procedure call (RPC) between the client module and the server. Discuss the impact of the call semantics on a write-only scenario. [12]

Question 5 [15 points]

Consider a kafka cluster containing three (03) brokers, CL_1, CL_2 and CL_3 . Each topic contains three (03) partitions with a replication factor of two (02) i.e., each partition is replicated once (on another broker). Using a diagram representing the cluster illustrate how a producer submits messages to the cluster and a consumer group consumes such messages. You will be explicit about how the partitions are handled.

John



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