MANICALAND STATE UNIVERSITY OF APPLIED SCIENCES

FACULTY OF ENGINEERING, APPLIED SCIENCES AND TECHNOLOGY

DEPARTMENT: COMPUTER SCIENCE AND INFORMATION SYSTEMS

MODULE: DATABASE SYSTEMS

CODE: INSY122

SESSIONAL EXAMINATIONS
JUNE 2024

DURATION: 3 HOURS

EXAMINER: MS C KATSANDE

INSTRUCTIONS

1. Answer ALL **questions** in Section A
2. Answer Any **three (3) questions** in Section B
3. Each question carries 25 marks
4. Start a new question on a fresh page
5. Total marks 100

Additional material(s): None

SECTION A

Question 1

a) ERD Case Scenario

A patient is admitted to a hospital with a medical condition. The hospital maintains patients' information. Name, age, sex, DOB, and address are recorded. Hospital identifies each patient by a unique id and creates a patient admission record. Each admission record has an admission number, admission date, and discharge date information. Hospital assigns a doctor to treat a patient. Hospital stores doctor's name, id, specialty and years of experience. Each doctor has multiple patients. A patient is admitted to a ward. Ward is identified by ward number, name, and type (e.g., medical/surgical). Each ward contains multiple beds. Bed has number and type (e.g., side room bed/ open ward bed) as well. If patient needs a surgery the hospital schedule an operation. Operation number, date, time, patient id and doctors' id are required to schedule an operation. We assume multiple doctors participate in an operation.

i) Design an Entity Relationship Diagram (ERD) to capture the above requirements. Make sure cardinalities and primary keys are clear.   [**15 Marks**]

ii) Map the ERD diagram in i) above to create the relational model corresponding to the described application. Clearly define the primary keys and foreign keys.   [**10 Marks]**

SECTION B

Question 2

a) Identify any six (6) limitations of file-based systems, and explain how Relational Database Management Systems (RDBMS) have addressed the limitations.

[12 Marks]

b) Outline any nine (9) functions of a Database Administrator (DBA) in handling a Database Management System (DBMS). **[9 Marks]**

c) Differentiate between logical and physical data independence, and provide two examples of possible changes they allow. **[4 Marks]**

Question 3

a) Explain any three types of transparency that a distributed database system should ideally display. **[9 Marks]**

b) Consider a distributed database system where a customer's information is replicated across three different servers in different regions.
Provide any three advantages and three challenges of this replication strategy.

[**6 Marks**]

c) 'The CAP theorem states that when a network partition occurs, a distributed database system must choose between consistency and availability'. Justify why this choice is necessary, and provide an example of a scenario in which choosing consistency or availability would be the best approach for a distributed database system.

[10 Marks]

Question 4

a) Outline the four properties of a transaction and provide examples to illustrate each
   property.   **[8 Marks]**

b) Explain any three (3) concurrent control protocols that a Database Management
   System (DBMS) can utilise to prevent poor concurrency problems.   **[9 Marks]**

c) Illustrate how the Wait-die and Wound-wait schemes prevent deadlock in the given
   two scenarios.   **[8 Marks]**

	Transaction requesting a lock	**Transaction owning the lock**
Scenario 1	Transaction T1 has a timestamp 1155	Transaction T2 has a timestamp 1350
Scenario 2	Transaction T1 has a timestamp 1350	Transaction T2 has a timestamp 1155

Question 5

a) Identify any five threats to database security faced by organizations and provide one
   preventative measure for each threat.   **[10 Marks]**

b) You are a Database Administrator (DBA) responsible for managing sensitive customer
   data in a large organization. Unexpectedly, a server crash occurs, and your priority is
   to restore the database promptly to minimize the impact on the organization. You have
   three backup options at your disposal: full, differential, and incremental backups. The
   most recent full backup was performed a week ago, differential backups are executed
   daily at midnight, and incremental backups are taken every hour. Based on the
   scenario, which backup type would you select to restore the database, and explain why
   it is the optimal choice for the given scenario. In your response, highlight the
   advantages and limitations of each backup type**.   **[15 Marks]**

END OF EXAMINATION