No. of Printed Pages : **8**

A7-R5.1 : DATABASE TECHNOLOGIES

DURATION : 03 Hours **MAXIMUM MARKS : 100**

OMR Sheet No. :						

Roll No. : | | | | | | |

Answer Sheet No. : | | | | | | |

Name of Candidate : _____ **; Signature of Candidate :** _____

INSTRUCTIONS FOR CANDIDATES :

- Carefully read the instructions given on Question Paper, OMR Sheet and Answer Sheet.
- Question Paper is in English language. Candidate has to answer in English language only.
- There are **TWO PARTS** in this Module/Paper. **PART ONE** contains **FOUR** questions and **PART TWO** contains **FIVE** questions.
- **PART ONE** is Objective type and carries **40** Marks. **PART TWO** is Subjective type and carries **60** Marks.
- **PART ONE** is to be answered in the **OMR ANSWER SHEET** only, supplied with the question paper, as per the instructions contained therein. **PART ONE** is **NOT** to be answered in the answer book for **PART TWO**.
- Maximum time allotted for **PART ONE** is **ONE HOUR**. Answer book for **PART TWO** will be supplied at the table when the Answer Sheet for **PART ONE** is returned. However, Candidates who complete **PART ONE** earlier than one hour, can collect the answer book for **PART TWO** immediately after handing over the Answer Sheet for **PART ONE** to the Invigilator.
- **Candidate cannot leave the examination hall/room without signing on the attendance sheet and handing over his/her Answer Sheet to the invigilator. Failing in doing so, will amount to disqualification of Candidate in this Module/Paper.**
- After receiving the instruction to open the booklet and before answering the questions, the candidate should ensure that the Question Booklet is complete in all respects.

DO NOT OPEN THE QUESTION BOOKLET UNTIL YOU ARE TOLD TO DO SO.

PART - ONE

(Answer all the questions; each question carries ONE mark)

1. Each question below gives a multiple-choice of answers. Choose the most appropriate one and enter in the "OMR" answer sheet supplied with the question paper, following the instructions therein. **(1x10)**

1.1 Which of the following ensures referential integrity in a relational database ?

(A) Primary key

(B) Foreign key

(C) Unique constraint

(D) Check constraint

1.2 In the context of database normalization, which normal form ensures that there are no transitive dependencies ?

(A) 1NF

(B) 2NF

(C) 3NF

(D) BCNF

1.3 Which SQL clause is used to filter the groups of data after they are grouped by the GROUP BY clause ?

(A) WHERE

(B) HAVING

(C) ORDER BY

(D) DISTINCT

1.4 In MariaDB, which of the following operations would result in a table-level lock being applied ?

(A) DELETE

(B) INSERT

(C) ALTER

(D) SELECT

1.5 Which of the following best describes a surrogate key in a relational database ?

(A) A key generated from existing columns in the table

(B) A unique identifier created artificially, not derived from the actual data

(C) A key used to establish foreign key relationships

(D) A key that is automatically updated when the primary key is updated

1.6 In an SQL database, which join operation will include unmatched rows from both tables and fill them with NULL values ?

(A) INNER JOIN

(B) LEFT JOIN

(C) RIGHT JOIN

(D) FULL OUTER JOIN

1.7 In MongoDB, which feature allows you to store multiple documents with different structures in the same collection ?

(A) Indexing

(B) Sharding

(C) Dynamic schemas

(D) Replica sets

1.8 Which type of NoSQL database model is best suited for representing hierarchical relationships ?

(A) Document-based

(B) Graph-based

(C) Key-value based

(D) Column-based

1.9 In a database system, what is the primary function of a view ?

(A) To store data permanently

(B) To simplify complex queries by creating a virtual table

(C) To enhance performance by indexing large datasets

(D) To enforce data integrity through constraints

1.10 Which of the following operations in MongoDB is used to combine documents from multiple collections, similar to SQL JOINs ?

(A) $lookup

(B) $group

(C) $merge

(D) $match

2. Each statement below is either TRUE or FALSE. Choose the most appropriate one and enter your choice in the "OMR" answer sheet supplied with the question paper, following the instructions therein.

(1x10)

2.1 A database is a collection of related data that is organized to be easily accessed, managed and updated.

2.2 In a DBMS, Physical Data Independence ensures that changes to the physical schema affect only the conceptual schema.

2.3 In a relational database, a foreign key uniquely identifies a row within its own table.

2.4 The 1NF (First Normal Form) ensures that there are no partial dependencies in a relation.

2.5 In MariaDB, the UPDATE statement is used to add new records to a table.

2.6 In SQL, the GROUP BY clause is used to group the result-set by one or more columns and is typically used with aggregate functions.

2.7 NoSQL databases are always better than relational databases for handling structured data with complex relationships.

2.8 In MongoDB, the $group pipeline operation in the aggregation framework is used to group documents by a specified field.

2.9 In an RDBMS, Codd's Rule states that every relation must have at least one foreign key to maintain referential integrity.

2.10 When selecting a database, a NoSQL database is ideal for applications requiring high scalability and handling unstructured or semi-structured data.

3. **Match words and phrases in column X with the closest related meaning/word(s)/phrase(s) in column Y. Enter your selection in the "OMR" answer sheet supplied with the question paper, following the instructions therein.** **(1x10)**

X		Y	
3.1	A software that manages databases and provides data access control.	**A.**	Foreign Key
3.2	A NoSQL database that uses collections and documents for data storage.	**B.**	SELECT
3.3	The process of organizing data into tables to minimize redundancy.	**C.**	ACID Properties
3.4	A key used to establish a link between two tables.	**D.**	Primary Key
3.5	A structure that describes how data is organized in a database.	**E.**	E-R Diagram
3.6	The SQL command used to retrieve data from a database table.	**F.**	MongoDB
3.7	A type of database that allows for flexible data models and is schema-less.	**G.**	Logical View
3.8	A method of enhancing query performance by creating a data structure that improves retrieval speed.	**H.**	SQL Functions
3.9	The architecture level that provides a user-specific view of the database.	**I.**	NoSQL Database
3.10	A diagram used to represent the relationships between entities in a database.	**J.**	Database Schema
		K.	Indexing
		L.	Normalization
		M.	Relational Model

4. Each statement below has a blank space to fit one of the words (s) or phrase(s) in the list below. Enter your choice in the "OMR" answer sheet supplied with the question paper, following the instructions therein. (1x10)

A	Relational	**B**	UPDATE	**C**	Aggregation
D	DOMAIN	**E**	DELETE	**F**	Relationship
G	ACID	**H**	Constraint	**I**	three-schema
J	Multivalued attribute	**K**	primary key	**L**	Normalization
M	DROP				

4.1 The _____ command in SQL is used to permanently remove data from a table, while keeping the structure intact.

4.2 In a relational database, a _____ is a unique identifier for a record in a table.

4.3 _____ is a three-step technique that places the data model into first normal form, second normal form and third normal form.

4.4 The _____ architecture model consists of three levels : external, conceptual, and internal.

4.5 In SQL, the command used to modify existing records in a database table is _____.

4.6 The _____ model is used to define the structure of a relational database and the relationships between its tables.

4.7 A _____ is a set of all possible data values.

4.8 The process of ensuring that a database remains consistent, isolated, and durable in the event of a failure is known as the _____ property.

4.9 In an E-R diagram, a _____ represents an entity's attribute and can hold multiple values.

4.10 The _____ command in SQL is used to remove a table from the database completely.

PART - TWO

(Answer any FOUR questions)

5. (a) Critically analyse the role of a Database Management System (DBMS) in ensuring data integrity and security. Discuss the mechanisms that a DBMS employs to maintain these aspects, citing examples of potential vulnerabilities that could arise in the absence of a DBMS.

(b) Discuss the implications of data independence in database systems. Analyse the impact of logical and physical data independence on database schema evolution and how it affects application development over time.

(7+8)

6. (a) Evaluate the challenges and limitations of the relational model. Discuss scenarios where the relational model might fail to adequately represent complex data relationships and how alternative database models (like NoSQL) can overcome these challenges.

(b) Explain the significance of Codd's rules in the context of relational database design. Critically assess how adherence to these rules can influence a relational database system's performance, reliability, and usability.

(7+8)

7. (a) Design a database schema for a real-world application of your choice, ensuring that it adheres to the principles of normalization. Justify your choices of normalization forms (upto 5NF) and discuss the trade-offs involved in the normalization process.

(b) Provide a detailed critique of the Entity-Relationship (E-R) model as a database design tool. Discuss its strengths and weaknesses, particularly in the context of complex relationships and advanced data structures.

(7+8)

8. (a) Compare and contrast the transaction management features of MariaDB with those of other relational databases like MySQL or PostgreSQL. Discuss the implications of transaction isolation levels and their effect on data consistency in concurrent environments.

(b) Discuss the implementation of indexing in MariaDB. Evaluate the performance trade-offs involved with different types of indexes (e.g., single-column vs. composite indexes) and discuss when it is appropriate to use each type.

(7+8)

9. (a) Explore the architectural design of NoSQL databases, specifically focusing on MongoDB. Discuss how its architecture supports horizontal scalability and flexibility in handling semi-structured and unstructured data, and provide examples of applications where these features are advantageous.

(b) Critically analyse the implications of data consistency models in NoSQL databases. Discuss how eventual consistency differs from strong consistency and evaluate their impact on application development and user experience.

(7+8)

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