**Topic 2- Database Environments**

**Tutorial Questions**

1. Describe the concept of database schema and explain the three types of schema in a database.

The overall description of a database is database schema. The three types of database schema are Physical / Internal, Logical / Conceptual / View / External

1. What is a data model? What are the three main components of a data model?

It is a framework that organizes data. The three main components are:  
Structural, Manipulative and Constraints

1. What functions and services would you expect a multi-user DBMS provide?

Concurrency Control, Security and Access Control, Backup and Recovery, Data Integrity and Consistency, and Transaction Management.

1. Which functions and services would not be required for a standalone PC DBMS?

Concurrency Control, Security and Access Control, and Transaction Management.

1. Describe the function a system catalogue. What are the benefits of having a system catalog?

It gives extra information about the data which helps to organize it. It is the metadata which provides data about the data itself. It stores table definitions, columns, indexes, constraints. It supports query optimization. It helps to enforce data integrity and security. Overall, it improves efficiency, consistency, and management of database.

1. What is the difference between DDL and DML?

DDL stands for Data Definition Language where as DML stands for Data Manipulation Language. DDL allows the Database Administrator to describe entities, attributes, relationships. It also contains constraints and integrated security like validation and prevention of sql injection.

1. Name three record-based data models. Discuss the main differences between these data models.

Hierarchical, Network, Relational

Practical :

**1️ Database Schema**

**Icebreaker:** “If a database was a city, what would the *schema* represent?”  
(→ The blueprint or map of how everything is organized!)

**Task:** Draw a simple schema of your classroom (tables = students, subjects, teachers).

**Explain:**

* **Physical Schema** – how data is actually stored.
* **Logical Schema** – the structure of the data (tables, relationships).
* **View Schema** – how different users see the data (customized perspectives).

If the database was about a classroom, I will have this database schema.

**Physical:**

Relational DBMS like SQL

These are the data and their format in which these data will be stored.

Student Table:

Student ID: Integer

Student Name: String

Email: String

Date of Birth: Date

Enrolled Course ID: Integer

Enrolled Course Name: String

Subjects: Array of Integers

Payment Details: String

Subjects Table:

Subject Name: String

Subject ID: Integer

Subject Description: String

Subject Credits: Integer

Teachers Table:

Teacher ID: Integer

Teacher Name: String

Email: String

Date of Birth: Date

Registered Course IDs: Integer

Registered Course Names: String

Subjects: Array of Integers

Payment Details: String

**Logical:**

Table: Student

Primary Key: Student ID

Foreign Key: Subject ID

Table: Subjects

Primary Key: Subject ID

Table: Teachers

Primary Key: Teacher ID

Foreign Key: Subject ID

Attributes: Listed in the Physical Layer for each table

These are the fields the city table will have.

**View:**

The data representation of the student users.

First the display of student name under that course names will be displayed with credits assigned for the course.

Accordingly, there will be a list of subjects. Under the subjects there will be information about subject.

The data representation of the teacher users.

First the display of teacher name under that course names will be displayed with credits assigned for the course.

Accordingly, there will be a list of subjects. Under the subjects there will be information about subject.

The data representation of subjects:

First the subject name with subject credits and subject id as subject code.

Then there will be description of the subject.

**2️ Data Model**

**Analogy:** “Imagine explaining Instagram’s database to a 5-year-old. What would you show first?”

**Explain:** A data model is a **framework** that organises data.

**Three Components:**

* + **Structural** – how data is organized (tables, objects).
  + **Manipulative** – how you work with data (queries, updates).
  + **Constraints** – the rules (no duplicate usernames, etc.).
* **Quick Activity:** Classify everyday examples: *contacts app*, *Spotify playlists*, *Amazon orders* into structural / manipulative / constraints.

**Instagram’s database data model:**

**Structural:**

There are tables of users, admins, posts, likes, comments.

The objects are described respectively.

Users – Their Name, Email, Id, Password

Admins - Their Name, Email, Id, Password

Posts – Post ID, The Post’s Data, Likes, Poster\_User\_Id,

Likes – Likes, Liker\_User\_Id, Liked\_Post\_ID

Comments - Comments, Commenter\_User\_Id, Commented\_Post\_ID

**Manipulative:**

The user has posted a photo a new row with the post details will be added into the Posts Table.

**Constraints:**

The user wants to make a post there must be a media or text to publish a post. Without these fields the data will not add inside the post table

MCQ **Questions**

1. **What does a database schema define?**
   * A) The physical storage of data.
   * B) The structure of the database, including tables and relationships.
   * C) The security measures for data access.
   * D) The application logic used to manipulate data.
2. **Which of the following is NOT one of the three types of database schemas?**
   * A) Conceptual Schema
   * B) Logical Schema
   * C) Physical Schema
   * D) Operational Schema
3. **What is a data model?**
   * A) A programming language for databases.
   * B) A theoretical representation of data structures.
   * C) A type of database management system.
   * D) A set of rules for data encryption.
4. **Which of the following are the three main components of a data model?**
   * A) Data types, Data integrity, Data storage
   * B) Entities, Attributes, Relationships
   * C) Tables, Views, Indexes
   * D) Users, Permissions, Transactions
5. **Which function is typically provided by a multi-user DBMS?**
   * A) Data entry only
   * B) Concurrency control
   * C) Single user access
   * D) Data backup only
6. **Which of the following functions is NOT typically required for a standalone PC DBMS?**
   * A) User authentication
   * B) Multi-user access
   * C) Data integrity constraints
   * D) Backup and recovery
7. **What is the function of a system catalog in a database?**
   * A) To store user data
   * B) To provide metadata about database objects
   * C) To manage network connections
   * D) To enforce data security
8. **What is one major benefit of having a system catalog?**
   * A) Increased storage capacity
   * B) Enhanced query performance
   * C) Simplified database administration
   * D) Automated data backup
9. **What does DDL stand for?**
   * A) Data Definition Language
   * B) Data Distribution Language
   * C) Database Development Language
   * D) Data Delivery Language
10. **What is the primary difference between DDL and DML?**
    * A) DDL is for querying data, DML is for defining data structures.
    * B) DDL is used to manipulate data, DML is for database design.
    * C) DDL is for defining database schemas, DML is for data manipulation.
    * D) DDL is used for user permissions, DML is for system administration.