

# **DATABASE MANAGEMENT SYSTEM (DBMS)**

## **Organized Notes**

Prepared for Students

## 1. Introduction to DBMS

A Database Management System (DBMS) is software that manages data and allows users to store, modify, and retrieve information efficiently. It acts as an interface between the database and its users or application programs. It ensures data integrity, security, and concurrency.

## 2. Characteristics of DBMS

- Provides abstraction and data independence.
- Multiple views of the same data.
- Ensures data integrity and security.
- Concurrency control for multi-user access.
- Backup and recovery support.
- Minimizes redundancy.

## 3. Types of DBMS

- Hierarchical DBMS: Organizes data in tree structures.
- Network DBMS: Uses graph structures for relationships.
- Relational DBMS (RDBMS): Data stored in tables (rows and columns).
- Object-Oriented DBMS: Supports objects, classes, inheritance.
- NoSQL DBMS: Deals with unstructured and large-scale data.

## 4. Database Models

A database model defines the logical structure of data. Common models include:

- Hierarchical Model
- Network Model
- Relational Model
- Entity-Relationship Model
- Object-Oriented Model

## 5. Relational Database Concepts

- Table (Relation): Collection of rows and columns.
- Tuple: A single row.
- Attribute: A column.
- Primary Key: Uniquely identifies rows.
- Foreign Key: References primary key in another table.
- Schema: Structure/definition of a database.

## 6. Entity-Relationship (E-R) Model

The E-R model helps in designing databases conceptually.

- Entities: Real-world objects (e.g., Student, Course).
  - Attributes: Properties of entities.
  - Relationships: Associations between entities.
- Represented using E-R diagrams with rectangles, ovals, and diamonds.

## 7. Normalization

Normalization is the process of minimizing redundancy:

- 1NF: Remove repeating groups.
- 2NF: Remove partial dependencies.
- 3NF: Remove transitive dependencies.
- BCNF: Stronger form of 3NF.

Helps in reducing anomalies in insert, update, and delete.

## 8. Structured Query Language (SQL)

SQL is used for interacting with databases:

- DDL: CREATE, DROP, ALTER.
- DML: INSERT, UPDATE, DELETE.
- DQL: SELECT.
- DCL: GRANT, REVOKE.
- TCL: COMMIT, ROLLBACK, SAVEPOINT.

## 9. Transactions and Concurrency Control

A transaction is a sequence of operations as one logical unit.

ACID properties:

- Atomicity: All or nothing.
- Consistency: Valid state after execution.
- Isolation: Transactions do not interfere.
- Durability: Changes persist permanently.

Concurrency control techniques: Locking, timestamps, multiversion.

## 10. Database Security

Security protects data from unauthorized access.

- User authentication & authorization.
- Data encryption.
- Privilege management (GRANT, REVOKE).
- Backup and recovery mechanisms.

## 11. Advantages of DBMS

- Data sharing and integration.
- Reduced redundancy.
- Improved data security.
- Backup and recovery.
- Data consistency and integrity.

## 12. Disadvantages of DBMS

- High cost of hardware/software.
- Complexity in design.
- Performance overhead.
- Requires technical expertise.
- Failure affects entire system.

## **13. Conclusion**

DBMS is vital for managing structured and unstructured data. It ensures reliability, security, and efficiency. With advancements in Big Data, Cloud, and AI, DBMS continues to evolve to meet modern challenges.