Database Management System (DBMS) - Complete Notes

1. Introduction to DBMS

A Database Management System (DBMS) is software that interacts with users, applications, and the database itself to capture and analyze data.

It allows for data to be defined, stored, and manipulated efficiently.

Examples: MySQL, Oracle, SQL Server, PostgreSQL.

Key Characteristics:

- Data Abstraction
- Data Independence
- Efficient Data Access
- Data Integrity and Security
- Data Administration

2. DBMS Architecture

DBMS architecture can be seen as either single-tier or multi-tier.

1. Single Tier Architecture: The database is directly accessible to the user.
2. Two-Tier Architecture: Application on client side communicates with the database server.
3. Three-Tier Architecture:
   - Tier 1: Client (presentation layer)
   - Tier 2: Application Server (business logic)
   - Tier 3: Database Server (data storage and access)

3. Data Models

A data model defines how data is connected to each other and how they are processed and stored.

Types:

- Hierarchical Model
- Network Model
- Relational Model

- Object-Oriented Model

4. Relational Model

The Relational Model represents data in tables (called relations).

Key Terminologies:

- Relation: Table
- Tuple: Row
- Attribute: Column
- Domain: Possible values for a given attribute

Keys:

- Primary Key
- Foreign Key
- Candidate Key
- Super Key

5. SQL (Structured Query Language)

SQL is used to communicate with the database.

Types of SQL commands:

- DDL (Data Definition Language): CREATE, ALTER, DROP
- DML (Data Manipulation Language): SELECT, INSERT, UPDATE, DELETE
- DCL (Data Control Language): GRANT, REVOKE
- TCL (Transaction Control Language): COMMIT, ROLLBACK

6. Normalization

Normalization is the process of organizing data to reduce redundancy and improve data integrity.

Normal Forms:

- 1NF: Eliminate repeating groups
- 2NF: Eliminate partial dependency
- 3NF: Eliminate transitive dependency
- BCNF: A stronger version of 3NF

7. Transactions and Concurrency Control

Transaction: A unit of work that is performed against a database.

ACID Properties:

- Atomicity
- Consistency
- Isolation
- Durability

Concurrency Control: Ensures correct execution of transactions in multi-user environments.

Techniques:

- Lock-based Protocol
- Time-stamp Protocol
- Validation-based Protocol

8. Indexing

Indexing is a data structure technique used to quickly retrieve records from a database file.

Types:

- Primary Index
- Secondary Index
- Clustered Index
- Non-clustered Index

Database Management System (DBMS) - Complete Notes

9. ER Model

The Entity-Relationship (ER) Model is a high-level conceptual data model.

Key Concepts:

- Entity: Object with a physical or conceptual existence
- Attribute: Properties of an entity
- Relationship: Association among entities

ER Diagrams are used for database design.

10. DBMS vs RDBMS

DBMS:

- Stores data as files
- No support for relationships between tables
- Less secure

RDBMS:

- Stores data in tabular form
- Supports relationships using foreign keys
- More secure and scalable