# DATABASE MANAGEMENT SYSTEM

**ENCT 301**

**Lecture : 3** **Year : III**
**Tutorial : 1** **Part : I**
**Practical : 3**

**Course Objectives:**
The objective of this course is to provide a comprehensive understanding of the principles and practices involved in the design and implementation of database systems. It enables students to develop data models, and perform data modification, processing, and management efficiently. The course also introduces advanced concepts such as object-oriented databases, data warehousing, data processing, and big data management.

## 1 Introduction (3 hours)

1.1 Application and evolution of database
1.2 Data abstraction (Physical, logical, and view level) and data independence
1.3 Schema and instances

## 2 Data Models (7 hours)

2.1 Introduction to data models (Entity-relationship, relational, object model, hierarchical, network, graph data models)
2.2 E-R model
  2.2.1 Entities and entity sets
  2.2.2 Attributes and keys
  2.2.3 Strong and weak entity sets
  2.2.4 Relationship and relationship sets (Mapping cardinalities)
  2.2.5 Specialization, generalization and aggregation
2.3 Relational model
  2.3.1 Concept of relational model, key constraints
  2.3.2 Converting ER model into relational model

## 3 Relational Query Languages (7 hours)

3.1 Relational algebra
3.2 Concept of DDL, DML and DCL
3.3 Overview of the SQL query language-DDL and DML queries
3.4 Set operations
3.5 Aggregate functions – GROUP BY – HAVING

3.6 Joins and types of joins
3.7 Nested sub queries
3.8 Database modification (Insert, update, delete)
3.9 Views
3.10 Triggers and stored procedures
3.11 Privilege and roles management – GRANT and REVOKE statements

**4 Database Constraints and Normalization (6 hours)**

4.1 Integrity constraints and domain constraints
4.2 Assertions
4.3 Functional dependencies
4.4 Different normal forms (1NF, 2NF, 3NF, BCNF)

**5 Query Processing and Optimization (4 hours)**

5.1 Query processing, optimization and evaluation
5.2 Transformation of relational expressions
5.3 Techniques of implementing query optimization - Cost based optimization and heuristic optimization
5.4 Query evaluation -Materialization and pipelining
5.5 Denormalization for performance
5.6 Materialized view
5.7 Performance tuning

**6 File Structure and Hashing (5 hours)**

6.1 Disks and storage
6.2 Records organizations
6.3 Ordered indices
6.4 B+ tree index
6.5 Hashing concepts - Static and dynamic hashing

**7 Transaction Processing and Concurrency Control (5 hours)**

7.1 Transaction and transaction model - State diagram
7.2 Acid properties
7.3 Concurrent execution of transactions
7.4 Serializability (Conflict and view serializability)
7.5 Lock based protocols
7.6 Deadlock handling and prevention
7.7 Multiple granularity

**8 Crash Recovery (4 hours)**

8.1 Failure classification
8.2 Recovery and atomicity

8.3 Log-based recovery
8.4 Shadow paging
8.5 High availability using remote backup systems

**9 Advanced Database Concepts (4 hours)**

9.1 Concept of object-oriented databases
9.2 Distributed database model
9.3 Concept of data warehousing and online analytical processing
9.4 Basic concepts of NoSQL and big data

**Tutorial (15 hours)**

1. Designing ER model for sample cases
2. Converting an ER diagram to a relational schema
3. Practice with simple relational algebra queries
4. Insert, update and delete with relational algebra queries using assignment operator
5. Executing DDL commands to create a database, define primary and foreign key constraints
6. Simple queries with SELECT and filtering
7. Complex queries with joins and sub-queries
8. Aggregating data with GROUP BY and HAVING
9. Database manipulation with INSERT, UPDATE and DELETE queries
10. Creating and using views
11. Creating users, roles and using GRANT and REVOKE statements
12. Triggers and stored procedures
13. Identifying functional dependencies and normal forms
14. Decomposing a table into BCNF and 3NF
15. Introduction to NoSQL databases with MongoDB

**Practical (45 hours)**

1. Database server installation and configuration
2. DB client installation and connection to DB server. Introduction and practice with SELECT command with the existing DB
3. Further practice with DML queries – Select, insert, update and delete
4. Advanced queries with joins and subqueries
5. Aggregation and grou8ping
6. Practice with DDL commands – Create/alter/drop table, integrity constraints and views
7. Triggers and stored procedures
8. Query processing, optimization, performance tuning and database administration
9. Group project work

**Final Exam**

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

| Chapter | Hours | Marks distribution* |
|---|---|---|
| 1 | 3 | 3 |
| 2 | 7 | 9 |
| 3 | 7 | 9 |
| 4 | 6 | 9 |
| 5 | 4 | 6 |
| 6 | 5 | 8 |
| 7 | 5 | 8 |
| 8 | 4 | 4 |
| 9 | 4 | 4 |
| Total | 45 | 60 |

* There may be minor deviation in marks distribution.

**References**


1. Silberschatz, A., Korth, H.F., Sudarshan, S. (2019). Database system concepts. McGraw-Hill.
2. Elmasri, R., Navathe, S.B. (2021). Fundamentals of database systems. Pearson.
3. Ramakrishnan, R., Gehrke, J. (2002). Database management systems. McGraw-Hill.
4. Connolly, T.M., Begg, C.E. (2021). Database systems: A practical approach to design, implementation, and management. Pearson.