

# **Intermediate: Database Management**

# **Description:**

This intermediate-level course dives deep into the fundamentals and advanced concepts of database systems. You will learn how to design, manage, and optimize databases using both **relational** (SQL-based) and **non-relational** (NoSQL) technologies. The course covers **MySQL** and **PostgreSQL** for structured data, and **MongoDB** and **Firebase** for unstructured or real-time data. Emphasis is placed on data modeling, performance tuning, and integration into real-world applications.

# **Learning Outcomes:**

By completing this course, students will:

- Understand the concepts and differences between relational and non-relational databases.
- Gain fluency in writing SQL queries for data retrieval, manipulation, and schema design.
- Model scalable and normalized relational databases.
- Use MongoDB for document-based storage and Firebase for real-time data handling.
- Apply indexing and optimization strategies for performance tuning.
- Integrate databases with web applications using appropriate tools and libraries.

# **Course Duration:**

- Total Duration: 6 Weeks
- Sessions per Week: 2 sessions
- Session Duration: 1.5 hours each
- **Total Contact Hours:** 18 hours (plus optional assignments and practice)

## **6-Week Course Plan:**

### Week 1: Introduction to Databases & SQL

#### **Topics Covered:**

- Relational vs. Non-relational databases
- Introduction to RDBMS concepts
- MySQL/PostgreSQL installation & setup
- Basic SQL syntax: SELECT, INSERT, UPDATE, DELETE

#### **Deliverables:**

- SQL practice exercises
- Simple relational schema design

### Week 2: Advanced SQL & Data Modeling

#### **Topics Covered:**

- Normalization: 1NF to 3NF
- Entity-Relationship (ER) diagrams
- Joins, subqueries, and aggregate functions

• Constraints and transactions

#### **Deliverables:**

- Normalized database schema for a sample app
- SQL queries covering joins and aggregations

### Week 3: PostgreSQL and Optimization

#### **Topics Covered:**

- PostgreSQL-specific features
- Indexing strategies
- Query optimization and EXPLAIN
- Backup and restore

#### **Deliverables:**

- Indexed PostgreSQL schema
- Performance-optimized queries

### Week 4: Introduction to NoSQL and MongoDB

#### **Topics Covered:**

- NoSQL concepts and types
- Document-based databases (MongoDB)
- CRUD operations in MongoDB
- Schema-less vs schema design in MongoDB

#### **Deliverables:**

• MongoDB data model

• Mini project: Data storage with MongoDB

### Week 5: Firebase & Real-Time Databases

#### **Topics Covered:**

- Firebase Realtime Database & Firestore
- JSON data structure
- Real-time syncing and listener setup
- Security rules and authentication basics

#### **Deliverables:**

- Firebase app connected to a frontend
- Real-time data sync feature

### Week 6: Integration Project & Performance

#### **Topics Covered:**

- Integrating SQL/NoSQL databases with web apps
- Use cases and best practices
- Data security and access control
- Final project: Choose and build with appropriate DB stack

#### **Deliverables:**

- Full-stack mini app using either SQL or NoSQL
- Project hosted and presented with documentation

# **Final Deliverables:**

- Working project with SQL or NoSQL database integration
- ER diagrams and schema documentation
- SQL scripts or MongoDB collections
- GitHub repository with code and project notes
- CodeHills Certificate of Completion

# **Course Fees (Pakistan):**

• Standard Fee: PKR 15,000