

## Teaching Guidelines for Database Technologies PG-DAC February 2025

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**Duration:** 72 hours (36 theory hours + 36 lab hours)

**Objective:** To introduce students to RDBMS and NoSQL Databases and facilitate hands-on experience on SQL (using MySQL) and MongoDB.

**Prerequisites:** Working knowledge of Windows and Linux, familiarity with programming.

**Evaluation:** 100 Marks

**Weightage:** CCEE – 40%, Lab exam – 40%, internals – 20%

**Text Book:**

- Murach's MySQL by Joel Murach / Shroff Publisher

**References:**

- Database System Concepts by Abraham Silberschatz, Henry Korth and S. Sudarshan / McGraw Hill
  - Database Design and Relational Theory: Normal Forms and All That Jazz by C. J. Date (Author) / O'Reilly
  - Fundamentals of Database System by Shamkant B. Navathe, Ramez Elmasri / Pearson
  - MySQL: The Complete Reference by Vikram Vaswani / McGraw Hill
  - SQL & NoSQL Databases: Models, Languages, Consistency Options and Architectures for Big Data Management by Andreas Meier and Michael Kaufmann / Springer
  - MongoDB: The Definitive Guide by Shannon Bradshaw, Eoin Brazil and Kristina Chodorow / O'Reilly
  - <http://bigdata.stratebi.com/?language=en>
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(Note: Each Lecture and Lab Session is of 2 hours)

**Session 1:**

**Lecture**

Introduction to DBMS, Basic Database Terminology

Types of DBMS: Relational, Object Relational and NoSQL Databases

Introduction to MySQL, MySQL Clients (Monitor, Shell, Workbench)

**Lab**

Using MySQL Monitor, Shell, and Workbench

**Session 2:**

**Lecture**

Data Models (Conceptual, Logical, Physical)

Database Design, Entity-Relationship Diagram (ERD)

Codd's 12 rules for RDBMS

Introduction to SQL, Categories of SQL Commands: DDL, DML, DCL, DTL/TCL

DDL (CREATE/ALTER/DROP/TRUNCATE)

**Lab**

Performing basic CREATE, ALTER, DROP Commands

**Sessions 3 & 4:****Lecture**

Data Redundancy, Data Anomalies, Functional Dependency

Normalization, Need for Normalization

Normal Forms (1st NF, 2nd NF, 3rd NF, BCNF) with examples, Introduction to 4th and 5th NF

DML (INSERT/UPDATE/DELETE)

**Lab (2 hours)**

DML (INSERT/UPDATE/DELETE), TRUNCATE

**Session 5:****Lecture**

MySQL Data Types, Database Constraints (Primary Key, Unique, Not Null, Foreign Key, Default, Check\*)

Aggregate Functions, Grouping Things Together (Group By, Having)

LIKE Operator, DISTINCT, Sorting (Order by clause)

BETWEEN... AND Operators, Comparing Nulls (IS NULL/IS Not NULL), IN/NOT IN

**Lab**

Defining Data Types for Columns

Creating, Altering, Dropping Constraints

Aggregate Functions: SUM(), AVG(), COUNT(), MAX(), MIN(), COUNT(), Group By, Having Clause

Using Like, Distinct, Order By, Between...And

Comparing Nulls, Using IN/Not-In

**Session 6:****Lecture**

Relational Algebra Operations (Selection, Projection, Union, Intersect\*, Minus\*, Cross/Cartesian)

Joins (Eqvi, Inner, Outer, Natural, Cross), SQL Standard Syntax for Joins

Copying table structure/data, Sequences (AUTO\_INCREMENT)

**Lab**

Union/Union ALL

Queries on Various type of Joins using OLD and SQL Standard Syntax

Copying table structure, Copying data from one table to another

Using AUTO\_INCREMENT

**Session 7:****Lecture**

Subquery, Correlated Subquery, EXISTS/NOT EXISTS

TCL Commands (Commit/Rollback/Savepoint), DCL Commands (GRANT/REVOKE/GRANT OPTION)

Views, Types of Views, Simple and Complex Views

**Lab**

Subqueries, Correlated Queries

Using Exists/Not-Exists

Using Commit/Rollback/Savepoint

Granting/revoking privileges on database objects

Creating Views, Querying using Views

Creating Indexes

Creating Temporary Tables

**Session 8:****Lecture**

Indexes, Benefit of Indexes, Type of Indexes, Temporary Tables  
ACID Properties, Concept of Database Instance and Schema  
MySQL Storage Engines (InnoDB, MyISAM and others),

**Lab**

Indexes, Temporary Tables  
All other SQL Commands Revision

**Session 9:****Lecture**

Introduction to MySQL Programming, Use of MySQL Programs,  
Introduction to Stored Procedures, Benefits of Stored Procedures  
Procedure Parameters (IN, OUT and INOUT).

**Lab**

Creating procedure without parameters  
Creating Procedure with (IN/OUT/INOUT) Parameters

**Session 10:****Lecture**

Flow Control Statements (LOOP, WHILE and REPEAT)  
Using above statements in Stored Procedures/Functions  
Conditional Statements (IF, IF-ELSE-THEN, SWITCH CASE)  
Example of each type of statement

**Lab**

Use of flow control statement in Stored Procedure  
Use of conditional statements in Stored Procedure

**Session 11:****Lecture**

Loop constructs (ITERATE, LEAVE)  
Functions with and without parameters  
MySQL Built-in functions (string, numeric, date etc.)

**Lab (4 hours)**

Creating Function and returning value from it  
Use of built-in functions in queries

**Session 12:****Lecture**

Cursors (Asensitive, Insensitive, Read only, Nonscrollable)  
Cursors example and real time use

**Lab:**

Writing procedures with Declare, fetch and close cursor  
Example of each type of cursors

**Session 13:****Lecture**

Triggers (BEFORE, AFTER), New and Old trigger variables

Trigger Examples and real time use

**Lab**

Create Before Triggers

Create After Triggers

**Session 14:****Lecture**

Error Handling and Exceptions, Types of Handler Actions, How to write Handler

Defining and handling exceptions in Stored Procedures and Functions

**Lab**

Exception handling in Stored Procedure

Exception handling with various handler actions

**Session 15:****Lecture**

Introduction to NoSQL database, Features of NoSQL Database

Structured vs. Semi-structured and Unstructured Data

Difference between RDBMS and NoSQL databases

CAP Theorem, BASE Model

Categories of NoSQL Databases: Key-Value Store, Document Store, Column-Oriented, Graph

**No Lab****Session 16, 17, 18:****Lecture**

Introduction to MongoDB, Features of MongoDB

MongoDB command interface and MongoDB compass

MongoDB Documents & Collections

RDBMS & MongoDB analogies: relations/tables => collections; tuples/records => documents

JSON and BSON documents

Performing CRUD (CREATE, READ, UPDATE, DELETE) Operations, UPSERT

MongoDB – Operators, Sorting, Indexing

**Lab (8 hours)**

Using MongoDB Shell and Compass

Creating database, Connecting to a database, Creating Collections

Performing CRUD operations

MongoDB: Complex Read Using Operators, Sorting Operations, Creating Indexes