Teaching Guidelines for **Database Technologies** PG-DAC September 2023

**Duration: 72 hours** (32 theory hours + 32 lab hours + 8 revision/practice 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>

(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

# Session 3:

**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

DML (INSERT/UPDATE/DELETE), TRUNCATE

# Session 4:

**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 5:

**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 6:

**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 7:

**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 8:

**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 9:

**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 10:

**Lecture**

Loop constructs (ITERATE, LEAVE) Functions with and without parameters

MySQL Built-in functions (string, numeric, date etc.)

# Lab

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

# Session 11:

**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 12:

**Lecture**

Triggers (BEFORE, AFTER), New and Old trigger variables Trigger Examples and real time use

# Lab

CreateBefore Triggers Create After Triggers

# Session 13:

**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 14:

**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 Introduction to MongoDB, Features of MongoDB

MongoDB command interface and MongoDB compass

# Lab

Using MongoDB Shell and Compass

# Session 15 & 16:

**Lecture**

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:

Creating database, Connecting to a database, Creating Collections Performing CRUD operations

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