

Teaching Guidelines for
Database Technologies
Diploma in Advanced Computing (e-DAC)
May 2021

Duration: 30 theory hours + 30 lab hours (**60 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 and Object Oriented concepts.

Evaluation: 100 Marks

Weightage: Theory Exam – 40%, Lab exam – 40%, Internal exam– 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 Session is of 2 hours)

Session 1:

Lecture

Introduction to DBMS, Basic Database Terminology

Database Storage Architecture, Concept of Database Instance and Schema, Distributed Databases

Types of DBMS: Relational, Object Relational and NoSQL Databases

Data Models (Conceptual, Logical, Physical), Codd's 12 rules for RDBMS

Database Design, Entity-Relationship Diagram (ERD)

Lab

Using MySQL Monitor, Shell and Workbench

ER Diagrams to Relational Table mapping

Session 2:**Lecture**

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

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

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

Lab (3 hrs)

Performing basic CREATE, SELECT, INSERT, UPDATE, DELETE, DROP operations on Tables

Session 3:**Lecture**

Normalization, Need for Normalization

Data Redundancy, Data Anomalies, Functional Dependency

Normal Forms (1NF, 2NF, 3NF, BCNF) with examples, Introduction to 4th and 5th NF, Need of Denormalization

Lab

Perform 1NF, 2NF, 3NF, BCNF

Session 4:**Lecture**

LIKE Operator, DISTINCT, Sorting (Order by clause).

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

Relational Algebra Operations (Selection, Projection, Union, Intersect, Minus)

Lab

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

Comparing Nulls, Using IN/Not-In

Union/Union ALL

Session 5:**Lecture**

Aggregate Functions

Grouping Things Together (Group By, Having)

Lab

Defining Data Types for Columns

Creating, Altering, Dropping Constraints

Aggregate Functions: SUM(), AVG(), COUNT(), MAX(), MIN(), COUNT()

Using Group By, Having Clause

Session 6:**Lecture**

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

Copying table structure/data, Sequences (AUTO_INCREMENT)

Lab

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)

Lab (3 hrs)

SubQueries, Correlated Queries
Using Exists/Not-Exists
Using Commit/Rollback/Savepoint
Granting/revoking privileges on database objects

Session 8:**Lecture**

Views, Types of Views, Simple and Complex Views
Indexes, Benefit of Indexes, Type of Indexes, Temporary Tables
MySQL Storage Engines (InnoDB, MyISAM and others),
ACID Properties, Concurrency and Locks

Lab

Creating Views, Querying using Views
Creating Indexes
Creating Temporary Tables
Database Locks

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

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
Triggers (BEFORE, AFTER), New and Old trigger variables
Trigger Examples and real time use
Full-Text Search, Pattern Matching with RegEx

Lab

Writing procedures with Declare, fetch and close cursor
Example of each type of cursors
Create Triggers
Creating FULLTEXT Indexes for Full-Text Search
Using RegEx in queries

Sessions 13 & 14:**Lecture**

Introduction to NoSQL database, Features of NoSQL Database
Structured vs. Semistructured and Unstructured Data
Difference between RDBMS and NoSQL databases,
CAP Theorem, BASE Model
Categories of NoSQL Databases
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

Lab (2 hrs)

Using MongoDB Shell and Compass
Creating Collections in MongoDB
Performing Basic CRUD operations

Session 15:**Lecture**

MongoDB Operators, Sorting and Indexing in MongoDB
Migrating from RDBMS to NoSQL

Lab

Complex Searching Using MongoDB Operators
Sorting data
Creating and using indexes
Migrating from MySQL to MongoDB and Vice versa