Institute of Business Administration

CSF 505: Database Management

(Tentative Course Outline and Syllabus)

"Data is a precious thing and will last longer than the systems themselves."
— Tim Berners-Lee

"Without a database, you're just another person with an opinion."
— W. Edwards Deming

IBA SMCS

School of Mathematics and Computer Science

Fall 2025

Institute of Business Administration
School of Mathematics and Computer Science

CSF 505: Database Management

Credit hours (structure)	3 Credit Hours
Prerequisites	Basic Understanding of Computer Science
Class timings & Venue	Saturday 9:00 AM to 11:30 AM & MTC-28
Office	Room 208, Second Floor, Tabba Building, IBA Main Campus
Course Lead / E-mail	Dr. Imran Khan (ikhan@iba.edu.pk)
Last Modified	August 30, 2025

Course Description

This course introduces students to the essential concepts of database systems with a strong focus on practical applications in Data Science. It begins with the foundations of database design and relational databases, gradually moving toward advanced topics. Core areas include the relational model, relational algebra, SQL, and procedural extensions (functions, procedures, triggers). As the course progresses, students are introduced to modern data models such as NoSQL (e.g., MongoDB) and NewSQL, which are widely used in big data and analytics. Emphasis is placed on database design principles, normalization, indexing, views, transactions, and integrity constraints, enabling students to design efficient and reliable databases. The course also explores advanced database capabilities, including support analytical processing (OLAP), and the handling of semi-structured data formats such as XML and JSON. Additionally, important topics such as database security, data privacy, and compliance are covered, preparing students to manage modern, distributed, and cloud-based systems. Designed specifically for students from non-computer science backgrounds, the course adopts a hands-on, step-by-step approach to ensure that all learners can grasp and apply the concepts effectively in their Data Science journey.

Program Learning Outcomes/Graduate Attributes

PLO-2 - Knowledge for Solving Computing Problems
PLO-3 - Problem Analysis
PLO-4 - Design / Development of Solutions
PLO-5 - Modern Tool Usage
PLO-6 - Individual and Teamwork

Course Learning Outcomes

Course Learning Outcome		
CLO	**Description**	
CLO-1	**Understand Computational Thinking & Database Concepts -** Develop a strong foundation in database principles.	
CLO-2	**Design and Model Databases -** Apply design principles and create database models using Entity-Relationship Diagrams (ERD).	
CLO-3	**Develop SQL Proficiency -** Write, execute, and analyze SQL queries to address diverse information needs.	
CLO-4	**Explore NoSQL Databases -** Gain conceptual understanding and practical experience with non-relational databases, including MongoDB.	
CLO-5	**Apply Problem-Solving Skills -** Build real-life information systems using modern database technologies such as Oracle (23c/21c).	

CLOs to PLOs Mapping

	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6
CLO-1	✓				
CLO-2			✓		
CLO-3		✓			
CLO-4				✓	
CLO-5					✓

Brief Course outline (Tentative)

Week	*Dates*	*Topics to be covered (tentative)*
1	August 30, 2025	Introduction to Computational Thinking History of Database Systems Introduction to SQL, SQL sub-languages
2	September 6, 2025	Database Systems Models & Architecture SQL Functions
3	September 13, 2025	Data Modeling & ERD DDL, DML, DCL, TCL
4	September 20, 2025	Mapping from conceptual to logical model ERD modeling using Erwin or any other tool
5	September 27, 2025	Relational Algebra SQL Join & sub queries
6	October 4, 2025	Normalization Normalized hands-on activities
7	October 11, 2025	Normalization Term Project Assignment, Normalized ERD design
	October 13 – 18	**Midterm**
	October 20 - 25	**Mid Semester Break**
8	November 1, 2025	Transaction Management Term project prototype (wireframe) modeling workshop
9	November 8, 2025	Concurrency Control Isolation Level Practical Exercises, PL/SQL Functions/Proc.
10	November 15, 2025	Database Security & Performance Tuning SQL-Subquery refactoring & Window function, PL/SQL Triggers
11	November 22, 2025	Semi-structured Data (XML & JSON) XML/JSON document creation, XML/JSON Schema creation
12	November 29, 2025	Non-Relational Database (No-SQL) MongoDB hands-on activities
		Project Presentations (9 to 1 pm)
13	December 6, 2025	**Adv. DB Concepts:** Introduction to Data warehousing/Data Lake Dimensional modelling, Advanced SQL queries
14	December 13, 2025	Business Intelligence, Data Analytics
	December	**Final Exam**

Detailed Course outline (Tentative)

Week	*Dates*	*Topics to be covered (tentative)*
1	August 30, 2025	Introduction to computational Thinking History of Database Systems Data/ Database/ DBMS, History of Database Systems, File-Based Systems Introduction to SQL, SQL sub-languages, DDL, DML, DCL, TCL, Select, User creation, Role Creation, Grant rights, Revoke rights, Select, Where clause, Distinct, column alias, Selecting specific columns, selecting all columns, Arithmetic expression, is Null, is not Null, concatenation operator (||), Describe command, Logical operators (AND, OR, NOT), Comparison operators (=,<,>,>=,<=,<>,!=), IN operators, Define, set verify on Patterns matching using Like operators
2	September 6, 2025	Database Systems Models & Architecture Data Models, Three-schema Architecture, Data Independence, DBMS classification & Architecture, Multi-user DBMS architecture, Two tier, n-tier database architecture, Transaction processing monitor, Oracle 12c/19c Architecture. SQL Functions Single Row Functions, Character (Upper, lower, initcap, length, etc), Number (mod, round, trunc etc.), Date (months_between, last_day, round, trunc etc.), Conversion (to_char, to_date, to_number etc.), general functions (nvl, decode, case etc.) Group functions (max, min, count, sum etc.), group by, having.
3	September 13, 2025	Data Modeling & ERD Type of Data Models, Relational Model Concepts, Entities, Attributes, Keys, Relationship, Recursive relationship, Degree & Cardinality, Integrity Constraints, Participation Constraints DDL, DML, DCL, TCL Create table, default option, data types (char, varchar2, number, rowid, clob, blob, bfile etc.), date time datatypes (timestamp, interval year to month, interval day to second), table constraint (not null, unique, primary key, foreign key, check), column-level constraint, table-level constraint, table creation using subquery, Read only tables, drop table, Insert, Update, Detail, Grant, Revoke, Commit, Rollback.
4	September 20, 2025	Mapping from conceptual to logical model Composite & Multi-valued attributes, 1-1, 1-m, m-m relationships, Identifier Dependency, Existence Dependency, Weak Entities, Artificial Keys, Specialization and Generalization ERD modeling using Erwin or any other tool
5	September 27, 2025	Relational Algebra Concept of Set-based Operations, Relational Operations, Type of Joins (Theta join, Equi join, Natural join, Outer join), Universal & Existential Quantifiers SQL Join & sub queries Equi join, Natural Join, Using clause, On clause, Left Outer join, Right Outer Join etc.
6	October 4, 2025	Normalization Functional Dependencies, Normalization (1NF – 5NF), Normalized hands-on activities
7	October 11, 2025	Normalization Normalization Examples, Denormalization Term Project Assignment, Normalized ERD design
	October 13 – 18	**Midterm**

	October 20 - 25	**Mid Semester Break**
8	November 1, 2025	Transaction Management Transaction, ACID Properties, Transaction Schedules, Term project prototype (wireframe) modeling workshop
9	November 8, 2025	Concurrency Control Transaction Schedular, Precedence Graph Isolation Level Practical Exercises, PL/SQL Functions/Proc. Isolation Level Practical Exercises, Read Committed & Serializability Isolation Level Exercises, PL/SQL anonymous Functions, named functions, procedures. Packages, exceptional handling
10	November 15, 2025	Database Security & Performance Tuning Query optimization, Indexing, Authentication vs Authorization, Role based Security SQL-Subquery refactoring & Window function, PL/SQL Triggers Horizontal/Vertical Partitioning, Indexing, DCL (Data Control Language), Grant, Revoke, Roles, Application Triggers & Systems Triggers
11	November 22, 2025	Semi-structured Data (XML & JSON) XML/JSON Data - Well-formed XML/JSON, DTDs, IDs & IDREFs XML/JSON XML/JSON document creation & Schema creation, Querying XML – Xpath, XQuery, XSLT, Querying JSON
12	November 29, 2025	Non-Relational Database (No-SQL) Collections, directory, Impedance mismatch, Blog post case study (Relational DB vs Document DB), Embedding vs Linking etc. MongoDB hands-on activities Collection, MongoDB commands, Logical operators, comparison operators, CRUD operations, Aggregation Pipelines etc.
		Project Presentations (9 to 1 pm)
13	December 6, 2025	**Adv. DB Concepts:** Introduction to Data warehousing/Data Lake Cube, OLTP vs OLAP, Star schema, ETL Dimensional modelling, Advanced SQL queries
14	December 13, 2025	**Adv. DB Concepts:** Business Intelligence, Data Analytics Power BI Dashboard designing
	December 17 – 30 2025	**Final Exam**

Text book / Reference Material

1. Database Systems - A practical approach to Design, Implementation and Management - Thomas Connolly, Carolyn Begg, Anne Strachan, *4th Edition*
2. Principles of Database Management: The Practical Guide to Storing, Managing and Analyzing Big and Small Data (2019) - Wilfried Lemahieu et al., 1st Edition
3. Database System Concepts, Seventh Edition
   Avi Silberschatz, Henry F. Korth, S. Sudarshan

Reference books

1. Database Management Systems - Ramakrishnan, Johannes Gehrke, 2nd edition
2. A First Course in Database Systems - Jeffery D. Ullman, Jennifer Widom, 3rd edition
3. Fundamentals of Database Systems (2017) - Navathe et al. 7th Edition

Online references

- Live SQL Learn and share SQL, for free. Get instant access to the Oracle Database and learn from a collection of community scripts and tutorials.
- W3Schools.com's SQL Tutorial covers SQL for a variety of systems. It has loads of live examples as well as a good reference section.
- Other language references that may be useful with MongoDB
    - PHP function reference.
    - Javascript tutorial at w3schools.

NoSQL Tools

- MongoDB Compass A FREE MongoDB GUI from the MongoDB team. Available on Windows, OS X, and Linux.

Assessments:

- **Midterm Exam**: Covers lectures 1-14
- **Final Exam**: Covers lectures 15-28
- **Assignments**: Regular assignments based on lecture topics
- **Final Project**: Implementation of an OLTP system tailored to a specific business domain, addressing a real-world problem through the development of an Information System that leverages relational database concepts.
- **Marks Distribution**

Assessment Method	Contribution to the Final Marks
Final Exam	30 %
Midterm	30 %
Quizzes (5+):	10 %
Assignments (5+):	10 %
Project	20 %

Labs

Labs will cover database modeling in CA ERWin Data Modeler 2021 and DB Designer. Database development, Querying, and transactions will be done using PostgresSQ or Oracle Database 23ai/21c

Project

Students are required to do semester projects in this course. Project will typically be an OLTP system implemented for any business domain.

Academic Progress

It is essential to keep the instructor informed of your progress as well as any special difficulties you may be experiencing. Failure to do so may lead to a poor grade.

Syllabus/Course Changes

The instructor reserves the right to make necessary changes to this syllabus and to the delivery of the course considering unforeseen circumstances provided such changes are announced.

Office hours

Saturday 11.30 pm to 12:30 pm. If you need to speak to the instructor besides the designated office hours, you may book an appointment via email.

Attendance Policy

IBA attendance policy applies.

Academic Integrity

Each student enroll in this course is expected to abide by the IBA Code of Conduct. Scholastic dishonesty shall be considered a serious violation of these rules and regulations and is subject to strict disciplinary action as prescribed by IBA regulations and policies. Scholastic dishonesty includes, but is not limited to, cheating on exams, plagiarism on assignments, and collusion.
Kindly refer to https://examination.iba.edu.pk/CheatingPlagiarism.php for more details.

• **PLAGIARISM:** Plagiarism is the act of taking the work created by another person or entity and presenting it as ones own for the purpose of personal gain or of obtaining academic credit. Plagiarism includes the submission of or incorporation of the work of others without acknowledging its provenance or giving due credit according to established academic practices. This includes the submission of material that has been appropriated, bought, received as a gift, downloaded, or obtained by any other means. Students must not, unless they have been granted permission from all faculty members concerned, submit the same assignment or project for academic credit for different courses.

• **CHEATING:** The term cheating shall refer to the use of or obtaining of unauthorized information in order to obtain personal benefit or academic credit.

• **COLLUSION:** Collusion is the act of providing unauthorized assistance to one or more people or of not taking the appropriate precautions against doing so. Any student violating academic integrity a second time in this course will receive a failing grade for the course, and additional disciplinary sanctions may be administered.

• **SHARING CREDENTIALS:** It has been observed that some students share their credentials (log in id's and passwords) of LMS, portal, email, etc., with with other students. These credentials are private and confidential and not to be shared with anyone. Any violation will be considered as aiding in plagiarism/collusion/cheating and appropriate action might be taken against such students.