Institute of Business Administration

CS 341: Database Systems

(Tentative Course Outline and Syllabus)

Fall 2024

Institute of Business Administration
School of Mathematics and Computer Science

CS 341: Database Systems

"The goal is to transform data into information, and information into insight"
~ Carly Fiorina – Executive and president of Hewlett-Packard Co. in 1999. Chairwoman in 2000

Course Logistics

Instructor: Abeera Tariq
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Course schedule:

DB1	M/W	10.00 am – 11.15 am	Lab1	Th	8.30 am – 11.15 am
DB2	M/W	1.00 pm – 2.15 pm	Lab2	Th	11.30 am – 2.15 pm.

Credits: 4 (3 + 1)

Pre-requisites: Data Structures

Course Description:

Welcome to the World of Data!

CS341 Database Systems is a core course for Computer Science students, designed to build a strong foundation in the fundamental concepts of database systems. Throughout this course, students will explore key topics, including:

- *Database Fundamentals:* Understand the definition and importance of databases while exploring the evolution of database systems.
- *Database Design:* Learn about Entity-Relationship (ER) models, relational data models, normalization, and the design of database schemas tailored for real-world business scenarios.
- *SQL Proficiency:* Gain expertise in SQL for querying and manipulating data, including advanced features such as joins, aggregations, and subqueries. Additionally, delve into PL/SQL to understand functions, procedures, and triggers, while grasping the underlying concepts of relational algebra.
- *Transaction Management:* Explore the key principles of transaction management and concurrency control to ensure data integrity.
- *Emerging Technologies:* Get an overview of non-relational databases (NoSQL), including XML data and JSON schemas, complemented by hands-on practice with MongoDB.

Program Learning Outcomes:

- PLO-2: Knowledge for Solving Computing Problems
- PLO-5: Modern Tool Usage
- PLO-6: Individual and Teamwork

Course Learning Outcomes:

- CLO1: Gain practical and theoretical knowledge of database systems including design and modelling, query writing in SQL, concepts of relational algebra and other advanced topics.
- CLO2: Use of modern relational database management systems and non-relational databases such as MongoDB.
- CLO3: Inculcate problem-solving skills through collaborative teamwork and development of database systems.

PLO/CLO mapping:

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

Format and Procedures:

The LMS site will be used to share the syllabus, give out assignments, and to share other course resources. The University's standard policies on attendance, inclusivity, office hours, and academic integrity apply in this course. These are described in later sections below.

Course Textbooks:

1. *Database Systems - A practical approach to Design, Implementation and Management* - Thomas Connolly, Carolyn Begg, Anne Strachan, 4th Edition
2. *Database Systems – Design, Implementation & Management* – Carlos Coronel, Steve Morris, 14th Edition
3. *Database System Concepts*, Seventh Edition Avi Silberschatz, Henry F. Korth, S. Sudarshan
4. *Principles of Database Management: The Practical Guide to Storing, Managing and Analyzing Big and Small Data (2019)* - Wilfried Lemahieu et al., 1st Edition

Grading Procedures: (tentative)

Midterm	20%
Final Exam	30%
Course Project	20%
Quizzes	10%
Assignments/Labs	20%

- ***Labs****:* Labs will cover database modeling using DB Designer. Database development and SQL querying will be done using Oracle Database 21c/19c Rel 3 and SQL Developer.
- ***Lab Grading Policy***: Each lab must be completed individually by each student. Each lab will be marked out of 10. The students can gain 4/10 marks for progress during the lab.
  Marks for progress may be evaluated by the following methods:
  - *Being present in the lab and meeting the minimum required number of questions for lab attempt.*
  - *To assess understanding, a short viva may be conducted, and marks will be assigned accordingly.*
  - *In some labs, the progress may be marked through a pop quiz from the contents of the lab.*

  In case of absence from the lab, the progress marks are lost.
  The remaining 6/10 marks will be awarded for completion and correct submission.

- ***Course Project***: Team based. Information will be released during the semester.

Attendance Policy

IBA attendance policy applies.

Academic Integrity

Each student 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 person 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 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.

Office hours

Information will be shared in class. If you need to speak to the instructor besides the designated office hours, you may book an appointment via email.

Late Submission Policy:

All assignments must be timely submitted via LMS. For any assignment, late submission up to one day late will be accepted with a 10% late penalty of the maximum score. Beyond that, no late submissions will be acceptable.

Missed assessments policy:

There will be no makeup for any missed assessments including assignments, project, quizzes and exams. In case of any medical emergency, proof must be submitted for any consideration.

Weekly breakdown of classes (tentative)

Week	Theory	Labs
1	**Introduction to Database Systems** Data/ Database/ DBMS, History and Evolution of Database Systems	Introduction to SQL
2	**Database Systems Concepts & 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 Aggregation SQL Functions
3	**Data Modeling & ERD** Type of Data Models, Relational Model Concepts, Entities, Attributes, Keys, Relationship, Recursive relationship, Degree & Cardinality, Integrity Constraints, Participation Constraints	Introduction to Data Definition Language (DDL)
4	**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 Design
5	**Relational Algebra** Concept of Set-based Operations, Relational Operations, Type of Joins (Theta join, Equi join, Natural join, Outer join), Universal & Existential Quantifiers	Introduction to SQL Joins
6	**Normalization** Functional Dependencies, Normalization (1NF – 5NF), Denormalization	SQL With, Exists, Case clause Sub-queries SQL Views, Set operators, Update, Delete
7	**SQL continued** Select/Insert/Update/Delete, Wildcard, IN/Not IN, EXISTS/NOT EXISTS, Aggregates, Group By/Having, Sub-queries, Correlated. Queries, Derived tables, Stored Procedures, Views, Triggers, DDL	Application Development and Integration with SQL
	MIDTERM EXAM	
	RESERVE WEEK	

8	**Transaction Management** Transaction, ACID Properties, Transaction Schedules, Precedence Graph	Introduction to PL/SQL
9	**Concurrency Control** Concurrency, Locks & Type of Locks, 2-Phase locking, Isolation levels, Read committed, Serializability	PL/SQL II
10	**Database Security** Authentication vs Authorization, Role based Security, Oracle Flashback Technology, SQL Injection **Performance Tuning** Horizontal/Vertical Partitioning, Indexing	Transactions and Concurrency
11	**Introduction to NoSQL and XML - Semi structured Data** XML Data - Well-formed XML, DTDs, IDs & IDREFs, XML Schema Querying XML – Xpath, XQuery, XSLT	Data Control Language (DCL) and Advanced PL/SQL
12	**Non-Relational Database (NoSQL) – Intro to JSON and MongoDB** Collections, directory etc.	Hands-on MongoDB
13	**Advanced Database Systems Concepts** Introduction to Data warehousing, OLTP vs OLAP, Introduction to Distributed Databases, Big Data, Data Analytics	Data Analytics Queries
14	**Presentations (Project)**	
	FINAL EXAM	