NATIONAL UNIVERSITY
of Computer & Emerging Sciences, Lahore

F A S T S c h o o l o f C o m p u t i n g

CS2005 – Database Systems

Spring 2022

Instructor Name: Uzair Naqvi
Email address: uzair.naqvi@nu.edu.pk
Office Location/Number: M-118
Office Hours: Tu, Th 11:30-1:00 PM

TA Name: TBA
Email address:
Office Location/Number:
Office Hours:

Course Information

Program: BS **Credit Hours:** 3 **Type:** Core
Pre-requisites (if any): CS2001 - Data Structures
Course Website (if any):
Class Meeting Time: Sec BDS-4A: M, W 1:00am – 02:40pm
Class Venue: CS-3

Course Description/Objectives/Goals

This course is an introduction to relational databases management Systems. The course will cover fundamental concepts of databases with an emphasis on modeling, designing and implementation of database systems. The theory will be augmented with hands-on exercises on database system. A project will be conducted in the database system lab that runs in parallel with the course. In project, the students will develop a data-centric application with complete set of business transactions and appropriate user interface using a popular programming language and a popular database management system.

Course Learning Outcomes (CLOs)		
At the end of the course students will be able to:	**Domain**	**BT* Level**
Describe how databases store and retrieve information using the basic concepts and terminology of relational databases.	C	2
Create a logical data model from an ER diagram to design a set of DB relations.	C	3
Normalize a set of attributes to eliminate update anomalies or redundancies from a set of relations.	C	4
Implement a logical data model using a DBMS.	C	3
Write queries using formal query languages such as relational algebra.	C	3
Write SQL statements to query a set of tables in a DBMS involving multiple conditions, ordering, aggregate functions, grouping, and group selection, set operations, joins, and nested queries.	C	3
Write SQL statements to insert, delete and update a set of tables in a DBMS.	C	3
Write SQL statements to create, alter, drop, and rename a set of tables in a DBMS.	C	3
Write SQL statements to add and drop constraints on a set of tables in a DBMS.	C	3

Create an ER diagram (semantic model) about an enterprise (e.g., retail industry, airport, school, and library) that correctly describes the entities, attributes, and relationships among the entities, for some of its major business functions.	C	5
Comprehend the ACID properties of Transactions and recoverability schedules.	C	2
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain. **Bloom's taxonomy Levels:** 1. Knowledge, 2. Comprehension, 3. Application, 4. Analysis, 5. Synthesis, 6. Evaluation		

Course Textbook

1. Ramez Elmasri, *Fundamentals of Database Systems* (7th Edition)

Additional references and books related to the course

1. Raghu Ramakrishnan, *Database Management Systems* (3rd Edition)
2. C. J. Date, *An Introduction to Database Systems* (8th Edition)

Tentative Weekly Schedule

Week	Topics to be covered	Topics Detail		Readings (Textbook)	No of Lec.	Asst.
1	Introduction to Databases	• Databases and Database Users • Characteristics of the Database Approach • Advantages of Using the DBMS Approach • Data Models, Schemas, Instances • Architecture and Components of a DBMS		Ch 1,2	2	
2-3	Relational Data Model	RA	SQL	Ch 5, 6	4	A1
		• Relational Model Concepts o Domain, Attributes, Tuples, Relations o Characteristics of Relations • Relational Model Constraints o Domain, Keys, Integrity • Update Operations and Dealing with Constraint Violation	• Data Definition Statements (DDL) o Create, Alter, Drop, Rename • Specifying Constraints o Attribute, Key, Referential Integrity, Tuple-Based Using CHECK • Data Modification Statements (DML) o Insert, Update, Delete			
4-6	Formal Query Language: Relational Algebra and The Database Language: SQL	RA	SQL	Ch 6, 7, 8	6	A2, A3
		o Unary Relational Operations o SELECT, PROJECT, RENAME	o Retrieval Queries o Basic Queries: SELECT-FROM-WHERE o Ordering, Arithmetic Operations, Substring Comparison			
		o Binary Operations o Union, Intersection, Difference, Division	o Set Operations			
		o Cartesian Product, JOIN o Outer Join, Outer Union, Full	o Joining, Full, outer, inner, Cross			
		o Aggregate Functions and Grouping	o Aggregate Functions and Grouping			
		Query Tree	o Nested Queries o Correlated Nested Queries			
		--	o Views (Virtual Tables), Stores Procedures, Assertions and Triggers			

7-9	Database Design Theory and Normalization	• Design Anomalies • Informal Design Guidelines for Relational Databases • Functional Dependencies (FDs) o Convert Business statements into Dependencies o Armstrong's Inference Rules for FDs o Algorithm for computing Attribute Closure o Minimal Cover of FDs o Equivalence of Sets of FDs • Normalization for Relational databases o Normalization and De-Normalization o Normal Forms: 1NF, 2Nf, 3NF, BCNF, 4NF, 5NF • Overview of Relational Database Design Algorithms	Ch 14, 15	6	A4
10-12	Data Modeling Using Entity-Relationship (ER) Model	• Entity Types, Entity Sets, Attributes, Keys • Relationship Types, Relationship Sets, Roles • Constraints on Relationship Types • Relationship Types of Degree Higher than Two • Enhanced Entity-Relationship (EER) Model Concepts • Subclasses, Superclasses, Inheritance • Specialization and Generalization • Constraints and Characteristics of Specialization and Generalization • Shared and UNION Type subclasses	Ch 3, 4	5	A5
12-13	Relational Database Design by ER- and EER-to-Relational Mapping	• Mapping ER Model Constructs to Relations • Mapping EER Model Constructs to Relations	Ch 9	2	
13-14	Transaction Processing Concepts	• Issues in Transaction Processing • Why Concurrency Control is Needed • Why Recovery is Needed • Transaction States and Operations, System Log, Commit Point of a Transaction • ACID Properties of Transactions • Characterizing Schedules based on Recoverability • Characterizing Schedules based on Serializability • Transactions Isolation Levels and Possible Violations • Basic Two-Phase Locking Technique for Concurrency Control	Ch 20	3	

(Tentative) Grading Criteria

1. Assignments (10%)
2. Quizzes (10%)
3. Class Participation (5%)
4. 2 Midterm Exams (30%)
5. Final Exam (45%)

Grading Scheme: Absolute

Course Policies

1. Quizzes may be un-announced.
2. No makeup for missed quiz or assignment.
3. Minimum eligibility to pass this course is to get 50% marks.

Project

Students will design, implement, demonstrate and document a database system. The project is to be done in groups of 3/4 students. Pick your partner as soon as possible. The groups are self-policing (e.g. each group is responsible for its own division of labor, scheduling, etc.). A separate handout will be provided describing the project requirements in the 2nd Lab of the course.