Aror University of Art, Architecture, Design & Heritage Sukkur

BS (Artificial Intelligence) & Multimedia Gamming
Database Systems

Course Title: Database Systems
Course Code: CS-207
Credit Hours: (3+1)
Course Instructor: Engr. Muhammad Younis
Electronic mail: myounis.faculty@aror.edu.pk

Description:

This course provides a comprehensive introduction to database management systems (DBMS). Students will gain a solid understanding of fundamental database concepts, including data models, normalization, and query languages. The course will cover the design, implementation, and management of databases using various data models, such as relational, object-oriented, and NoSQL. Students will learn to use Structured Query Language (SQL) for database definition, manipulation, and querying. Practical exercises and hands-on experience with database management tools will reinforce the theoretical concepts learned in the course.

Assessment:

S. No	Assessment Activities	Percentage	Total Activities
1.	Sessional: Quizzes/ Assignments (Quizzes& Assignments)	30%	5
2.	Mid Term Exam	30%	1
3.	Final Exam	40%	1

Course Learning Outcomes (CLOs) :

S.No	Course Learning Outcome
CLO1	Explain fundamental database concepts
CLO2	Design conceptual, logical and physical database schemas using different data models.
CLO3	Identify functional dependencies and resolve database anomalies by normalizing database tables.
CLO4	Use Structured Query Language (SQL) for database definition and manipulation in any DBMS

Text Books

1. Abraham Silberschatz, Henry F. Korth, and S. Sudarshan "Database System Concepts"

Reference Books

1. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems," 7th Edition, Pearson, 2016.
2. Renee M. P. Teate, "SQL for Data Scientists: A Beginner's Guide for Building Datasets for Analysis," 1st Edition, Wiley, 2021.
3. Carlos Coronel, Steven Morris, "Database Systems: Design, Implementation, & Management," 13th Edition, Cengage Learning, 2018.

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Course Outlines:

WEEK	LEC#	SUB TOPICS	REFERENCE	(%) Course Covered
Week No: 1	1. Introduction to Databases	1.1 Course Overview & Introduction to Databases 1.2 Course objectives and structure 1.3 Data, Information, Knowledge & Wisdom 1.4 What is a database? 1.5 Types and applications of databases	Book [1],Slides	6.25%
	2. Database Management Systems (DBMS) & Applications	2.1 Definition and functions of DBMS 2.2 Types of DBMS (relational, object-oriented, etc.) 2.3 Examples of popular DBMS (MySQL, PostgreSQL, Oracle)	Book [1], ,Slides	
	3. Data Models: Hierarchical, Network, Relational, Object-Oriented	3.1.Hierarchical model: structure and examples 3.2.Network model: structure and examples 3.3.Relational model: tables, keys, and relationships 3.4.Object-oriented model: objects and classes	Book [1], ,Slides	
Week No: 2	4. Database Concepts & Architecture	4.1.Database Architecture & Schema Levels (Conceptual, Logical, Physical) 4.2.Three-schema architecture: external, conceptual, internal 4.3.Differences between conceptual, logical, and physical schemas	Book [1],Slides	

WEEK	LEC#	SUB TOPICS	REFERENCE	(%) Course Covered
	5. Data Independence & Database Languages	5.1. Concept of data independence 5.2.Introduction to database languages: DDL, DML, DCL	Book [1], ,Slides	6.25%
	6. ACID Properties & Transactions	6.1.ACID properties: Atomicity, Consistency, Isolation, Durability 6.2.Transactions: definitions and importance	Book [1], ,Slides	
Week No: 3	7. Entity-Relationship (ER) Model	7.1.Introduction to the ER Model 7.2.Purpose of ER modeling 7.3.Basic components: entities, relationships, attributes	Book [1],Slides	6.25%
	8. Entities, Relationships, and Attributes	8.1.Identifying entities and defining attributes 8.2.Establishing relationships between entities	Book [1], ,Slides	
	9. ER Diagrams: Symbols and Notations	9.1.Symbols used in ER diagrams 9.2.Creating and interpreting ER diagrams	Book [1], ,Slides	
Week No: 4	10. Weak Entities, Generalization, Specialization	10.1. Concepts of weak entities and their relationships 10.2. Generalization and specialization in ER modeling	Book [1],Slides	6.25%
	11. Converting ER Diagrams to Tables	11.1. Mapping ER diagrams to relational schema 11.2. Defining primary and foreign keys	Book [1], ,Slides	
	12. Case Study: ER Modeling	12.1. Practical application: creating an ER diagram for a real-world scenario		
Week No: 5	13. Introduction to the Relational Model	13.1. Concepts of tables, tuples, attributes 13.2. Relational integrity constraints	Book [1],Slides	6.25%
	14. Relational Algebra & Its Operations	14.1. Basic operations: selection, projection, union, difference, Cartesian product 14.2. Query examples using relational algebra	Book [1], ,Slides	
	15. Relational Schema Design Principles	15.1. Schema design best practices 15.2. Mapping relationships and constraints	Book [1], ,Slides	

WEEK	LEC#	SUB TOPICS	REFERENCE	(%) Course Covered
Week No: 6	16. Introduction to SQL & SQL Syntax	16.1. Basic SQL syntax and structure 16.2. Introduction to SQL commands	Book [1],Slides	12.5%
	17. SQL DDL: Creating and Modifying Tables	17.1. CREATE, ALTER, and DROP statements 17.2. Defining table structure and constraints	Book [1], ,Slides	
	18. SQL DML: Inserting, Updating, Deleting Data	18.1. INSERT, UPDATE, DELETE commands 18.2. Handling data manipulation	Book [1], ,Slides	
Week No: 7	19. SQL SELECT Statement: Basic Queries	19.1. Syntax and structure of SELECT queries 19.2. Filtering and sorting data	Book [1],Slides	6.25%
	20. SQL JOIN Operations: INNER, OUTER, LEFT, RIGHT	20.1. Types of JOIN operations and their usage 20.2. Examples of JOIN queries	Book [1], ,Slides	
	21. SQL Subqueries & Nested Queries	21.1. Writing subqueries and nested queries 21.2. Examples and use cases	Book [1], ,Slides	
Week No: 8	22. SQL Functions: Aggregate, Scalar, String Functions	22.1. Aggregate functions: COUNT, SUM, AVG, MIN, MAX 22.2. Scalar functions: UPPER, LOWER, ROUND, etc.	Book [1],Slides	6.25%
	23. SQL Views & Indexes	23.1. Creating and using views 23.2. Indexes: purpose and creation	Book [1], ,Slides	
	24. SQL Stored Procedures & Triggers	24.1. Introduction to stored procedures 24.2. Creating and using triggers	Book [1], ,Slides	
Week No: 9	25. Introduction to Normalization & Anomalies	25.1. What is normalization? 25.2. Types of anomalies: insertion, deletion, update	Book [1],Slides	6.25%
	26. Functional Dependencies & 1NF	26.1. Understanding functional dependencies 26.2. First Normal Form (1NF) principles and examples	Book [1], ,Slides	
	27. 2NF & 3NF: Concepts and Examples	27.1. Second Normal Form (2NF) and Third Normal Form (3NF) 27.2. Examples and application of 2NF and 3NF	Book [1], ,Slides	

WEEK	LEC#	SUB TOPICS	REFERENCE	(%) Course Covered
Week No: 10	28. BCNF & Higher Normal Forms	28.1. Boyce-Codd Normal Form (BCNF) 28.2. Higher normal forms: 4NF, 5NF	Book [1],Slides	6.25%
	29. Denormalization : When and Why?	29.1. Concept of denormalization 29.2. Scenarios where denormalization is beneficia	Book [1], ,Slides	
	30. Case Study: Normalization Process	30.1. Practical application of normalization techniques	Book [1], ,Slides	
Week No: 11	31. Conceptual Design Review: ERD to Relational Model	31.1. Reviewing and converting ER diagrams to relational models	Book [1],Slides	6.25%
	32. Logical Design: Converting ERD to Relational Schema	32.1. Detailed conversion process and examples	Book [1], ,Slides	
	33. Detailed conversion process and examples	33.1. Detailed conversion process and examples	Book [1], ,Slides	
Week No: 12	34. Introduction to PL/SQL: Basics and Block Structure	34.1. Overview of PL/SQL 34.2. Structure of PL/SQL blocks	Book [1],Slides	6.25%
	35. PL/SQL Control Structures: IF, LOOP, and CASE Statements (2.08%)	35.1. Using control structures for flow control 35.2. Examples of IF, LOOP, and CASE statements	Book [1], ,Slides	
	36. PL/SQL Procedures and Functions	36.1. Creating and using procedures 36.2. Creating and using functions	Book [1], ,Slides	
Week No: 13	37. PL/SQL Cursors and Exceptions	37.1. Using cursors for row-by-row processing 37.2. Handling exceptions in PL/SQL	Book [1],Slides	6.25%
	38. PL/SQL Packages and Triggers	38.1. Creating and using packages 38.2. Writing and using triggers	Book [1], ,Slides	

WEEK	LEC#	SUB TOPICS	REFERENCE	(%) Course Covered
	39. Case Study: PL/SQL Implementation	39.1. Practical project: implementing PL/SQL solutions	Book [1], ,Slides	
Week No: 14	40. Transactions Management & Concurrency Control	40.1. Managing transactions 40.2. Concurrency control mechanisms	Book [1],Slides	6.25%
	41. Database Security & Integrity Constraints	41.1. Security measures for databases 41.2. Implementing integrity constraints	Book [1], ,Slides	
	42. Backup, Recovery, and Disaster Management	42.1. Strategies for database backup and recovery 42.2. Disaster recovery planning	Book [1], ,Slides	
Week No: 15	43. Advanced Data Modeling Techniques	43.1. Data modeling for complex scenarios 43.2. Handling advanced relationships and constraints	Book [1],Slides	6.25%
	44. Comprehensive Case Study: Designing a Database from Scratch	44.1. Applying concepts to design a complete database system 44.2. Implementation and analysis	Book [1], ,Slides	
	45. Introduction to Data Warehousing and OLAP	45.1. Concepts of data warehousing and Online Analytical Processing (OLAP) 45.2. Differences between OLAP and OLTP systems	Book [1], ,Slides	
Week No: 16		REVISION &EXAM PREP		

CLOs	Graduate Attribute (PLOs)											
	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CLO1	1	0	0	0	0	0	0	0	0	0	0	0
CLO2	0	1	0	0	0	0	0	0	0	0	0	0
CLO3	0	0	0	1	0	0	0	0	0	0	0	0
CLO4	0	0	0	0	1	0	0	0	0	0	0	0

GA: Graduate Attributes

GA1 Computing Knowledge: An ability to apply knowledge of mathematics, science, computing fundamentals and computing specialization to the solution of complex computing problems.

GA2 Problem Analysis: An ability to identify, formulate, research literature, and analyze complex computing problems reaching substantiated conclusions using first principles of mathematics, natural sciences and computing sciences.

GA3 Design/Development of Solutions: An ability to design solutions for complex computing problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

GA4 Investigation: An ability to investigate complex computing problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.

GA5 Modern Tool Usage: An ability to create, select and apply appropriate techniques, resources, and modern IT tools, including prediction and modeling, to complex computing activities, with an understanding of the limitations.

GA6 The Computer Scientist and Society: An ability to apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional computing practice and solution to complex computing problems.

GA7 Environment and Sustainability: An ability to understand the impact of professional computing solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

GA8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of computing practice.

GA9 Individual and Team Work: An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.

GA10 Communication: An ability to communicate effectively, orally as well as in writing, on complex computing activities with the computing community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

GA11 Project Management: An ability to demonstrate management skills and apply computing principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.

GA12 Lifelong Learning: An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments