**COMSATS** **University Islamabad, Lahore Campus**

Department of Electrical Engineering

1.5 KM Defence Road, Off Raiwind Road, Lahore

Version: v.4.0

**Course Descriptive File**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Course Code and Title** | CSC270 Database Systems -1 | | | |
| **Credit Hours** | 4 (3,1) | | **Semester** | 4th |
| **Prerequisites** | CSC241 | | **Co requisites** | N/A |
| **WK** |  | **SDG** | |  |
| **Course Type** | Project Based | | | |

|  |  |
| --- | --- |
| **1** | **Course Outline as per SoS** |
| This course introduces the fundamental concepts of database systems. Topics include: Introduction to  Databases & Information Systems; Evolution of Database Systems; Components; Architecture; Functions;Relational Model; Relational Algebra; Relational Calculus; Data Modeling; Relational Data Model;Relational Algebra & Calculus; Integrity Constraints; Conceptual Models; Entity-Relationship (E-R)Model; Enhanced E-R Model; Mapping Conceptual Schema to Relational Schema; Functional Dependency & Normalization; Structured Query Language (SQL); Views; Materialized Views; Non-Relational/No SQL Databases; MongoDB as NoSQL Database; Document Model; and Transaction Management | |
| **2** | **Course Objectives as per SoS** |
| This course familiarizes students with the basic concepts of databases. This module is intended to lay a foundation for designing efficient database systems small to medium enterprises. The student in this course will learn the lifecycle of designing relational database models and data manipulation using structured query language SQL. | |
| **3** | **Suggested Books** |
| |  | | --- | |  | | **Text Book:**   1. Database systems: A Practical Approach to Design, Implementation, And Management, Thomas   Connolly, Carolyn Begg, Pearson, 2015.  **Reference Books:**   1. MongoDB: The Definitive Guide, Shannon Bradshaw, Eoin Brazil, Kristina Chodorow, O'Reilly   Media, 2019.   1. Fundamentals of Database Systems, Elmasri, R, Navathe, Pearson, 2016. 2. Database System Concepts, Silberschatz, Korth, Sudarshan, McGraw Hill, 2019. | | | |
| **4** | **Course Learning Outcomes (CLOs)** |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| After successful completion of this module, you will be able to:  **Theory CLOs:** CLO1: Apply the fundamental concepts of database systems, including components, architecture, and relational models, to explain their role in modern information systems.(C3-PLO1)CLO2: Design conceptual database schemas using Entity-Relationship (ER) and Enhanced ER models and optimize them using normalization techniques to ensure efficiency and integrity. (C4-PLO3)CLO3: Construct and execute T-SQL & PL-SQL queries, including advanced operations such as joins, nested queries, views, transactions, stored procedures and triggers to manipulate and retrieve relational data.(C3-PLO4) **Lab CLOs:**   1. CLO4: Develop practical skills in SQL, covering database creation, table relationships, data manipulation, advanced querying, indexing, triggers, and stored procedures (P3-PLO5) 2. **CLO5**: Prepare and present a comprehensive project report, documenting the design, development, and integration of a database application, including the front end (A3-PLO10)  |  |  |  |  | | --- | --- | --- | --- | | **CLO** | **PLO** | **Bloom Taxonomy Domain** | **Bloom Taxonomy Level** | | **1** | PLO1: Engineering Knowledge | Cognitive | C3 – Application | | **2** | PLO3: Design/Development of Solutions | Cognitive | C4 – Analysis | | **3** | PLO4: Investigation | Cognitive | C3 – Application | | **4** | PLO5: Modern Tools Usage | Psychomotor | P3 – Guided Response | | **5** | PLO10: Communication | Affective | A3 – Valuing |   **PLOs Coverage Explanation**  **PLO1 - Engineering Knowledge** PLO1 emphasizes the application of data sciences and the evolution of how the data is handled in the modern world by signifying the importance of relational algebra / calculus and identifying the database architecture on conceptual, external and internal level for small to medium commercial applications. (Cognitive)  **PLO3 - Design/Development of Solutions:**  PLO3 in this course is mapped at C4 ( Analysis) and it emphasizes the development of efficient and well-structured database schemas. (Cognitive)  **PLO4 – Investigation** Theory’s third course learning objective is mapped to application level of cognitive domain and directly mapped to PLO4. It illustrates the focus of applying the learnt concepts and managing the database-based applications on server level in a coherent and efficient manner along with effective data manipulation and handling (Cognitive)  **PLO5 – Modern Tools Usage** Lab CLO1 is mapped to PLO4 at P3 level of psychomotor domain as it focusses on the systemic exploration of various SQL tools for the implementation of advanced database functionalities (Psychomotor)  **PLO10 – Communication** Lab CLO2 is specifically placed for assessing the communication capabilities of students who undertake the project in this course and present themselves efficiently through detailed and structured documentation (Affective) | |
| **5** | **Marks Breakup** |
| **Theory**   |  |  |  | | --- | --- | --- | | Quizzes | 15% | | | Assignments | 10% | | | Midterm Exam | 25% | | | Terminal Exam | 50% | | | **Total (theory)** | **100%** |   **Lab**   |  |  |  |  | | --- | --- | --- | --- | | **Lab Assignments:**   1. Lab Assignment 1 Marks (Lab marks from Labs 1-3) 2. Lab Assignment 2 Marks (Lab marks from Labs 4-6) 3. Lab Assignment 3 Marks (Lab marks from Labs 7-9) 4. Lab Assignment 4 Marks (Lab marks from Labs 10-12) | | | 25% | | **Lab Mid Term** = 0.5 × (Lab Mid Term exam) + 0.5× (average of lab evaluation of Lab 1-6) | | | 25% | | **Lab Terminal** | | | 50% | | **CEA** | 0.5\*(Complex Engineering Problem) +0.375\*(average of lab evaluation of Lab 7-12) + 0.125\*(average of lab evaluation of Lab 1-6) | | | | **OEL** | 0.1\*(Open Ended Lab) +0.4\*(Lab Terminal Exam) +0.375 \*(average of lab evaluation of Lab 7-12) + 0.125\*(average of lab evaluation of Lab 1-6) | | | | **Project Based** | 0.2\*(Lab Project) +0.3\*(Lab Terminal Exam) +0.375\*(average of lab evaluation of Lab 7-12) + 0.125\*(average of lab evaluation of Lab 1-6) | | | | **Conventional** | 0.5\*(Lab Terminal Exam) +0.375\*(average of lab evaluation of Lab 7-12) + 0.125\*(average of lab evaluation of Lab 1-6) | | | | **Total (lab)** | | | **100%** | |  | | |  | | **Final marks** | | **Theory marks × 0.75 + Lab marks ×0.25** | | | |

|  |  |
| --- | --- |
| **Version No.** | Fall-2025/01 |
| **Revision Date** | N/A |
| **Last Modification Date** | 08-01-2025 |
| **Modification Details** | First Version developed by department of Computer Engineering |
| **Recommended by** |  |
| **Approved by** |  |

**Annexure – I: Lecture Plan**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sr. No** | **Topics Covered** | **CLO** | **Bloom Taxonomy** | **Contact Hours** | **Assessment** |
| 1 | Introduction to Database Systems. History and evolution of data organization and significance of data in modern world | CLO1 | C2 | 1.5 | Assignment 1  Quiz 1  Midterm Examination |
| 2 | Database approach and DBMS environment & stakeholders including DBA, users and developers | CLO1 | C2 | 1.5 |
| 3 | Advantages and Disadvantages of DBMS | CLO1 | C2 | 1.5 |
| 4 | Database Architectures, schema & mappings at external, conceptual and internal level to provide logical and physical data independence | CLO1 | C2 | 1.5 |
| 5 | Functions & components of a DBMS and overview of multi-user DBMS architectures | CLO1 | C2 | 1.5 |
| 6 | Relational data structure, terminologies and integrity constraints including Nulls, referential integrity and general constraints | CLO1 | C3 | 1.5 |
| 7 | Relational Algebra: Base operations including unary set operations | CLO1 | C3 | 1.5 |
| 8 | Relational Algebra: Derived operations including division and joins | CLO1 | C3 | 1.5 |
| 9 | Tuple and domain relational calculus | CLO1 | C3 | 1.5 |
| 10 | Aggregation & Grouping operations in relational algebra | CLO1 | C3 | 1.5 |
| 11 | Database planning and design techniques. Overview of database system development lifecycle | CLO2 | C2 | 1.5 | Assignment 2  Quiz 2  MidTerm Exam  Terminal Exam |
| 12 | Advantages and disadvantages of Fact Finding techniques and their significance during the earlier stages of database application development lifecycle. | CLO2 | C2 | 1.5 |
| 13 | Concepts of Entity-Relationship (ER) model and EER model for advanced data modeling | CLO2 | C3 | 1.5 |
| 14 | ER / EER Case study | CLO2 | C4 | 1.5 |
| 15 | Mapping EER to relational schema | CLO2 | C4 | 1.5 |
| **Midterm Examination** | | | | | |
| 16 | Normalization and its significance. Issues with unnormalized databases e.g. data redundancy, inconsistency and anomalies | CLO2 | C2 | 1.5 | Assignment 3    Quiz 3  Terminal Exam |
| 17 | Functional Dependencies including partial functional dependency, transitive dependencies | CLO2 | C3 | 1.5 |
| 18 | Decomposition of schema, lossless joins and dependency preservation properties of a decomposition | CLO2 | C4 | 1.5 |
| 19 | Normalization forms: 1st, 2nd and 3rd normalized forms. | CLO2 | C4 | 1.5 |
| 20 | Advanced normalization: Inference rules for functional dependencies and Boyce-Codd normal form (BCNF) | CLO2 | C4 | 1.5 |
| 21 | Database Views. Types and their limitations | CLO3 | C3 | 1.5 |
| 22 | Updateable views | CLO3 | C3 | 1.5 |
| 23 | Database Authorization and granting/revoking permissions to roles and users | CLO3 | C3 | 1.5 |
| 24 | Introduction to Database Transactions. ACID properties | CLO3 | C3 | 1.5 | Assignment 4  Quiz 4  Terminal Exam |
| 25 | Transaction Concurrency control. Serialization and recoverability | CLO3 | C3 | 1.5 |
| 26 | SQL Transactions. Implicit and Explicit transactions | CLO3 | C3 | 1.5 |
| 27 | Indexing overview – significance of indexed data | CLO3 | C3 | 1.5 |
| 28 | Primary, secondary and clustered indexing in relational databases | CLO3 | C3 | 1.5 |
| 29 | Overview of stored procedures in SQL | CLO3 | C3 | 1.5 |
| 30 | SQL Triggers and database Auditing | CLO3 | C3 | 1.5 |
| 31 | SQL triggers on DML operations like select, update and delete operations | CLO3 | C3 | 1.5 |
| 32 | SQL triggers on database servers and DDL operations | CLO3 | C3 | 1.5 |

**Annexure – I: List of Experiments**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sr. No.** | **Topics Covered** | **CLO** | **Bloom Taxonomy** |
| 1 | Execute the usage of DDL & DML category commands in SQL with precision. | LAB CLO1 | P3 |
| 2 | Demonstrate the application of scalar / aggregate functions in SQL with accuracy. | LAB CLO1 | P2 |
| 3 | Apply wildcards and operators in SQL to perform complex queries. | LAB CLO1 | P3 |
| 4 | Implement various SQL constraints to enforce data integrity. | LAB CLO1 | P2 |
| 5 | Restore and import databases using CSV files with procedural accuracy. | LAB CLO1 | P3 |
| 6 | Design and implement an ERD in SQL and execute SQL Join operations. | LAB CLO1 | P2 |
| 7 | Extract required data from databases using Subqueries (Nested & Correlated) in SQL with proficiency. | LAB CLO1 | P3 |
| 8 | Construct an efficient and normalized database following normalization principles in SQL Server. | LAB CLO1 | P3 |
| 9 | Secure a database by performing DBA tasks related to authorization and roles with expertise. | LAB CLO1 | P3 |
| 10 | Analyze and retrieve data using complex SQL queries from case studies. | LAB CLO1 | P3 |
| 11 | Execute and apply SQL concepts for DB backup/restoration and SQL Transactions with reliability. | LAB CLO1 | P3 |
| 12 | Demonstrate and implement SQL Triggers to automate database operations. | LAB CLO1 | P3 |