1. **Course Profile**
   1. **Course Summary**

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| Course ID: | Course Title: | Credit Hours: | Year: 3rd  Term: 1st |
| CSE 3109  CSE 3110 | Database Systems  Database Systems Lab. | 3.0  1.5 |

* 1. **Rationale**

This course is a major for CSE students and is important for actual information system design and implementation. The course covers major areas for database design and implementation with special focus on logical and physical data models, the relational algebra, schema design normalization, query optimization, concurrency and transactions.

* 1. **Course Content**

**Database System Concepts:** Data models, Schemas and instances, DBMS architectures.

**Relational Model**: Entity relationship model, Keys, Relationships, ER diagrams, Design issues, ER to relational mapping.

**Relational Algebra:** Basic relational algebra Operations, Additional relational operations. SQL, QBE, Query processing and optimization, Triggers and cursors, Database server administration.

**Relational Constraints, Functional Dependencies:** Relational constraints and relational database schema, Functional dependencies.

**Normalization:** Normal form based on primary keys, General definitions of second and third normal form, Boyce-Codd normal form.

**Database Indexing and Index Structures:** Types of single level ordered index, Multilevel indexes, Dynamic multilevel indexes, Dynamic multilevel indexes using B-trees and B+ trees, Indexes on multiple keys.

**Transaction Processing and Management:** Introduction to transaction processing, Transaction and system concepts, Properties of transaction, Schedules and recoverability, Serializability of schedules.

**Concurrency Control Techniques:** 2PL, Serializability and recoverability, Lock management, Lock conversions, Dealing with deadlocks, Specialized locking techniques, Concurrency control without locking.

**Database Security and Authorization:** Introduction to database security, Access control, Discretionary access control, Mandatory access control, Security for internet applications.

**Information Retrieval and XML Data:** Introduction to information retrieval**,** Indexing for text search**,** Data model for XML, Querying XML data, Evaluation of XML queries.

* 1. **CLO to PLO mapping**

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| Course Learning Outcome (CLO) Matrix | | | | | | |  |
| CLOs | CLO Description | Bloom’s Learning Levels | | | | PLO Assessed | CLO-PLO Correlation |
| C | A | P | S |
| CLO1 | Develop and implement logical and physical schema to construct the secure database system using logical and physical data models and Normalization techniques | 3 |  |  |  | PLO1, PLO2 | 3, 2 |
| CLO2 | Formulate and implement data retrieval and manipulation techniques using relational algebra, SQL, indexing and transaction management tools. | 3 | 2 | 2 |  | PLO1 | 3 |
| CLO3 | Apply the integrity, security and confidentiality of database system using the relevant principles | 2 |  | 3 |  | PLO1 | 3 |
| CLO4 | Identify and apply the transactional information systems using various algorithms of transactional systems. |  |  | 3 | 3 | PLO3 | 3, 3, 2, 2 |

* 1. **Lesson Planning with Mapping of CLO, Teaching and Assessment Strategies**

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|  | **Week** | **Topic** | **Teaching-Learning Strategy** | **Assessment Strategy** | **Corresponding CLOs** |
| CSE 3109 (Theory) | 1 | * Introduction to Database System Concepts: Data models, schemas, and instances * Overview of DBMS architectures | Lecture (3h) x 13 weeks | Class Test-1,  Class Test-2,  Class Test-3 | CLO1, CLO2, CLO3 |
| 2 | * Introduction to the Relational Model: Entity relationship model, keys, relationships * ER diagrams and design issues |
| 3 | * Mapping ER diagrams to the relational model * Relational Algebra: Basic operations and additional relational operations |
| 4 | * Introduction to SQL and QBE (Query by Example) * Query processing and optimization techniques |
| 5 | * Triggers and cursors in SQL * Database server administration and management |
| 6 | * Relational Constraints and Relational Database Schema * Functional Dependencies and their role in database design |
| 7 | * Normalization: Primary keys, Second Normal Form (2NF), and Third Normal Form (3NF) * Boyce-Codd Normal Form (BCNF) and its significance |
| 8 | * Database Indexing and Index Structures: Single-level ordered indexes * Multilevel indexes and dynamic multilevel indexes |
| 9 | * Dynamic multilevel indexes using B-trees and B+ trees * Indexes on multiple keys for efficient data retrieval |
| 10 | * Introduction to Transaction Processing: Concepts and properties of transactions * Schedules, recoverability, and serializability of schedules |
| 11 | * Concurrency Control Techniques: Two-Phase Locking (2PL) and its variations * Dealing with deadlocks and specialized locking techniques |
| 12 | * Concurrency control without locking: Optimistic concurrency control * Introduction to Database Security: Access control and authentication |
| 13 | * Discretionary access control and mandatory access control * Security considerations for internet applications * Information Retrieval and XML Data: Indexing for text search, querying XML data, and evaluating XML queries |
| CSE 3110 (Laboratory) | 1 | * Environment Setup * Introduction to Oracle DBMS and its features * Installation of Oracle 11g Express Edition | Lab (2.5h) x 13 weeks | Viva-Voce conducted in Lab Class, Regular Lab Work | CLO4 |
| 2 | * User Creation in Oracle DBMS * Granting Privileges to Users |
| 3 | * Data Definition Language (DDL) - CREATE, ALTER, DROP statements * Creating and Modifying Database Objects |
| 4 | * Data Modification Language (DML) - INSERT, UPDATE, DELETE, SELECT statements * Inserting, Viewing, and Modifying Database Data |
| 5 | * Transaction Management - COMMIT and ROLLBACK statements * Ensuring Data Consistency and Atomicity |
| 6 | * Domain Integrity and Constraints * Enforcing Data Integrity Rules and Constraints |
| 7 | * Aggregate Functions and Group By Clause * Performing Calculations on Grouped Data |
| 8 | * Having Clause and Subqueries * Filtering Data based on Aggregated Results and Nested Queries |
| 9 | * Joining Multiple Tables - Inner Join, Outer Join, Cross Joins/ Cartesian Products * Combining Data from Multiple Tables |
| 10 | * Conditions using Multiple Columns * Working with Conditions involving Multiple Columns * Natural Join - Joining Tables based on Columns with the Same Name and Data Type |
| 11 | * Introduction to PL/SQL - Procedural Language/Structured Query Language * PL/SQL Block Structure - Declaration Section, Execution Section, and Exception-Handling Section * PL/SQL Operators - Arithmetic, Logical, Comparison, and Assignment Operators |
| 12 | * Program Flow Control in PL/SQL - IF-THEN-ELSE, CASE, and LOOP Statements * Procedures in Oracle DBMS - Creating and Executing Procedures * Functions in Oracle DBMS - Creating and Executing Functions with Return Values * Triggers in Oracle DBMS - Automating Actions based on Predefined Events |
| 13 | Final Evaluation | Final Lab Test, and Quiz, etc. |

* 1. **References**
* Silberschatz, Korth and Sudarshan, “Database System Concept” by McGraw Hill.
* Elmasri Navathe, Fundamentals of database systems, Addison-Wesley.
  1. **Tools**
* Oracle Database Management System, Toad
  1. **Assessment and Evaluation**

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|  | **Assessment**  **Type** | **Assessment**  **Tools** | **Allotted**  **Marks** | **Assessment**  **No** | **CLO**  **Assessed** | **Blooms**  **Category** | **Sub**  **Total** |
| CSE 3109 (Theory) | Continuous  Assessment | Class Participation, Attendance, Assignments | 10% |  |  |  | 30% |
| Class Test, Quizzes, Spot Test, etc. | 20% | Class Test-1 | CLO1, CLO2, CLO3 | Comprehend, Demonstrate, Construct |
| Class Test-2 |
| Class Test-3 |
| Summative Assessment | Term Final Examination | 70% |  | CLO1, CLO2, CLO3 | Comprehend, Demonstrate, Construct | 70% |
| Total | | | | | | | 100% |
| CSE 3110 (Laboratory) | Continuous  Assessment | Class participation, Attendance | 10% |  | CLO4 | Apply, Design, Create | 30% |
| Quizzes, Viva-Voce conducted in Lab Class, Regular Lab Work | 20% |  |
| Summative Assessment | Viva-Voce Conducted Centrally | 20% |  | 70% |
| Performance (Final Lab Test, and Quiz, etc.), Report | 50% |  |
| Total | | | | | | | 100% |