Course Code	Course Title	L	T	P	C
BACSE202	Database Systems	3	0	2	4
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives

1. To familiarize with database concepts and entity relationship modeling.
2. To impart knowledge on relational database design, normalization, physical database design, query optimization and distributed databases.
3. To equip with the strategies for handling transactions, concurrency control and database recovery.

Course Outcomes

1. Understand the role of database management systems in organizations and design relational data models and their operations.
2. Analyze and apply indexing structures for efficient data access and query optimization.
3. Gain insight into transaction management, concurrency control, and recovery mechanisms in databases.
4. Demonstrate the knowledge on distributed databases and NoSQL databases.
5. Apply database design principles to create scalable and maintainable data models for real-world systems.

Module:1	Database Systems and Data Models	7 hours

Introduction to database systems - Characteristics of database approach - Advantages of using DBMS approach - Actors on the scene - Classification of DBMS - Data Models - Schemas and Instances - Three-Schema Architecture - Database System Environment - Introduction to relational, semi structured, graph, vector, time series, distributed and unstructured databases - Relational model concepts: characteristics of relations - Relational model constraints and relational database schemas: domain constraints - key constraints and constraints on null values - entity integrity, referential integrity, and foreign Keys - dealing with constraint violations.

Module:2	ER Modeling and Relational Database Design	10 hours

Entity Relationship Model: Types of attributes, relationship types and sets, roles, structural constraints, weak entity -Mapping ER model to a relational schema - Extended ER Model: generalization - specialization – aggregations Guidelines for relational schema - Functional dependencies: inference rules, equivalence, and minimal cover - axioms on functional dependencies - Normalization: first, second and third normal forms - boyce codd normal form, multi-valued dependency and fourth normal form - join dependency and fifth normal form.

Module:3	Physical Database Design and Query Processing	9 hours

File structures: operations on files - files of unordered and ordered records - hashing techniques: static and dynamic - indexing: single level indexing, multi-level indexing, dynamic multilevel indexing - B+ tree indexing – LSM trees and its variants - Relational Algebra: operators - translating SQL queries into relational algebra - Tuple Relational Calculus - Query Optimization: query trees and heuristic optimization of query trees.		
Module:4	**Transaction Processing, Concurrency Control and Database Recovery**	**10 hours**
Introduction to transaction processing and concepts: ACID properties of transactions, transaction states - serial and serializable schedules - schedules based on recoverability - schedules based on serializability - conflict serializabilty - concurrent transactions – need of concurrency control - Concurrency control techniques: two phase locking techniques – guaranteeing serializability by two-phase locking – dealing with deadlock and starvation – concurrency control based on timestamp ordering: timestamp ordering algorithm – granularity of data items and multiple granularity locking - Recovery Concepts: categorization of recovery algorithms - recovery based on deferred update and immediate update.		
Module:5	**Distributed and NOSQL Databases**	**7 hours**
Distributed Database: introduction - architectures - data fragmentation, replication, and allocation techniques - transaction management, concurrency control and recovery - query processing and optimization - NoSQL Databases: introduction - characteristics of NoSQL Systems, CAP theorem, ACID vs BASE properties, NoSQL modeling techniques - aggregate data models, distribution models, map reduce, types of NoSQL databases: key-value databases, document based databases, column based databases and graph databases.		
Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours:	**45 hours**

Text Book(s)

R. Elmasri and S. B. Navathe, "**Fundamentals of Database Systems**", Pearson India Education, 7th Edition, **2021**

Reference Books

A. Silberschatz, H. F. Korth and S. Sudarshan, "**Database System Concepts**", McGraw Hill India, 7th Edition, **2021**

Mark L. Gillenson and Pradeep Singh, "**Fundamentals of Database Management Systems - An Indian Adaptation**", Wiley, India, 3rd Edition, **2025**

M. Tamer Özsu , Patrick Valduriez, "**Principles of Distributed Database Systems**", Springer Nature, 4th Edition, **2020**

Gerardus Blokdyk, "**NoSQL Databases A Complete Guide**", 5STARCooks, 1st Edition, **2021**

Indicative Experiments

1. Design an ER / EER diagram for any real-world data requirements (E.g.: Bank Database) using any suitable drawing tool.	2 hours
2. Translate the ER diagram into the corresponding relational databases.	2 hours
3. Apply the Normalization concept and normalize the given table into 1NF, 2NF and 3NF.	2 hours
4. Populate the relational database with real world Customer and Transaction data (refer to Kaggle or any open data sources for real world datasets) using Data Manipulation Languages. Use Data Control Language and Transaction Control Language commands.	2 hours
5. Apply retrieval of data using operators, functions like arithmetic, comparison, logical and like Operators.	2 hours
6. Apply the single row functions and group functions on the normalized tables.	2 hours
7. Retrieve the data from the relational database using sub queries, Joins and Views.	4 hours
8. Use features of PL/SQL like control structures, conditional statements, user defined functions and procedures, cursors and triggers to retrieve or modify data.	6 hours
9. Interface the database with Front Ends using ODBC and JDBC. Perform the retrieval and DML operations from the Front End.	2 hours
10. Implementation of database creation, deletion, insertion, updation, view and retrieval of documents in a NoSQL database environment. Implement a scale in / scale out operation on NoSQL database.	2 hours
11. Implementation of database replication, backup and restore of files in a NoSQL database environment. Demonstrate how data is shared in NoSQL environment.	2 hours
12. Create and configure cloud resources, then perform CRUD operations. Integrate the database with a sample application to demonstrate real-world usage.	2 hours
Total Laboratory Hours:	**30 hours**
Mode of Evaluation : Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment	
Recommended by Board of Studies :	21-05-2025
Approved by Academic Council : No. 78	12-06-2025