Kadi Sarva Vishwavidyalaya, Gandhinagar

25CAMJ205: Database Management Systems

Program: B.E. Computer Engineering / Computer Science and Engineering / Information Technology (Year - 2)
Teaching Scheme: 3L - 0T - 2P (4 Credits)
Prerequisite: Basic mathematics and logic (sets, relations, functions)

Rationale: Database Management System (DBMS) is a fundamental pillar of Computer Engineering and Information Technology. This course equips students with the essential concepts and practical skills required to organize, store, retrieve, and manage data efficiently in modern software applications. By mastering data models, normalization, SQL/PL-SQL, and transaction management, students develop the ability to build robust, scalable, and secure data-driven systems.

1. **Course Objectives:**

The Purpose of learning this course is

- To understand the fundamental concepts of database management systems, including architecture and data independence.
- To develop skills in designing efficient database schemas using Entity-Relationship (ER) modeling and normalization techniques.
- To master Relational Query Languages, specifically SQL and PL/SQL, for effective data manipulation and control.
- To impart knowledge of transaction processing, ACID properties, and concurrency control mechanisms to ensure data integrity.
- To explore modern database technologies and recovery strategies to handle system failures with a focus on sustainable and energy-efficient data management.

2. Teaching and Evaluation Scheme:

Teaching Scheme					Examination Scheme				
L	**T**	**P**	**C**	**Hrs / Week**	**IE**	**EE**	**CIA**	**Practical**	**Total Marks**
3	0	2	4	5	40	60	30	20	150

IE: Internal Exam
EE: External Exam (End Semester)
CIA: Continuous Internal Assessment
Practical: Practical Exam (End Semester)

3. Detailed Syllabus

Unit	Topic	Lectures	% weigh	Outcomes
1	**Basic Concepts and Architecture of Database** Database Systems versus File Systems, Data Abstraction, Data Independence, Applications of Database Systems, Database Users. Understand and explain database fundamentals supporting Quality Education and Industry, Innovation and Infrastructure.	10	15	CO1
2	**Data Models and ER Design** Entity-Relationship (ER) Model: Entities, Attributes, Relationships. Relational Model basics and Integrity Constraints. Design and develop data models for industry and innovation.	5	15	CO2

3	**Relational Database Design and Normalization** Basic System Development Life Cycle, Functional dependencies, Normalization, Normal forms (1NF, 2NF, 3NF, BCNF, 4NF, 5NF), Loss less joins and dependency preserving decomposition. Apply and implement efficient queries for sustainable data usage	10	20	CO2
4	**Relational Query Languages and SQL** DDL (Data Definition Language), Data Dictionary, DML (Data Manipulation Language), DRL (Data Retrieval Language), DCL (Data Control Language), TCL (Transaction Control Language), SQL Functions and Aggregate Functions, Join Operations, Views. Authentication, Authorization. Set Operations. Analyze and evaluate system reliability in real-world applications	5	25	CO3
5	**Transaction Management and Concurrency** Introduction and Properties of Transaction- ACID property, Concurrent execution of transactions. Serializability of scheduling – Conflict and View Concurrency Control-Lock – Based Protocols, Timestamp-based Protocols Database Recovery – Failure classifications, Log Based Recovery, Checkpoints. Evaluate and assess secure and sustainable database technologies	15	25	CO4, CO5

4. List of Experiments:

No	Details	Hours	CO
1	Creating and Manipulating Database Objects (Table). – DDL	02	CO3
2	Including and Enforcing Constraints on the table. – DDL	02	CO3
3	Manipulating Data with Database Objects. – DML	02	CO3
4	Retrieving, Restricting and Sorting Data. – DRL	02	CO3
5	SQL Single Row Functions.	02	CO3
6	SQL Multiple Row Functions (Aggregate Function).	02	CO3
7	Displaying Data from Multiple Tables (Join).	02	CO3
8	Using Commit and Rollback show Transaction ACID Property.	02	CO4
9	Securing data using Views and Controlling User Access (DCL).	02	CO3
10	Database SET Operations.	02	CO3
11	PL/SQL Block Syntax and DML Operation through PL/SQL Block.	02	CO3
12	Control Structures in PL/SQL.	02	CO3
13	Working with Cursor.	02	CO3
14	Creating Procedures and Functions in PL/SQL.	02	CO3
15	Creating Database Triggers.	02	CO3

5. Course Outcomes (COs)

After completion of the course, the student will be able to:

CO No.	Course Outcome (CO)	RBT Level (Cognitive Domain)
CO1	Explain DBMS architecture, data models, and the advantages of database systems over traditional file systems.	Understand
CO2	Design ER models and apply normalization rules (1NF to BCNF) to create optimized relational database schemas.	Apply/Create
CO3	Construct complex SQL queries and PL/SQL programs (procedures, functions, triggers) for data management.	Apply/Analyze
CO4	Apply transaction management principles and ACID properties to ensure database consistency.	Apply
CO5	Evaluate concurrency control protocols and recovery techniques in multi-user database environments.	Evaluate

6. Mapping of COs with POs & PSOs:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	1	3	1
CO2	3	3	3	2	-	-	-	-	-	-	1	3	2
CO3	2	2	3	-	3	-	-	-	-	-	2	3	2
CO4	3	2	2	-	-	-	-	-	-	-	1	3	1
CO5	2	3	2	2	-	-	-	-	-	-	1	3	1
Avg.	2.6	2.4	2.5	2	3	-	-	-	-	-	1.2	3	1.4

7. Reference Reading:

7.1 Text Books

- Database System Concepts, Silberschatz, Korth, Sudarshan, McGraw Hill.
- Fundamentals of Database Systems, Elmasri & Navathe, Pearson.

7.2 Reference Books

- Principles of Database and Knowledge-Base Systems, J.D. Ullman.
- Foundations of Databases, Abiteboul, Hull, Vianu.
- Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke, McGraw Hill.

7.3 Online References

- NPTEL: Database Management Systems by Prof. Partha Pratim Das (IIT Kharagpur).
- Coursera: Database Management Systems Specialization (University of Colorado).
- Oracle Academy: SQL and PL/SQL Fundamentals.
- W3Schools: SQL Tutorial for interactive learning.

8. Course Outcomes Mapping Table

CO	Course Outcome (CO)	POs/PSOs Map
CO1	Explain DBMS architecture, data models, and the advantages of database systems over traditional file systems.	PO1, PO2, PO11, PSO1, PSO2
CO2	Design ER models and apply normalization rules (1NF to BCNF) to create optimized relational database schemas.	PO1, PO2, PO3, PO4, PO11, PSO1, PSO2
CO3	Construct complex SQL queries and PL/SQL programs (procedures, functions, triggers) for data management.	PO1, PO2, PO3, PO5, PO11, PSO1, PSO2
CO4	Apply transaction management principles and ACID properties to ensure database consistency.	PO1, PO2, PO3, PO11, PSO1, PSO2
CO5	Evaluate concurrency control protocols and recovery techniques in multi-user database environments.	PO1, PO2, PO3, PO4, PO11, PSO1, PSO2

9 Evaluation Scheme:

- The course evaluation shall comprise Internal Examination (IE) and End Semester Examination (EE) for theory, along with Continuous Internal Assessment (CIA) and External Practical Examination.
- The Internal Examination (40 marks) will be conducted through one or more mid-semester tests covering the prescribed syllabus.
- The End Semester Examination (60 marks) will assess the overall understanding of the course with emphasis on problem-solving and analytical ability.
- The Practical Examination (20 marks) shall be conducted externally and will include implementation, performance, and viva-voce.
- Students are required to secure minimum qualifying marks in each component separately as per university rules.

10 Pedagogical Framework:

- The course adopts a blended teaching approach combining lectures, coding demonstrations, and interactive problem-solving sessions.
- Emphasis is placed on learning by doing through extensive laboratory work, assignments, and mini-projects.
- Conceptual understanding is reinforced with real-world examples and algorithm visualization techniques.
- Students are encouraged to engage in collaborative learning, discussions, and peer problem-solving.
- Continuous feedback through assessments and lab performance supports progressive skill development and mastery.

11 Innovative Practices:

- Utilizing real-world scenarios - such as hospital management or e-commerce logistics—to strengthen skills in ER modeling and normalization (1NF to BCNF).
- Students must use complex joins, subqueries, and aggregate functions to on provided database.
- Instead of simple classroom examples, students are given real-world problem statements to create complex ER diagrams and normalization sets.
- Students develop small-scale applications that connect PL/SQL back-ends with front-end interfaces, demonstrating the practical application of triggers, procedures, and functions.

12 Self-Learning Component:

- Students are encouraged to engage in self-paced learning through online coding platforms (NPTEL/SWAYAM), tutorials, and technical resources to strengthen their understanding of SQL, PL and Database Concepts. (e.g. https://nptel.ac.in/courses/106106220 and https://nptel.ac.in/courses/106104135)
- Regular practice of SQL queries beyond the syllabus helps in improving problem-solving skills and logical thinking.
- Utilizing online practice platforms, such as Virtual Labs, to execute SQL queries and experiment without local software installation. (i.e. Oracle Live SQL, W3Schools, SQL Online IDE etc.)
- Students can often cement their learning by building standalone database systems for real-world scenarios.

13 Sustainable Development Goals (SDG) Integration

This course integrates principles of sustainable engineering by Promoting Quality Education **(SDG 4)**, Decent Work and Economic Growth **(SDG 8)**, Industry, Innovation and Infrastructure **(SDG 9)**, Responsible Consumption and Production **(SDG 12)**, and Climate Action **(SDG 13)** by fostering knowledge, innovation, sustainable practices, and responsible growth.

SDG Mapping with Course Outcomes

CO	Course Outcome	Relevant SDGs	Justification
CO1	Describe DBMS architecture, data models, and key database concepts.	SDG 4, SDG 9	Promotes quality education and supports digital infrastructure development
CO2	Design ER models and apply normalization to develop relational databases.	SDG 8, SDG 9	Enables industry-relevant skills and supports innovation in system design
CO3	Write SQL and PL/SQL programs for data management and control	SDG 12, SDG 13	Encourages efficient data handling, reducing redundancy and energy consumption
CO4	Learn the transaction concepts and its properties.	SDG 4, SDG 8, SDG 9	Enhances problem-solving skills and ensures reliable systems in industries
CO5	Evaluate database security and emerging technologies with a focus on sustainable and energy-efficient data management.	SDG 9, SDG 12, SDG 13	Supports sustainable and secure data systems while promoting resource-efficient technologies