Course Code: CSE 311		CIE Marks: 60
Course Title: Database Management System		SEE Marks: 40
Credits: 3	Weekly: 3 Hours	Total Week: 16

Course Content (from syllabus):

Overview of database management systems; Relational Data Model; Database Design and Normalization; SQL Basics; Advanced SQL Queries;Database Implementation; Database Security; Data Warehousing and Data Mining; NoSQL Databases; Distributed Databases; Database Administration; Big Data and Cloud Databases; Emerging Trends in Databases

Course Description/Rationale:

DBMS refers to an introductory course for understanding the fundamental concepts, principles, and techniques of database management systems. DBMS aims at the design, implementation and maintenance of relational databases, as well as various database models, query languages, normalization techniques, and database administration.

Course objective:

- Gain a foundational understanding of database management systems, including data models, normalization principles, and relational algebra.
- Develop proficiency in SQL for data manipulation, querying, and database schema definition.
- Learn to design and implement efficient relational databases using normalization techniques and proper schema design principles.
- Understand database security concepts and implement measures such as authentication, authorization, encryption, and auditing to protect data integrity and confidentiality.
- Explore advanced topics such as distributed databases, NoSQL databases, and data warehousing to understand emerging trends and technologies in the field.

Course Learning Outcome (CO): (at the end of the course, students will be able to:)

CO1	demonstrate a comprehensive **understanding** of fundamental database management concepts, including the relational data model, normalization techniques, and SQL basics.
CO2	design, implement and optimize relational databases, incorporating advanced SQL queries, indexing techniques and query optimization strategies.
CO3	understand and analyze security measures, distributed database architectures and emerging trends in database management, demonstrating an understanding of the broader context and challenges in the field.

Content of the course:

Week	Course Content (as summary)	Hrs	COs
1	Introduction to Databases, Evolution of databases, Types of databases, Introduction to SQL	2.5	CO1
2	Discussion on Relational Data Model, Entity-Relationship (ER) modeling	2.5	CO1
3	Discussion on Relational algebra, Relational calculus	2.5	CO1
4	Discussion on Database Design and Normalization, Functional dependencies and normalization, Normal forms (1NF, 2NF, 3NF, BCNF), Denormalization	2.5	CO1, CO3
5	Discussion on SQL Basics, Data definition language (DDL), Data manipulation language (DML), Querying databases with CRUD Operations	2.5	CO1
6	Discussion on CRUD operations using SQL	2.5	CO2
7	Discussion on SQL Queries, Joins and subqueries, Set operations, Grouping and aggregation, Views and indexes	2.5	CO3
8	Discussion on Database Implementation, Storage and file structures, Indexing techniques, Query processing and optimization, Transaction processing	2.5	CO2
9	Discussion on Database Security, Security threats and vulnerabilities, Authentication and authorization, Encryption and access control, Auditing and monitoring	2.5	CO3
10	Discussion on Data Warehousing and Data Mining, Introduction to data warehousing, Data warehouse architecture, OLAP (Online Analytical Processing), Introduction to data mining techniques	2.5	CO1,CO3
11	Discussion on NoSQL Databases, Overview of NoSQL databases Types of NoSQL databases: document-oriented, key-value, column-family, graph, Use cases and applications	2.5	CO1
12	Discussion on Distributed Databases, Introduction to distributed databases, Distributed database architecture, Replication and fragmentation, Distributed query processing and optimization	2.5	CO1,CO2
13	Discussion on Database Administration, Database administration tasks and responsibilities, Backup and recovery, Performance tuning and optimization, Monitoring and troubleshooting	2.5	CO2
14	Discussion on Big Data and Cloud Databases, Introduction to big data technologies, Cloud computing and databases, Scalability and elasticity, Case studies and applications	2.5	CO3
15	Discussion on Emerging Trends in Databases, Blockchain and distributed ledger technology (DLT), Spatial and temporal databases, In-memory databases, Graph databases	2.5	CO3
16	Review of course materials, Project presentations and demonstrations, Future directions in database management	2.5	CO1,CO3
	Total	**40**	

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CO's/PO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2			✓									
CO3					✓							

PO Descriptions

PO1 Engineering knowledge: Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization as specified in K1 to K4 respectively to the solution of complex engineering problems.

PO3 Design/development of solutions: Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. (K5)

PO5 Modern tool usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering problems, with an understanding of the limitations. (K6)

Justification: CO, PO Mapping

PO1 By mastering the relational data model, normalization principles, and SQL basics, students fulfill the program outcome of acquiring a solid foundation in fundamental database management concepts. This knowledge forms the basis for advanced topics and practical applications in the field of database management systems, which is explicitly addressed in CO1.

PO3 Designing and implementing relational databases require problem-solving skills and the ability to translate conceptual designs into practical database structures. By mastering advanced SQL queries, indexing techniques, and query optimization, students develop the capability to design and implement effective database solutions to meet specific requirements, aligning with the program outcome focused on practical problem-solving abilities.

PO5 Understanding security measures, distributed database architectures, and emerging trends in database management situates students within the broader context of contemporary issues and challenges in the field. By analyzing and evaluating these topics, students develop critical thinking skills and an awareness of the evolving landscape of database management systems, aligning with the program outcome focused on staying abreast of contemporary issues and trends in the discipline.

Teaching Learning Activity:

TLA	Activity
TLA1	Introduce the importance of DBMS and explore real-life case studies where DBMS principles have been successfully applied.
TLA2	Delve into the core concepts of DBMS, including Relational Database, SQL queries, Relational Algebra, Normalization, Database Security and Database Administration.
TLA3	Work with Database Management Systems necessity and security. Explore practical examples and design DBMS using different techniques.

Mapping Course Learning Outcome (COs) with the Teaching-Learning and Assessment Strategy:

COs	POs	Teaching Learning Activity	Assessment Strategy	Learning Domains	Knowledge Profile (WK)	Complex Engineering Problem (EP)	Complex Engineering Activity (EA)
CO1	PO1	TLA1	Quiz Assignment	C1	WK1	EP1 & EP2, EP3	-
CO2	PO3	TLA2	Midterm Final, Quiz	C4	WK5	EP1 & EP2, EP3	-
CO3	PO5	TLA3	Final, Quiz Presentation	C3	WK6	EP1 & EP2, EP6	-

Justification: PO and Learning Domains Mapping

PO1 **Remembering** (Recalling information from memory)

PO3 **Analyzing** (Breaking down complex information and examining relationships)

PO5 **Applying** (Using learned information in new situations or contexts)

Justification: PO and Knowledge Profile (WK) Mapping

PO1 PO1 requires a conceptual, theory-based understanding of natural science, to support the analysis and modeling of problems in the discipline (**WK1**).

PO3 PO3 involves the application of engineering design principles and practical engineering knowledge to develop solutions for real-world complex problems. It requires an understanding of design concepts (**WK5**)

PO5 PO4 involves the application of engineering technology in the practical area of engineering science to solve problems (**WK6**)

Justification: PO and Complex Engineering Problem (EP) Mapping

PO1

1. **EP1**: Aligns with PO1 as a deep understanding is vital for addressing the complexities of a banking system.
2. **EP2**: Addresses conflicting needs, aligning with the problem-solving nature of engineering knowledge.

3. **EP3**: Reflects the need for a profound analysis, harmonizing with the analytical aspect of engineering knowledge.

PO3
1. Effective design and development require a strong foundation, aligning with the depth of knowledge in **EP1**.
2. Design necessitates a thorough analysis, aligning with the principles of **EP3**.
3. Designing solutions requires familiarity with relevant issues, linking with **EP4**.

PO5
1. Effective use of modern tools requires a deep understanding, aligning with the depth of knowledge in **EP1**.
2. Modern tool usage involves addressing conflicting needs, aligning with **EP2**.
3. Using tools effectively includes considering stakeholder needs, aligning with **EP6**.

Justification: PO and Complex Engineering Problem (EP) Mapping

PO1 By mastering the relational data model, normalization principles, and SQL basics, students fulfill the program outcome of acquiring a solid foundation in fundamental database management concepts. This knowledge forms the basis for advanced topics and practical applications in the field of database management systems.

PO3 Designing and implementing relational databases require problem-solving skills and the ability to translate conceptual designs into practical database structures. By mastering advanced SQL queries, indexing techniques, and query optimization, students develop the capability to design and implement effective database solutions to meet specific requirements, aligning with the program outcome focused on practical problem-solving abilities.

PO5 Understanding security measures, distributed database architectures, and emerging trends in database management situates students within the broader context of contemporary issues and challenges in the field. By analyzing and evaluating these topics, students develop critical thinking skills and an awareness of the evolving landscape of database management systems, aligning with the program outcome focused on staying abreast of contemporary issues and trends in the discipline.

Course Delivery Plan/Lesson Delivery Plan:

Week/Lesson (hour)	**Discussion Topic and Book Reference**	**Student Activities during Online and Onsite** [course teacher will decide based on the type of the contents]on the type of the contents]	**Mapping with CO and PO**	**Assessment Plan**
Week-1 Lesson 1 & 2 [3 Hours]	**Lesson 1:** Overview of database management systems, Evolution of databases Types of databases: relational, NoSQL, object-oriented	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture video, Lecture	CO1 PO1	Class Test, Assignment, Midterm

	Lesson 2: Introduction to SQL with Examples and exercises	note, Open discussion.		
Week-2 Lesson 3 & 4 [3 Hours]	**Lesson 3:** Relational model concepts Entity-Relationship (ER) modeling **Lesson 4:** Entity-Relationship (ER) modeling with Examples and exercises	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture video, Lecture note, Open discussion.	CO1 PO1	Class Test, Assignment , Midterm
Week-3 Lesson 5 & 6 [3 Hours]	**Lesson 5:** Relational algebra with Examples and exercises **Lesson 6:** Relational calculus with Examples and exercises	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture video, Lecture note, Open discussion.	CO1 PO1	Class Test, Assignment , Midterm
Week-4 Lesson 7 & 8 [3 Hours]	**Lesson 7:** Functional dependencies and normalization, Normal forms: 1NF, 2NF, **Lesson 8:** Normal forms: 3NF, BCNF, Denormalization, Practical database design considerations	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture video, Lecture note, Open discussion.	CO1 PO1 CO3 PO5	Class Test, Assignment , Midterm
Week-5 Lesson 9 & 10 [3 Hours]	**Lesson 9:** Basic SQL syntax, Data definition language (DDL) **Lesson 10:** Data manipulation language (DML), Querying databases with SELECT	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture video, Lecture note, Open discussion.	CO1 PO1	Class Test, Assignment , Midterm
Week-6 Lesson 11 & 12 [3 Hours]	**Lesson 11:** Basic of CRUD Operations with Examples and exercises **Lesson 12:** Basic of CRUD Operations with Examples and exercises	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture video, Lecture note, Open discussion.	CO2 PO3	Class Test, Assignment , Midterm

Week-7 Lesson 13 & 14 [3 Hours]	**Lesson 13:** Joins and subqueries, Set operations **Lesson 14:** Grouping and aggregation, Views and indexes	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture video, Lecture note, Open discussion.	CO3 PO5	Class Test, Assignment, Midterm
Week-8 Lesson 15 & 16 [3 Hours]	**Lesson 15:** Storage and file structures, Indexing techniques **Lesson 16:** Query processing and optimization, Transaction processing	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture video, Lecture note, Open discussion.	CO2 PO3	Class Test, Assignment, Midterm
Week-9 Lesson 17 & 18 [3 Hours]	**Lesson 17:** Security threats and vulnerabilities, Authentication and authorization **Lesson 18:** Encryption and access control Auditing and monitoring	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture video, Lecture note, Open discussion.	CO3 PO5	Class Test, Assignment, Presentation, Final
Midterm Examination **Syllabus: Week 1 – Week 9**				
Week-10 Lesson 19 & 20 [3 Hours]	**Lesson 19:** Introduction to data warehousing, Data warehouse architecture OLAP (Online Analytical Processing) **Lesson 20:** Introduction to data mining techniques	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture video, Lecture note, Open discussion.	CO1 PO1 CO3 PO5	Class Test, Assignment, Presentation, Final
Week-11 Lesson 21 & 22 [3 Hours]	**Lesson 21:** Overview of NoSQL databases, Types of NoSQL databases: document-oriented **Lesson 22:** Types of NoSQL databases: key-value, column-family, graph; Use cases and applications	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture video, Lecture note, Open discussion.	CO1 PO1	Class Test, Assignment, Presentation, Final

Week-12 Lesson 23 & 24 [3 Hours]	**Lesson 23:** Introduction to distributed databases, Distributed database architecture **Lesson 24:** Replication and fragmentation, Distributed query processing and optimization	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture video, Lecture note, Open discussion.	CO1 PO1 CO2 PO3	Class Test, Assignment , Presentation , Final
Week-13 Lesson 25 & 25 [3 Hours]	**Lesson 25:** Database administration tasks and responsibilities, Backup and recovery **Lesson 26:** Performance tuning and optimization, Monitoring and troubleshooting	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture video, Lecture note, Open discussion.	CO2 PO3	Class Test, Assignment , Presentation , Final
Week-14 Lesson 27 & 28 [3 Hours]	**Lesson 27:** Introduction to big data technologies, Cloud computing and databases Scalability and elasticity **Lesson 28:** Case studies and applications of Cloud Databases	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture video, Lecture note, Open discussion.	CO3 PO5	Class Test, Assignment , Presentation , Final
Week-15 Lesson 29 & 30 [3 Hours]	**Lesson 29:** Blockchain and distributed ledger technology (DLT) **Lesson 30:** Spatial and temporal databases, In-memory databases, Graph databases	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture video, Lecture note, Open discussion.	CO3 PO5	Class Test, Assignment , Presentation , Final
Week-16 Lesson 31 & 32 [3 Hours]	**Lesson 31:** Review Class – 1: for preparing for the final exam **Lesson 32:** Review Class – 2: for preparing for the final exam Future Directions on DBMS	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture video, Lecture note, Open discussion.	CO1 PO1 CO3 PO5	Class Test, Assignment , Presentation , Final
Final Examination				

Syllabus: Week 10 – Week 16

Assessment Pattern:

Assessment Task	CO's			Mark (Total=100)
	CO1	CO2	CO3	
Attendance	--	--	--	7
Class Test	--	--	--	15
Assignment	--	--	--	5
Presentation	--	--	--	8
Midterm Examination	5	10	10	25
Final Examination	5	15	20	40
Total Marks	10	15	15	100

CIE – Breakup [60 marks]

Bloom's Criteria	Attendance (07)	Class Test (15)	Assignment (05)	Presentation (08)	Mid Exam (25)
Remember		02			2.5
Understand		05	02	02	7.5
Apply		05		03	12.5
Analyze		03	03	03	2.5
Evaluate					
Create					

SEE – Semester End Examination [40 marks]

Bloom Criteria	Score for the Test
Remember	5
Understand	10
Apply	20
Analyze	5
Evaluate	
Create	

Learning Materials:

Textbook/Recommended Readings:

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

2. "Database Management Systems" by Raghu Ramakrishnan and Johannes Gehrke
3. "Database Design for Mere Mortals" by Michael J. Hernandez
4. "SQL Queries for Mere Mortals" by John L. Viescas and Michael J.
5. "SQL Cookbook" by Anthony Molinaro
6. Database Systems: The Complete Book" by Hector Garcia-Molina, Jeffrey D. Ullman, and Jennifer Widom

Reference Books/Supplementary Readings:

1. Online materials
2. Online resources using Google search engine, YouTube, etc.

Other Readings:

1. Powerpoint Lecture Slide Prepared by course teacher