

COURSE TITLE	RELATIONAL DATABASE MANAGEMENT AND NOSQL
COURSE CODE	01AS0301
COURSE CREDITS	4

Objective:

- 1 The course aims to provide a comprehensive understanding of the fundamental concepts of Relational Database Management Systems (RDBMS) and NoSQL databases. It covers essential topics such as database design, normalization, indexing, and query optimization. Students will explore various types of NoSQL databases and their practical use cases. Through hands-on experience with SQL databases like MySQL as well as NoSQL databases such as MongoDB, Cassandra, and Redis, learners will develop the necessary skills to design and implement robust, database-driven applications.

Course Outcomes: After completion of this course, student will be able to:

- 1 Design and implement relational and NoSQL databases
- 2 Write efficient SQL and NoSQL queries for different use cases
- 3 Understand trade-offs between different database architectures
- 4 Develop applications integrating RDBMS and NoSQL databases
- 5 Work on real-world projects using database technologies

Pre-requisite of course:Basic Programming

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	Introduction to Databases Overview of Databases and Database Management Systems, Difference between RDBMS and NoSQL, ACID vs. BASE properties, Database Models : Hierarchical, Network, Relational, and NoSQL	5
2	Relational Database Management Systems (RDBMS) Introduction to SQL and Relational Algebra, Database Design and Normalization (1NF to 5NF), SQL Queries: SELECT, INSERT, UPDATE, DELETE, Joins, Views, Indexing, Stored Procedures, Triggers, Query Optimization Techniques	10
3	Introduction to NoSQL Databases Introduction to NoSQL, need of NoSQL, Types of NoSQL Databases: Key-Value, Document, Column-Family, Graph, Advantages and Disadvantages of NoSQL, NoSQL vs. SQL, use of noSQL in Software applications	7

Contents : Unit	Topics	Contact Hours
4	Document-Oriented Databases (MongoDB) Basics of MongoDB: Collections, Documents, Indexes, CRUD Operations in MongoDB, Aggregation Framework, Schema Design Best Practices, Performance Tuning in MongoDB	8
5	Column-Family & Key-Value Databases Apache Cassandra: Architecture, CQL, Partitioning, Redis: Data Structures, Caching, Transactions, CAP Theorem and Trade-offs, Replication and Sharding in NoSQL	6
6	Database Applications Building Scalable Applications with RDBMS and NoSQL, , Database Security and Access Control, Case Studies: Social Media, E-Commerce, Big Data	6
Total Hours		42

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	Relational Database Management Systems (RDBMS) Create a relational database using MySQL/PostgreSQL., Perform basic SQL operations: CREATE, DROP, ALTER, INSERT, SELECT, DELETE, UPDATE	2
2	Relational Database Management Systems (RDBMS) Apply PRIMARY KEY, FOREIGN KEY, UNIQUE, NOT NULL, and CHECK constraints, Demonstrate referential integrity between tables	2
3	Relational Database Management Systems (RDBMS) Implement different types of joins (INNER, LEFT, RIGHT, FULL OUTER), Retrieve data using multiple table queries	2
4	Relational Database Management Systems (RDBMS) Design a relational schema and normalize it up to 3rd Normal Form (3NF), Implement indexing to improve query performance	2
5	Relational Database Management Systems (RDBMS) Write and execute stored procedures and functions, Implement triggers for automated database operations	2
6	Relational Database Management Systems (RDBMS) Query optimization using indexing	2
7	Relational Database Management Systems (RDBMS) Implement BEGIN, COMMIT, ROLLBACK transactions, Demonstrate isolation levels and concurrency issues	2
8	Document-Oriented Databases (MongoDB) Install and set up MongoDB, Perform INSERT, FIND, UPDATE, and DELETE operations on a document collection	2
9	Document-Oriented Databases (MongoDB) Use \$match, \$group, \$sort, \$limit, and \$project to analyze data	2

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
10	Introduction to NoSQL Databases Design an optimized document schema for an e-commerce application	2
11	Column-Family & Key-Value Databases Install and set up Apache Cassandra., Perform CREATE TABLE, INSERT, SELECT, and DELETE operations using CQL	2
12	Column-Family & Key-Value Databases Install and configure Redis, Perform basic CRUD operations using Redis commands (SET, GET, EXPIRE, DEL)	2
13	Document-Oriented Databases (MongoDB) Set up MongoDB replication (Replica Set) for high availability, Implement sharding in MongoDB for distributed storage	2
Total Hours		26

Textbook :

- 1 Database System Concepts, Abraham Silberschatz, Henry F. Korth, and S. Sudarshan, McGraw-Hill, 2019
- 2 MongoDB: The Definitive Guide, Kristina Chodorow, O'Reilly Media, 2019
- 3 Cassandra: The Definitive Guide, Jeff Carpenter, Eben Hewitt, O'Reilly Media, 2018
- 4 Redis in Action, Josiah L. Carlson, Manning Publications, 2013

References:

- 1 NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Pramod J. Sadalage and Martin Fowler, Pearson Education Inc, 2012
- 2 SQL Performance Explained, SQL Performance Explained, Markus Winand, Markus Winand, 2012
- 3 Designing Data-Intensive Applications, Designing Data-Intensive Applications, Martin Kleppmann, O'Reilly Media , 2017
- 4 Fundamentals of Database Systems, Fundamentals of Database Systems, Ramez Elmasri, Shamkant B. Navathe, Pearson, 2025

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery					
Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking / Creative
10.00	15.00	30.00	20.00	15.00	10.00

Instructional Method:

- 1 The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc. The internal evaluation will be done on the basis of continuous evaluation of students in the class-room. Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory

Supplementary Resources:

- 1 <https://www.khanacademy.org/computing/computer-programming/sql>
- 2 <https://university.mongodb.com/>
- 3 <https://www.datastax.com/resources/getting-started-cassandra>
- 4 <https://www.tutorialspoint.com/cassandra/index.htm>
- 5 <https://www.tutorialspoint.com/redis/index.htm>