



SRI VENKATESWARA UNIVERSITY

II Year Syllabus for 4-Year UG Honours in B.Sc. (Data Science) as Major in consonance with Curriculum framework w.e.f. AY 2026-27

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
II	IV	8	Data Mining	3	3
			Data Mining Lab	2	1
		9	Python for Data Analysis and Visualization	3	3
			Python for Data Analysis and Visualization lab	2	1
		10	Document Oriented Database	3	3
			Document oriented Database lab	2	1

SEMESTER-IV
COURSE 10: DOCUMENT ORIENTED DATABASE

Theory

Credits: 3

3 hrs/week

Course Objectives

1. To introduce students to the concepts of NoSQL databases and their significance compared to traditional relational databases.
2. To provide hands-on experience with MongoDB for performing CRUD operations, querying, and advanced data handling.
3. To develop skills in schema design, data modeling, and working with embedded and referenced documents.
4. To explore MongoDB's advanced features such as indexing, aggregation framework, replication, and transactions.
5. To prepare students for real-world applications of MongoDB in scalable, high- performance data-driven applications.

Course Outcomes

On successful completion of this course, students will be able to:

1. Differentiate between SQL and NoSQL databases, and explain the architecture and features of MongoDB.
2. Perform CRUD operations and construct queries using MongoDB Query Language (MQL).
3. Apply schema design strategies and use appropriate data modeling techniques for different application scenarios.
4. Utilize advanced features like indexing, aggregation, GridFS, and transactions to optimize data handling.
5. Implement replication concepts and ensure high availability, fault tolerance, and scalability in MongoDB-based applications.

Unit 1. Introduction to NoSQL & Fundamentals of MongoDB:

What is NoSQL DB? History & evolution of NoSQL, Features of NoSQL databases, CAP theorem & BASE properties, Types of NoSQL (Key-Value, Document, Column, Graph), Difference between RDBMS & NoSQL, Why and when to use NoSQL?, NoSQL Database misconceptions, Benefits & real-world use cases of NoSQL, Comparison of popular NoSQL systems (Redis, Cassandra, CouchDB, Neo4j), Introduction to JSON & BSON

Installation & Setup: Installing MongoDB locally and using Atlas (MongoDB's cloud service), connecting via Mongo shell or GUI.

Unit 2. MongoDB Architecture, Data Modeling and Basics:

MongoDB Architecture: Database, Collection, Document concepts, BSON format, Advantages of MongoDB over RDBMS, MongoDB Datatypes (String, Number, Date, Boolean, Array, ObjectId, Embedded Documents, Null)

Data Modeling in MongoDB: Schema design strategies, Embedded vs Referenced documents

Database & Collection Management: Create & Drop Database, Create & Drop Collection

Unit 3. CRUD Operations and Querying in MongoDB:

CRUD Operations: Insert Documents (insertOne, insertMany), Query Documents (find, operators, conditions), Update Documents (updateOne, updateMany, replaceOne), Delete Documents (deleteOne, deleteMany), Query operators (\$gt, \$lt, \$in, \$nin, \$and, \$or, \$not), Regular expression queries, Bulk operations, Working with Arrays.

Unit 4. Data Modelling and Aggregation:

Data Modelling and Aggregation: Data Models: Introduction to embedded vs normalized models, advantages and trade-offs

Embedded Data Models: Use cases, benefits, and limitations

Normalized Data Models: References between documents, when to normalize data Relationships

Between Documents, Data Model Using an Embedded Document, Data Model Using Document References

Aggregation Basics: Introduction to MongoDB Aggregation Framework, simple pipelines and operators

Unit 5. Advanced Query Processing and Optimization in MongoDB:

Query Optimization & Operations: Projection, Limiting & Skipping Records, Sorting Records

Indexing in MongoDB (single field, compound, multikey, text index), Aggregation Framework (pipelines, stages, operators), Replication Concepts: Replica sets, failover, consistency

Textbooks:

1. MongoDB: The Definitive Guide, Shannon Bradshaw, Eoin Brazil, Kristina Chodorow, 3rd Edition, O'Reilly Media, 2019.
2. MongoDB Recipes: With Data Modeling and Query Building Strategies, Subhashini Chellappan, Dharanitharan Ganesan, Apress

Reference Books:

1. MongoDB in Action, Kyle Banker, 2nd Edition, Manning Publications, 2016.
2. MongoDB Applied Design Patterns, Steve Francia, O'Reilly Media, 2013.
3. MongoDB for Developers, Rick Copeland, O'Reilly Media, 2013.

Web Resources:

1. Official MongoDB Documentation: <https://www.mongodb.com/docs/>
2. MongoDB University Free Courses: <https://learn.mongodb.com/>
3. W3Schools, Tutorialspoint, geeksforgeeks

Activities:

Outcome: Differentiate between SQL and NoSQL databases, and explain the architecture and features of MongoDB

Activity: Students create a comparative chart (SQL vs NoSQL) and draw MongoDB architecture diagram.

Evaluation Method: Assess based on accuracy, clarity of explanation, and presentation.

Outcome: Perform CRUD operations and construct queries using MongoDB Query Language (MQL)

Activity: Implement CRUD operations and write 5 different queries on a sample dataset (e.g., Library or E-commerce).

Evaluation Method: Marks for correct execution, query correctness, and output validation.

Outcome: Apply schema design strategies and use appropriate data modeling techniques for different application scenarios

Activity: Design schema for a university management system (students, courses, faculty) using MongoDB data modeling techniques.

Evaluation Method: Evaluate on schema correctness, use of embedding/referencing, and justification of design.

Outcome: Utilize advanced features like indexing, aggregation, GridFS, and transactions to optimize data handling

Activity: Create indexes and implement an aggregation pipeline to generate sales report from a dataset.

Evaluation Method: Marks for index implementation, aggregation correctness, and efficiency of results.

Outcome: Implement replication concepts and ensure high availability, fault tolerance, and scalability in MongoDB-based applications

Activity: Configure a replica set with primary and secondary nodes, and demonstrate failover.

Evaluation Method: Assess on setup correctness, successful failover demonstration, and report/documentation.

SEMESTER-IV
COURSE 10: DOCUMENT ORIENTED DATABASE
Practical Credits: 1 2 hrs/week

List of Experiments

1. Installation and setup of MongoDB, connecting to Mongo Shell and Compass.
2. Creating and using databases, creating collections, inserting documents.
3. Basic queries using find(), filtering with comparison operators.
4. Using logical operators (\$and, \$or, \$not, \$nor) for complex queries.
5. Updating documents with \$set, \$unset, \$inc, \$rename.
6. Deleting documents using deleteOne() and deleteMany().
7. Using projection to display selective fields.
8. Sorting documents, limiting output, skipping records.
9. Designing an Embedded Data Model for a student-course enrollment system.
10. Designing a Normalized Data Model using document references.
11. Modeling relationships: One-to-One, One-to-Many, Many-to-Many in MongoDB.
12. Implementing schema validation using JSON Schema in MongoDB.
13. Creating and testing single-field and compound indexes.
14. Using text search and multikey indexes.
15. Building aggregation pipelines with \$match, \$group, \$project, \$sort.
16. Advanced aggregation operators: \$lookup, \$unwind, \$bucket.
17. Configuring and testing replication with a replica set (minimum 3 nodes).
18. Storing and retrieving large files using GridFS.
19. Using MongoDB Transactions for multi-document consistency.
20. Case Study: Developing a mini-application (e.g., Library Management / E-commerce Cart) using MongoDB CRUD, Aggregation, Indexing, and Replication.

SRI VENKATESWARA UNIVERSITY::TIRUPATI
B.Sc. Data Science Honours
II Year IV Semester
COURSE 10: DOCUMENT ORIENTED DATABASE

MODEL QUESTION PAPER

Time: **3 Hours**

Max. Marks: **75**

PART-A

Answer any **FIVE** of the following. Each Question Carries 3 marks.

(5X3=15)

1. Short answer question from unit-I
2. Short answer question from unit-I
3. Short answer question from unit-II
4. Short answer question from unit-II
5. Short answer question from unit-III
6. Short answer question from unit-III
7. Short answer question from unit-IV
8. Short answer question from unit-IV
9. Short answer question from unit-V
10. Short answer question from unit-V

PART-B

Answer **FIVE** of the following. Each Question Carries 12 marks.

(5X12=60)

11. a) Essay question from Unit-I
OR
b) Essay question from Unit-I
12. a) Essay question from Unit-II
OR
b) Essay question from Unit-II
13. a) Essay question from Unit-III
OR
b) Essay question from Unit-III
14. a) Essay question from Unit-IV
OR
b) Essay question from Unit-IV
15. a) Essay question from Unit-V
OR
b) Essay question from Unit-V