



SRI VENKATESWARA UNIVERSITY
II Year Syllabus for 4-Year UG Honours in BCA. (Data Science) as Major
in consonance with the Curriculum framework w.e.f. AY 2026-27

II Year IV Semester

Sl. No.	Category	Course No.	Course Name	No. of Hours		Total No. of Hours	No. of Credits		Total No. of Credits
				Theory	Practical		Theory	Practical	
1	Major-Core	8	Python Programming	3	2	5	3	1	4
2	Major-Core	9	Document Oriented Database	3	2	5	3	1	4
3	Major-Core	10	Data Mining	3	2	5	3	1	4
4	Minor	2		4	0	4	4	0	4
5	MDC	3	-	2	0	2	2	0	2
6	SEC	4	SEC: Design Thinking/Problem solving/ others	2	0	2	2	0	2
				17	6	23	17	3	20

Note:

The number of instructional hours shall be five (5) for courses involving problem-solving, and four (4) for courses comprising only theory.


 (A. Ravi Prasad)
 CHAIRPERSON
 BOS (PASSING) COMPUTER SCIENCE
 S.V. UNIVERSITY
 TIRUPATI



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II Year Syllabus for 4-Year UG Honours in BCA 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	Python Programming	3	3
			Python Programming – Practical	2	1
		9	Document Oriented Database	3	3
			Document Oriented Database – Practical	2	1
		10	Data Mining	3	3
			Data Mining – Practical	2	1

(A. Ravi Prasad)
CHAIRPERSON
BOS (PASS) IN COMPUTER SCIENCE
S.V. UNIVERSITY
TIRUMALA

SEMESTER-IV
BCA Data Science Honours
II Year IV Semester
COURSE 9 : Document Oriented Database

Theory

Credits: 3

3 hrs/week

Course Objectives:

- To introduce the concepts, evolution, and characteristics of **NoSQL databases** and differentiate them from traditional RDBMS.
- To understand the architecture, data types, and data modeling strategies of **MongoDB**.
- To develop practical skills in performing CRUD operations and advanced querying in MongoDB.
- To design efficient data models using embedded and referenced document approaches.
- To implement aggregation, indexing, and query optimization techniques in MongoDB.

Course Outcomes:

At the End of the Course, The Students will be able to:

- Explain the evolution, features, and types of NoSQL databases and compare them with relational databases.
- Describe MongoDB architecture, BSON format, data types, and implement effective schema design strategies.
- Perform CRUD operations and construct complex queries using operators, conditions, and array handling techniques in MongoDB.
- Design appropriate data models using embedded and referenced documents and implement aggregation pipelines for data analysis.
- Apply indexing, query optimization, projection, sorting, and limiting techniques to improve MongoDB performance.

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.


(A. Ravi Prasad)
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S.V. UNIVERSITY
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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

Text Books:

1. MongoDB: The Definitive Guide – Shannon Bradshaw, Kristina Chodorow & Eoin Brazil, O'Reilly Media.
2. NoSQL Distilled – Pramod J Sadalage & Martin Fowler, Addison-Wesley.
3. Seven Databases in Seven Weeks – Luc Perkins & Eric Redmond, Pragmatic Bookshelf.

Reference Books:

1. Designing Data-Intensive Applications – Martin Kleppmann, O'Reilly Media.
2. MongoDB Applied Design Patterns – Rick Copeland, O'Reilly Media.
3. Professional NoSQL – Shashank Tiwari, Wrox Publications.

Activities:

Outcome: Explain the evolution, types, features, and theoretical foundations (CAP theorem and BASE properties) of NoSQL databases and justify the use of MongoDB for modern applications.

Activity: Prepare a comparative analysis chart and presentation showing:

- o Types of NoSQL databases (Key-Value, Document, Column, Graph)
- o Difference between RDBMS and NoSQL
- o CAP theorem and BASE properties
- o Comparison of Redis, Cassandra, CouchDB, and Neo4j
- o Demonstration of MongoDB installation (local or Atlas) and connection using Mongo shell/GUI

Evaluation Method:

Oral presentation or technical seminar. Use a rubric to assess conceptual clarity, correctness of comparisons, explanation of CAP/BASE principles, and demonstration skills on a 10-point scale.

Outcome: Describe MongoDB architecture, BSON format, data types, and design appropriate schema models using embedded and referenced documents.

Activity: Design and implement a sample database (e.g., Student Management or E-commerce) demonstrating:

- o Database, Collection, and Document structure
- o Use of various MongoDB data types (String, Number, Date, Array, ObjectId, Embedded Documents)
- o Schema design strategy (Embedded vs Referenced model)
- o Create and Drop database and collections

Evaluation Method:

Lab demonstration and viva voce. Use a rubric to assess correctness of schema design, appropriate use of data types, and understanding of embedded vs referenced modeling on a 10-point scale.

Outcome: Perform CRUD operations and construct complex queries using operators, conditions, arrays, and bulk operations in MongoDB.

Activity: Develop and execute MongoDB commands that demonstrate:

- o Insert operations (insertOne, insertMany)
- o Query operations using operators (\$gt, \$lt, \$in, \$and, \$or, \$not)
- o Regular expression queries
- o Update operations (updateOne, updateMany, replaceOne)
- o Delete operations (deleteOne, deleteMany)
- o Working with arrays and bulk operations

Evaluation Method:

Hands-on lab test. Use a rubric to assess correctness of commands, appropriate use of query operators, accuracy of output, and proper handling of arrays on a 10-point scale.

Outcome: Design efficient MongoDB data models and implement aggregation pipelines for data analysis and reporting.

Activity: Create a real-world data model (e.g., Online Store or Library System) demonstrating:

- o Embedded and normalized (referenced) data models
- o Relationships between documents
- o Implementation of aggregation pipeline using stages such as \$match, \$group, \$project, and \$sort
- o Analysis of advantages and trade-offs of chosen model

Evaluation Method:

Mini project submission and presentation. Use a rubric to assess model appropriateness, correct implementation of aggregation stages, result interpretation, and explanation of trade-offs on a 10-point scale.

Outcome: Apply indexing, query optimization, aggregation framework, and replication concepts to enhance MongoDB performance and reliability.

Activity: Implement and demonstrate:

- o Projection, limiting, skipping, and sorting records
- o Creation of indexes (single field, compound, multikey, text index)
- o Performance comparison before and after indexing
- o Basic aggregation pipeline with multiple stages
- o Explanation or demonstration of replica sets and failover concept

Evaluation Method:

Practical demonstration and technical viva. Use a rubric to assess correct use of indexing techniques, performance improvement analysis, understanding of replication concepts, and clarity of explanation on a 10-point scale.

(A. Ravi Prasad)
 CHAIRPERSON
 BOS (PRACTICE) IN COMPUTER SCIENCE
 S.V. UNIVERSITY
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SEMESTER-IV

COURSE 9: 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.


(A. Ravi Prasad)
CHAIRPERSON
BOS (PASSING COMPUTER SCIENCE)
S.V. UNIVERSITY
TIRUPATI

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II Year IV Semester
COURSE 9 : Document Oriented Database

Time : 3 Hrs

Max Marks : 75

SECTION - A

Answer any FIVE of the following

5 X 3= 15 Marks

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

SECTION-B

Answer FIVE of the following.

5 X 12=60 Marks

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


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Chairperson
BOS (PASSING) COMPUTER SCIENCE
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