

ADA (Algorithms Design & Analysis)

Complexity Analysis

Quick Sort

Binary Search Tree

Heaps

Backtracking

Graph

Dynamic Programming (DP)

Greedy Algorithms

Data Mining

Unit 1: Data Cleaning and Preprocessing

Unit 2: Classification

Unit 3: Association Rule Mining

Unit 4: Clustering

Unit 5: Anomaly Detection

Maths

Linear Algebra

Systems & Vectors

Solution of Linear Systems

Vectors in 2D & 3D

Span, Linear Independence, Basis & Dimension

Matrices & Computation

Matrix Notation & Matrix Multiplication

Gaussian Elimination

Rank of a Matrix

Matrix Systems & their Solvability (2D and general)

Column Space & Null Space

Transformations & Geometry

Linear Transformations

Change of Basis

Norms, Inner Products & Distance

Parallelogram Law, Cauchy–Schwarz Inequality, Triangle Inequality

Pythagoras Theorem for Vectors

Matrix Representation of Linear Transformations

Advanced Topics

Eigenvalues & Eigenvectors

Diagonalization of Matrices

CALCULUS

Functions of one variable

Function, Domain, Range

Graphs of Functions

Limit of a Function
Continuity & Discontinuity
Differentiation
Maxima & Minima
Functions of two variables
Derivative of two variable Functions
Partial derivatives
Maxima & Minima (Two Variables)
Domain of two variable functions
Contour plots
Gradient & Directional Derivative
Optimization & Numerical Methods
Newton–Raphson Method
Lagrange’s Multiplier Method (Constrained Optimization)

AP

Backend-Development

- * Client-Server Architecture
- * HTTP Methods
- * HTTP Status Codes and Headers
- * Backend-Development Introduction
- * Node.js

Node.js

- * Node.js Module System
 - * In built Modules
 - * 3rd Party Modules
 - * Local Modules
- * Node.js Process Module
 - * process.argv
 - * process.env
- * Node.js fs Module
 - * Node.js Synchronous File Handling
 - * Node.js Asynchronous File Handling

Asynchronous JavaScript

- * Callback Hell
- * JavaScript Promises
- * Using async/await
- * JavaScript Error Handling

Node.js http server

- * HTTP Request
- * HTTP Response
- * Node.js npm Modules
 - * Introduction to npm & package.json file

Express.js

- * Express.js Request

- * Express.js Response
- * Middlewares in Express

REST API(s)

- * Resource Based URL(s)
- * HTTP Methods
- * HTTP Status Codes and Headers
- * API Versioning
- * Request Response Format

Database

- * Relational Databases
- * ORM(Object Relational Mapping)
- * Prisma ORM

Prisma ORM

- * CRUD
- * Database Migrations
- * Prisma Seeding
- * Prisma Database Relations
- * Prisma Relation Filtering Operations
- * Prisma Relation Pagination Operations
- * Prisma Relation Sorting Operations
- * Prisma Transactions

Authentication

- * Authentication Strategies
 - * Basic Authentication
 - * Encryption
 - * Hashing

Token Based Authentication

- * JSON Web Tokens
- * Web Storage API
- * Session Based Authentication
- * OAuth

Express.js Best Practices

- * Folder structure (Express)
- * dotenv
- * Data Validation
- * Node.js Event Loop

Error Handling

- * Node.js Error Handling
- * Express.js Error Handling
- * Logging & Monitoring

TypeScript

- * TypeScript Basic Types
- * TypeScript Interfaces
- * TypeScript & Node.js
- * TypeScript & Express
- * TypeScript Type Definitions

Object Oriented Programming

- * Classes & Objects
- * Class Access Modifiers
- * Class Static Members
- * Inheritance
- * Interfaces
- * Enumerations
- * OOP in TSNODE.js Deployment
- * Logging Systems
- * Environment Variables
- * Node.js Deployment Platforms

DBMS

Unit 1: Introduction to Data & DBMS

1.1 Understanding Data

Definition of Data Types of Data

Data Storage Approaches

1.2 Database & DBMS

- What is a Database?
- Why Databases are Needed?
- What is DBMS?
- Advantages of DBMS over File System

1.3 Schema & Data Types

Definition of Schema Types of Schema

Data Types Used in Databases

1.4 Database Constraints

- Primary Key, Foreign Key
- Unique, Check, Not Null, Default
- Referential Integrity

Unit 2: Getting Started with SQL

2.1 Introduction to SQL

- What is SQL?
- Role of MySQL
- Types of SQL Commands (DDL, DML, DQL, DCL, TCL)

CREATE ALTER DROP TRUNCATE

2.3 DML Commands

- INSERT
- UPDATE
- DELETE

2.4 DQL Commands

- SELECT Statement
- WHERE Clause
- ORDER BY, LIMIT, OFFSET
- DISTINCT

2.5 Operators & Wildcards

Comparison & Logical Operators Introduction to Wildcards

LIKE Keyword (_ , %)

Unit 3: SQL Functions

3.1 Aggregate Functions

COUNT, AVG, SUM, MIN, MAX

3.2 Numeric Functions

ROUND, ABS, CEIL, FLOOR

3.3 String Manipulation Functions

UPPER, LOWER SUBSTR

REPLACE, CONCAT LEFT, RIGHT, INSTR TRIM, LTRIM, RTRIM ASCII, POSITION

3.4 NULL Handling Functions

- IFNULL
- COALESCE

3.5 Nested Functions

Concept & Usage

3.6 Grouping & Filtering

GROUP BY HAVING

3.7 Case Statements & Date Functions

CASE Syntax & Use-Cases

Date Functions (NOW, CURDATE, DATEDIFF, etc.)

Unit 4: Data Modelling

4.1 Data Entities

Types of Entities: Strong, Weak, Associative

4.2 Attributes

Types: Simple, Composite, Multivalued, Derived

4.3 Relationships

One-to-One, One-to-Many, Many-to-Many

4.4 Keys in SQL

Super Key, Candidate Key, Primary Key Foreign Key, Composite Key, Surrogate Key

4.5 ER Diagrams & Relational Mapping

Creating ERD

Converting ERD to Relational Schema

Unit 5: SQL JOINS & Set Operators

5.1 Types of Joins

- Inner Join
- Left Join
- Right Join
- Full Join
- Cross Join
- Self Join

5.2 Set Operators

UNION INTERSECT EXCEPT

Unit 6: Subqueries, CTEs, Views

6.1 Subqueries

- Non-Correlated Subqueries
- Correlated Subqueries
- EXISTS vs NOT EXISTS

6.2 CTEs (Common Table Expressions)

Definition & Usage

6.3 Views

Creating, Updating & Dropping Views

Unit 7: Normalization & Query Optimization

7.1 Database Normalization

1NF, 2NF, 3NF, BCNF

Redundancy & Anomalies

7.2 Transactions

Definition & ACID Properties

7.3 Indexing

Types & Usage

7.4 Query Optimization

Best Practices

Unit 8: Introduction to MongoDB

8.1 NoSQL Basics

Difference Between SQL & NoSQL MongoDB Introduction

MongoDB Architecture & Tools

8.2 MongoDB CRUD Operations

- Insert, Find, Update, Delete
- Insert Methods
- Find Methods
- Update Operators
- Delete Methods

8.3 MongoDB Query Operators

Comparison Operators Logical Operators Element Operators

8.4 MongoDB Relationships

Embedding Documents

- Referencing Documents
- Best Practices for Schema Design

8.5 MongoDB Aggregation

- Aggregation Methods & Pipeline
- Stages: \$match, \$group, \$sort, \$project
- \$lookup for Joins