TULSIRAMJI GAIKWAD-PATIL COLLEGE OF ENGINEERING & TECHNOLOGY
Wardha Road, Nagpur - 441108
Accredited with NAAC A+ Grade & NBA Accredited (EE, ME, CE & ECE)
Approved by AICTE, New Delhi, Govt. of Maharashtra
(An Autonomous Institution Affiliated to Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur)

Department of Artificial Intelligence & Machine Learning

Program: B. Tech Artificial Intelligence and Machine Learning

Semester-IV | **BAI42401: Database Management System**

Teaching Scheme		Examination Scheme (Th)		Examination Scheme (P)	
Theory (Th)	4 Hrs./week	**CT-I**	15 Marks	-	-
Practical (P)	-	**CT-II**	15 Marks	-	-
Total Credits	**4 (Th) = 4**	**CA**	10 Marks	-	-
Duration of ESE: 3 Hrs.		**ESE**	60 Marks	-	-
		Total Marks	**100 Marks**	-	-

Pre-Requisites: Basic knowledge of computer fundamentals, data organization, programming concepts, and mathematical logic.

Course Objectives:

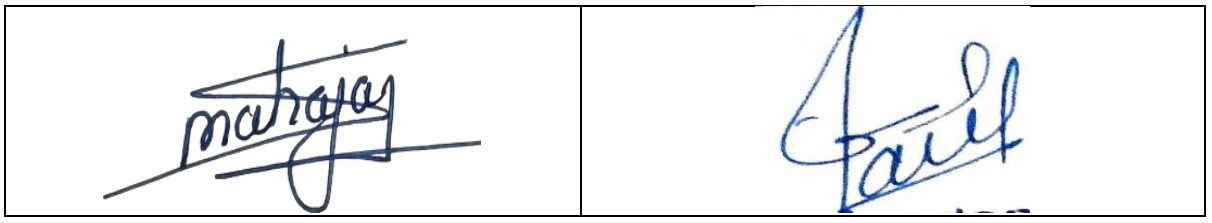
1	To provide fundamental knowledge of database architectures, data models, and modern database technologies including distributed and cloud-based systems. .
2	To develop skills in designing database models using ER/EER/UML diagrams and applying agile tools like Jira for project tracking and manual testing activities.
3	To enable learners to analyze database schemas by identifying redundancy, functional dependencies, and applying normalization techniques for efficient design
4	To equip students with the ability to evaluate and optimize SQL queries, triggers, and indexing, along with understanding performance testing and automation tools.
5	To impart practical knowledge to implement transaction management, concurrency control, and recovery mechanisms using modern monitoring and DevOps-oriented database tools

Course Content

Unit I	Database System Concepts and Architecture, Introduction to data and databases, Database system architecture, Data models and schemas, Relational model and constraints, Relational algebra, Distributed and Cloud Databases, Database as a Service (DBaaS), Overview of Database Testing and Automation Tools
Unit II	Conceptual Modelling and Database Design: Data modeling using Entity-Relationship (ER) diagrams, Enhanced Entity-Relationship (EER) model, Relational database design from ER/EER models, Practical database design methodology, Use of UML diagrams in database design, Agile-based Database Design Process, Introduction to Jira Tool for Project and Issue Tracking in Database Projects, Manual Testing of Database Applications (Test Cases, Data Validation, CRUD testing)
Unit III	Database Design Theory and Normalization: Relational Database Design, Features of Good Relational Designs, Normalization, De-Normalization, Functional Dependencies, Multivalued Dependencies, Normal Forms - 1NF, 2NF, 3NF, BCNF, Relational database design and further dependencies, Database Testing for Schema Integrity and Normalization, Data Quality and Consistency Testing, Introduction to Database Version Control (e.g., Git, Liquibase)
Unit IV	Introduction to SQL: Basic SQL commands (SELECT, INSERT, UPDATE, DELETE) Complex queries and joins, Triggers and views, Schema modification, Query processing and optimization, File structures, hashing, and indexing, Database Performance Testing and Query Optimization Tools, Automation Tools for Database Testing (e.g., Selenium with SQL, Apache JMeter), Integration of SQL Databases with Modern Applications (Python/Java)
Unit V	Transaction Management, Concurrency Control, and Recovery: Transaction concepts and ACID properties, Transaction control commands, Concurrency control techniques, Lock-based protocols and deadlock handling, Timestamp-based protocols, Recovery concepts and log-based recovery, Database Testing in Transaction Environments, Introduction to Database Monitoring Tools (e.g., pg Admin, MySQL Workbench, Oracle APEX), Overview of DevOps in Database Systems (Continuous Integration & Deployment of DBs)

Text Books	
T.1	DATABASE MANAGEMENT SYSTEM,ISRD GROUP,TATA MCGRAW HILL
T.2	MODERN OPERATING SYSTEMS: ANDREW S. TANENBAUM, HERBERT BOS, PEARSON EDUCATION, 2015
Reference Books	
R.1	DATABASE SYSTEMS: THE COMPLETE BOOK: HECTOR GARCIA-MOLINA, JEFFREY D. ULLMAN, JENNIFER WIDOM, PEARSON EDUCATION, 2020
R.2	OPERATING SYSTEMS: DESIGN AND IMPLEMENTATION: ANDREW S. TANENBAUM, ALBERT S. WOODHULL, PEARSON EDUCATION, 2015
Useful Links	
1.	https://nptel.ac.in/courses/106105214
2.	https://pages.cs.wisc.edu/~remzi/OSTEP/
3.	https://nptel.ac.in/courses/106106093

CO	Course Outcomes	CL	Class Sessions
CO1	**Explain** database architectures, data models, and emerging database technologies including distributed and cloud databases.	3	10
CO2	**Implement** database models using ER/EER/UML diagrams and utilize agile tools such as Jira for effective project tracking and manual testing.	3	10
CO3	**Analyze** database schemas for redundancy, dependencies and normalization to produce efficient relational designs.	4	10
CO4	**Analyze** optimized SQL queries using advanced operations, triggers, and indexing, and their performance with testing and automation tools.	4	10
CO5	**Implement** transaction management and concurrency control mechanisms ensuring data consistency and recovery using modern monitoring and DevOps database tools.	3	10



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Program: B. Tech Artificial Intelligence and Machine Learning

Semester-IV | **BAI42402: Computer Architecture and Organization**

Teaching Scheme		Examination Scheme (Th)		Examination Scheme (P)	
Theory (Th)	3 Hrs./week	**CT-I**	15 Marks	-	-
Practical (P)	-	**CT-II**	15 Marks	-	-
Total Credits	**3 (Th) = 3**	**CA**	10 Marks	-	-
Duration of ESE: 3 Hrs.		**ESE**	60 Marks	-	-
		Total Marks	**100 Marks**	-	-

Pre-Requisites: Basic knowledge of computer fundamentals, digital logic, number systems, and elementary electronic circuits.

Course Objectives:

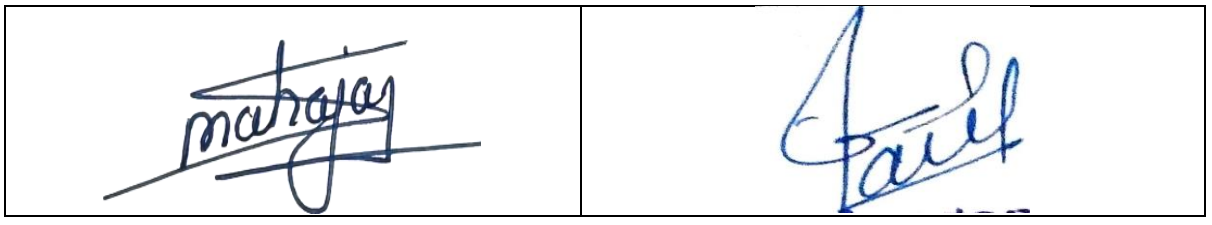
1	Understand the fundamentals of computer architecture, number systems, floating-point representation, and computer performance metrics.
2	Apply instruction set architecture concepts, addressing modes, pipelining, and arithmetic algorithms to perform computer operations.
3	Analyze memory hierarchy, cache mapping techniques, replacement policies, virtual memory, and memory interleaving.
4	Analyze input/output organization, data transfer modes, I/O addressing techniques, and interrupt handling mechanisms.
5	Analyze advanced computer architectures, superscalar execution, multicore systems, parallel processing, Flynn's taxonomy, and GPU applications.

Course Content

Unit I	Fundamentals of Computer Architecture: Number Systems and their operations, Floating Point number representation, Basics of Computer Architecture and Organization, Evolution of Computing System, Performance Metrics (MIPS, FLOPS, CPI, IPC, Execution time).
Unit II	Instruction Set Architecture and Arithmetic Operations: Instruction Execution cycle, Instruction Set Architecture, addressing modes, Instruction set classification, Pipelining Architecture, Multiplication: Booth's Algorithm, Bit-pair recoding, Integer Division: Restoring and non-restoring division.
Unit III	Memory Hierarchy and Management: Memory hierarchy, Types of memory in Computer System and their Characteristics, Cache memory: Mapping functions, Replacement policies, Virtual Memory: Paging and Segmentations, Memory interleaving
Unit IV	Input/output Organization: Introduction to I/O systems: I/O interface and bus systems, Modes of data Transfer: Program I/O, Interrupt driven I/O and Direct Memory access (DMA), I/O addressing Techniques, Interrupts: Interrupts and interrupt handling mechanisms.
Unit V	Advanced Computer Architectures and Parallel Processing: Pipelining and Super Scalar Execution, Parallel processing and Multicore Architecture, Flynn's Taxonomy for parallel architectures, GPUs and their role in modern computing.

Text Books	
T.1	COMPUTER ARCHITECTURE AND ORGANIZATION HAYES,JOHN.P.,TATA MCGRAW HILL,EDITION3
T.2	COMPUTER ARCHITECTURE AND ORGANIZATION, MURDOCCA, MILES;HEURING,VINCENT,WILEY INDIA
Reference Books	
R.1	M MANO; COMPUTER SYSTEM AND ARCHITECTURE; PHI PUBLICATION; 1993. A.S. TANENBAUM; STRUCTURED COMPUTER ORGANIZATION; PRENTICE
R.2	J. P. HAYES; COMPUTER ARCHITECTURE & ORGANIZATION; 3RD EDITION; MCGRAW-HILL; 1998
Useful Links	
1	https://nptel.ac.in/courses/106105163
2	https://nptel.ac.in/courses/106103180
3	https://nptel.ac.in/courses/117105078
4	https://nptel.ac.in/courses/117105078

CO	Course Outcomes	CL	Class Sessions
CO1	Explain the number systems, floating-point representation, fundamental concepts of computer architecture, and computer performance metrics.	3	9
CO2	Apply instruction set architecture, addressing modes, pipelining concepts, and arithmetic algorithms to perform computer operations. .	3	9
CO3	Analyze memory hierarchy, cache mapping techniques, replacement policies, virtual memory, and memory interleaving.	4	9
CO4	Analyze I/O organization, data transfer modes, I/O addressing techniques, and interrupt handling mechanisms.	4	9
CO5	Analyze advanced computer architectures, parallel processing techniques, multicore systems, Flynn's taxonomy, and GPU applications.	4	9



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Semester-IV | **BAI42403 : AI Tools and Techniques**

Teaching Scheme		Examination Scheme (Th)		Examination Scheme(P)	
Theory (Th)	-	**INT**	-	**INT**	-
Practical (P)	4 Hrs./week	**ESE**	-	**ESE**	-
Total Credits	**2**	**CA**	-	**CA**	50 Marks
Duration of ESE: 2Hrs		**ESE**	-	**ESE-P**	50 Marks
		Total Marks	-	**Total Marks**	**100 Marks**

Pre-Requisites: Basic knowledge of Python programming, elementary statistics, linear algebra, and database fundamentals.

Course Objectives:

1.	Introduce Python tools and libraries for data handling and visualization.
2.	Familiarize students with data preprocessing and exploratory data analysis.
3.	Develop skills in implementing and evaluating machine learning models.
4.	Introduce neural networks, natural language processing, and pre-trained AI models.
5.	Enable students to build and deploy basic AI applications using APIs and interactive interfaces.

List of Experiments

1	Set up Python, Jupyter Notebook, and Google Colab and run basic data handling programs.	**CO1**
2	Load, explore, and clean CSV datasets using Pandas and NumPy.	**CO1**
3	Visualize data distributions and feature relationships using Matplotlib and Seaborn.	**CO1**
4	Preprocess data using encoding, scaling, and train-test splitting with Scikit-learn.	**CO2**
5	Train and compare Logistic Regression, Decision Tree, and KNN classifiers.	**CO2**
6	Evaluate classification models using accuracy, precision, recall, F1-score, and confusion matrix.	**CO2**
7	Build and evaluate a regression model on housing data using MAE, MSE, and R^2.	**CO3**
8	Save and load trained models using Joblib and Pickle for future predictions.	**CO3**
9	Build a neural network using Keras to classify handwritten digits.	**CO3**
10	Perform text preprocessing and sentiment analysis using NLTK and TF-IDF.	**CO4**
11	Use Hugging Face pipelines for sentiment analysis, summarization, and translation.	**CO4**
12	Practice prompt engineering using zero-shot, few-shot, and role-based prompts.	**CO4**
13	Fetch data from public REST APIs and store JSON responses in CSV and SQLite.	**CO5**
14	Build an interactive prediction interface using Gradio or Streamlit.	**CO5**
15	Develop an end-to-end AI application with preprocessing, training, evaluation, and prediction.	**CO5**

Text Books

T.1	INTRODUCTION TO DATA SCIENCE, PRACTICAL APPROACH WITH R AND PYTHON,MAHESWARI B. UMA, SUJATHA R.,WILEY INDIA
T.2	PYTHON FOR DATA ANALYSIS – WES MCKINNEY, O'REILLY MEDIA, 3RD EDITION,

	2022.

Reference Books	
R.1	PYTHON DATA SCIENCE HANDBOOK – JAKE VANDERPLAS, O'REILLY MEDIA, 2ND EDITION, 2022.
R.2	DEEP LEARNING WITH PYTHON – FRANÇOIS CHOLLET, MANNING PUBLICATIONS, 2ND EDITION, 2021.

Useful Links	
L.1	nptel.ac.in/courses/106106212
L.2	https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_cs18

CO	Course Outcomes	CL	Class Sessions
CO1	Apply Python libraries for data handling and visualization.	3	4
CO2	Apply data preprocessing techniques to prepare datasets for machine learning.	3	4
CO3	Evaluate classification and regression models.	5	4
CO4	Develop neural networks and NLP applications using suitable AI libraries.	6	4
CO5	Develop and deploy basic AI applications using pre-trained models, APIs, and interactive interfaces.	6	4

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Semester-IV	**BAI42404: Introduction to Machine Learning (Open Elective-II)**				
Teaching Scheme		**Examination Scheme (Th)**		**Examination Scheme (P)**	
Theory (Th)	2 Hrs./week	**CT-I**	7 Marks	-	-
Practical (P)	-	**CT-II**	7 Marks	-	-
Total Credits	**23 (Th) = 2**	**CA**	6 Marks	-	-
Duration of ESE: 2 Hrs.		**ESE**	30 Marks	-	-
		Total Marks	**50 Marks**	-	-

Pre-Requisites: Basic knowledge of computer fundamentals, digital logic, number systems, and elementary electronic circuits.

Course Objectives:

1	To apply basic ML algorithms to solve problems.
2	To analyze model performance using evaluation metrics.
3	To evaluate and select suitable ML techniques for applications.

Course Content

Unit I	**Fundamentals of Machine Learning:** Introduction to Artificial Intelligence and Machine Learning, Types of Learning: Supervised, Unsupervised, Semi-supervised, Reinforcement, Applications of ML in various domains, Steps in building a Machine Learning model, Data preprocessing: cleaning, normalization, encoding, train-test split, Performance metrics: Accuracy, Precision, Recall, F1 Score, Confusion Matrix
Unit II	**Supervised Learning:** Regression: Linear Regression, Polynomial Regression, Evaluation using MSE, RMSE, R^2 Score, Classification: k-Nearest Neighbours (k-NN), Decision Trees and Random Forests, Naïve Bayes Classifier, Support Vector Machines (SVM), Overfitting and Regularization (L1, L2) .
Unit III	**Unsupervised and Advanced Learning:** Clustering: K-Means, Hierarchical Clustering, Evaluation: Silhouette Score, Elbow Method, Dimensionality Reduction: PCA (Principal Component Analysis), t-SNE, Reinforcement Learning: Basics of RL, Agent – Environment interaction, Q-Learning, Introduction to Neural Networks (Perceptron Model, Backpropagation)

Text Books	
T.1	INTRODUCTION TO MACHINE LEARNING – ETHEM ALPAYDIN, MIT PRESS, 2020.
T.2	MACHINE LEARNING – TOM M. MITCHELL, MCGRAW-HILL, 2017.
T.3	PYTHON MACHINE LEARNING – SEBASTIAN RASCHKA AND VAHID MIRJALILI, PACKT, 2020.
Reference Books	
R.1	PATTERN RECOGNITION AND MACHINE LEARNING – CHRISTOPHER M. BISHOP, SPRINGER, 2016.
R.2	HANDS-ON MACHINE LEARNING WITH SCIKIT-LEARN, KERAS & TENSORFLOW – AURÉLIEN GÉRON, O'REILLY, 2023.
R.3	MACHINE LEARNING FOR BEGINNERS – OLIVER THEOBALD, 2021.
Useful Links	
1	NPTEL Course: Introduction to Machine Learning – IIT Madras
2	NPTEL Course: Introduction to Machine Learning – IIT Kharagpur

CO	Course Outcomes	CL	Class Sessions
CO1	**Apply** basic machine learning algorithms to real-world data.	3	9
CO2	**Explain** model performance using evaluation metrics.	3	9
CO3	**Analyze** appropriate ML models for applications.	4	9





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Semester-IV | **BAI42405 : Database Management System Lab**

Teaching Scheme		Examination Scheme (Th)		Examination Scheme(P)	
Theory (Th)	-	**INT**	-	**INT**	-
Practical (P)	2 Hrs./week	**ESE**	-	**ESE**	-
Total Credits	**1**	**CA**	-	**CA**	25 Marks
Duration of ESE: 2Hrs		**ESE**	-	**ESE-P**	25 Marks
		Total Marks	-	**Total Marks**	**50 Marks**

Pre-Requisites: Basic knowledge of computer fundamentals, programming concepts, data types, and basic SQL concepts. Students should have an understanding of data organization and basic problem-solving techniques.

Course Objectives:

1.	To Introduce the fundamentals of SQL for creating tables, defining constraints, and organizing relational data.
2.	To Develop the ability to perform data manipulation operations such as inserting, updating, deleting, and retrieving records.
3.	To Build competency in writing SQL queries using filtering, sorting, grouping, aggregation, joins, subqueries, and views.
4.	To Enable learners to apply advanced SQL features such as constraints, computed columns, unions, and nested queries for real-world scenarios.
5.	To Equip students to design and implement a mini real-life database application demonstrating complete SQL workflow including triggers and views

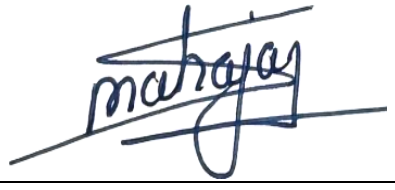
List of Experiments

1	Creating a Table: Write an SQL query to create a table named Products with columns: ProductID, ProductName, Category, Quantity, and Price.	**CO1**
2	Write SQL commands to create tables with constraints — PRIMARY KEY, FOREIGN KEY, UNIQUE, NOT NULL, and CHECK — and demonstrate how they work with sample data from a Library database (Books and Authors tables).	**CO1**
3	Inserting Data into a Table: Insert at least five records into the Students table, containing Student ID, Name, Course, Semester, and Marks.	**CO1**
4	Updating Data in a Table: Update the basic salary of an employee in the Staff table based on their StaffID.	**CO2**
5	Deleting Data from a Table: Delete a customer record from the Customers table based on a specific condition (e.g., Age less than 25).	**CO2**
6	Performing a SELECT Query with a WHERE Clause: Retrieve orders from the Orders table where the OrderStatus is "Delivered" and the OrderAmount is greater than 50,000.	**CO2**
7	SELECT Query with Calculated Columns: Write a query to display the ProductName, UnitPrice, and a calculated column Total Price (UnitPrice × Quantity) from the SalesDetails table.	**CO3**
8	Using DISTINCT, BETWEEN, and LIKE Clauses: (i) Retrieve distinct course names from the Courses table. (ii) Select transactions whose Amount is between 40,000 and 80,000. (iii) Retrieve supplier names starting with 'A' from the Suppliers table.	**CO3**
9	Using ORDER BY and UNION Clauses: (i) Retrieve book titles sorted by Price in descending order from the Books table. (ii) Perform a UNION query between the CurrentStudents and Alumni tables having similar columns.	**CO3**

10	SELECT Query with GROUP BY: Group sales records by region and compute the total sales amount for each region using the Regional Sales table.	**CO4**
11	Nested Query (Subquery): Retrieve students who score more than the average marks in the examination using the Students table.	**CO4**
12	Write SQL queries using INNER JOIN, LEFT JOIN, and RIGHT JOIN to display student details along with their course names from two tables — Students and Courses.	**CO4**
13	Write SQL queries to find the maximum, minimum, average, and total sales amount for each region and filter regions having total sales greater than ₹1,00,000. Use the Sales table.	**CO5**
14	Create a view that displays only ProductName, Category, and Price of products priced above ₹60,000. Retrieve data from this view using the Products table.	**CO5**
15	Write SQL queries using the Sales table to: 1. Calculate the percentage contribution of each product to the total sales. 2. Rank products based on their total sales using RANK(), DENSE_RANK(), and ROW_NUMBER() functions.	**CO5**

Text Books	
T.1	DATABASE SYSTEM CONCEPTS – ABRAHAM SILBERSCHATZ, HENRY F. KORTH, S. SUDARSHAN, MCGRAW HILL, 7TH EDITION, 2020.
T.2	DATABASE MANAGEMENT SYSTEMS – RAGHU RAMAKRISHNAN AND JOHANNES GEHRKE, MCGRAW HILL, 3RD EDITION, 2019.
Reference Books	
R.1	FUNDAMENTALS OF DATABASE SYSTEMS – RAMEZ ELMASRI AND SHAMKANT B. NAVATHE, PEARSON EDUCATION, 7TH EDITION, 2020.
R.2	SQL, PL/SQL: THE PROGRAMMING LANGUAGE OF ORACLE – IVAN BAYROSS, BPB PUBLICATIONS, 5TH EDITION, 2021.
Useful Links	
L.1	https://onlinecourses.nptel.ac.in/noc22_cs91/preview
L.2	https://onlinecourses.swayam2.ac.in/ini24_cs01/preview

CO	Course Outcomes	CL	Class Sessions
CO1	**Implement** relational tables with appropriate constraints and structure using SQL DDL commands.	3	2
CO2	**Perform** data effectively using SQL DML operations such as insert, update, delete, and conditional retrieval.	3	2
CO3	**Apply** filtering, sorting, grouping, aggregation, joins, and subqueries to analyze and retrieve meaningful information from relational datasets.	3	2
CO4	**Implement** views, computed columns, unions, and constraint-based designs to enhance database functionality and integrity.	3	2
CO5	**Implement** a real-life SQL-based mini application integrating table creation, data handling, joins, views, and triggers.	3	2





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Semester-IV | **BAI42406 : Data Analytics & Visualization Lab**

Teaching Scheme		Examination Scheme (Th)		Examination Scheme(P)	
Theory (Th)	-	**INT**	-	**INT**	-
Practical (P)	2 Hrs./week	**ESE**	-	**ESE**	-
Total Credits	**1**	**CA**	-	**CA**	25 Marks
Duration of ESE: 2Hrs		**ESE**	-	**ESE-P**	25 Marks
		Total Marks	-	**Total Marks**	**50 Marks**

Pre-Requisites: Basic knowledge of programming fundamentals, statistics, data handling, spreadsheet operations, and basic mathematical concepts. Familiarity with data representation and visualization techniques is desirable.

Course Objectives:

1.	Apply programming concepts and built-in functions to perform numerical, statistical, and matrix operations.
2.	Perform data import, export, cleaning, and preprocessing operations using R data frames.
3.	Apply dimensionality reduction and regression techniques to analyze datasets and identify meaningful patterns.
4.	Implement and evaluate clustering, association analysis, recommendation systems, and time-series models using suitable datasets.
5.	Develop data collection and visualization solutions using web scraping, APIs, cartographic visualization, and text mining techniques.

List of Experiments

1	Perform numerical operations (MAX, MIN, AVG, SUM, SQRT, ROUND) by accepting input from the user.	**CO1**
2	Implement data import and export operations for CSV, XLS, and TXT files using data frames.	**CO1**
3	Implement matrix addition, subtraction, multiplication, inverse, transpose, and division operations using input matrices and vector concepts.	**CO1**
4	Perform statistical operations to calculate Mean, Median, Mode, and Standard Deviation on a given dataset.	**CO2**
5	Implement data preprocessing techniques, including missing data handling and Min-Max normalization.	**CO2**
6	Apply Principal Component Analysis (PCA) for dimensionality reduction on a house price dataset.	**CO3**
7	Implement Simple Linear Regression on a suitable dataset and evaluate model performance.	**CO3**
8	Implement K-Means clustering on the Iris dataset and visualize the resulting clusters.	**CO3**
9	Collect data through web scraping, APIs, and data connectors from suitable sources specified by the instructor.	**CO4**
10	Perform association analysis on a given dataset and visualize frequent itemsets and association rules.	**CO4**
11	Develop a recommendation system using a given dataset and visualize the generated recommendations.	**CO4**
12	Implement a time-series model on a given dataset, visualize trends, and evaluate model	**CO4**

	accuracy.	
13	Develop interactive dashboards using Microsoft Power BI, incorporating data import, data transformation, charts, slicers, and geographical visualizations.	**CO5**
14	Develop interactive dashboards using Tableau, incorporating data connections, calculated fields, filters, charts, maps, and word clouds.	**CO5**
	Develop a module for sales analysis, student performance, healthcare, or agriculture using data analytics and Power BI/Tableau dashboards.	

Text Books	
T.1	BIG DATA ANALYTICS, KAMAL RAJ; SAXENA PREETI, MC GRAW HILL
T.2	MODERN DATA WAREHOUSING MINING AND VISUALIZATION,MARAKAS,GEORGE,M, PEARSON EDUCATION
Reference Books	
R.1	DATA ANALYTICS USING PYTHOD, MOTWANI BHARTI, WILEY INDIA Edition2
R.2	DATA PROCESSING AND INFORMATION TECHNOLOGY,FRENCH C.,BPB PUBLICATION,10 REVISE
Useful Links	
L.1	https://nptel.ac.in/courses/106106179
L.2	https://nptel.ac.in/courses/110107092

CO	Course Outcomes	CL	Class Sessions
CO1	**Apply** numerical operations, data import/export using data frames, and matrix and vector operations to solve computational problems using Python.	3	2
CO2	**Implement** numerical and statistical analysis on data sources	3	2
CO3	**Implement** linear regression technique on numeric data for prediction	3	2
CO4	**Implement** data analytics and predictive modeling techniques**.**	3	2
CO5	**Develop** interactive dashboards for data analysis and visualization.	6	2

