SIPNA COLLEGE OF ENGINEERING & TECHNOLOGY, AMRAVATI

An Autonomous Institute Affiliated to

Sant Gadge Baba Amravati University, Amravati, Maharashtra (India)

(Approved by AICTE, New Delhi and Recognized by DTE, Maharashtra)

(Accredited With 'A+' Grade by NAAC)

Bachelor of Technology (B. Tech.)

Syllabus -Semester V & Semester VI

Department of Artificial Intelligence (AI) and Data Science

Effective from Academic Year 2026-27

Prepared by: Boards of Studies- Artificial Intelligence (AI) and Data Science

Approved by: Academic Council Sipna COET, Amravati

			30/03/2026	1.00
Chairman Board of Studies	Dean Academics	Chairman Academic Council	Date of Release	Version

Program:	B. Tech. (Artificial Intelligence (AI) and Data Science)			Semester:			V	
Course:	Statistical Analysis and Computing			Code:			BTADPC14AD5T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Test, Assignment, Quiz

Course Objectives: To provide knowledge of data visualization, time series analysis, ANOVA models, data sampling, data processing, inferential statistics, and scaling techniques for effective application in machine learning and hypothesis testing.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Analyse data distribution using plots, graphs, and statistical indices.	L4
CO-2	Apply time series analysis to calculate least squares and measure cyclic variations in the performance of machine learning algorithms.	L3
CO-3	Interpret analysis of variance (ANOVA) models, their types, and **apply** them to machine learning models.	L2
CO-4	Describe data sampling methods and their types for dataset processing.	L2
CO-5	Apply estimation and inferential statistics for testing of hypothesis using Z test, t test, Chi-squared test.	L3
CO-6	Interpret scaling techniques applied to educational data using various scaling tests.	L2

Unit I: Data Visualization **(6 Hrs.)**

Plots and Graphs: Scatter Plot, Line Chart, Pie-diagram for dataset visualization. Data Distribution Measures: Normal curves, Dispersion, Skewness, Kurtosis statistical indices.

Unit II: Analysis of Time Series **(6 Hrs.)**

Introduction, Components of Time Series Data, Time series analysis and decomposition techniques, Measurement of Tends: Principal of Least square, Measurement of Seasonal and Cyclic Variation, Auto-Regression Series.

Unit III: Analysis of Variance (ANOVA) **(6 Hrs.)**

Introduction, Assumptions and Correlations, Types of ANOVA: One way classification: ANOVA for Fixed Effect model and Random Effect model, Two way classification: ANOVA for Fixed Effect model and Random Effect model with m-observations per cell.

Unit IV: Theory of Sampling **(6 Hrs.)**

Introduction, Parameters and Statistics, Principles of sample survey, sampling errors, Sampling Types: Simple random sampling, Stratified Sampling, Systematic Sampling.

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Unit V: Inferential Statistics **(6 Hrs.)**

Introduction, Parameter Estimation and Probability distribution of data sampling. Design of Hypothesis, Types of Hypotheses, Testing of Hypothesis: z test, t test for difference of mean, paired t test, chi-squared test.

Unit VI: Scaling Techniques **(6 Hrs.)**

Introduction, Scaling Tests: z-score, Standard score, Normalized Score, T-score, Percentile Score; Scaling in terms of normal probability curve.

Total: 36 Hrs

Textbook:

1. Gupta S C, Kapoor V K. (2007). "Fundamentals of applied statistics". New Delhi: Sultan Chand & Sons Publication.
2. Gupta S C, Kapoor V K. "Fundamentals of mathematical statistics". New Delhi: Sultan Chand & Sons Publication.

Reference Books:

1. A. M. Gun, M. K. Gupta, B. Dasgupta, "Fundamentals of Statistics", World Press Publisher, 2008.
2. K.R.gupta, "Mathematical Statistics", Vol 1, Atlantic Publishers and Distributors, 2021.

MOOC Links and additional reading, learning, video material:

Coursera: Probability & Statistics for Machine Learning & Data Science | Coursera

Coursera: Mathematics for Machine Learning and Data Science | Coursera

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Dated:- 30th March 2026

Program:	B. Tech. (Artificial Intelligence (AI) and Data Science)			Semester:			V	
Course:	Computer Organization and Design			Code:			BTADPC15AD5T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Test, Assignment, Quiz

Course Objectives: To understand computer system architecture by analysing hardware operations, data path design, memory hierarchies, and evaluating system performance and efficiency.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Classify computing applications based on their purpose, characteristics, and resource requirements.	L4
CO-2	Demonstrate the ability to represent signed and unsigned numbers in binary form, and apply logical operations and decision-making instructions in a computational context.	L3
CO-3	Evaluate how parallel processing and arithmetic associativity influence computational performance and numerical accuracy.	L5
CO-4	Interpret the role of logic design conventions and **list** the components involved in building a Datapath.	L2
CO-5	Describe the operation of caches and virtual memory within a computer's memory hierarchy.	L2
CO-6	Evaluate the integration of processors, memory, and I/O devices affects the overall reliability and performance of computer systems.	L5

Unit I: Computer Abstraction and Technology **(6 Hrs.)**

Introduction, Classes of Computing Applications and their characteristics, from a High-level language to the Language of Hardware, Opening the Box, A Safe Place for data

Unit II: Instructions: Language of the Computer **(6 Hrs.)**

Introduction, Operations of Computer Hardware, Operands of the Computer Hardware, Signed and Unsigned Numbers, Representing Instructions in the Computer, Logical Operations, Instructions for making Decisions.

Unit III: Arithmetic for Computer **(6 Hrs.)**

Addition and Subtraction, Arithmetic for media, Multiplication, Division, Floating Point: Floating point representation, Floating point addition, Floating point multiplication, Accurate arithmetic.

Unit IV: The Processor **(6 Hrs.)**

Introduction: An Overview of Implementation, Logic Design Conventions, Building a Datapath, A Simple Implementation Scheme: the ALU Control, Designing the Main control unit, operation of the Datapath, Finalizing control.

Unit V: Large and Fast Exploiting Memory Hierarchy **(6 Hrs.)**

Introduction, The Basics of Caches: Accessing a Cache, Handling Cache Misses, Handling Writes, Measuring and Improving Cache Performance, Virtual Memory, Placing a Page and Finding It again, Page Faults.

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Unit VI: Storage and Other I/O Topics **(6 Hrs.)**

Introduction, Dependability, Reliability, and Availability, Disk Storage, Flash Storage, Connecting Processor, Memory, and I/O Devices.

Total: 36 Hrs

Textbook:

1. "Computer Organization and Design", David A. Patterson, John L. Hennessy, ARM EDITION, ELSEVIER.

Reference Books:

1. "Computer Organization", Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Fifth Edition, Mc Graw Hill. Media
2. "Computer Architecture" by John L. Hennessy, David A. Patterson (Paperback, John L. Hennessy, David A. Patterson)
3. "Computer Organization and Design", P. Pal Chaudhari, PHI.

MOOC Links and additional reading, learning, video material:

NPTEL: 1. https://onlinecourses.nptel.ac.in/noc22_cs88/preview
2. https://nptel.ac.in/courses/106102229

Coursera: https://www.coursera.org/learn/introduction-to-computer-organization

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Dated:- 30th March 2026

Program:	B. Tech. (Artificial Intelligence (AI) and Data Science)			Semester:			V	
Course:	Data Base Management System			Code:			BTADPC16AD5T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Test, Assignment, Quiz

Course Objectives: To understand and apply database management concepts, including query languages, schema design, normalization, transaction management, and concurrency control.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Describe database terminology, entity relationships, and the process of converting ER diagrams into RDBMS	L2
CO-2	Create relational databases schema and formulate SQL queries on the database	L6
CO-3	Apply constraints and normalization on databases.	L3
CO-4	Apply ACID properties for transaction management and concurrency control.	L3
CO-5	Discuss the concept of concurrency control and various database protocols.	L2
CO-6	Describe the concepts and importance of database security.	L2

Unit I: Introduction to DBMS **(6 Hrs.)**

Database System Applications, Purpose of database systems, View of Data, Database Languages, Database Architecture, Database Users and Administrators, Entity- Relationship Model, Constraints, removing redundant attributes in Entity sets, E-R diagrams, Reduction to Relational Schemas, E-R design issues, Extended E-R Features

Unit II: Relational Data Model **(6 Hrs.)**

Relational Model: Structure of Relational Databases, Database schema, keys, schema diagram, relational query languages, relational operators, The Relational Algebra, Normalization functional dependencies. Decomposition, Domain & data dependency, types of Normal forms: INF, 2NF, 3NF, BCNF, 4NF.

Unit III: Introduction to SQL **(6 Hrs.)**

SQL: Characteristic, advantages, data types, operators, wildcard operators, expressions, Database Commands: create, drop, select and show database, create table, drop table, Query with Select statements, Insert statement, Update statement, Delete statement with use of where, and, or clauses, Use of like and top clause, Alter command, Distinct Command. View in SQL, create view using one to multiple tables, delete view, index creation & Drop, Null Values, SQL sub queries rules, sub queries using select, insert, update, delete statements, SQL Clauses: having, group by, order by, join, SQL. Aggregate functions: Count, sum average, max, min; Date function, SQL Join: inner, left, right, full join.

Unit IV: Transaction Management **(6 Hrs.)**

Transaction Concept, Simple transaction model, Storage structure, Transaction Atomicity and Durability, transaction isolation, Serializability, transaction isolation and atomicity, transaction isolation levels. Implementation of isolation levels, Transactions as SQL statements.

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Unit V: Concurrency Control **(6 Hrs.)**

Lock-Based Protocols, Deadlock Handling, Multiple Granularities, Timestamp- Based Protocols, Validation-Based Protocols, Multi version schemes.

Unit VI: Database Security **(6 Hrs.)**

Authentication, Authorization and access control. DAC, Mandatory Access Control and Role Based Access Control models, intrusion detection, SQL injection.

Total: 36 Hrs

Textbook:

1. Korth, Sudarshan: Database System Concept, Mc Graw Hill, 7th Edition.

Reference Books:

1. "Fundamentals of Database Systems" by Ramez Elmasri and Shamkant B. Navathe, Pearson, 7th Edition
2. Raghu Ramkrishnan: Database system
3. C. J Date: 'Database System', 7th edition.
4. "SQL: The Complete Reference" by James R. Groff and Paul N. Weinberg

MOOC Links and additional reading, learning, video material:

NPTEL : https://onlinecourses.nptel.ac.in/noc22_cs91/preview

Scaler: https://www.scaler.com/topics/course/dbms/

Coursera: https://www.coursera.org/learn/introduction-to-databases

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Program:	B. Tech. (Artificial Intelligence (AI) and Data Science)			Semester:	V	
Course:	Data Base Management System Lab			Code:	BTADPC17AD5P	
Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	-	2	1	30	20	50

Course Objectives: To develop practical skills in MySQL for database design, SQL queries, joins, and triggers.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level (L1 to L6)
CO1	Outline the concept of DBMS and MYSQL	L2
CO2	Apply various DDL commands in MYSQL	L3
CO3	Apply various DML commands in MYSQL	L3
CO4	Create Database Schema using referential integrity constraints	L6
CO5	Analyse various application on joins in MYSQL	L4
CO6	Create Triggers in MYSQL	L6

General Guidelines: The provided sample list of programs is intended as a guide, and the subject teacher has the flexibility to curate a customized set of experiments aligned with the curriculum. While designing schema or writing any queries use appropriate Database.

List of Practicals

1. Study of basic concepts of DBMS and introduction to MySQL environment.
2. Installation and setup of MySQL and creation of a sample database.
3. Execution of basic DDL commands (CREATE, ALTER, DROP).
4. Execution of DDL commands on tables with different data types.
5. Execution of basic DML commands (INSERT, UPDATE, DELETE).
6. Execution of DML commands with conditions (WHERE clause).
7. Implementation of integrity constraints (PRIMARY KEY, NOT NULL, UNIQUE).
8. Implementation of FOREIGN KEY constraints and referential integrity.
9. Execution of aggregate functions (COUNT, SUM, AVG, MIN, MAX).
10. Use of GROUP BY and HAVING clauses with aggregate functions.
11. Execution of simple and complex SQL queries using subqueries.
12. Implementation of different types of joins (INNER, LEFT, RIGHT, NATURAL).
13. Creation and execution of views in MySQL.
14. Creation and execution of triggers in MySQL.
15. Mini project based on DBMS (design and implementation of a database system).

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Program:	B. Tech. (Artificial Intelligence (AI) and Data Science)			Semester:	V	
Course:	Computer Skill Lab – III			Code:	BTADPC18AD5P	
Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	-	2	1	30	20	50

Course Objectives: To build a strong foundation in statistical analysis and data interpretation by applying visualization, time series analysis, inferential statistics, ANOVA, scaling tests, and sampling techniques to real-world datasets.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level (L1 to L6)
CO1	Apply appropriate data visualization to represent and interpret datasets effectively.	L3
CO2	Analyze and forecast time series data using moving averages, and least square methods.	L4
CO3	Design statistical hypotheses and perform inferential statistical tests, z-test, t-test, chi-square test to draw valid conclusions.	L6
CO4	Evaluate factor effects using ANOVA techniques such as one-way, two-way measures of ANOVA.	L6
CO5	Formulate and solve scaling test with z-test and standard test for optimization in real-world applications.	L6
CO6	Select and implement suitable sampling techniques for continuous datasets.	L4

General Guidelines: The provided sample list of programs is intended as a guide, and the subject teacher has the flexibility to curate a customized set of experiments aligned with the curriculum.

List of Practical

1. Import the supermarket dataset and understand its variables and structure.
2. Perform data preprocessing (handling missing values, encoding, normalization) on the supermarket dataset.
3. Create scatter plots to visualize relationships between variables in the supermarket dataset.
4. Create pie charts and bar graphs for categorical data representation.
5. Calculate measures of central tendency (mean, median, mode) for the dataset.
6. Compute dispersion measures (range, variance, standard deviation).
7. Calculate and interpret skewness and kurtosis of the dataset.
8. Perform clustering on an unlabeled supermarket dataset based on customer purchasing habits.
9. Formulate null and alternative hypotheses for a weather dataset.
10. Perform hypothesis testing using the Z-test and calculate the mean.
11. Conduct Analysis of Variance (ANOVA) using two independent factors.
12. Design and solve real-life case studies using linear programming.
13. Perform trend estimation using the moving average method in time series data.
14. Conduct Chi-square test using two independent variables in an employee dataset.
15. Calculate normalization techniques and T-score for a dataset.

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Program:	B. Tech. (Artificial Intelligence (AI) and Data Science)			Semester:		V
Course:	Computer Skills Lab - IV			Code:		BTADPC19AD5P
Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	-	2	1	30	20	50

Course Objectives: To understand the concepts of Web development with Python.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Design static web pages using HTML and CSS for proper structure, layout, and styling.	L3
CO-2	Develop responsive web interfaces using Bootstrap components and grid systems.	L3
CO-3	Build dynamic web applications using Flask by implementing routing, templates, and form handling.	L4
CO-4	Integrate Flask applications with databases for performing CRUD operations.	L4
CO-5	Design, implement, and test a complete web application	L5
CO-6	Create s mini project integrating frontend and backend functionalities.	L6

General Guidelines: The provided sample list of programs is intended as a guide, and the subject teacher has the flexibility to curate a customized set of experiments aligned with the curriculum.

List of Practical

1. Create a basic static web page using HTML with headings, paragraphs, and formatting tags.
2. Design web pages using HTML elements such as images, lists, and hyperlinks.
3. Create and design HTML forms with various input controls.
4. Create tables in HTML and apply basic formatting.
5. Apply basic CSS for styling (colors, fonts, spacing).
6. Use CSS selectors and properties for styling different HTML elements.
7. Design a multi-section web page (header, navigation, content, footer) using HTML and CSS.
8. Implement responsive design using CSS (media queries).
9. Create a multi-page website using Bootstrap framework.
10. Use Bootstrap components like Navbar, Cards, Buttons, and Alerts.
11. Introduction to Flask and setting up a Python web server.
12. Create dynamic web pages using Jinja2 templates in Flask.
13. Handle web forms and user input using Flask.
14. Connect Flask application with SQLite database and perform CRUD operations.
15. Develop a mini web application/project integrating frontend and backend

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Program:	B. Tech. (Artificial Intelligence (AI) & Data Science)			Semester:			V	
Course:	Information Retrieval			Code:			BTADPE01AD5T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance

Course Objectives: To understand information retrieval concepts, indexing techniques, query processing, and advanced search mechanisms.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Describe the basic concepts and evolution of Information Retrieval, including Boolean and ranked retrieval models.	L1
CO-2	Outline the structure and functioning of inverted indexes, vocabulary, postings lists, and Boolean query processing.	L2
CO-3	Apply dictionary structures, indexing techniques, and query expansion methods such as wildcard queries, spelling correction, and phonetic correction.	L3
CO-4	Analyse index compression techniques, statistical term properties, and weighting schemes including tf–idf and vector space models.	L4
CO-5	Evaluate document scoring, ranking strategies, and Information Retrieval system performance using standard evaluation metrics and test collections.	L5
CO-6	Design and assess advanced Information Retrieval solutions involving relevance feedback, XML retrieval, and web search systems including crawling and distributed indexing.	L6

Unit I: Introduction to Information Retrieval **(6 Hrs.)**

Boolean Retrieval: Information Retrieval, Inverted index, Processing Boolean queries, The Extended Boolean Model vs ranked retrieval.

The term vocabulary and postings list: Document delineation and character sequence decoding, determining the vocabulary terms, faster postings list intersection via skip pointers, Positional postings and phrase queries.

Unit II: Dictionaries and Index **(6 Hrs.)**

Search structures for dictionaries, Wildcard queries, Spelling correction, Phonetic correction, Hardware Basics, blocked sort-based indexing, single-pass in-memory indexing, distributed indexing, dynamic indexing

Unit III: Index compression **(6 Hrs.)**

Statistical properties of terms in information retrieval, dictionary compression, posting file compression, parametric and zone indexes, term frequency and weighing, vector space model for scoring, variant tf-idf functions

Unit IV: Computing scores **(6 Hrs.)**

Efficient scoring and ranking, components of an information retrieval system, vector space scoring and query operator interaction, Information retrieval system evaluation, standard test collections, evaluation of unranked retrieval sets, evaluation of ranked retrieval sets, assessing relevance

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Unit V: Relevance feedback and XML retrieval **(6 Hrs.)**

Relevance feedback and pseudo relevance feedback, global methods for query formulation, Basics of XML concepts, Challenges, Vector space model, Evaluation, Text centric vs data centric XML retrieval

Unit VI: Web Search, Crawling and indexes **(6 Hrs)**

Background, Web characteristics, Advertising as the economic model, search user experience, index size estimation Near-duplicates and shingling, Crawling, distributed indexes, connectivity servers.

Total: 36 Hrs

Textbooks:

1. **Christopher D. Manning, Prabhakar Raghavan,** Introduction to *Information Retrieval*, Cambridge University Press.

Reference Books:

1. **Charu C. Aggarwal**, *Machine Learning for Text*, Springer
2. **Manning, Raghavan, Schütze**, *Introduction to Information Retrieval*.
3. **Badal Soni & Suganya Devi K.**, *Information Retrieval: Models and Concepts*, **Wiley India**
4. **I. A. Dhotre**, *Information Retrieval Techniques*, **Technical Publications, Pune**

MOOC Links and additional reading, learning, video material:

NPTEL / SWAYAM : Introduction to Information Retrieval
https://onlinecourses.nptel.ac.in/noc26_cs13/preview
Coursera :Text Retrieval and Search Engines
https://www.coursera.org/learn/text-retrieval

Approved in 4TH Academic Council Meeting
Dated:- 30TH March 2026

Program:	B. Tech. (Artificial Intelligence (AI) & Data Science)	Semester:	V
Course:	Information Retrieval– Lab	Code:	BTADPE02AD5P

Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	0	2	1	30	20	50

Course Objectives: To provide hands-on experience in implementing, analysing, and evaluating Information Retrieval techniques and systems using appropriate tools and programming methods.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO1	Implement basic Information Retrieval models, including inverted index construction and Boolean query processing.	L3
CO2	Apply dictionary structures and query handling techniques such as wildcard queries, spelling correction, and phonetic correction..	L3
CO3	Construct and optimize indexing mechanisms using BSBI, SPIMI, and index compression techniques.	L4
CO4	Compute and compare term weighting schemes and document relevance scores using vector space models and ranking algorithms.	L4
CO5	Evaluate Information Retrieval system performance using standard metrics for unranked and ranked retrieval.	L5
CO6	Design and analyze advanced IR applications, including relevance feedback, XML retrieval, web crawling, near-duplicate detection, and distributed indexing.	L6

General Guidelines: The provided sample list of programs is intended as a guide, and the subject teacher has the flexibility to curate a customized set of experiments aligned with the curriculum.

List of Practical

1. Study of Information Retrieval concepts and retrieval models.
2. Implementation of inverted index for a document collection.
3. Processing Boolean queries using postings lists.
4. Implementation of phrase queries using positional postings.
5. Postings list intersection using skip pointers.
6. Implementation of dictionary search structures.
7. Handling wildcard queries in Information Retrieval.
8. Implementation of spelling correction techniques.
9. Implementation of phonetic correction techniques.
10. Construction of index using BSBI and SPIMI methods.
11. Statistical analysis of terms (TF, DF, Zipf's law).
12. Implementation of dictionary and postings file compression.
13. Computation of term weighting schemes (tf, idf, tf–idf variants).
14. Implementation of vector space model for document scoring.
15. Efficient document ranking and score computation.
16. Evaluation of Information Retrieval systems using precision and recall.
17. Evaluation of ranked retrieval using MAP, MRR, and NDCG.
18. Implementation of relevance feedback and pseudo relevance feedback.

Approved in 4TH Academic Council Meeting
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Program:	B. Tech. (Artificial Intelligence (AI) and Data Science)			Semester:			V	
Course:	Techniques of Data Mining			Code:			BTADPE03AD5T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Test, Assignment, Quiz

Course Objectives: To understand and apply data mining techniques, including data preprocessing, pattern discovery, classification, clustering, and advanced analytical methods.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Outline the basics of data mining techniques.	L2
CO-2	Identify and evaluate the similarity and dissimilarity between the data sets.	L5
CO-3	Apply appropriate Data Preprocessing techniques for improving data quality.	L3
CO-4	Analyse datasets using frequent pattern mining and Classification concepts.	L4
CO-5	Analyze data using advanced classification methods, clustering techniques.	L4
CO-6	Discuss the emerging trends, research frontiers, and applications.	L2

Unit I: Introduction **(6 Hrs.)**

Introduction to Data Mining, Kinds of Mined Data, Mined Patterns, Technologies Used, Kinds of Applications Targeted, Major Issues in Data Mining.

Unit II: Getting to Know Your Data **(6 Hrs.)**

Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity and Dissimilarity.

Unit III: Data Preprocessing **(6 Hrs.)**

Data Preprocessing: An Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization.

Unit IV: Mining Frequent Patterns, Classification **(6 Hrs.)**

Basic Concepts: Market Basket Analysis, Frequent Itemsets, Closed Items, and Association Rules, Frequent Itemset Mining Methods, Classification Basic Concepts, Decision Tree Induction.

Unit V: Classification Advanced Methods and Cluster Analysis **(6 Hrs.)**

Classification by Backpropagation, Support Vector Machines, Cluster Analysis, Outliers and Outlier Analysis, Outlier Detection Methods.

Unit VI: Data Mining Trends and Research Frontiers **(6 Hrs.)**

Mining Complex Data Types, Other Methodologies of Data Mining, Data Mining Applications.

Total: 36 Hrs

Textbook:

1. Data Mining – Concepts and Techniques, Jiawei Han & Micheline Kamber, Morgan Kaufmann (MK) Publishers, Elsevier, 3rd Edition, 2006.

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Reference Books:

1. Data Mining Techniques, Arun K Pujari, 3rd edition, Orient Blackswan/Universities Press, 2013.

2. Introduction to Data Mining, Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Pearson Education, 2007

3. Insight into Data mining Theory and Practice, K.P. Soman, Shyam Diwakar and V. Ajay, Easter Economy Edition, Prentice Hall of India, 2006.

4. G. K. Gupta, "Introduction to Data Mining with Case Studies", Easter Economy Edition, Prentice Hall of India, 2006.

MOOC Links and additional reading, learning, video material:

NPTEL : 1. https://onlinecourses.nptel.ac.in/noc26_mg64/preview

2. https://onlinecourses.nptel.ac.in/noc26_cs58/preview

3. https://onlinecourses.nptel.ac.in/noc26_cs14/preview

Approved in 4TH Academic Council Meeting
Dated: 30TH March 2024

Program:	B. Tech. (Artificial Intelligence (AI) and Data Science)	Semester:	V
Course:	Techniques of Data Mining-Lab	Code:	BTADPE04AD5P

Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	-	2	1	30	20	50

Course Objectives: To apply database operations, data preprocessing, statistical analysis, and data mining techniques using tools like WEKA for knowledge discovery.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level (L1 to L6)
CO1	Apply database concepts and data preprocessing techniques to prepare datasets for data mining tasks.	L3
CO2	Analyze datasets using data mining tools and statistical methods for exploration and visualization.	L4
CO3	Implement and evaluate classification algorithms such as decision trees, KNN, Bayesian classifiers, and neural networks.	L5
CO4	Implement clustering algorithms to group data objects and analyze patterns in large datasets.	L4
CO5	Generate and analyze association rules using appropriate mining algorithms and interestingness measures.	L4
CO6	Apply web mining techniques to extract, preprocess, and analyze web content, structure, and usage data.	L4

General Guidelines: The provided sample list of programs is intended as a guide, and the subject teacher has the flexibility to curate a customized set of experiments aligned with the curriculum. While designing schema or writing any queries use appropriate Database.

List of Practical

1. Study the basics of database creation and manipulation using tables.
2. Create and manage databases using DDL commands.
3. Perform data manipulation operations (INSERT, UPDATE, DELETE).
4. Introduction to WEKA tool and its interface.
5. Load datasets in WEKA and explore dataset attributes.
6. Apply basic statistical methods (mean, median, standard deviation) on datasets.
7. Understand different data types and dataset characteristics.
8. Perform data preprocessing: handling missing values.
9. Perform data preprocessing: normalization and transformation.
10. Apply data visualization techniques in WEKA.
11. Implement Market Basket Analysis using Apriori algorithm.
12. Analyze association rules generated from transactional datasets.
13. Implement Backpropagation algorithm for classification.
14. Perform classification using Support Vector Machine (SVM).
15. Mini project based on data mining using WEKA or Python.

Program:	B. Tech. (Artificial Intelligence (AI) and Data Science)			Semester:			V	
Course:	Mathematics for Machine Learning			Code:			BTADPE05AD5T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Test, Assignment, Quiz

Course Objectives: To develop a strong mathematical foundation and analytical skills for understanding and implementing machine learning algorithms.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Outline the core concepts of data modelling and learning in machine learning.	L2
CO-2	Apply linear algebra and analytic geometry concepts to ML problems.	L3
CO-3	Solve linear regression problems using classical and Bayesian approaches.	L3
CO-4	Analyse high-dimensional data using PCA for dimensionality reduction.	L4
CO-5	Apply density estimation techniques using GMM and EM algorithm.	L4
CO-6	Design and evaluate SVM-based classification models.	L5

Unit I: Data Modelling **(6 Hrs.)**
Data, Models and Learning, Empirical Risks Minimization, Parameter Estimation, Probabilistic Modelling and Inferences, Direct graphical Models, Model Selection.

Unit II: Analytic Geometry **(6 Hrs.)**
Norms, Inner Products, Lengths and Distances, Angles and Orthogonality, Orthonormal Basis, orthogonal Complement, Inner Product of Functions, Orthogonal Projections, Rotations

Unit III: Linear Regression **(6 Hrs.)**
Problem formulation, Parameter Estimation, Bayesian Linear Regression, Maximum Likelihood as Orthogonal Projection, Further Reading.

Unit IV: Dimensionality Reduction with Principal Component Analysis **(6 Hrs.)**
Problem Setting, Maximum Variance Perspective, Projection Perspective, Eigenvector Computation and Low-Rank Approximations, PCA in High Dimensions, Key Steps of PCA in Practice, Latent Variable Perspective.

Unit V: Density Estimation with Gaussian Mixture Models **(6Hrs.)**
Gaussian Mixture Model, Parameter Learning via Maximum Likelihood, EM Algorithm, Latent-Variable Perspective

Unit VI: Classification with Support Vector Machines **(6 Hrs.)**
Separating Hyperplanes, Primal Support Vector Machine, Dual Support Vector Machine, Kernels, Numerical Solutions.

Total: 36 Hrs

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Textbook:

1.Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong– Mathematics Machine Learning, Cambridge University Press.

MOOC Links and additional reading, learning, video material:

1. https://nptel.ac.in/courses/106/106/106106202/
2. https://ocw.mit.edu/courses/6-036-introduction-to-machine-learning-fall-2020/

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Program:	B. Tech. (Artificial Intelligence (AI) and Data Science)	Semester:	V
Course:	Mathematics of Machine Learning-Lab	Code:	BTADPE06AD5P

Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	-	2	1	30	20	50

Course Objectives: To build mathematical foundations for machine learning and apply them to model implementation, data analysis, and problem-solving.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO1	Outline basic learning paradigms and data representation in ML	L2
CO2	Apply distance, similarity, and vector space concepts	L3
CO3	Implement regression models using mathematical principles	L3
CO4	Design and evaluate dimensionality reduction techniques	L6
CO5	Apply probabilistic models for density estimation	L4
CO6	Develop and analyse ML solutions using mathematical foundations	L6

General Guidelines: The provided sample list of programs is intended as a guide, and the subject teacher has the flexibility to curate a customized set of experiments aligned with the curriculum.

Experiment List

1. Understand supervised vs unsupervised learning
2. Identify features, labels, and hypothesis space using sample datasets
3. Implement ERM for a simple regression/classification problem
4. Estimate parameters of Gaussian distribution from data
5. Implement basic probabilistic models
6. Compute cosine similarity and Euclidean distance
7. Apply Gram–Schmidt orthonormalization process
8. Perform 2D/3D rotations using rotation matrices
9. Show equivalence between MLE and least squares
10. Implement Bayesian linear regression
11. Visualize data before and after PCA
12. Fit GMM to a dataset

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Program:	B. Tech. (Artificial Intelligence (AI) and Data Science)			Semester:		V
Course:	Comm. Engg.Project/ Field project			Code:		BTADFP01AD5P
Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	-	2	1	50	-	50

Methods of Teacher Assessment (TA): Class Test, Assignment, Quiz

Course Objectives: To apply AI and data science techniques to solve real-world community or industry problems through fieldwork, data collection, analysis, and solution development.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Identify real-world problems from society/industry	L3
CO-2	Acquire real-world data for analysis	L3
CO-3	Apply AI and machine learning techniques to solve practical problems.	L3
CO-4	Communicate project findings and solutions effectively	L3
CO-5	Develop teamwork and collaboration skills in project-based environments	L6
CO-6	Develop socially responsible and ethical AI-based solutions.	L6

General Guidelines:

- Group of 10 to 15 students will choose a domain from the given list (The list is not limited to these domains, Choose another domain with the approval from BOS Chairman).
- Students will prepare a case study and will deliver it in nearby community.
- Model/Mobile app/Web app could also be prepared.

Domain List

- Agriculture
- Healthcare
- Smart City / Traffic
- Education
- Environment
- Business / Local Industry
- Banking & Financial Applications
- Retail & E-Commerce Systems
- Transportation & Traffic Management
- Smart City Applications
- Energy & Power Management
- Manufacturing & Production Systems

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Program:	B. Tech. (Artificial Intelligence (AI) and Data Science)			Semester:			VI	
Course:	Computer Networks			Code:			BTADPC20AD6T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Test, Assignment, Quiz

Course Objectives: To understand the fundamentals of computer networks, including layered architecture, protocols, data transfer, addressing, security, and network management.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Describe network architecture and application-layer protocols such as HTTP, FTP, SMTP, and DNS.	L2
CO-2	Analyse the services, mechanisms, and performance of UDP, TCP, reliable data transfer, and congestion control algorithms.	L4
CO-3	Apply routing principles and IP addressing, and outline IPv6 features.	L3
CO-4	Demonstrate link-layer functions, MAC protocols, and LAN addressing mechanisms.	L3
CO-5	Summarize cryptographic techniques, authentication methods, and security protocols such as SSL, SET, and IPsec.	L2
CO-6	Analyse firewall mechanisms and network management components like SNMP, MIB, and SMI.	L4

Unit I: Introduction **(6 Hrs.)**

Brief history of computer networks & Internet, Layered architecture, Internet protocol stack, Network entities & layers, Application layer: Principles of protocols, HTTP, FTP, SMTP and DNS protocols.

Unit II: Transport layer **(6 Hrs.)**

Services & principles, multiplexing & demultiplexing applications, UDP, principles of reliable data transfer, TCP details, principles of congestion control, TCP congestion control.

Unit III: Network layer **(6 Hrs.)**

Network service model, routing principles, hierarchical routing, Internet Protocol (IP) & ICMP details, routing in the Internet, router internals, IPV6.

Unit IV: Link layer **(6 Hrs.)**

Introduction, services, multiple access protocol, LAN addresses & ARP, CSMA / CD, PPP details.

Unit V: Network security **(6 Hrs.)**

Basic issues, principles of cryptography, authentication and authentication protocol, version, integrity: digital signatures, message digests, hash function algorithm, key distribution & certification, secure e- mail, E-Commerce: SSL & SET, IP Sec details.

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Unit VI: Firewalls **(6 Hrs.)**

Packet filtering and Application gateway, Network Management: Basic principles, infrastructure for network management, The Internet Network – management framework: SMI, MIB, SNMP details, security and administration, ASN.1

Total: 36 Hrs

Textbook:

James F. Kurose & K W Ross: Computer Networking, Pearson Education (LPE)

Reference Books:

1. Douglas E. Comer: Computer Network & Internet, Addison Wesley.
2. Andrew S. Tanenbaum: Computer Networks, PHI (5E)
3. Leon Garcia & Widjaja: Communication Networks, TMH
4. William Stallings: Data & Computer Communication, Pearson Education.

MOOC Links and additional reading, learning, video material:

1. https://www.coursera.org/learn/computer-networking?
2. https://www-net.cs.umass.edu/kurose_ross/lectures.php?
3. https://nptel.ac.in/courses/106105080
4. https://nptel.ac.in/courses/106105081
5. https://nptel.ac.in/courses/106105183
6. https://nptel.ac.in/courses/106106091

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Program:	B. Tech. (Artificial Intelligence (AI) and Data Science)			Semester:			VI	
Course:	Software Project Management			Code:			BTADPC21AD6T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Test, Assignment, Quiz

Course Objectives: To understand and apply software engineering principles, including process models, project management, system design, testing, and quality practices.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Outline the software engineering concepts, crisis, and myths.	L2
CO-2	Analyse and choose suitable software process models and project management practices.	L4
CO-3	Apply metrics, estimation, and risk-handling methods in project planning.	L3
CO-4	Analyse project schedules, EV analysis, and quality assurance processes.	L4
CO-5	Analyse requirements and design effective modular software systems.	L4
CO-6	Create test cases and apply testing strategies with debugging and metric evaluation	L6

Unit I: Software Process **(6 Hrs.)**

The Nature of Software, The Changing Nature of Software, A Generic Process Model, Prescriptive Process Models, Agility: What is an Agile Process? Extreme Programming, Requirement Analysis, Scenario based Modeling

Unit II: Design Concepts **(6 Hrs.)**

Design Concepts: Design within the Context of Software Engineering, The Design Process, Design Concepts. Architectural Design: Software Architecture. Component-Level Design: What Is a Component? Designing Class-Based Components. User Interface Design: The Golden Rules.

Unit III: Quality Management **(6 Hrs.)**

Quality Concepts: What is Quality? Software Quality. Review Techniques: Formal Technical Reviews. Software Quality Assurance: Elements of Software Quality Assurance, SQA Processes and Product Characteristics, SQA Tasks, Goals, and Metrics, Formal Approaches to SQA, Statistical Software Quality Assurance, Software Reliability.

Unit IV: Software Configuration Management **(6 Hrs.)**

Software Configuration Management: Software Configuration Management, The SCM Repository, The SCM Process. Product Metrics: A Framework, Metrics for the Requirements Model, Metrics for the Design Model

Unit V: Managing Software Projects **(6 Hrs.)**

Project Management Concepts: The Management Spectrum, People, The Product, The Process. Process And Project Metrics: Metrics in the Process and Project Domains, Software Measurement, Metrics for Software Quality. Estimation For Software Projects: The Project Planning Process, software Scope and Feasibility, Resources, Software Project Estimation, Decomposition Techniques

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Unit VI: Project Scheduling and Risk Management **(6 Hrs.)**

Project Scheduling: Basic Concepts, Project Scheduling, Defining a Task Set, Defining a Task Network, Scheduling. Risk Management: Reactive versus Proactive Risk Strategies, Software Risks, Risk Identification, Risk Projection, Risk Refinement, Risk Mitigation, Monitoring, and Management, The RMMM Plan.

Total: 36 Hrs

Textbook:

Pressman Roger. S, Maxim Bruce R. .: Software Engineering, A Practitioner's Approach TMH. Eight Edition

Reference Books:

1. Somerville: Software Engineering (Addison-Wesley) (5/e)
2. Fairly R.: Software Engineering (McGraw Hill)
3. Davis A.: Principles of Software Development (McGraw Hill)
4. Shooman, M.L.: Software Engineering (McGraw-Hill)

MOOC Links and additional reading, learning, video material:

1. https://alison.com/course/introduction-to-software-project-management
2. https://www.udemy.com/course/software-engineering-sen/
3. https://www.coursera.org/learn/software-engineering-software-design-and-project-management
4. https://onlinecourses.nptel.ac.in/noc25_cs108/preview
5. https://www.shiksha.com/online-courses/software-engineering-implementation-and-testing-course-cour15009

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Program:	B. Tech. (Artificial Intelligence (AI) and Data Science)			Semester:	VI	
Course:	Software Project Management Lab			Code:	BTADPC22AD6P	
Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	-	2	1	30	20	50

Course Objectives: To understand and apply SDLC, requirement analysis, modeling, estimation, and software testing.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level (L1 to L6)
CO1	Outline the SDLC models and their application in software projects.	L2
CO2	Analyse problem statements to prepare software requirements.	L4
CO3	Apply estimation techniques to compute project metrics.	L3
CO4	Develop UML use case diagrams and scenarios.	L6
CO5	Design ER, sequence, state chart, activity diagrams, and DFDs.	L6
CO6	Evaluate appropriate software testing methods.	L5

General Guidelines: The provided sample list of programs is intended as a guide, and the subject teacher has the flexibility to curate a customized set of experiments aligned with the curriculum.

List of Practicals

1. Study of various phases of SDLC
2. Identifying the Requirements from Problem Statements.
3. Estimation of Project Metrics.
4. Modeling UML Use Case Diagrams and Capturing Use Case Scenarios.
5. Modeling UML ER Diagrams and Sequence diagrams
6. Statechart and Activity Modeling
7. Modeling Data Flow Diagram
8. Study of various testing methods
9. Write Down the Test Case scenario for Login page authentication.
10. Introduction to agile methodology

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Program:	B. Tech. (Artificial Intelligence (AI) and Data Science)			Semester:	VI	
Course:	Computer Skill Lab – V			Code:	BTADPC23AD6P	
Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	-	2	1	30	20	50

Course Objectives: To develop a comprehensive understanding of computer networks and practical network programming skills, including communication protocols, socket programming, and network configuration through hands-on implementation.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level (L1 to L6)
CO1	Outline the basic computer networking concepts, protocols, and network architectures.	L2
CO2	Analyse network-related information such as IP addresses, host names, port numbers, and protocol types using programs.	L4
CO3	Implement network utility programs such as Ping and web page source code retrieval.	L6
CO4	Develop client–server applications using socket programming for sending and receiving data.	L6
CO5	Identify active port numbers and analyze services running on a server or within a LAN.	L4
CO6	Design, create, and configure a Local Area Network (LAN) and verify its proper functioning.	L6

General Guidelines: The provided sample list of programs is intended as a guide, and the subject teacher has the flexibility to curate a customized set of experiments aligned with the curriculum.

List of Practicals

1. Introduction to Computer Network.
2. Write a Program to obtain the IP address of the system.
3. Write a Program to obtain the information about the (a) Host Name (b) Port Number (c) Protocol Name from URL.
4. Write a Program to find the Local Port in LAN.
5. Write a Program for Implementation of Ping Command.
6. Write a Program to read the source code of the web page.
7. Write a Program to create socket for sending the data.
8. Write a Program to create socket for receiving the data.
9. Write a Program to find port number running on server.
10. Create and configure a Local Area Network (LAN).

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Program:	B. Tech. (Artificial Intelligence (AI) and Data Science)			Semester:			VI	
Course:	PE-I (Natural Language Processing)			Code:			BTADPE07AD6T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Test, Assignment, Quiz

Course Objectives: To understand and apply NLP concepts including language modeling, syntactic and semantic analysis, and discourse processing techniques.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level (L1 to L6)
CO-1	Describe natural language processing, its concepts and application.	L2
CO-2	Analyse various grammar and it's based language model.	L4
CO-3	Evaluate regular expressions FA for spelling error detection andcorrections.	L4
CO-4	Outline the context free grammar and parsing.	L2
CO-5	Describe semantic analysis and its ambiguity.	L2

Unit I: Introduction to NLP **(6 Hrs.)**

Introduction to Natural Language processing, Origins of NLP, Language and Knowledge, The Challenges of NLP, Language and Grammar, Processing Indian Languages, NLP Application, Information Retrieval.

Unit II: Language Modelling **(6 Hrs.)**

Introduction, Various Grammar-Based Language Models: Generative Grammars, Hierarchical Grammar, Government and Binding, Lexical Functional Grammar (LFG) Model, Statistical Language Model.

Unit III: Word Level Analysis **(6 Hrs.)**

Introduction, Regular Expressions, Finite-State Automata, Morphological Parsing, Spelling Error Detection and Correction, Words and Word classes, Part-of-Speech tagging: Rule-based tagger.

Unit IV: Syntactic Analysis **(6 Hrs.)**

Introduction, Context-Free Grammar, Constituency: Phrase Level Contractions, Sentence Level Contractions, Parsing, Probabilistic Parsing, Estimating rule probabilities, Parsing PCFGs, Problem with PCFG.

Unit V: Semantic Analysis **(6 Hrs.)**

Introduction, Meaning Representation: Characteristics of Meaning Representation Language, Meaning structure of Language, Syntax-driven Semantic Analysis, Semantic grammar, Lexical Semantics, Ambiguity.

Unit VI: Discourse Processing **(6 Hrs.)**

Introduction, Cohesion, Reference Resolution, Discourse Coherence and Structure: Coherence Relations, Discourse Interpretation, Discourse Structure.

Total: 36 Hrs

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Textbook:

1. "Natural Language Processing and Information Retrieval", Tanveer Siddiqui and U. S. Tiwary Oxford University Press.

Reference Books:

1. "Understanding Natural Language Processing (Machine Learning and Deep Learning Perspectives)" T V Geetha – Pearson
2. "Natural Language Processing Paperback" – 6 December 2023 by Pushpak Bhattacharyya , Aditya Joshi , Wiley
3. "Practical Natural Language Processing", *Comprehensive Guide to Building Real-World NLP Systems,* published by O'Reilly Media and authored by Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, and Harshit Surana.

MOOC Links and additional reading, learning, video material:

NPTEL:

"Natural Language Processing"

https://onlinecourses.nptel.ac.in/noc19_cs56/preview

"Deep Learning for Natural Language Processing."

https://onlinecourses.nptel.ac.in/noc26_cs33/preview

Coursera:

https://www.coursera.org/specializations/natural-language-processing

Approved in 4TH Academic Council Meeting
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Program:	B. Tech. (Artificial Intelligence (AI) and Data Science)	Semester:	VI
Course:	PE-I Lab (Natural Language Processing)	Code:	BTADPE08AD6P

Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	-	2	1	30	20	50

Course Objectives: To understand and analyze NLP techniques including language modeling, syntactic and semantic analysis, and cohesion and reference resolution.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level (L1 to L6)
CO-1	Analyse the use of tokenization.	L3
CO-2	Construct how to tag a given text with basics Language features.	L3
CO-3	Design an innovative application using NLP components.	L6
CO-4	Choose a rule-based system to tackle morphology/syntax of a language.	L1
CO-5	Categorize a tag set to be used for statistical processing for real -time applications.	L4
CO-6	Assess the use of different statistical approaches for different types of NLP applications.	L5

General Guidelines: The provided sample list of programs is intended as a guide, and the subject teacher has the flexibility to curate a customized set of experiments aligned with the curriculum.

List of Practicals

1. Write a program in python for tokenization.
2. How to find the most common words in the text excluding stop words.
3. Write a program in python for part-of-speech (POS) Tagging.
4. Extract and print all the nouns present in the below text.
5. Find all similar words to "amazing" using Google news Word2Vec.
6. Detect if a text is positive or negative sentiment.
7. Extract any first name and last name in that occur in the text document
8. Identify and print all the named entities with their labels in the given text
9. Identify and extract a list of all organizations/Companies mentioned in the given news article.
10. Extract all Bigrams, Trigrams using Ngrams of NLTK library.

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Program:	B. Tech. (Artificial Intelligence (AI) and Data Science)	Semester:	VI
Course:	PEC-I : Architecture for Management of Large Datasets	Code:	BTADPE09AD6T

Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Tests, Assignments & Quiz

Course Objectives: To understand big data analytics concepts, tools like Hadoop and NoSQL, and techniques such as MapReduce for scalable and streaming data processing.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Outline the key issues in big data management and its associated applications	L2
CO-2	Acquire fundamental enabling techniques like Hadoop, and NO SQL in big data analytics	L3
CO-3	Achieve basic knowledge and operations of Map-Reduce	L3
CO-4	Interpret business models and scientific computing paradigms and apply software tools for big data analytics.	L4
CO-5	Implement algorithms for Clustering, Classifying and finding associations in Big Data	L5
CO-6	Achieve adequate perspectives of big data analytics in various applications like recommender systems, social media applications.	L6

Unit I: Introduction to Big Data: **(6 Hrs.)**

Introduction to Big Data, Big Data characteristics, types of Big Data, Traditional vs. Big Data business approach, Case Study of Big Data Solutions.

Unit II: Introduction to big data frameworks: Hadoop and NoSQL **(6 Hrs.)**

Introduction to Hadoop, Hadoop Components; Hadoop Ecosystem; Overview of : Apache Spark, Pig, Hive, and Hbase, Introduction to NoSQL, NoSQL data architecture patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores.

Unit III: MapReduce Paradigm **(6 Hrs.)**

MapReduce: The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution, Coping with Node Failures. Algorithms Using MapReduce: Matrix-Vector Multiplication by MapReduce, Relational-Algebra Operations, Computing Selections by MapReduce, Computing Projections by MapReduce, Union, Intersection, and Difference by MapReduce, Computing Natural Join by MapReduce, Grouping and Aggregation by MapReduce, Matrix Multiplication, Matrix Multiplication with One MapReduce.

Unit IV: Mining Big Data Stream **(6 Hrs.)**

The Stream Data Model: A DataStream-Management System, Examples of Stream Sources Stream Queries, Issues in Stream Processing, Sampling Data in a Stream: Reservoir Sampling, Biased Reservoir Sampling, Concise Sampling,

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Unit V: Big Data Analytics Applications **(6 Hrs.)**

Link Analysis: PageRank Definition, Structure of the web, dead ends, Using Page rank in a search engine, Efficient computation of Page Rank, PageRank Iteration Using MapReduce, Topic sensitive Page Rank, link Spam, Hubs and Authorities

Unit VI: Mining Social- Network **(6 Hrs.)**

Mining Social- Network Graphs: Social Networks as Graphs, Types , Clustering of Social Network Graphs, Direct Discovery of Communities, counting triangles using Map-Reduce. Recommendation Engines: Content based Recommendation, Collaborative Filtering.

Total: 36 Hrs

Textbooks:

1. Radha Shankarmani, M Vijayalakshmi," Big Data Analytics", Wiley Publications

Reference Books:

1. Anand Rajaraman and Jeff Ullman "Mining of Massive Datasets", Cambridge University Press.
2. Analytics in a Big Data World: The Essential Guide to Data Science and its Applications, Bart Baesens ,WILEY Big Data Series.
3. Alex Holmes "Hadoop in Practice", Manning Press, Dreamtech Press
4. Big Data Analytics with R and Hadoop by Vignesh Prajapati Paperback, Packt Publishing Limited Hadoop:The Definitive Guide by Tom White, O'Reilly Publications.

MOOC Links:

1. Introduction to Data Analytics: https://www.coursera.org/learn/introduction-to-data-analytics
2. Big Data with Hadoop: Apply MapReduce, Pig & Hive : https://www.coursera.org/learn/big-data-hadoop-apply-mapreduce-pig-hive

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Program:	B. Tech. (Artificial Intelligence (AI) and Data Science)	Semester:	VI
Course:	PEC-I : Architecture for Management of Large Datasets - Lab	Code:	BTADPE10AD6P

Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
3	-	3	3	30	20	50

Course Objectives: To understand the Practical concepts of Large Datasets.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Analyse the key challenges in big data management and identify suitable big data applications.	L2
CO-2	Apply fundamental big data enabling technologies such as Hadoop ecosystem and NoSQL databases for data storage and processing.	L3
CO-3	Perform basic MapReduce operations to process large-scale datasets.	L3
CO-4	Interpret business and scientific computing problems and apply appropriate big data analytics tools.	L4
CO-5	Implement basic data mining algorithms such as clustering, classification, and association rule mining on large datasets.	L5
CO-6	Analyse real-world big data applications including recommender systems and social media analytics.	L6

General Guidelines: The provided sample list of programs is intended as a guide, and the subject teacher has the flexibility to curate a customized set of experiments aligned with the curriculum.

List of Prcticals

1. Study of Big Data characteristics and applications
2. Implement Big Data tool environment setup and HDFS Operations
3. Study and implementation of basic operations using MongoDB / HBase.
4. Implement a simple Word Count program using MapReduce.
5. Implement MapReduce for log file analysis and sales data aggregation
6. Apply K-Means clustering on large datasets using Hadoop / Spark/ Python
7. Implement classification and association rule mining on large dataset
8. Execute a MapReduce or Spark job on large datasets and Analyze execution time, memory usage, and scalability
9. Develop a simple application using Big Data Analytics (like Movie or product recommender system /Social media trend analysis)
10. Study and implementation of data ingestion and preprocessing techniques using Sqoop / Flume / Spark

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Program:	B. Tech (Artificial Intelligence (AI) and Data Science)	Semester:	VI
Course:	PEC-I Introduction to toolkits for Machine Learning	Code:	BTADPE11AD6T

Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Test, Assignment, Quiz

Course Objectives: To understand and apply machine learning concepts, including data preprocessing, feature selection, model training, evaluation, and neural network implementation using TensorFlow.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Outline the types, uses, and challenges of Machine Learning.	L2
CO-2	Analyse the working of real dataset by framing the problem.	L2
CO-3	Prepare the Data to Select and train the machine learning model and features extractions.	L4
CO-4	Implement Machine Learning Models based on Binary, Multiclass, Multioutput Classification.	L6
CO-5	Apply training to Machine Learning Models & evaluating model performance with regression type algorithms.	L3
CO-6	Comprehend TensorFlow and TensorBoard libraries to implement neural network models.	L2

Unit I: Machine Learning Landscape **(6 Hrs.)**

Machine Learning: Definition, Types, Uses; Instance-Based Versus Model-Based Learning, Challenges of Machine Learning, Testing and Validating ML model.

Unit II: Working with Real Data **(6 Hrs.)**

Frame the Problem, Select a Performance Measure, Create the Workspace, Download the Data, Create a Test Set, Discover and Visualize the Data to Gain Insights.

Unit III: Prepare the Data for Machine Learning Algorithms **(6 Hrs.)**

Data Cleaning, Handling Text and Categorical Attributes, Custom Transformers, Feature Scaling, Select and Train a Model: Training and Evaluating on the Training Set, Better Evaluation Using Cross-Validation; Ensemble Methods Overview.

Unit IV: Classification **(6 Hrs.)**

Training a Binary Classifier, Confusion Matrix, The ROC Curve, Multiclass Classification, Error Analysis, Multilabel Classification, Multioutput Classification.

Unit V: Training Machine Learning Models **(6 Hrs.)**

Linear Regression Algorithm, Gradient Descent Algorithm, Polynomial Regression, Learning Curves, Logistic Regression Algorithm.

Unit VI: Running with TensorFlow **(6 Hrs.)**

Managing Graphs, Linear Regression with TensorFlow , Feeding Data to the Training Algorithm, Saving and Restoring Models, Visualizing the Graph and Training Curves Using TensorBoard, Modularity, Sharing Variables

Total: 36 Hrs

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Textbook:

1. G Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow", Published by O'Reilly Media, First Edition, March 2017.

Reference Books:

1. G Aurélien Géron, "Hands-On Machine Learning With Scikit-Learn and Pytorch: Concepts, Tools, and Techniques to Build Intelligent Systems", Published by O'Reilly Media, First Edition, December 2025.
3. Ashwin Pajankar, Aditya Joshi, "Hands-on Machine Learning with Python", A-Press Publisher, March 2022.
4. Dhairya Parikh, "Machine Learning Essentials You Always Wanted to Know: A Hands-On Beginner's Guide to Mastering AI, Supervised, Unsupervised, and Deep Learning Algorithms, Vibrant Publishers, July 2025.

MOOC Links and additional reading, learning, video material:

Coursera: https://www.udemy.com/course/deep-reinforcement-learning-in-python

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Program:	B. Tech. (Artificial Intelligence (AI) and Data Science)	Semester:	VI
Course:	PEC-I Introduction to toolkits for Machine Learning – Lab	Code:	BTADPE12AD6P

Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	-	2	1	30	20	50

Course Objectives: To enable students to effectively design, implement, evaluate, and manage machine learning solutions by applying data preparation techniques, model building, performance analysis, and modern ML tools such as TensorFlow to real-world problems.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level (L1 to L6)
CO1	Demonstrate understanding of machine learning concepts by implementing instance-based and model-based learning algorithms.	L2
CO2	Formulate real-world machine learning problems by identifying relevant features, target variables, and appropriate performance metrics.	L4
CO3	Perform data acquisition, exploration, cleaning, preprocessing, and transformation to prepare datasets for machine learning tasks.	L6
CO4	Design, train, and evaluate regression and classification models using suitable validation techniques and performance measures.	L6
CO5	Analyze model performance through error analysis, learning curves, and optimization techniques such as gradient descent.	L4
CO6	Develop machine learning models using TensorFlow, including visualization, model persistence, and training monitoring tools.	L6

General Guidelines: The provided sample list of programs is intended as a guide, and the subject teacher has the flexibility to curate a customized set of experiments aligned with the curriculum.

List of Practicals

1. Study the ML landscape by implementing a simple instance-based using KNN algorithm learning approach on a small dataset.
2. Frame a real-world ML problem, identify input/output variables, and select appropriate performance metrics.
3. Download a Iris dataset, create training and test sets, and perform exploratory data analysis with basic visualizations.
4. Handle missing values, outliers, categorical attributes, and apply feature scaling techniques for spam email dataset.
5. Build custom data transformers and train a basic ML model; evaluate performance using cross-validation.
6. Train a binary classifier and evaluate it using confusion matrix, precision, recall, and F1-score.
7. Implement multiclass and multilabel classification models and perform error analysis.
8. Implement Linear and Polynomial Regression models and analyze bias–variance using learning curves.
9. Implement Logistic Regression using Gradient Descent and analyze convergence behavior.
10. Build a Linear Regression model using TensorFlow, visualize training using TensorBoard, and save/restore the trained model.

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Program:	B. Tech. (Artificial Intelligence (AI) and Data Science)			Semester:			VI	
Course:	PEC-II Applications of Data Science			Code:			BTADPE13AD6T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Test, Assignment, Quiz

Course Objectives: To understand and apply data science techniques in healthcare, including data handling, analysis, data mining, and predictive modelling with NLP and computer vision.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Outline the role, lifecycle, applications of data science in healthcare.	L2
CO-2	Identify and analyse healthcare data types, sources, EHR structures.	L4
CO-3	Apply data preparation, exploratory data analysis, and clustering techniques.	L3
CO-4	Build and evaluate predictive models and computer vision.	L5
CO-5	Apply natural language processing techniques.	L3
CO-6	Analyse and utilize generative AI, interoperability standards, privacy regulations and emerging technologies.	L4

Unit I: Introduction to Data Science: Healthcare **(6 Hrs.)**

Introduction, Structure, Objective, Understanding health tech, The dawn of technology in healthcare, Analytics in healthcare, Essence of data science in healthcare, Unraveling the key concepts in data science for healthcare, Lifecycle of a healthcare data science project, Applications of data science in healthcare, Predictive analytics in-patient outcomes and radiology, Challenges in merging data science with healthcare, Ethics in healthcare data science.

Unit II: Fundamentals of Healthcare Data **(6 Hrs.)**

Introduction, Role of data in modern healthcare, Types of healthcare data, Comparative analysis, Data sources in healthcare, Structure and components of EHRs, Role in-patient care and research, Medical imaging in healthcare.

Unit III: Data Preparation and Mining **(6 Hrs.)**

Introduction to data preparation in healthcare, Common challenges in healthcare datasets, Handling missing values in healthcare datasets, Addressing outliers and noisy data, Data transformation, normalization, and standardization, Exploratory data analysis in healthcare, Clustering in healthcare data analysis, Case studies and real-world applications, Data preparation and analysis.

Unit IV: Predictive Modeling and Computer Vision in Healthcare **(6 Hrs.)**

Introduction to predictive modeling in healthcare, Building machine learning models for disease diagnosis, Evaluation methods for model performance and interpretability, Predictive modeling for treatment recommendations. Image Analysis and Computer Vision in Healthcare: Introduction to computer vision in medical imaging, Applications of computer vision in medical imaging, Utilizing deep learning for image

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classification, segmentation, and anomaly detection, Real-world examples of computer vision in disease diagnosis.

Unit V: Natural Language Processing in Healthcare **(6 Hrs.)**

Introduction, Objectives, Evolution of medical data analysis, Introduction to natural language processing, Role of NLP in analyzing medical text, Extracting clinical insights, NLP for clinical decision support and coding, Real-world examples of NLP in disease diagnosis, Challenges and future directions.

Unit VI: Generative AI in Healthcare **(6 Hrs.)**

Introduction, Using generative AI for producing medical data, Generative AI workflow for medical data creation, Applications of generative AI, Challenges and opportunities in using generative AI.

Fundamentals of Healthcare Data: Wearable devices in healthcare, Data quality in healthcare, Patient privacy and ethics in healthcare data, Health Insurance Portability and Accountability Act, Healthcare ontologies and coding systems, Healthcare interoperability, Health Level 7, Real-world applications in healthcare data science.

Total: 36 Hrs

Textbook:

Nitin Singh, "Data Science for Healthcare Applying ML and AI to solve real-world healthcare problems", bpb, First Edition 2026.

Reference Books:

1. Dr. Hari Singh, Ravindara Bhatt, Prateek Thakral, Dinesh Chander Verma, " Data Science for Effective Healthcare Systems" Chapman & Hall/CRC Publications, First Edition, 2023.
2. Pradeep Kumar Singh , "Data Science and Artificial Intelligence for Digital Healthcare", Springer Nature, Edition First, 2024.

MOOC Links and additional reading, learning, video material:

NPTEL : 1. https://nptel.ac.in/courses/109107190

MOOC Link: 1. https://www.coursera.org/learn/datascimed

1. https://www.futurelearn.com/courses/introduction-to-data-science-for-healthcare-professionals
2. https://www.edx.org/course/collaborative-data-science-for-healthcare

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Program:	B. Tech. (Artificial Intelligence (AI) and Data Science)	Semester:	VI
Course:	PEC-II Applications of Data Science Lab	Code:	BTADPC14AD6P

Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	-	2	1	30	20	50

Course Objectives: To understand and apply data science in healthcare, including data handling, analysis, predictive modeling, NLP, computer vision, and emerging technologies.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level (L1 to L6)
CO1	Outline the role, lifecycle, applications of data science in healthcare.	L2
CO2	Identify and analyze healthcare data types, sources, EHR structures.	L4
CO3	Apply data preparation, exploratory data analysis, and clustering techniques.	L3
CO4	Build and evaluate predictive models and computer vision.	L5
CO5	Apply natural language processing techniques.	L3
CO6	Analyze and utilize generative AI, interoperability standards, privacy regulations and emerging technologies.	L4

General Guidelines: The provided sample list of programs is intended as a guide, and the subject teacher has the flexibility to curate a customized set of experiments aligned with the curriculum.

List of Practicals

1. Study of Healthcare Data Science Ecosystem.
2. Analysis of Healthcare Technology Evolution
3. Exploration of Healthcare Data Types
4. Hands-on with Electronic Health Records.
5. Analysis of Healthcare Data Sources
6. Handling Missing Values in Healthcare Datasets
7. Outlier Detection and Noise Handling
8. Data Transformation and Normalization
9. Disease Diagnosis using Machine Learning Models.
10. Text Preprocessing of Clinical Notes
11. NLP for Extracting Clinical Insights
12. Generating Synthetic Healthcare Data using Generative AI
13. Generative AI Workflow for Medical Data Creation

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Program:	B. Tech. (Artificial Intelligence (AI) and Data Science)	Semester:	VI
Course:	PEC-II Applications of Artificial Intelligence	Code:	BTADPE15AD6T

Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Test, Assignment, Quiz

Course Objectives: To understand and apply AI techniques including knowledge representation, computer vision, NLP, modern AI methods, and emerging technologies.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Apply propositional logic, inference rules, and chaining techniques.	L3
CO-2	Apply computer vision concepts and tools to process images.	L3
CO-3	Outline the NLP concepts, models, and techniques.	L2
CO-4	Analyse ethical issues, AI services, robotics.	L4
CO-5	Describe the integration of AI with IoT, edge computing.	L2
CO-6	Apply genetic algorithms, soft computing techniques, and transfer learning.	L3

Unit I: Techniques of Knowledge Representation **(6 Hrs.)**

Techniques of Knowledge Representation in AI, Syntax of Propositional Logic, Logical Connectives in Propositional Logic, Inference Rules, Forward Chaining and Backword Chaining in AI.

Unit II: Computer Vision **(6 Hrs.)**

Human Vision vs Computer Vision, The Evolution of Computer Vision, Tasks in Computer Vision, Applications of Computer Vision, Challenges in Computer Vision, Understanding Image Pixels, DPI and PPI, Convolutional Neural Networks, Working with Images Using OpenCV, Immersive Experience.

Unit III: Natural Language Processing **(6 Hrs.)**

What is Natural Language Processing, Chatbot, How does Natural Language Processing Works, Components of NLP, Steps in NLP, Phases of NLP, Applications of NLP, PROS and CONS of NLP, Evolution of NLP, Handling Ambiguities, The NLP Model of Perception, Constituency Grammar, Context-Free Grammar, Speech Recognition.

Unit IV: Current Trends in Artificial Intellience **(6 Hrs.)**

AI and Ethical Concerns: Ethical Use of AI, Ethics in AI, AI and Bias, Towards Ethical and Trustworthy AI, AI as a Service: Factors Triggering Growth of AIaaS, The Growth of AIaas, Challenges of AIaaS, Vendors of AIaaaS, Robotics: Artificially Intelligence Robot, Characteristics of Robots, Types of Robots, Types of Robots on Degree of Human Control, Components of a Robot, AI Technology Used in a Robots, Planning and Navigation, Recent Trends in AI: Collaborative systems, Machine Assisting Humans, Algorithmic Game Theory and Computational Social Choice, Multi-Agent Reinforcement Learning, Neuromorphic Computing.

Unit V: Future of AI **(6 Hrs.)**

Expert System, Internet of Things, Artificial Intelligence of Things , Edge Computing, Metaverse.

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Unit VI: AI Evolving with New Age Techniques **(6 Hrs.)**

Genetic Algorithms: Advantages of Genetic Algorithms, Limitations of Genetic Algorithms, Basic Terminology, Basic Structure, Genotype Representation, Population, Population Initialization, Population Models, Fitness Function, Parent Selection, Crossover, Mutation, Termination condition, Application Areas, Soft Computing: Characteristics of Soft Computing, Need for Soft Computing, Applications of Soft Computing, Elements of Soft Computing, Transfer Learning.

Total: 36 Hrs

Textbook:

Reema Thareja, "Artificial Intelligence Beyond Classical AI", Pearson.

Reference Books:

"A classical Approach to Artificial Intelligence ", Dr. Mukesh Chandra Trivedi, Khanna Publishing, 2016

MOOC Links and additional reading, learning, video material:

NPTEL : https://nptel.ac.in/courses/106106140

NPTEL : https://nptel.ac.in/courses/108103174

Scaler:

Coursera:https://www.coursera.org/learn/ai-applications-computer-vision-and-speech-analysis

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Program:	B. Tech. (Artificial Intelligence (AI) and Data Science)	Semester:	VI
Course:	PEC-II Applications of Artificial Intelligence Lab	Code:	BTADPC16AD6P

Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	-	2	1	30	20	50

Course Objectives: To understand and implement AI techniques including logic, inference, computer vision, NLP, expert systems, IoT integration, and soft computing methods.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level (L1 to L6)
CO1	Apply propositional logic, inference rules, and chaining techniques.	L3
CO2	Apply computer vision concepts and tools to process images.	L3
CO3	Outline the NLP concepts, models, and techniques.	L2
CO4	Analyze ethical issues, AI services, robotics.	L4
CO5	Describe the integration of AI with IoT, edge computing.	L2
CO6	Apply genetic algorithms, soft computing techniques, and transfer learning.	L3

General Guidelines: The provided sample list of programs is intended as a guide, and the subject teacher has the flexibility to curate a customized set of experiments aligned with the curriculum.

List of Practicals

1. Study and implement Propositional Logic expressions using truth tables.
2. Demonstrate rules of inference using sample logical statements.
3. Study the differences between Human Vision and Computer Vision using examples.
4. Load, display, and manipulate images using OpenCV.
5. Perform image pixel analysis (grayscale conversion, resizing, thresholding).
6. Perform text preprocessing (tokenization, stop-word removal, stemming)
7. Implement part-of-speech (POS) tagging using NLP libraries.
8. Demonstrate an IoT-based application integrated with AI.
9. Implement a basic AIoT use case (sensor data analysis).
10. Study edge computing through a real-time or simulated example.
11. Implement a Genetic Algorithm for optimization problems.

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Program:	B. Tech. (Artificial Intelligence (AI) and Data Science)			Semester:			VI	
Course:	PEC-II Introduction to Data Analytics and Visualization			Code:			BTADPE17AD6T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance

Course Objectives: To understand the basic concepts of R programming to be used for data analytics.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Implement basic R programs and use various data structures.	L3
CO-2	Manipulate and transform complex datasets using various data manipulation functionalities in R.	L4
CO-3	Analyse a dataset by calculating measures of central tendency (Mean, Median, Mode) and spread (standard deviation and variance).	L5
CO-4	Create and interpret informative data visualizations such as bar graphs, scatter plots, box plots, and histograms.	L4

Unit I: Introduction to Data Science **(6 Hrs.)**
Data Science, Terminology, Methods of Data repository, Types of Data, Data Science Process, Toolkits, Example and Applications.

Unit II: Data Management Using 1BM SPSS **(6 Hrs.)**
Data Management planning, Data management plan, Data Collection and management, API, Exploring Data, Building Models, Storage management, Importing Data.

Unit III: Data Analysis Using R Programming Language **(6 Hrs.)**
Introduction to Applies Statistical Techniques, Types of statistical data, Types of Big Data Analytics, Collecting data for sampling and distribution, Probability, Frequency Distribution, Population and parameters, Central tendency, Measure of Central tendency, Different types of statistical means, Problems of Estimation, Normal Distribution curve.

Unit IV: Data Visualization **(6 Hrs.)**
Data visualization, Importance of Data visualization, Conventional Data visualization methods, Retinal Variables, Mapping Variables to Encoding.

Unit V: Applications of Data Science, Technologies for Visualization **(6 Hrs.)**
Applications of Data Science, Technologies for Visualization, Introduction to python, basic numeric operations, data types, modules, Library, Introduction to Bokeh.

Unit VI: Recent Trends in Data Science **(6 Hrs.)**
Recent Trends in various data collection and analysis techniques, various big data visualization tools, visualizing big data, preattentive attributes, Challenges, Potential Solutions.

Total: 36 Hrs

Textbooks:

1. Data Science and Analytics , by V.K. Jain, Khanna Publishing.

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2. Business Analytics, S. Christian Allright, Wayne L. Winstone

Reference Books:

1. R for Data Science, Hadley Wickham and Garrett Grolemund

MOOC Links:

1. https://onlinecourses.nptel.ac.in/noc20_mg24/preview

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Program:	B. Tech. (Artificial Intelligence (AI) and Data Science)	Semester:	VI
Course:	PEC-II Introduction to Data Analytics and Visualization-Lab	Code:	BTADPC18AD6P

Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	-	2	1	30	20	50

Course Objectives: To understand and apply data science concepts, statistical analysis using R, data visualization, NLP, and modern trends for effective data interpretation.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level (L1 to L6)
CO1	Outline the core concepts, process, and applications of Data Science..	L2
CO2	Apply data management and preprocessing techniques.	L3
CO3	Perform statistical analysis and data modeling using R programming.	L3
CO4	Analyze data distributions and statistical measures for decision-making.	L4
CO5	Evaluate data visualization techniques using Python and visualization tools.	L5
CO6	Design data science solutions considering recent trends, challenges, and visualization technologies.	L6

General Guidelines: The provided sample list of programs is intended as a guide, and the subject teacher has the flexibility to curate a customized set of experiments aligned with the curriculum.

List of Practicals

1. Identification and classification of different types of data.
2. Designing a Data Science process workflow for a given problem.
3. Creation of a basic Data Management Plan (DMP).
4. Data collection and data import using IBM SPSS.
5. Exploring and preprocessing data using IBM SPSS.
6. Building simple analytical models using IBM SPSS.
7. Data storage and management techniques using SPSS.
8. Introduction to R programming environment and basic commands.
9. Implementation of descriptive statistics using R.
10. Computation of measures of central tendency in R.
11. Probability and frequency distribution analysis using R.
12. Implementation of normal distribution curve using R.
13. Study and implementation of basic data visualization concepts.
14. Creation of conventional charts (bar, line, pie, histogram).
15. Mapping data variables to visual encodings.
16. Introduction to Python programming for data science.
17. Performing numeric operations and data handling using Python.
18. Data visualization using Python libraries.

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19. Introduction and implementation of Bokeh for interactive visualization.
20. Study of data science applications in real-world domains.
21. Study of big data visualization tools and techniques.
22. Visualization of large datasets using modern tools.

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Program:	B. Tech. (Artificial Intelligence (AI) and Data Science)	Semester:	VI
Course:	IoT and Embedded Computing	Code:	BTADVS05AD6P

Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	1	3	2	30	20	50

Course Objectives: To enable students to design, simulate, and analyze IoT and Embedded computing-based sensing, automation, and monitoring applications.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level (L1 to L6)
CO1	Identify IoT components, virtual devices, and software-based simulation tools used in IoT experimentation.	L1
CO2	Outline the working principles of simulated sensors, actuators, and IoT communication models in software-defined environments.	L2
CO3	Demonstrate sensor interfacing, device control, and complete IoT workflows.	L3
CO4	Analyse data acquisition, processing, and response mechanisms in virtual IoT applications.	L4
CO5	Demonstrate embedded system programming concepts, including GPIO control, timing, and peripheral interfacing, using simulated microcontroller platforms.	L3
CO6	Develop embedded system applications by integrating sensors, actuators, and control logic to realize real-time monitoring and automation tasks.	L6

General Guidelines: The provided sample list of programs is intended as a guide, and the subject teacher has the flexibility to curate a customized set of experiments aligned with the curriculum.

List of Practicals

1. Simulation of IoT Devices using Tinkercad
2. Virtual Temperature & Humidity Sensor Data Generation using Python
3. MQTT Publisher–Subscriber Simulation using Mosquitto & MQTT Explorer
4. IoT Dashboard Creation using Node-RED
5. Software-Based Home Automation using Node-RED Dashboard
6. IoT Network Simulation using Cisco Packet Tracer (IoT Mode)
7. Blynk IoT Cloud Simulation using Virtual Pins
8. Study of Microcontroller GPIO Programming using Simulator
9. Study Analog Sensor Interfacing and Perform Analog to Digital Conversion Simulation
10. Use of timers and PWM to control LED brightness or motor speed.
11. Design and simulation of simple state-machine-based control (ON/OFF)

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