D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY

AUTONOMOUS

Approved by AICTE, New Delhi & Permanently Affiliated to JNTUK, Kakinada

Accredited with A^{++} Grade by NAAC & Accredited by NBA (B. TECH – CSE, ECE & EEE)

Ph: 08816-221238 Email: dnrcet@gmail.com website: https://dnrcet.org

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DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

COURSE STRUCTURE & SYLLABUS
for

B.Tech -ARTIFICIAL INTELLIGENCE and DATA SCIENCE

(Applicable for batches admitted from 2024-2025)

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY

(Autonomous)

BALUSUMUDI, BHIMAVARAM, W.G. Dist., A.P., PIN-534 202

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B.Tech. AI&DS (DR24 Regulation III Year COURSE STRUCTURE &SYLLABUS)

B.Tech. – III Year I Semester

S. No.	Course Code	Title	Category	L/D	T	P	Credits
1	BT24CS3101	Data Warehousing and Data Mining	Professional Core	3	0	0	3
2	BT24DS3101	Principles of Machine Learning	Professional Core	3	0	0	3
3	BT24DS3102	Data Visualization	Professional Core	3	0	0	3
4	BT24DS31P1A	Object Oriented Analysis and Design	Professional Elective-I	3	0	0	3
	BT24DS31P1B	Soft computing					
	BT24DS31P1C	Internet of Thing					
	BT24DS31P1D	Exploratory Data Analysis with Python					
5	BT24HS3101	OR Entrepreneurship Development & Venture Creation	Open Elective- I	3	0	0	3
6	BT24DS3103	Data Warehousing and Machine Learning Lab	Professional Core	0	0	3	1.5
7	BT24DS3104	Data Visualization Lab	Professional Core	0	0	3	1.5
8	BT24DS3105	Full Stack Development-2 / SWAYAM Plus – Data Engineer/ AI Engineer	Skill Enhancement Course	0	1	2	2
9	BT24DS3106	Tinkering Lab *(User Interface design using Flutter)*	ES	0	0	2	1
10	BT24BS3102	Evaluation of Community Service Internship		-	-	-	2
Total				**15**	**1**	**10**	**23**
MC		Minor Course (Student may select from the same specialized minors pool)		3	0	3	4.5
MC		Minor Course through SWAYAM / NPTEL (Minimum 12 Week, 3 credit course)		3	0	0	3
HC		Honors Course (Student may select from the same Honors pool)		3	0	0	3
HC		Honors Course (Student may select from the same Honors Pool)		3	0	0	3

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B.Tech.–III Year II Semester

S. No.	Course Code	Title	Category	L/D	T	P	Credits
1	BT24DS3201	Big Data Analytics	Professional Core	3	0	0	3
2	BT24ML3202	Deep Learning	Professional Core	3	0	0	3
3	BT24ML3201	Natural Language Processing	Professional Core	3	0	0	3
4	BT24DS32P2A	Cryptography & Network Security	Professional Elective-II	3	0	0	3
	BT24DS32P2B	Operating Systems					
	BT24DS32P2C	Recommender Systems					
	BT24DS32P2D	Computer Vision					
	BT24DS32P2E	Automata Theory & Compiler Design					
5	BT24DS32P3A	Quantum Computing	Professional Elective-III	3	0	0	3
	BT24DS32P3B	NoSQL databases					
	BT24DS32P3C	Cloud Computing					
	BT24DS32P3D	Social Media Analytics					
	BT24DS32P3E	Any of the 12-Week SWAYAM /NPTEL Course suggested by the BoS					
6			Open Elective – II	3	0	0	3
7	BT24DS3202	Deep Learning & Natural Language Processing Lab	Professional Core	0	0	3	1.5
8	BT24DS3203	Big Data Analytics Lab	Professional Core	0	0	3	1.5
9	BT24BS3201	Soft skills / SWAYAM Plus - Century Employability Skills	Skill Enhancement Course	0	1	2	2
10	BT24BS3202	Technical Paper Writing & IPR	Audit Course	2	0	0	-
Total				**20**	**1**	**8**	**23**
*Mandatory Industry Internship/Mini Project of 08 weeks duration during summer vacation							
MC		Student may select from the same minors pool		3	0	3	4.5
MC		Minor Course (Student may select from the same specialized minors pool)		3	0	0	3
HC		Student may select from the same honors pool		3	0	0	3
HC		Honors Course (Student may select from the honors pool)		3	0	0	3

* Under Industry Internship interested students can pursue SWAYAM Plus courses viz., Hands-on Master class on Data Analytics OR Artificial Intelligence for Real-World Application

III Year - I Semester	Course Code: BT24CS3101	L	T	P	C
		3	0	0	3
DATA WAREHOUSING AND DATA MINING					

Pre-requisites: Data Structures, Algorithms, Probability & Statistics, Data Base Management Systems

Course Objectives: The main objective of the course is to

- Introduce basic concepts and techniques of data ware housing and data mining
- Examine the types of the data to be mined and apply pre-processing methods on raw data
- Discover interesting patterns, analyse supervised and unsupervised models and estimate the accuracy of the algorithms.

Course Outcomes:

CO1: Apply Java data structures, generics, wrapper classes, and serialization to build efficient, type-safe applications. (L3)

CO2: Explain Big Data concepts and analyze Hadoop and HDFS architecture, components, and configurations.(L4)

CO3: Design and implement Hadoop MapReduce programs to process large-scale data efficiently.(L6)

CO4: Analyze stream processing concepts and apply Apache Spark architecture and RDD operations for distributed data processing.(L4)

CO5: Develop data processing solutions using Apache Pig and Pig Latin scripts in Hadoop environments.(L3)

CO6: Create, manage, and query structured big data using Apache Hive and Hive QL for analytics.(L6)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	1	2	-	-	-	-	-	-	1
CO2	3	2	2	2	2	-	-	-	-	-	-	1
CO3	2	3	3	2	3	-	-	-	-	-	-	1
CO4	2	2	3	2	3	-	-	-	-	-	-	1
CO5	2	2	3	1	3	-	-	-	-	-	-	1
CO6	2	2	3	2	3	-	-	-	-	-	-	1

CO / PSO	PSO-1	PSO-2
CO1	3	1
CO2	1	3
CO3	1	3
CO4	1	3
CO5	1	3
CO6	1	3

UNIT–I: Data Warehousing and Online Analytical Processing: Basic concepts, Data Warehouse Modeling: Data Cube and OLAP, Data Warehouse Design and Usage, Data Warehouse Implementation, Cloud Data Warehouse, Data Mining and Patten Mining, Technologies, Applications, Major issues, Data Objects & Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity and Dissimilarity. (Text Book- 1)

UNIT II: Data Pre-processing: An Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization. (Text Book- 1)

UNIT–III: Classification: Basic Concepts, General Approach to solving a classification problem, Decision Tree Induction: Attribute Selection Measures, Tree Pruning, Scalability and Decision Tree Induction, Visual Mining for Decision Tree Induction, Bayesian Classification Methods: Bayes Theorem, Naïve Bayes Classification, Rule-Based Classification, Model Evaluation and Selection. (Text Book- 2)

UNIT–IV: Association Analysis: Problem Definition, Frequent Item set Generation, Rule Generation: Confident Based Pruning, Rule Generation in Apriori Algorithm, Compact Representation of frequent item sets, FP-Growth Algorithm. (Text Book- 2)

UNIT–V: Cluster Analysis: Overview, Basics and Importance of Cluster Analysis, Clustering techniques, Different Types of Clusters; K-means: The Basic K-means Algorithm, K-means Additional Issues, Bi-secting K Means, Agglomerative Hierarchical Clustering: Basic Agglomerative Hierarchical Clustering Algorithm DBSCAN: Traditional Density Center-Based Approach, DBSCAN Algorithm, Strengths and Weaknesses. (Text Book- 2)

Text Books:

1. Data Mining concepts and Techniques, 3rd edition, JiaweiHan, Michel Kamber, Elsevier, 2011.
2. Introduction to Data Mining: Pang-Ning Tan & Michael Steinbach, Vipin Kumar, Pearson, 2012.

Reference Books:

1. Data Mining: Vikram Pudi and P.Radha Krishna, Oxford Publisher.
2. Data Mining Techniques, Arun KPujari,3rd edition,UniversitiesPress,2013.
3. (NPTEL course by Prof. Pabitra Mitra) http://onlinecourses.nptel.ac.in/noc17_mg24/preview
4. http://www.saedsayad.com/data_mining_map.htm

III Year - I Semester	Course Code: BT24DS3101	L	T	P	C
		3	0	0	3
PRINCIPLES OF MACHINE LEARNING					

Course Objectives:

The objectives of the course is to

- Define machine learning and its different types (supervised and unsupervised) and understand their applications.
- Apply supervised learning algorithms including decision trees and k-nearest neighbours (k-NN).
- Implement unsupervised learning techniques, such as K-means clustering.

Course Outcomes: At the end of the course, student will be able to

CO1: Enumerate the Fundamentals of Machine Learning. (L1)

CO2: Build Nearest neighbor based models. (L3)

CO3: Apply Models based on decision trees and Bayes rule. (L3)

CO4: Analyze the optimality of the Bayes Classifier. (L4)

CO5: Make use of Linear discriminates for machine Learning. (L3)

CO6: Choose appropriate clustering technique. (L5)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	–	–	–	–	–	–	–	–	–	2
CO2	2	3	2	–	3	–	–	–	–	–	–	2
CO3	2	3	3	2	3	–	–	–	–	–	–	2
CO4	2	3	–	3	–	–	–	–	–	–	–	2
CO5	2	3	2	2	3	–	–	–	–	–	–	2
CO6	2	3	2	2	3	–	–	–	–	–	–	2

CO / PSO	PSO-1	PSO-2
CO1	3	1
CO2	1	3
CO3	1	3
CO4	1	3
CO5	1	3
CO6	1	3

UNIT-I: Introduction to Machine Learning: Evolution of Machine Learning, Paradigms for ML, Learning by Rote, Learning by Induction, Reinforcement Learning, Types of Data, Matching, Stages in Machine Learning, Data Acquisition, Feature Engineering, Data Representation, Model Selection, Model Learning, Model Evaluation, Model Prediction, Search and Learning, Data Sets.

UNIT-II: Nearest Neighbor-Based Models: Introduction to Proximity Measures, Distance Measures, Non-Metric Similarity Functions, Proximity Between Binary Patterns, Different Classification Algorithms Based on the Distance Measures ,K-Nearest Neighbor Classifier, Radius Distance Nearest Neighbor Algorithm, KNN Regression, Performance of Classifiers, Performance of Regression Algorithms.

UNIT-III: Models Based on Decision Trees: Decision Trees for Classification, Impurity Measures, Properties, Regression Based on Decision Trees, Bias–Variance Trade-off, Random Forests for Classification and Regression.
The Bayes Classifier: Introduction to the Bayes Classifier, Bayes' Rule and Inference, The Bayes Classifier and its Optimality, Multi-Class Classification | Class Conditional Independence and Naive Bayes Classifier (NBC)

UNIT-IV: Linear Discriminants for Machine Learning: Introduction to Linear Discriminants, Linear Discriminants for Classification, Perceptron Classifier, Perceptron Learning Algorithm, Support Vector Machines, Linearly Non-Separable Case, Non-linear SVM, Kernel Trick, Logistic Regression, Linear Regression, Multi-Layer Perceptrons (MLPs), Back propagation for Training an MLP.

UNIT-V:Clustering : Introduction to Clustering, Partitioning of Data, Matrix Factorization | Clustering of Patterns, Divisive Clustering, Agglomerative Clustering, Partitional Clustering, K-Means Clustering, Soft Partitioning, Soft Clustering, Fuzzy C-Means Clustering, Rough Clustering, Rough K-Means Clustering Algorithm, Expectation Maximization-Based Clustering, Spectral Clustering.

Text Books:

1. "Machine Learning Theory and Practice", M N Murthy,V S Ananthanarayana, Universities Press(India),2024.

Reference Books:

1. "Machine Learning",TomM. Mitchell, McGraw – Hill Publication, 2017
2. "Machine Learningin Action", Peter Harrington, Dream Tech
3. "Introduction to Data Mining", Pang-Ning Tan, Michel Stenbach, Vipin Kumar, 7th Edition, 2019.

III Year - I Semester	Course Code: BT24DS3102	L	T	P	C
		3	0	0	3
DATA VISUALIZATION					

Pre - Requisites: Computer Graphics, Image Processing

Course Objective:

- Familiarize students with the basic and advanced techniques of information visualization and scientific visualization
- Learn key techniques of the visualization process
- a detailed view of visual perception, the visualized data and the actual visualization, interaction and distorting techniques.

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

CO1: Explain visualization concepts, visual perception, and design principles for effective data representation. (L2)
CO2: Apply visualization reference models and visual mapping techniques to design visualization applications. (L3)
CO3: Analyze and classify visualization systems and apply interaction techniques for multidimensional data. (L4)
CO4: Visualize complex data structures such as trees, graphs, clusters, networks, and software systems. (L3)
CO5: Apply visualization techniques for volumetric, spatial, geographic, and simulation-based data. (L3)
CO6: Evaluate visualization effectiveness, address information overload, and explore recent trends and collaborative visualization techniques. (L5)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	–	1	–	–	–	–	2	–	2
CO2	2	2	3	–	3	–	–	–	–	2	–	2
CO3	2	3	2	2	3	–	–	–	–	2	–	2
CO4	2	3	3	2	3	–	–	–	–	1	–	2
CO5	2	3	3	3	3	–	–	–	–	1	–	2
CO6	2	2	2	2	2	–	–	1	2	3	–	3

CO / PSO	PSO-1	PSO-2
CO1	1	1
CO2	2	2
CO3	2	1
CO4	2	2
CO5	3	1
CO6	2	3

UNIT-1: Introduction: What Is Visualization?, History of Visualization, Relationship between Visualization and Other Fields. The Visualization Process, Introduction of visual perception, visual representation of data, Gestalt principles, information overloads.

UNIT-2: Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications

UNIT-3: Classification of visualization systems, Interaction and visualization techniques misleading, Visualization of one, two and multi-dimensional data, text and text documents.

UNIT-4: Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization

UNIT-5: Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GIS systems, collaborative visualizations, Evaluating visualizations

Recent trends in various perception techniques, various visualization techniques, data structures used in data visualization.

TEXT BOOK:

1. WARD, GRINSTEIN, KEIM. Interactive Data Visualization: Foundations, Techniques, and Applications. Natick : A K Peters, Ltd.
2. E. Tufte, The Visual Display of Quantitative Information, Graphics Press.

Resources:

1. https://kdd.cs.ksu.edu/Courses/CIS536/Lectures/Slides/Lecture-34-Main_6up.pdf

III Year - I Semester	Course Code: BT24DS31P1A	L	T	P	C
		3	0	0	3
OBJECT ORIENTED ANALYSIS AND DESIGN					

Course Objectives: The main objective is the students to

- Become familiar with all phases of OOAD.
- Master the main features of the UML.
- Master the main concepts of Object Technologies and how to apply them at work and develop the ability to analyze and solve challenging problem in various domains.
- Learn the Object design Principles and understand how to apply them towards Implementation.

Course Outcomes:

CO1: Explain the structure and complexity of software systems, including organized and disorganized complexity. (L2)

CO2: Explain modeling concepts, UML, and object-oriented principles in the software development life cycle. (L2)

CO3: Apply structural UML modeling techniques to create class and object diagrams. (L3)

CO4: Develop behavioral UML models using use case, interaction, and activity diagrams. (L3)

CO5: Analyze system behavior using state chart diagrams with events and processes. (L4)

CO6: Design and evaluate system architectures using component and deployment diagrams. (L6)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	–	–	–	–	–	–	–	–	–
CO2	2	2	2	–	1	–	–	–	–	–	–	–
CO3	2	3	3	–	2	–	–	–	–	–	–	–
CO4	2	3	3	–	2	–	–	–	1	–	–	–
CO5	2	3	2	2	2	–	–	–	–	–	–	–
CO6	2	3	3	2	3	–	–	–	1	–	2	–

CO / PSO	PSO-1	PSO-2
CO1	2	2
CO2	2	2
CO3	1	2
CO4	2	2
CO5	3	1
CO6	2	2

UNIT I: Introduction: The Structure of Complex systems, The Inherent Complexity of Software, Attributes of Complex System, Organized and Disorganized Complexity, Bringing Order to Chaos, Designing Complex Systems. **Case Study:** System Architecture: Satellite-Based Navigation

UNIT II: Introduction to UML: Importance of modeling, principles of modeling, object oriented modeling, conceptual model of the UML, Architecture, and Software Development Life Cycle.

Basic Structural Modeling: Classes, Relationships, common Mechanisms, and diagrams.

Case Study: Control System: Traffic Management.

UNIT III: **Class & Object Diagrams:** Terms, concepts, modelling techniques for Class & Object Diagrams. **Advanced Structural Modeling:** Advanced classes, advanced relationships, Interfaces, Types and Roles, Packages. **Case Study:** AI: Cryptanalysis.

UNIT IV: Basic Behavioral Modeling-I: Interactions, Interaction diagrams Use cases, Use case Diagrams, Activity Diagrams. **Case Study:** Web Application: Vacation Tracking System

UNIT V: Advanced Behavioral Modeling: Events and signals, state machines, processes and Threads, time and space, state chart diagrams. **Architectural Modeling:** Component, Deployment, Component diagrams and Deployment diagrams **Case Study:** Weather Forecasting.

Text Books:

1. Grady BOOCH, Robert A.Maksimchuk, Michael W.ENGLE, BobbiJ.Young,Jim Conallen, Kellia Houston , “Object- Oriented Analysis and Design with Applications”, 3rd edition,2013,PEARSON.
2. Grady Booch, James Rumbaugh, IvarJacobson: The Unified Modeling Language User Guide, Pearson Education.

Reference Books:

1. Meilir Page-Jones: Fundamentals of Object Oriented Design in UML, Pearson Education.
2. Pascal Roques: Modeling Software Systems Using UML2, WILEY-Dreamtech India Pvt.Ltd.
3. Atul Kahate: Object Oriented Analysis & Design, The McGraw-Hill Companies.
4. Appling UML and Patterns: An introduction to Object–Oriented Analysis and Design and Unified Process, Craig Larman, Pearson Education.

III Year - I Semester	Course Code: BT24DS31P1B	L	T	P	C
		3	0	0	3
SOFT COMPUTING					

Course Objectives:

1. To introduce the concepts in Soft Computing such as Artificial Neural Networks, Fuzzy logic-based systems, genetic algorithm-based systems and their hybrids.

Course Outcomes: The Students will be able to

CO1: Learn soft computing techniques and their applications. (L2)

CO2: Analyze various neural network architectures. (L3)

CO3: Define the fuzzy systems. (L1)

CO4: Apply rank ordering techniques and λ-cuts (Lambda-cuts) to analyze and manipulate fuzzy sets. (L3)

CO5: Understand the genetic algorithm concepts and their applications. (L2)

CO6: Identify and select a suitable Soft Computing technology to solve the problem; construct a solution and implement a Soft Computing solution. (L6)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	-	2	-	-	-	-	-	-	-
CO2	2	3	2	-	2	-	-	-	-	-	-	-
CO3	2	1	-	-	-	-	-	-	-	-	-	-
CO4	2	3	2	-	2	-	-	-	-	-	-	-
CO5	2	1	-	-	2	-	-	-	-	-	-	-
CO6	2	3	3	2	3	-	-	-	1	-	2	2

CO / PSO	PSO-1	PSO-2
CO1	2	1
CO2	3	1
CO3	3	2
CO4	2	2
CO5	2	2
CO6	2	2

UNIT-I: Introduction to Soft Computing, Artificial neural networks, biological neurons, Basic models of artificial neural networks, Connections, Learning, Activation Functions, McCulloch and Pitts Neuron, Hebb network.

UNIT-II: Perceptron networks, Learning rule, Training and testing algorithm, Adaptive Linear Neuron, Back propagation Network, Architecture, Training algorithm

UNIT-III: Fuzzy logic, fuzzy sets, properties, operations on fuzzy sets, fuzzy relations, operations on fuzzy relations, Fuzzy membership functions, fuzzification, Methods of membership, value assignments, intuition, inference, rank ordering, Lambda –Cuts for fuzzy sets , Defuzzification methods

UNIT-IV: Truth values and Tables in Fuzzy Logic, Fuzzy propositions, Formation of fuzzy rules, Decomposition of rules, Aggregation of rules, Fuzzy Inference Systems, Mamdani and Sugeno types, Neuro-fuzzy hybrid systems, characteristics, classification

UNIT-V: Introduction to genetic algorithm, operators in genetic algorithm, coding, selection, crossover, mutation, stopping condition for genetic algorithm flow, Genetic-neuro hybrid systems, Genetic Fuzzy rule based system

Text Books:

1. S. N. Sivanandam and S. N. Deepa, Principles of soft computing John Wiley & Sons,2007.
2. Timothy J. Ross, Fuzzy Logic with engineering applications, John Wiley & Sons, 2016.

Reference Books:

1. N.K. Sinhaand M.M. Gupta, Soft Computing & Intelligent Systems: Theory & Applications - Academic Press /Elsevier. 2009.
2. Simon Haykin, Neural Network – A Comprehensive Foundation-Prentice Hall International, Inc.1998.
3. R. Eberhart and Y. Shi, Computational Intelligence: Concepts to Implementation, Morgan Kaufman/Elsevier, 2007.
4. Driankov D.,Hellendoorn H. and Reinfrank M., An Introduction to Fuzzy Control Narosa Pub., 2001.
5. BartKosko, Neural Network and Fuzzy Systems-Prentice Hall,Inc., Englewood Cliffs, 1992.
6. Goldberg D.E, Genetic Algorithms in Search, Optimization, and Machine Learning Addison Wesley, 1989.

III Year - I Semester	Course Code: BT24DS31P1C	L	T	P	C
		3	0	0	3
INTERNET OF THINGS					

Course Objectives:

- Vision and Introduction to Internet of Things (IoT).
- Understand IoT Market perspective.
- Data and Knowledge Management and use of Devices in IoT Technology.
- Understand State of the Art –IoT Architecture.
- Understand Real World IoT Design Constraints, Industrial Automation and Commercial.

Course Outcomes (COs): At the end of the course, student will be able to

CO1: Understand the fundamentals, architecture, and communication principles of Internet of Things systems. (L2)

CO2: Explain IoT/M2M system layers, standards, business models, and device management mechanisms. (L2)

CO3: Analyze web and message-based communication protocols for connected IoT devices. (L4)

CO4: Apply data acquisition, organization, and analytics techniques in IoT/M2M applications. (L3)

CO5: Use cloud platforms and service models for IoT data collection, storage, and computation. (L3)

CO6: Identify sensing technologies including sensors, RFID, wireless sensor networks, and actuators. (L2)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1	-	-	-	-	-	-	2
CO2	3	3	2	2	2	1	-	-	-	-	2	2
CO3	3	3	2	2	2	-	-	-	-	-	-	2
CO4	3	3	3	2	3	-	-	-	-	-	-	2
CO5	3	3	3	2	3	-	-	-	2	1	2	3
CO6	3	2	2	1	2	1	2	-	-	-	-	2

CO / PSO	PSO-1	PSO-2
CO1	2	1
CO2	2	1
CO3	2	1
CO4	3	2
CO5	3	3
CO6	2	1

UNIT I: The Internet of Things: An Overview of Internet of things, Internet of Things Technology, behind IoTs Sources of the IoTs, M2M Communication, Examples of IoTs, Design Principles For Connected Devices Internet Connectivity Principles, Internet connectivity, Application Layer Protocols: HTTP, HTTPS, FTP, Telnet.

UNIT II: Business Models for Business Processes in the Internet of Things, IoT/M2M systems LAYERS AND designs standardizations, Modified OSI Stack for the IoT/M2M Systems, ETSI M2M domains and High- level capabilities ,Communication Technologies, Data Enrichment and Consolidation and Device Management Gate way Ease of designing and affordability

UNIT III: Design Principles for the Web Connectivity for Connected-Devices, Web Communication protocols for Connected Devices, Message Communication protocols for Connected Devices, Web Connectivity for Connected-Devices.

UNIT IV: Data Acquiring, Organizing and Analytics in IoT/M2M, Applications/Services /Business Processes, IOT/M2M Data Acquiring and Storage, Business Models for Business Processes in the Internet Of Things, Organizing Data, Transactions, Business Processes, Integration and Enterprise Systems.

UNIT V: Data Collection, Storage and Computing Using a Cloud Platform for IoT/M2M Applications/Services, Data Collection, Storage and Computing Using cloud platform Everything as a service and Cloud Service Models, IOT cloud-based services using the Xively (Pachube/COSM), Nimbits and other platforms Sensor, Participatory Sensing, Actuator, Radio Frequency Identification, and Wireless, Sensor Network Technology, Sensors Technology, Sensing the World.

Text Books:

1. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education
2. Internet of Things, A. Bahgya and V. Madisetti, Univesity Press, 2015

Reference Books:

1. Designing the Internet of Things, Adrian McEwen and Hakim Cassimally, Wiley
2. Getting Started with the Internet of Things, CunoPfister, Oreilly

III Year - I Semester	Course Code: BT24DS31P1D	L	T	P	C
		3	0	0	3
EXPLORATORY DATA ANALYSIS WITH PYTHON					

Course Objectives: The main objectives of the course are to

- Introduce the fundamentals of Exploratory Data Analysis
- Cover essential exploratory techniques for understanding multivariate data by
- Summarizing it through statistical methods and graphical methods.
- Evaluate the Models and select the best model

Course Outcomes (COs): After completion of course, students would be able to

CO1: Understand the fundamentals, process, and tools of Exploratory Data Analysis for data-driven decision making. (L2)

CO2: Apply data visualization techniques to explore patterns, trends, and relationships in datasets. (L3)

CO3: Perform data transformation, cleaning, and preprocessing to prepare datasets for analysis.(L3)

CO4: Analyze datasets using descriptive statistics, probability distributions, and time series techniques. (L4)

CO5: Develop and evaluate machine learning models using appropriate performance metrics. (L6)

CO6: Conduct end-to-end data analysis using EDA and model evaluation on real-world datasets. (L4)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	-	-	-	-	-	-	2
CO2	3	3	2	2	2	-	-	-	-	-	-	2
CO3	3	3	2	2	2	-	-	-	-	-	-	2
CO4	3	3	2	3	2	-	-	-	-	-	-	2
CO5	3	3	2	2	2	-	-	-	-	-	-	2
CO6	3	3	3	2	3	-	-	-	2	1	-	3

CO / PSO	PSO-1	PSO-2
CO1	2	1
CO2	2	1
CO3	3	2
CO4	3	2
CO5	3	3
CO6	3	3

UNIT-I: Exploratory Data Analysis Fundamentals: Understanding data science, The significance of EDA, Steps in EDA, Making sense of data, Numerical data, Categorical data, Measurement scales, Comparing EDA with classical and Bayesian analysis, Software tools available for EDA, Getting started with EDA.

Sample Experiments:

1. a) Download Dataset from Kaggle using the following link: https://www.kaggle.com/datasets/sukhmanibedi/cars4u
   b) Install python libraries required for Exploratory Data Analysis (numpy, pandas, matplotlib, seaborn)
2. Perform Numpy Array basic operations and Explore Numpy Built-in functions.
3. Loading Dataset into pandas data frame
4. Selecting rows and columns in the data frame

UNIT-II: Visual Aids for EDA: Technical requirements, Line chart, Bar charts, Scatter plot using seaborn, Polar chart, Histogram, Choosing the best chart
Case Study: EDA with Personal Email, Technical requirements, Loading the dataset, Data transformation, Data cleansing, Applying descriptive statistics, Data refactoring, Data analysis.

Sample Experiments:

1. Apply different visualization techniques using sample dataset
   a. Line Chart b. Bar Chart c. Scatter Plots d. Bubble Plot
2. Generate Scatter Plot using sea born library foriris dataset
3. Apply following visualization Techniques for a sample dataset
   a. Area Plot b. Stacked Plot c. Pie chart d. Table Chart
4. Generate the following charts for a dataset.
   a. Polar Chart b. Histogram c. Lollipop chart
5. Case Study: Perform Exploratory Data Analysis with Personal Email Data

UNIT-III: Data Transformation: Merging database – style dataframes, Concatenating along with an axis, Merging on index, Reshaping and pivoting, Transformation techniques, Handling missing data, Mathematical operations with NaN, Filling missing values, Discretization and

binning, Outlier detection and filtering, Permutation and random sampling, Benefits of data transformation, Challenges.

Sample Experiments:

1. Perform the following operations
    a) Merging Data frames b) Reshaping with Hierarchical Indexing
    b) Data Deduplication d) Replacing Values
2. Apply different Missing Data handling techniques
    a) NaN values in mathematical Operations b) Filling in missing data
    c) Forward and Backward filling of missing values d) Filling with index values
    e) Interpolation of missing values
3. Apply different data transformation techniques
    a) Renaming axis indexes b) Discretization and Binning
    b) Permutation and Random Sampling d) Dummy variables

UNIT-IV: Descriptive Statistics: Distribution function, Measures of central tendency, Measures of dispersion, Types of kurtosis, Calculating percentiles, Quartiles, Grouping Datasets, Correlation, Understanding univariate, bivariate, multivariate analysis, Time Series Analysis

Sample Experiments:

1. Study the following Distribution Techniques on a sample data
    a) Uniform Distribution b) Normal Distribution
    c) Gamma Distribution d) Exponential Distribution
    e) Poisson Distribution f) Binomial Distribution
2. Perform Data Cleaning on a sample dataset.
3. Compute measure of Central Tendency on a sample dataset
    a) Mean b) Median c) Mode
4. Explore Measures of Dispersion on a sample dataset
    a) Variance b) Standard Deviation c) Skewness d) Kurtosis
5. a) Calculating percentiles on sample dataset
    c) Calculate Inter Quartile Range(IQR) and Visualize using Box Plots
6. Perform the following analysis on automobile dataset.
    a) Bivariate analysis b) Multivariate analysis
7. Perform Time Series Analysis on Open Power systems dataset

UNIT-V: Model Development and Evaluation: Unified machine learning workflow, Data pre-processing, Data preparation, Training sets and corpus creation, Model creation and training, Model evaluation, Best model selection and evaluation, Model deployment

Case Study: EDA on Wine Quality Data Analysis

Sample Experiments:

1. Perform hypothesis testing using stats models library

    a) Z-Test b) T-Test

2. Develop model and Perform Model Evaluation using different metrics such as prediction score, R2 Score, MAE Score, MSE Score.

3. Case Study: Perform Exploratory Data Analysis with Wine Quality Dataset

Text Book:

1. Suresh Kumar Mukhiya,Usman Ahmed, Hands – On Exploratory Data Analysis with Python, Packt Publishing, 2020.

Reference Books:

1. .Pearson, Exploratory Data Analysis UsingR, CRC Press, 2020
2. Radhika Datar, Harish Garg, Hands-On Exploratory Data Analysis with R: Become an expert in exploratory data analysis using R packages, 1st Edition,PacktPublishing,2019

Web References:

1. https://github.com/PacktPublishing/Hands-on-Exploratory-Data-Analysis-with-Python
2. https://www.analyticsvidhya.com/blog/2022/07/step-by-step-exploratory-dataanalysis-eda-using-python/#h-conclusion
3. https://github.com/PacktPublishing/Exploratory-Data-Analysis-with-Python-Cookbook

III Year - I Semester	Course Code: BT24DS3103	L	T	P	C
		0	0	3	1.5
DATA WARE HOUSING AND MACHINE LEARNING LAB					

Course Objectives: The main objective of the course is to

- Inculcate Conceptual, Logical, and Physical design of Data Warehouses OLAP applications and OLAP deployment
- Design a data warehouse or data mart to present information needed by management in a form that is usable
- Emphasize hands – on experience working with all real data sets.
- Test real datasets using popular data mining tools such as WEKA, Python Libraries
- Develop ability to design various algorithms based on data mining tools.

Course Outcomes:

CO1: Design and implement data warehouses/data marts using multidimensional schemas and ETL processes. (L6)

CO2: Use data mining and machine learning tools (WEKA/R) to load, visualize, and analyze datasets. (L3)

CO3: Apply and analyze data preprocessing and association rule mining techniques to discover useful patterns. (L3)

CO4: Implement and evaluate classification algorithms using WEKA/R/Python and interpret performance metrics. (L5)

CO5: Apply and analyze clustering techniques using WEKA/R/Python and interpret results through visualization. (L3)

CO6: Develop data mining and machine learning programs using Java, Python, and R for analysis and visualization. (L6)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	3	-	-	-	-	-	-	-
CO2	2	1	-	-	3	-	-	-	-	-	-	-
CO3	2	3	2	2	3	-	-	-	-	-	-	-
CO4	2	3	2	2	3	-	-	-	-	-	-	-
CO5	2	3	-	2	3	-	-	-	-	-	-	-
CO6	3	3	3	2	3	-	-	-	1	-	2	2

CO / PSO	PSO-1	PSO-2
CO1	2	1
CO2	2	2
CO3	1	2
CO4	3	2
CO5	2	2
CO6	2	2

Software Requirements: WEKA Tool/ Python/ R-Tool/ Rapid Tool/ Oracle Data mining

List of Experiments:

1. Creation of a Data Warehouse.

- Build Data Warehouse/Data Mart (using open source tools like Pentaho Data Integration Tool, Pentaho Business Analytics; or other data warehouse tools like Microsoft-SSIS, Informatica, Business Objects, etc.,)
- Design multi-dimensional data models namely Star, Snow flake and Fact Constellation schemas for any one enterprise (ex. Banking, Insurance, Finance, Healthcare, manufacturing, Automobiles, sales etc).
- Write ETL scripts and implement using data ware house tools.
- Perform Various OLAP operations such slice, dice, rollup, drill up and pivot.

2. Explore machine learning tool "WEKA"

- Explore WEKA Data Mining/ Machine Learning Toolkit.
- Downloading and/ or installation of WEKA data mining tool kit.
- Understand the features of WEKA tool kit such as Explorer, Knowledge Flow interface, Experimenter, command-line interface.
- Navigate the options available in the WEKA (ex. Select attributes panel, Preprocess panel, Classify panel, Cluster panel, Associate panel and Visualize panel)
- StudythearfffileformatExploretheavailabledatasetsinWEKA.Loadadataset (ex. Weather dataset, Iris dataset, etc.)
- Load each dataset and observe the following:

  1. List the attribute names and they types
  2. Number of records in each dataset
  3. Identify the class attribute(if any)
  4. Plot Histogram

5. Determine the number of records for each class.
6. Visualize the data in various dimensions

3. Perform data preprocessing tasks and Demonstrate performing association rule mining on datasets
   - Explore various options available in Weka for preprocessing data and apply Unsupervised filters like Discretization, Resample filter, etc. on each dataset
   - Load weather nominal, Iris, Glass datasets in to Weka an drun Apriori Algorithm with different support and confidence values.
   - Study the rules generated. Apply different discretization filters on numerical attributes and run the Apriori association rule algorithm. Study the rules generated.
   - Deriveinterestinginsightsandobservetheeffectofdiscretizationintherule generation process.

4. Demonstrate performing classification on datasets Weka/R
   - Load each dataset and run1d3, J48 classification algorithm. Study the classifier output. Compute entropy values, Kappa statistic.
   - Extract if – then rules from the decision tree generated by the classifier, Observe the confusion matrix.
   - Load each dataset into Weka/R and perform Naïve-bayes classification and k-Nearest Neighbour classification. Interpret the results obtained.
   - Plot RoC Curves
   - Compare classification results of ID3, J48, Naïve-Bayes and k-NN classifiers for each dataset, and deduce which classifier is performing best and poor for each dataset and justify.

5. Demonstrate performing clustering of datasets
   - Load each dataset intoWeka/Rand run simple k-means clustering algorithm with different values of k (number of desired clusters).
   - Study the clusters formed. Observe the sum of squared errors and centroids, and derive insights.
   - Explore other clustering techniques available in Weka/R.
   - Explore visualization features of Weka/R to visualize the clusters. Derive interesting insights and explain.

6. Demonstrate knowledge flow application on datasets into Weka/R
   - Develop a knowledge flow layout for finding strong association rules by using Apriori, FP Growth algorithms.

- Set up the knowledge flow to load an ARFF (batch mode) and perform across validation using J48 algorithm
- Demonstrate plotting multiple ROC curves in the same plot window by using j48 and Random forest tree

7. Demonstrate Zero R technique on Iris dataset (by using necessary preprocessing technique(s)) and share your observations
8. Write a java program to prepare a simulated data set with unique instances.
9. Write a Python program to generate frequent item sets/association rules using Apriori algorithm
10. Write a program to calculate chi-square value using Python /R. Report your observation.
11. Write a program of Naïve Bayesian classification using Python/R programming language.
12. Implement a Java/R program to perform Apriori algorithm
13. Write a R program to cluster your choice of data using simple k-means algorithm using JDK
14. Write a program of cluster analysis using simple k-means algorithm Python/R programming language.
15. Write a program to compute/display dissimilarity matrix (for your own dataset containing at least four instances with two attributes) using Python
16. Visualize the datasets using matplotlib in python/R.(Histogram, Box plot, Bar chart, Pie chart etc.,)

III Year - I Semester	Course Code: BT24DS3104	L	T	P	C
		0	0	3	1.5
DATA VISUALIZATION LAB					

Course Objectives:

- To visualize the different data sets using histograms, line charts.
- To understand the use of bar charts and box plots.
- To understand Scatter plots, mosaic plots
- To understand different Map visualizations
- To learn advanced graphs such as correlogram, heat map and 3D graphs.

Course Outcomes: At the end of the course student will be able to

CO1: Load and explore datasets in R to understand data structure and types. (L2)

CO2: Apply basic visualization techniques such as histograms, line charts, and bar charts to represent data. (L3)

CO3: Use advanced visualizations like box plots, scatter plots, and scatter plot matrices for multivariate data analysis. (L3)

CO4: Implement visualizations for large datasets using hex bin plots, heat maps, and correlograms. (L3)

CO5: Create interactive map visualizations using R libraries like leaflet and maps. (L6)

CO6: Apply 3D visualization techniques for better understanding of complex datasets. (L3)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	–	–	1	1	1	–	2
CO2	3	2	2	2	2	–	–	1	1	1	–	2
CO3	3	2	2	2	2	–	–	2	1	2	–	2
CO4	3	2	2	2	2	–	–	2	2	2	–	2
CO5	3	2	2	2	2	–	–	2	2	2	–	2
CO6	3	2	2	2	2	–	–	2	2	2	–	2

CO / PSO	PSO-1	PSO-2
CO1	3	1
CO2	3	1
CO3	3	2
CO4	3	2
CO5	3	2
CO6	3	2

List of Experiments:

1. a) Load VA Deaths (Death Rates in Virginia) dataset in R and visualize the data using different histograms.
   b) Load air quality dataset in R and visualize LaGuardia Airport's dialy maximum temperature using histogram.
2. Load Air Passengers dataset in R and visualize the data using line chart that shows increase in air passengers over given time period.
3. a) Load iris dataset in R, visualize the data using different Bar Charts and also demonstrate the use of stacked plots.
   b)Load air quality dataset in R and visualize ozone concentration in air.
4. a) Load iris dataset in R, visualize the data using different Box plots including group by option and also use color palette to represent species.
   b) Load air quality dataset in R and visualize air quality parameters using box plots.
5. Visualize iris dataset using simple scatter, multivariate scatter plot and also visualize scatter plot matrix to visualize multiple variables across each other.
6. Load diamonds dataset in R and visualize the structure in datasets with large data points using hexagon binning and also add color palette then use the
7. Load Hair Eye Color dataset in R and plot categorical data using mosaic plot.
8. Load mtcars dataset in R and visualize data using heat map.
9. Install leaf let library in R and perform different map visualizations.
10. Visualize iris dataset using 3d graphs such as scatter 3d, cloud, xyplot.
11. Make use of correlogram to visualize data in correlation matrices for iris dataset.
12. Install maps library in R and draw different map visualizations.

Web References:

1. https://www.analyticsvidhya.com/blog/2015/07/guide-data-visualization-r/
2. https://www.geeksforgeeks.org/data-visualization-in-r/

III Year - I Semester	Course Code: BT24DS3105	L	T	P	C
		0	1	2	2
FULL STACK DEVELOPMENT-2					

Course Objectives:
The main objectives of the course are to

- Make use of router, template engine and authentication using sessions to develop application in Express JS.
- Build a single page application using REST ful API sin Express JS.
- Apply router and hooks in designing React JS application.
- Make use of Mongo DB queries to perform CRUD operations on document database.

Course Outcomes: On completion of this course, the student will be able to

CO1: Apply Type Script features such as types, classes, generics, modules, and functions to develop structured applications. (L3)

CO2: Develop backend applications using Express JS with routing, middleware, authentication, and session management.(L6)

CO3: Build RESTful APIs and perform CRUD operations using Mongo DB and Mongoose.(L6)

CO4: Design dynamic and interactive user interfaces using React components, props, state, hooks, and routing.(L6)

CO5: Integrate frontend and backend to develop full-stack web applications following MVC and REST principles.(L5)

CO6: Work collaboratively to design, deploy, and document real-world web applications using modern development practices.(L4)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	–	3	–	–	–	–	–	–	2
CO2	3	2	3	–	3	–	–	2	2	–	–	2
CO3	3	3	3	2	3	–	–	2	–	–	–	2
CO4	2	2	3	–	3	–	–	–	2	2	–	2
CO5	3	3	3	2	3	–	–	2	2	2	2	2
CO6	2	–	2	–	2	2	–	3	3	3	2	3

CO / PSO	PSO-1	PSO-2
CO1	2	1
CO2	3	1
CO3	3	2
CO4	3	2
CO5	2	1
CO6	3	3

List of Experiments:

Experiment 1: Express JS – Routing, HTTP Methods, Middleware.

a. Write a program to define a route, Handling Routes, Route Parameters, Query Parameters and URL building.

b. Write a program to accept data, retrieve data and delete a specified resource using http methods.

c. Write a program to show the working of middleware.

Experiment 2: Express JS – Templating, Form Data

a. Write a program using templating engine.

b. Write a program to work with form data.

Experiment 3: Express JS – Cookies, Sessions, Authentication

a. Write a program for session management using cookies and sessions.

b. Write a program for user authentication.

Experiment 4: Express JS – Database, REST ful APIs

a. Write a program to connect MongoDB database using Mangoose and perform CRUD operations.

b. Write a program to develop a single page application using REST ful APIs.

Experiment 5: ReactJS – Render HTML, JSX, Components – function & Class

a. Write a program to render HTML to a web page.

b. Write a program for writing markup with JSX.

c. Write a program for creating and nesting components (function and class).

Experiment 6: ReactJS – Props and States, Styles, Respond to Events

a. Write a program to work with props and states.
b. Write a program to add styles(CSS & Sass Styling) and display data.
c. Write a program for responding to events.

Experiment 7: ReactJS – Conditional Rendering, Rendering Lists, React Forms

a. Write a program for conditional rendering.
b. Write a program for rendering lists.
c. Write a program for working with different form fields usingreact forms.

Experiment 8: ReactJS – React Router, Updating the Screen

a. Write a program for routing to different pages using react router.
b. Write a program for updating the screen.

Experiment 9: ReactJS – Hooks, Sharing data between Components

a. Write a program to understand the importance of using hooks.
b. Write a program for sharing data between components.

Experiment 10: ReactJS Applications – To – do list and Quiz

a. Design to – do list application

Experiment 11: MongoDB – Installation, Configuration, CRUD operations

a. Install MongoDB and configure ATLAS
b. Write MongoDB queries to perform CRUD operations on document using insert(), find(), update(), remove()

Experiment 12: MongoDB – Databases, Collections and Records

a. Write MongoDB queries to Create and drop databases and collections.

b. Write MongoDB queries to work with records using find(), limit(), sort(), createIndex(), aggregate().

Experiment 13: Augmented Programs : (Any 2 must be completed)

13. Design a to – do list application using Node JS and Express JS.
14. Design a Quiz app using ReactJS.
15. Complete the MongoDB certification from MongoDB University website.

Text Books:

1. Programming the World Wide Web,7th Edition, Robet WSebesta, Pearson, 2013.
2. Pro MERN Stack : Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, 2nd edition, APress, O'Reilly.

Web Links

1. ExpressJS - https://www.tutorialspoint.com/expressjs
2. ReactJS - https://www.w3schools.com/REACT (and) https://react.dev/learn#
3. MongoDB - https://learn.mongodb.com/learning-paths/introduction-to-mongodb

III Year - I Semester	Course Code: BT24DS3106	L	T	P	C
		0	0	2	1
TINKERING LAB (USER INTERFACE DESIGN USING FLUTTER)					

Course Objectives:

- Learns to Implement Flutter Widgets and Layouts
- Understands Responsive UI Design and with Navigation in Flutter
- Knowledge on Widgets and customize widgets for specific UI elements, Themes
- Understand to include animation apart from fetching data.

Course Outcomes: On completion of this course, the student will be able to

CO1: Understand Dart programming fundamentals and set up the Flutter development environment.(L2)
CO2: Design user interfaces using Flutter widgets, layouts, and responsive design principles.(L6)
CO3: Implement navigation, state management, and reusable custom widgets in Flutter applications.(L3)
CO4: Develop interactive forms, apply validation techniques, and enhance UI using themes and animations.(L6)
CO5: Integrate REST APIs, fetch and display dynamic data, and handle asynchronous operations.(L5)
CO6: Apply testing, debugging, teamwork, and ethical development practices to deliver robust mobile applications.(L3)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	–	–	3	–	–	–	–	–	–	2
CO2	2	2	3	–	3	–	–	–	–	–	–	2
CO3	2	2	3	–	3	–	–	–	2	–	–	2
CO4	2	2	3	–	3	–	–	1	–	–	–	2
CO5	3	3	3	2	3	–	–	–	–	–	–	2
CO6	2	–	2	–	2	2	–	3	3	2	2	3

CO / PSO	PSO-1	PSO-2
CO1	1	1
CO2	1	1
CO3	2	2
CO4	1	2
CO5	3	1
CO6	2	3

List of Experiments: Students need to implement the following experiments

1. a) Install Flutter and Dart SDK.
   b) Write a simple Dart program to understand the language basics.
2. a) Explore various Flutter widgets (Text, Image, Container, etc.).
   b) Implement different layout structures using Row, Column, and Stack widgets.
3. a) Design a responsive UI that adapts to different screen sizes.
   b) Implement media queries and breakpoints for responsiveness.
4. a) Setup navigation between different screens using Navigator.
   b) Implement navigation with named routes.
5. a) Learn about stateful and stateless widgets.
   b) Implement state management using set State and Provider.
6. a) Create custom widgets for specific UI elements.
   b) Apply styling using themes and custom styles.
7. a) Design a form with various input fields.
   b) Implement form validation and error handling.
8. a) Add animations to UI elements using Flutter's animation frame work.
   b) Experiment with different types of animations(fade,slide,etc.).
9. a) Fetch data from a REST API.
   b) Display the fetched data in a meaning fulway in the UI.
10. a) Write unit tests for UI components.
    b) Use Flutter's debugging tools to identify and fix issues.

Text Book:

1. MarcoL. Napoli, Beginning Flutter : A Hands – on Guide to AppDevelopment.
2. Rap Payne, Beginning App Development with Flutter : Create Cross – Platform Mobile
3. Apps 1st Edition, Apres.

III Year - II Semester	Course Code: BT24DS3201	L	T	P	C
		3	0	0	3
BIG DATA ANALYTICS					

Course Objectives:

- Optimize business decisions and create competitive advantage with Big Data analytics
- Introducing Java concepts required for developing map reduce programs
- Derive business benefit from unstructured data
- Imparting the architectural concepts of Hadoop and introducing map reduce paradigm
- To introduce programming tools PIG & HIVE in Hadoop ecosystem.

Course Outcomes:

At the end of the course students will be able to

CO1: Apply Java data structures and core features to develop efficient applications. (L3)

CO2: Explain Big Data concepts and analyze Hadoop and HDFS architecture and components.(L2)

CO3: Design and implement Hadoop MapReduce programs to process large datasets.(L6)

CO4: Analyze stream processing concepts and apply Apache Spark for distributed data processing.(L4)

CO5: Develop data processing applications using Apache Pig and Pig Latin.(L6)

CO6: Create and query structured big data using Apache Hive and HiveQL.(L6)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	1	2	-	-	-	-	-	-	1
CO2	3	2	2	2	2	-	-	-	-	-	-	1
CO3	2	3	3	2	3	-	-	-	-	-	-	1
CO4	2	2	3	2	3	-	-	-	-	-	-	1
CO5	2	2	3	1	3	-	-	-	-	-	-	1
CO6	2	2	3	2	3	-	-	-	-	-	-	1

CO / PSO	PSO-1	PSO-2
CO1	3	1
CO2	1	3
CO3	1	3
CO4	1	3
CO5	1	3
CO6	1	3

UNIT-I: Data structures in Java: Linked List, Stacks, Queues, Sets, Maps; Generics: Generic classes and Type parameters, Implementing Generic Types, Generic Methods, Wrapper Classes, Concept of Serialization

UNIT-II: Working with Big Data : Google File System, Hadoop Distributed File System (HDFS) Building blocks of Hadoop (Namenode, Datanode, Secondary Namenode, Job Tracker, Task Tracker), Introducing and Configuring Hadoop cluster (Local, Pseudo-distributed mode, Fully Distributed mode), Configuring XML files.

UNIT-III: Writing Map Reduce Programs : A Weather Dataset, Understanding Hadoop API for Map Reduce Framework (Old and New), Basic programs of Hadoop Map Reduce: Driver code, Mapper code, Reducer code, Record Reader, Combiner, Practitioner

UNIT-IV: Stream Memory and Spark: Introduction to Streams Concepts– Stream Data Model and Architecture, Stream computing, Sampling Data in a Stream, Filtering Streams , Counting Distinct Elements in a Stream , Introduction to Spark Concept ,Spark Architecture and components , Spark installation , Spark RDD(Resilient Distributed Dataset) – Spark RDD operations.

UNIT-V: **Pig:** Hadoop Programming Made Easier Admiring the Pig Architecture, Going with the Pig Latin Application Flow, Working through the ABCs of Pig Latin, Evaluating Local and Distributed Modes of Running Pig Scripts, Checking out the Pig Script Interfaces, Scripting with Pig Latin.

Applying Structure to Hadoop Data with Hive : Saying Hello to Hive, Seeing How the Hive is Put Together, Getting Started with Apache Hive, Examining the Hive Clients, Working with Hive Data Types, Creating and Managing Databases and Tables, Seeing How the Hive Data Manipulation Language Works, Querying and Analysing data

Text Books:

1. Wiley & Big Java4thEdition, Cay Horstmann, Wiley John Sons, INC
2. Hadoop : The Definitive Guide by Tom White, 3rd. Edition, O'reilly

Reference Books:

1. Hadoop in Action by Chuck Lam, MANNING Publ.
2. Hadoop for Dummies by Dirk deRoos, Paul C. Zikopoulos, Roman B. Melnyk, Bruce Brown, Rafael Coss
3. Hadoop in Practice by AlexHolmes, MANNING Publ.
4. Big Data Analytics by Dr.A.Krishna Mohanand Dr. E. Laxmi Lydia
5. Hadoop Map Reduce Cook book, Srinath Perera, Thilina Gunarathne

Software Links:

1. Hadoop:http://hadoop.apache.org/
2. Hive:https://cwiki.apache.org/confluence/display/Hive/Home
3. Piglatin:http://pig.apache.org/docs/r0.7.0/tutorial.html

III Year - II Semester	Course Code: BT24ML3202	L	T	P	C
		3	0	0	3
DEEP LEARNING					

Course Objectives:

- The objective of this course is to cover the fundamentals of neural networks as well as some advanced topics such as recurrent neural networks, long short- term memory cells and convolution neural networks.

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

CO1: Explain biological neuron models and apply perceptron learning algorithms for linear classification. (L2)

CO2: Design and train feed-forward neural networks using back propagation, regularization, and auto encoders. (L6)

CO3: Apply advanced optimization and regularization techniques to improve deep neural network training. (L3)

CO4: Implement recurrent and convolutional neural networks for sequential and spatial data modeling. (L3)

CO5: Analyze generative deep learning models including RBMs, deep Boltzmann machines, and variational auto encoders. (L4)

CO6: Evaluate recent deep learning architectures such as Transformers and GPT for vision, speech, and NLP applications. (L5)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	–	1	–	–	–	–	–	–	2
CO2	3	3	3	2	3	–	–	–	–	–	–	2
CO3	3	3	3	2	3	–	–	–	–	–	–	2
CO4	3	3	3	3	3	–	–	–	1	–	–	2
CO5	3	3	2	3	2	–	–	–	–	–	–	2
CO6	3	3	3	3	3	–	–	1	2	2	–	3

CO / PSO	PSO-1	PSO-2
CO1	2	1
CO2	3	1
CO3	3	2
CO4	3	2
CO5	3	2
CO6	3	3

UNIT-I: Basics- Biological Neuron, Idea of computational units, McCulloch – Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability, Convergence theorem for Perceptron Learning Algorithm.

UNIT-II: Feed forward Networks-Multilayer Perceptron, Gradient Descent, Back propagation, Empirical Risk Minimization, regularization, auto encoders. Deep Neural Networks: Difficulty of training deep neural networks, Greedy layer wise training.

UNIT-III: Better Training of Neural Networks-Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization).

UNIT-IV: Recurrent Neural Networks- Back propagation through time, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs.
Convolutional Neural Networks: LeNet, AlexNet. Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines.

UNIT-V: Recent trends - Variational Auto encoders, Transformers, GPT Applications: Vision, NLP, Speech

Text Books :

1. Deep Learning, Ian Good fellow and Yoshua Bengio and Aaron Courville, MIT Press, 2016.

Reference Books:

1. Neural Networks : A Systematic Introduction, Raúl Rojas, 1996
2. Pattern Recognition and Machine Learning, Christopher Bishop, 2007
3. Deep Learning with Python, François Chollet, Manning Publications, 2017.

III Year - II Semester	Course Code: BT24ML3201	L	T	P	C
		3	0	0	3
NATURAL LANGUAGE PROCESSING					

Course Objectives: This course introduces the fundamental concepts and techniques of natural language processing (NLP).

- Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information.
- The course examines NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.
- Enable students to be capable to describe the application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing.

Course Outcomes: After completion of this course

CO1: Explain the foundations of NLP including language modeling, morphology, tokenization, and spelling correction. (L2)

CO2: Analyze word-level language models and apply PoS tagging using rule-based and probabilistic approaches. (L4)

CO3: Apply syntactic parsing techniques using context-free grammars, dependency grammars, and probabilistic models. (L3)

CO4: Interpret semantic representations and apply word sense disambiguation using supervised and knowledge-based methods. (L3)

CO5: Analyze discourse phenomena including anaphora, coreference resolution, and coherence modeling. (L4)

CO6: Utilize standard NLP tools, corpora, and lexical resources to build and evaluate real-world NLP applications. (L5)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	–	–	1	–	–	–	–	–	–	2
CO2	3	3	–	2	2	–	–	–	–	–	–	2
CO3	3	3	2	3	2	–	–	–	–	–	–	2
CO4	3	3	2	3	2	–	–	–	–	–	–	2
CO5	2	3	2	3	2	–	–	–	1	–	–	2
CO6	2	2	3	2	3	–	–	1	2	2	–	3

CO / PSO	PSO-1	PSO-2
CO1	2	1
CO2	3	1
CO3	3	1
CO4	3	2
CO5	2	2
CO6	3	3

UNIT I: INTRODUCTION: Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.

UNIT II: WORD LEVEL ANALYSIS: Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part- of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum

UNIT III: SYNTACTIC ANALYSIS: Context-Free Grammars, Grammar rules for English, Tree banks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures

UNIT IV: SEMANTICS AND PRAGMATICS: Requirements for representation, First- Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.

UNIT V: DISCOURSE ANALYSIS AND LEXICAL RESOURCES: Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).

Text Books:

1. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, 2nd Edition, Daniel Jurafsky, James H. Martin - Pearson Publication,2014.
2. Natural Language Processing with Python, First Edition, Steven Bird, Ewan Klein and Edward Loper, OReilly Media,2009.

Reference Books:

1. Language Processing with Java and Ling Pipe Cookbook, 1st Edition, Breck Baldwin, Atlantic Publisher, 2015.
2. Natural Language Processing with Java, 2nd Edition, Richard M Reese, OReilly Media, 2015.
3. Hand book of Natural Language Processing, Second, Nitin Indurkhya and Fred J. Damerau, Chapman and Hall/CRC Press, 2010.Edition
4. Natural Language Processing and Information Retrieval, 3rd Edition, Tanveer Siddiqui, U. S. Tiwary, Oxford University Press, 2008.

III Year - II Semester	Course Code: BT24DS32P2A	L	T	P	C
		3	0	0	3
CRYPTOGRAPHY & NETWORK SECURITY					

Course Objectives:

- Explain the objectives of information security.
- Explain the importance and application of each of confidentiality, integrity, authentication and availability.
- Understand the basic categories of threats to computers and networks.
- Discusses the Mathematics of Cryptography.
- DiscussthefundamentalideasofSymmetricandAsymmetricCryptographicAlgorithms.
- Discusses the Network layer, Transport Layer and Application Layer Protocols Enhanced security mechanisms.

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

CO1: Explain security principles, attack models, and classical encryption techniques for protecting information. (L2)

CO2: Apply mathematical foundations and algebraic structures used in symmetric and asymmetric cryptography. (L3)

CO3: Implement and analyze symmetric and asymmetric key cryptographic algorithms for secure communication. (L4)

CO4: Apply cryptographic hash functions, message authentication codes, and digital signatures for data integrity and authentication. (L3)

CO5: Analyze network and internet security protocols including TLS, IPsec, and secure email mechanisms. (L4)

CO6: Design secure systems by integrating cryptographic techniques while addressing ethical and societal security challenges. (L6)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	–	–	2	–	2	–	–	–	2
CO2	3	3	2	2	–	–	–	–	–	–	–	2
CO3	3	3	3	2	2	–	–	–	–	–	–	2
CO4	3	3	3	2	2	–	–	1	–	–	–	2
CO5	3	3	3	3	2	1	–	1	–	–	–	2
CO6	2	2	3	2	2	3	–	3	2	2	–	3

CO / PSO	PSO-1	PSO-2
CO1	1	1
CO2	2	1
CO3	2	1
CO4	2	1
CO5	2	2
CO6	3	3

UNIT – I: Security Concepts: Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security Cryptography. Classical Encryption Techniques - symmetric cipher model, Substitution techniques, Transposition techniques, Rotor Machines, Stegnography.

UNIT – II: Introduction to Symmetric Cryptography: Algebraic Structures - Groups, Rings, Fields, GF(2^n) fields, Polynomials. **Mathematics of Asymmetric cryptography:** Primes, checking for Primness, Euler's phi-functions, Fermat's Little Theorem, Euler's Theorem, Generating Primes, Primality Testing, Factorization, Chinese Remainder Theorem, Quadratic Congruence, Exponentiation and Logarithm.

UNIT – III: Symmetric key Ciphers: Block Cipher principles, DES, AES, Blowfish, IDEA, Block cipher operation, Stream ciphers: RC4, RC5

Asymmetric key Ciphers: Principles of public key cryptosystems, RSA algorithm, Diffie-Hellman Key Exchange, Elgamal Cryptographic system, Elliptic Curve Arithmetic, Elliptic Curve Cryptography.

UNIT – IV: Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithms (SHA)

Message Authentication Codes: Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes, Security of MAC'S, MAC'S Based On Hash Functions: HMAC, MAC'S Based On Block Ciphers: DAA And CMAC

Digital Signatures: Digital Signatures, Elgamal Digital Signature Scheme, Elliptic Curve Digital Signature Algorithm, RSA-PSS Digital Signature Algorithm.

UNIT – V: Network and Internet Security: Transport-Level Security: Web Security Considerations, Transport Level Security, HTTPS, SSH.

IP Security: IP Security Overview, IP Security Policy, Encapsulating Security Payload,

Authentication Header Protocol.

Electronic – Mail Security: Internet – mail Security, Email Format, Email Threats and Comprehensive Email Security, S/MIME, PGP.

Text Books:

1. Cryptography and Network Security – Principles and Practice : William Stallings, Pearson Education, 7th Edition, 2017
2. Cryptography and Network Security: Behrouz A. Forouzan Debdeep, Mc Graw Hill, 3rd Edition, 2015

Reference Books:

1. Cryptography and Network Security: Atul Kahate, McGraw Hill, 3rd Edition.
2. Introduction to Cryptography with Coding Theory: Wade Trappe, Lawrence C.Washington, Pearson.
3. Modern Cryptography: Theory and Practice By Wenbo Mao. Pearson.

III Year - II Semester	Course Code: BT24DS32P2B	L	T	P	C
		3	0	0	3
OPERATING SYSTEMS					

Course Objectives:

The main objectives of the course is to make student

- Understand the basic concepts and principles of operating systems, including process management, memory management, file systems, and Protection
- Make use of process scheduling algorithms and synchronization techniques to achieve better performance of a computer system.
- Illustrate different conditions for dead lock and their possible solutions.

Course Outcomes:

At the end of the course students will be able to

CO1: Explain fundamental operating system concepts and services, with emphasis on open-source operating systems. (L2)

CO2: Analyze process management concepts including scheduling, IPC, and multithreading. (L4)

CO3: Apply synchronization mechanisms and evaluate deadlock conditions and solutions.(L3)

CO4: Illustrate and compare memory management and storage management techniques.(L3)

CO5: Describe and implement file system concepts and protection mechanisms. (L2)

CO6: Design, analyze, and debug basic operating system components and relate them to real-world systems. (L6)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	1	-	1
CO2	3	3	2	-	1	-	-	-	1	-	-	1
CO3	3	3	3	1	1	-	-	-	1	-	-	1
CO4	3	3	2	1	1	-	-	-	-	-	-	1
CO5	3	2	2	-	1	-	-	-	-	-	-	1
CO6	3	3	3	2	2	-	-	-	1	1	-	2

CO / PSO	PSO-1	PSO-2
CO1	2	-
CO2	3	2
CO3	3	3
CO4	2	2
CO5	2	3
CO6	3	3

UNIT-I: Operating Systems Overview: Introduction, Operating system functions, Operating systems operations, Computing environments, Free and Open-Source Operating Systems System Structures: Operating System Services, User and Operating-System Interface, system calls, Types of System Calls, system programs, Operating system Design and Implementation, Operating system structure, Building and Booting an Operating System, Operating system debugging

UNIT-II: Processes: Process Concept, Process scheduling, Operations on processes, Inter-process communication. Threads and Concurrency: Multithreading models, Thread libraries, Threading issues. CPU Scheduling: Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple processor scheduling.

UNIT–III: Synchronization Tools: The Critical Section Problem, Peterson's Solution, Mutex Locks, semaphores, Monitors, Classic problems of Synchronization. Deadlocks: system Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from Deadlock.

UNIT-IV: Memory – Management Strategies: Introduction, Contiguous memory allocation, Paging, Structure of the Page Table, Swapping. Virtual Memory Management: Introduction, Demand paging, Copy-on-write, Page replacement Allocation of frames, Thrashing Storage Management: Overview of Mass Storage Structure, HDD Scheduling.

UNIT-V: File System: File System Interface: File concept, Access methods, Directory Structure; File system Implementation: File-system structure, File-system Operations, Directory implementation, Allocation method, Free space management; File-System Internals: File-System Mounting, Partitions and Mounting, File Sharing. Protection: Goals of protection, Principles of protection, Protection Rings, Domain of protection, Access matrix

Text Books:

1. Operating System Concepts, Silberschatz A, GalvinPB, GagneG, 10th Edition, Wiley,2018.
2. Modern Operating Systems, Tanenbaum AS, 4th Edition, Pearson, 2016.

Reference Books:

1. Operating Systems -Internals and Design Principles, Stallings W, 9thedition, Pearson, 2018
2. Operating Systems: A Concept Based Approach, D. M Dhamdhere, 3rd Edition, McGraw- Hill, 2013

Online Learning Resources:

1. https://nptel.ac.in/courses/106/106/106106144/
2. http://peterindia.net/OperatingSystems.html

III Year - II Semester	Course Code: BT24DS32P2C	L	T	P	C
		3	0	0	3
RECOMMENDER SYSTEMS					

Course Objectives:

1. This course covers the basic concepts of recommender systems, including personalization algorithms, evaluation tools, and user experiences

Course Outcomes:

CO1: Explain the fundamentals, applications, mathematical foundations, and challenges of recommender systems. (L2)

CO2: Implement and analyze collaborative filtering techniques, including user-based, item-based, and model-based approaches. (L4)

CO3: Design content-based and knowledge-based recommender systems using feature extraction and user profiling techniques. (L6)

CO4: Develop hybrid recommender systems by integrating multiple recommendation strategies and architectures. (L6)

CO5: Evaluate recommender systems using statistical, decision-support, and user-centered evaluation metrics. (L5)

CO6: Analyze social, trust-based, and community-driven recommender systems while addressing ethical and security concerns. (L4)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	–	1	–	–	–	–	–	–	2
CO2	2	3	3	2	2	–	–	–	1	–	–	2
CO3	2	3	3	2	2	–	–	–	1	–	–	2
CO4	2	3	3	2	3	–	–	–	2	–	–	2
CO5	2	2	2	3	2	–	–	–	1	–	–	2
CO6	2	2	2	2	1	2	–	3	2	1	–	3

CO / PSO	PSO-1	PSO-2
CO1	2	1
CO2	3	1
CO3	3	1
CO4	3	2
CO5	2	2
CO6	2	3

UNIT-I: Introduction: Recommender system functions, Linear Algebra notation: Matrix addition, Multiplication, transposition, and inverses, covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with recommender system.

UNIT-II: Collaborative Filtering: User-based nearest neighbor recommendation, Item- based nearest neighbor recommendation, Model based and pre-processing based approaches, Attacks on collaborative recommender systems.

UNIT-III: Content-based recommendation: High level architecture of content-based systems, Advantages and drawbacks of content based filtering, Item profiles, Discovering features of documents, Obtaining item features from tags, Representing item profiles, Methods for learning user profiles, Similarity based retrieval, Classification algorithms.
Knowledge based recommendation: Knowledge representation and reasoning, Constraint based recommenders, Case based recommenders.

UNIT-IV: Hybrid approaches: Opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade Meta-level, Limitations of hybridization strategies.

UNIT-V: Evaluating Recommender System: Introduction, General properties of evaluation research, Evaluation designs, Evaluation on historical datasets, Error metrics, Decision-Support metrics, User - Centered metrics. **Recommender Systems and communities:** Communities, collaboration and recommender systems in personalized web search, Social tagging recommender systems, Trust and recommendations

Text Books:

1. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed.
2. Ricci F., Rokach L., Shapira D., Kantor B. P., Recommender Systems Hand book, Springer (2011), 1st ed.

References Books:

1. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer (2013), 1st ed.

III Year - II Semester	Course Code: BT24DS32P2D	L	T	P	C
		3	0	0	3
COMPUTER VISION					

Course Objectives:

- To understand the Fundamental Concepts related to sources, shadows and shading.
- To understand the Geometry of Multiple Views.

Course Outcomes:

CO1: Describe the types of computer networks, reference models (OSI and TCP/IP), and the historical evolution of the Internet. (L2)

CO2: Explain data link layer concepts including transmission media, error detection and correction techniques, data link protocols, and multiple access methods in wired LANs.(L2)

CO3: Analyze network layer design issues, routing and congestion control algorithms, and Internet Protocols including IPv4, IPv6, CIDR, and NAT.(L4)

CO4: Compare and evaluate transport layer protocols such as UDP, TCP, and SCTP with respect to services, performance, and reliability.(L5)

CO5: Illustrate application layer protocols and services including HTTP, DNS, electronic mail, remote login, and file transfer mechanisms.(L2)

CO6: Apply networking concepts and protocols across different layers to design and troubleshoot basic computer network scenarios.(L3)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	1	-	-	-	-	-	-	-
CO3	2	3	2	2	2	-	-	-	-	-	-	-
CO4	2	3	2	2	1	-	-	-	-	-	-	-
CO5	2	1	-	-	-	-	-	-	-	-	-	-
CO6	3	3	3	2	3	-	-	-	-	-	-	2

CO / PSO	PSO-1	PSO-2
CO1	2	1
CO2	3	1
CO3	3	1
CO4	3	2
CO5	2	2
CO6	2	3

UNIT I: Introduction: Types of Computer Networks, Reference Models- The OSI Reference Model, The TCP/IP Reference Model, A Critique of the OSI Model and Protocols, A Critique of the TCP/IP Reference Model. History of Internet.

UNIT II: The Data Link Layer: Transmission Media, Guided and Un-guided media, Data Link Layer Design Issues, Services Provided to the Network Layer, Error detecting and Error Correcting codes, Elementary Data Link Protocols, Sliding Window Protocols, HDLC, PPP. Multiple Access Protocols Wired Lans: Ethernet, Fast Ethernet, Gigabit Ethernet

UNIT III: The Network Layer: Network Layer Design Issues, Routing Algorithms, Congestion, Congestion control algorithms. The Network Layer in the Internet, The IP Version 4 Protocol, IP Addresses- Classful, CIDR, NAT, IP Version 6 Protocol, Transition from IPV4 to IPV6

UNIT IV: The Transport Layer: The Transport Layer Services, Transport Layer Protocols: UDP, TCP and SCTP

UNIT V: The Application Layer: The World Wide Web, HTTP, Domain Name Space, Remote Loging, Electronic Mail and File Transfer

Text books:

1. "Computer Networks", Andrew S Tanenbaum, David J Wetherall, 5th Edition, Pearson.
2. "Data Communications and Networking", Behrouz A Forouzan, 4th Edition, Tata McGraw Hill Education

Reference Books:

1. "Data and Computer Communication", William Stallings, Pearson
2. "TCP/IP Protocol Suite", Behrouz Forouzan, McGraw Hill.

III Year - II Semester	Course Code: BT24DS32P2E	L	T	P	C
		3	0	0	3
AUTOMATA THEORY& COMPILER DESIGN					

Course Objectives:

- To introduce the fundamental concepts of automata theory, including finite automata, alphabets, strings, languages, and their role in computational problem solving.
- To develop an understanding of regular expressions, regular languages, and context-free grammars, and to analyze language properties using tools such as the pumping lemma.
- To study pushdown automata and Turing machines, and to understand the concepts of computability and undecidability in formal languages.

Course Outcomes (COs): After completion of course, students would be able to

CO1: Understand the fundamentals of automata theory including finite automata, languages, and regular expressions. (L2)

CO2: Analyze nondeterministic and deterministic finite automata and their conversions. (L4)

CO3: Apply context-free grammars, pushdown automata, and parsing techniques to language recognition problems. (L3)

CO4: Explain Turing machines, computability concepts, and undecidable problems. (L2)

CO5: Understand compiler phases including lexical analysis, syntax analysis, and parsing methods. (L2)

CO6: Apply syntax-directed translation and intermediate code generation techniques in compiler design. (L3)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	-	-	-	-	-	-	2
CO2	3	3	2	2	-	-	-	-	-	-	-	2
CO3	3	3	3	2	-	-	-	-	-	-	-	2
CO4	3	3	2	3	-	-	-	-	-	-	-	2
CO5	3	2	2	2	2	-	-	-	-	-	-	2
CO6	3	3	3	2	2	-	-	-	2	1	-	3

CO / PSO	PSO-1	PSO-2
CO1	1	1
CO2	2	1
CO3	3	2
CO4	2	2
CO5	2	1
CO6	3	3

UNIT – I: Introduction to Finite Automata: Structural Representations, Automata and Complexity, the Central Concepts of Automata Theory – Alphabets, Strings, Languages, Problems. Non deterministic Finite Automata: Formal Definition, an application, Text Search, Finite Automata with Epsilon-Transitions. Deterministic Finite Automata: Definition of DFA, How A DFA Process Strings, The language of DFA, Conversion of NFA with €- transitions to NFA without €-transitions. Conversion of NFA to DFA

UNIT – II: Regular Expressions: Finite Automata and Regular Expressions, Applications of Regular Expressions, Algebraic Laws for Regular Expressions, Conversion of Finite Automata to Regular Expressions. Pumping Lemma for Regular Languages: Statement of the pumping lemma, Applications of the Pumping Lemma. Context-Free Grammars: Definition of Context-Free Grammars, Derivations Using a Grammar, Leftmost and Rightmost Derivations, the Language of a Grammar, Parse Trees, Ambiguity in Grammars and Languages.

UNIT – III: **Push Down Automata:** Definition of the Pushdown Automaton, the Languages of a PDA, Equivalence of PDA's and CFG's, Acceptance by final state Turing Machines: IntroductiontoTuringMachine,FormalDescription,Instantaneousdescription,Thelanguage of a Turing machine Undecidability: Undecidability, A Language that is Not Recursively Enumerable, An Undecidable Problem That is RE, Undecidable Problems about Turing Machines

UNIT – IV: Introduction: The structure of a compiler, Lexical Analysis: The Role of the Lexical Analyzer, Input Buffering, Recognition of Tokens, The Lexical- Analyzer Generator Lex,SyntaxAnalysis:Introduction,Context-FreeGrammars,WritingaGrammar,Top-Down Parsing, Bottom- Up Parsing, Introduction to LR Parsing: Simple LR, More Powerful LR Parsers R18 B.Tech. CS&D Syllabus JNTU Hyderabad

UNIT – V: Syntax - Directed Translation: Syntax-Directed Definitions, Evaluation Orders for SDD's, Syntax Directed Translation Schemes, Implementing L-Attributed SDD's. Intermediate-Code Generation: Variants of Syntax Trees, Three-Address Code Run-Time Environments: Stack Allocation of Space, Access to Nonlocal Data on the Stack, Heap Management

Text Books:

1. Introduction to Automata Theory, Languages, and Computation, 3nd Edition, John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Pearson Education.
2. Compilers: Principles, Techniques and Tools, Alfred V. Aho, Monica S. Lam, RaviSethi, Jeffry D. Ullman, 2nd Edition, Pearson.

3. Theory of Computer Science – Automata languages and computation, Mishra and Chandrashekaran, 2nd Edition, PHI.

Reference Books:

1. Introduction to Formal languages Automata Theory and Computation, Kamala Krithivasan, Rama R, Pearson.
2. Introduction to Languages and The Theory of Computation, John C Martin, TMH.
3. Lex & yacc– John R. Levine, Tony Mason, Doug Brown, O'reilly
4. Compiler Construction, Kenneth C. Louden, Thomson. Course Technology.

II Year - II Semester	Course Code: BT24DS32P3A	L	T	P	C
		3	0	0	3
QUANTUM COMPUTING					

Course Objectives:

- To introduce the fundamentals of quantum computing, the problem – solving approach using finite dimensional mathematics.

Course Outcomes:

CO1: Describe the historical evolution of quantum computing and distinguish between classical and quantum computation in terms of bits, qubits, and logical operations.(L2)

CO2: Explain the required mathematical, physical, and biological foundations of quantum computing, including linear algebra, Hilbert spaces, superposition, entanglement, and basic genomics concepts.(L2)

CO3: Analyze qubits as quantum units of information, their physical implementations, Bloch sphere representation, and the construction of quantum circuits using single- and multi-qubit gates.(L4)

CO4: Apply fundamental quantum algorithms such as Deutsch, Deutsch–Jozsa, Shor's, and Grover's algorithms to solve computational problems.(L3)

CO5: Analyze the impact of noise and decoherence and explain quantum error correction, graph states, and fault-tolerant computation techniques.(L4)

CO6: Evaluate quantum information and cryptographic techniques, including quantum teleportation and quantum cryptography, in comparison with classical information systems.(L5)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	-	-	-	-	-	-	-	-
CO2	3	1	-	-	-	-	-	-	-	-	-	-
CO3	3	3	2	2	2	-	-	-	-	-	-	-
CO4	2	3	2	2	2	-	-	-	-	-	-	-
CO5	3	3	2	2	2	-	-	-	-	-	-	-
CO6	2	2	1	1	1	-	-	2	-	-	-	-

CO / PSO	PSO-1	PSO-2
CO1	2	1
CO2	2	1
CO3	3	2
CO4	2	2
CO5	2	2
CO6	2	2

UNIT – I: History of Quantum Computing: Importance of Mathematics, Physics and Biology. Introduction to Quantum Computing: Bits Vs Qubits, Classical Vs Quantum logical operations

UNIT – II: Background Mathematics: Basics of Linear Algebra, Hilbert space, Probabilities and measurements. **Background Physics:** Paul's exclusion Principle, Superposition, Entanglement and super-symmetry, density operators and correlation, basicsof quantum mechanics, Measurements in bases other than computational basis. **Background Biology:** Basic concepts of Genomics and Proteomics (Central Dogma)

UNIT – III: Qubit: Physical implementations of Qubit. Qubit as a quantum unit of information. The Bloch sphere Quantum Circuits: single qubit gates, multiple qubit gates, designing the quantum circuits. Bell states.

UNIT – IV: Quantum Algorithms: Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor's factorization algorithm, Grover's search algorithm.

UNIT – V: Noise and error correction: Graph states and codes, Quantum error correction, fault-tolerant computation. Quantum Information and Cryptography: Comparison between classical and quantum information theory. Quantum Cryptography, Quantum teleportation

Text Books:

1. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge

Reference Books:

1. Quantum Computing for Computer Scientists by Noson S.Yan of sky and Mirco A. Mannucci
2. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol.I: Basic Concepts, Vol II
3. Basic Tools and Special Topics, World Scientific. Pittenger A. O., An Introduction to Quantum Computing Algorithms.

III Year - II Semester	Course Code: BT24DS32P3B	L	T	P	C
		3	0	0	3
NoSQL databases					

Course Objectives:

- Understand the history, evolution, and fundamental concepts of NoSQL databases and the limitations of traditional relational databases.
- Compare relational databases with different NoSQL database types and explain their data models, distribution strategies, replication, sharding, and MapReduce concepts.
- Apply document-oriented NoSQL databases (MongoDB) to design scalable applications and identify suitable real-time and web-based use cases.

Course Outcomes: At the end of the Course the student will be able to

CO1: Explain the evolution, principles, and need for NoSQL databases compared to relational databases. (L2)

CO2: Compare different NoSQL data models such as key–value, document, column-family, and graph databases. (L5)

CO3: Apply document-oriented NoSQL databases (MongoDB) for scalable data storage and real-time applications. (L3)

CO4: Analyze column-oriented NoSQL databases (HBase and Cassandra) for distributed storage and analytics use cases. (L4)

CO5: Apply key–value and graph NoSQL databases (Riak and Neo4j) to model relationships and large-scale data. (L3)

CO6: Select and design appropriate NoSQL database solutions for modern applications considering scalability, consistency, and availability. (L6)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	–	–	–	–	–	–	–	–	–	1
CO2	3	3	2	–	–	–	–	–	–	–	–	1
CO3	2	2	3	–	3	–	–	–	–	–	–	2
CO4	2	3	2	2	3	–	–	–	–	–	–	2
CO5	2	2	3	–	3	–	–	–	–	–	–	2
CO6	2	3	3	2	3	1	–	1	2	–	–	3

CO / PSO	PSO-1	PSO-2
CO1	2	1
CO2	3	1
CO3	3	2
CO4	3	2
CO5	2	1
CO6	3	3

UNIT-I: Overview and History of NoSQL Databases. Definition of the Four Types of NoSQL Database, The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL, Key Points.

UNIT-II: Comparison of relational databases to new NoSQL stores, MongoDB, Cassandra, HBASE, Neo4j use and deployment, Application, RDBMS approach, Challenges NoSQL approach, Key-Value and Document Data Models, Column-Family Stores, Aggregate- Oriented Databases. Replication and sharding, Map Reduce on databases. Distribution Models, Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication.

UNIT-III: NoSQL Key/Value databases using MongoDB, Document Databases, Document oriented Database Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable UseCases, Event Logging, Content Management Systems, Blogging Platforms, Web Analytics or Real-Time Analytics, E-Commerce Applications, Complex Transactions Spanning Different Operations, Queries against Varying Aggregate Structure.

UNIT-IV: Column-oriented NoSQL databases using Apache HBASE, Column-oriented NoSQL databases using Apache Cassandra, Architecture of HBASE, Column-Family Data Store Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Counters, Expiring Usage.

UNIT-V: NoSQL Key/Value databases using Riak, Key-Value Databases, Key-Value Store, Key-Value Store Features, Consistency, Transactions, Query Features, Structure of Data, Scaling, Suitable Use Cases, Storing Session Information, User Profiles, Preferences, Shopping Cart Data, Relationships among Data, Multi operation Transactions, Query by Data, Operations by Sets. Graph NoSQL databases using Neo4, NoSQL database development tools and programming

languages, Graph Databases, Graph Database. Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases.

Text Books:

1. Sadalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Wiley Publications, 1st Edition, 2019.

Web References:

1. https://www.ibm.com/cloud/learn/nosql-databases
2. https://www.coursera.org/lecture/nosql-databases/introduction-to-nosql-VdRNp
3. https://www.geeksforgeeks.org/introduction-to-nosql/
4. https://www.javatpoint.com/nosql-databa

III Year - II Semester	Course Code: BT24DS32P3C	L	T	P	C
		3	0	0	3
Cloud Computing					

Course Objectives:

- To explain the evolving utility computing model called cloud computing.
- To introduce the various levels of services offered by cloud.
- To discuss the fundamentals of cloud enabling technologies such as distributed computing, service - oriented architecture and virtualization.
- To emphasize the security and other challenges in cloud computing.
- To introduce the advanced concepts such as containers, serverless computing and cloud-centric Internet of Things.

Course Outcomes:

CO1: Describe cloud computing fundamentals, including models, architectures, characteristics, and benefits.(L2)

CO2: Explain core cloud-enabling technologies.(L2)

CO3: Analyze virtualization and container technologies and related cloud services.(L4)

CO4: Evaluate key challenges in cloud computing.(L5)

CO5: Apply advanced cloud concepts in cloud environments.(L3)

CO6: Design cloud-based solutions using appropriate models and emerging technologies.(L6)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	-	-	-	-	-	-	2
CO2	3	3	2	2	2	-	-	-	-	-	-	2
CO3	3	3	2	2	2	-	-	-	-	-	-	2
CO4	3	3	2	3	2	-	-	-	-	-	-	2
CO5	3	3	2	2	2	-	-	-	-	-	-	2
CO6	3	3	3	2	3	-	-	-	2	1	-	3

CO / PSO	PSO-1	PSO-2
CO1	2	1
CO2	3	1
CO3	3	2
CO4	3	2
CO5	2	1
CO6	3	3

UNIT -I: **Introduction to Cloud Computing Fundamentals:** Cloud computing at a glance, defining a cloud, cloud computing reference model, types of services (IaaS, PaaS, SaaS), cloud deployment models (public, private, hybrid), utility computing, cloud computing characteristics and benefits, cloud service providers (Amazon Web Services, Microsoft Azure, Google App Engine).

UNIT-II: Cloud Enabling Technologies: Ubiquitous Internet, parallel and distributed computing, elements of parallel computing, hardware architectures for parallel computing (SISD, SIMD, MISD, MIMD), elements of distributed computing, Inter-process communication, technologies for distributed computing, remote procedure calls (RPC), service-oriented architecture (SOA), Web services, virtualization.

UNIT-III: **Virtualization and Containers:** Characteristics of virtualized environments, taxonomy of virtualization techniques, virtualization and cloud Computing, pros and cons of virtualization, technology examples (XEN, VMware), building blocks of containers, container platforms (LXC, Docker), container orchestration, Docker Swarm and Kubernetes, public cloud VM (e.g.Amazon EC2) and container (e.g. Amazon Elastic Container Service) offerings.

UNIT-IV: **Cloud computing challenges**: Economics of the cloud, cloud interoperability and standards, scalability and fault tolerance, energy efficiency in clouds, federated clouds, cloud computing security, fundamentals of computer security, cloud security architecture, cloud shared responsibility model, security in cloud deployment models.

UNIT -V: **Advanced concepts in cloud computing**: Serverless computing, Function-as-a-Service,serverlesscomputingarchitecture,publiccloud(e.g.AWSLambda)andopen-source (e.g. Open FaaS) serverless platforms, Internet of Things (IoT), applications, cloud – centric IoT and layers, edge and fog computing, DevOps, infrastructure-as-code, quantum cloud computing.

Text Books:

1. Mastering Cloud Computing, 2nd edition, Rajkumar Buyya, Christian Vecchiola, Thamarai Selvi, Shivananda Poojara, Satish N. Srirama, Mc Graw Hill, 2024.
2. Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier, 2012.

Reference Books:

1. Cloud Computing, Theory and Practice, Dan C Marinescu, 2nd edition, M K Elsevier, 2018.
2. Essentials of cloud Computing, K. Chandrasekhran, C R Cpress, 2014.
3. Online documentation and tutorials from cloud service providers (e.g., AWS, Azure, GCP)

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III Year - II Semester	Course Code: BT24DS32P3D	L	T	P	C
		3	0	0	3
SOCIAL MEDIA ANALYTICS					

Course Objectives:

Knowledge on social media and its analytics Course

Course Outcomes:

CO1: Understanding characteristics and types of social media. (L2)

CO2: Knowledge on layers of social media analytics. (L2)

CO3: Apply text analysis tools on social media data. (L3)

CO4: Analyze a case study on Tapping Into Online Customer Opinions. (L4)

CO5: Understand the significance of action analytics. (L2)

CO6: Detect viral topics on social media (YouTube). (L3)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	-	-	-	-	-	-	2
CO2	3	3	2	2	2	-	-	-	-	-	-	2
CO3	3	3	2	2	2	-	-	-	-	-	-	2
CO4	3	3	2	3	2	-	-	-	-	-	-	2
CO5	3	3	2	2	2	-	-	-	-	-	-	2
CO6	3	3	3	2	3	-	-	-	2	1	-	3

CO / PSO	PSO-1	PSO-2
CO1	2	1
CO2	3	1
CO3	3	2
CO4	3	2
CO5	2	1
CO6	3	3

UNIT-I: Introduction to Social Media World Wide Web, Web 1.0, Web 2.0, Web 3.0, Social Media, Core Characteristics Of Social Media, Types Of Social Media, Social Networking Sites, Using Facebook For Business Purposes, Content Communities.

UNIT-II: Social Media Analytics Overview Purpose Of Social Media Analytics, Social Media Vs. Traditional Business Analytics, Seven Layers Of Social Media Analytics, Types Of Social

Media Analytics, Social Media Analytics Cycle, Challenges To Social Media Analytics, Social Media Analytics Tools.

Case Study: The Underground Campaign That Scored Big

UNIT-III: Social Media Text Analytics Types Of Social Media Text, Purpose Of Text Analytics, Steps In Text Analytics, Social Media Text Analysis Tools.

Case Study: Tapping Into Online Customer Opinions

UNIT-IV: Social Media Actions Analytics Introduction to Actions Analytics, Common Social Media Actions, Actions Analytics Tools.

Case Study: Cover - MoreGroup

UNIT-V: Social Media Hyperlink Analytics Types Of Hyperlinks, Hyperlink Analytics, Types Of Hyperlink Analytics, Hyperlink Analytics Tools.

Case Study: Hyper links And Viral You Tube Videos

Text Books:

1. Seven Layers Of Social Media Analytics Mining Business Insights From Social MediaText,Actions,Networks,Hyperlinks,Apps,SearchEngine,AndLocation Data By Gohar F. Khan Isbn: 1507823207, Isbn-13: 9781507823200.

Reference Books:

1. Social Media Analytics: Techniques And Insights For Extracting Business Value Out Of Social Media By Matthew Ganis, Avinash Kohirkar, Pearson Education.
2. Social Media Analytics: Effective Tools for Building, Interpreting, and Using Metrics, Marshall Sponder, MGH.
3. Big Data And Analytics, Seema Acharya, Subhasinin Chellappan, Wiley Publications.
4. Big Data, Black Booktm, Dream tech Press, 2015 Edition.

III Year - II Semester	Course Code: BT24DS3202	L	T	P	C
		0	0	3	1.5
Deep Learning and Natural language Processing Lab					

Course Outcomes: On completion of this course, the student will be able to

CO1: Design Neural networks to solve real world problems. (L6)

CO2: Design and train neural networks for text classification problems using datasets like IMDB and Reuters. (L6)

CO3: Build RNN, CNN models for classification. (L5)

CO4: Choose appropriate pre-trained model to solve real time problem. (L5)

CO5: Apply different NLP techniques using NLTK package. (L3)

CO6: Design solutions to real-world problems using NLP. (L6)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	3	–	–	–	1	2	–	2
CO2	3	3	3	2	3	–	–	–	2	2	–	2
CO3	3	2	3	2	3	–	–	–	1	2	–	2
CO4	3	2	3	2	3	–	–	–	1	2	–	2
CO5	3	3	3	2	3	–	–	–	1	2	–	2
CO6	3	3	3	2	3	–	–	–	1	2	–	2

CO / PSO	PSO-1	PSO-2
CO1	3	1
CO2	3	2
CO3	3	2
CO4	3	2
CO5	3	2
CO6	3	2

Software Packages Required:

- Keras
- Tensorflow
- PyTorch
- NLTK

List of Experiments:

1. Implement Multilayer Perceptron algorithm for MNIST Hand written Digit Classification.
2. Design Neural Network for following problems.

   i). Movie reviews classification (Binary Classification) using IMDB dataset.

   ii). News Wires classification (Multiclass Classification) using Reuters dataset.
3. Implement a Recurrent Neural Network (RNN) and LSTM for IMDB movie review classification problem.
4. Build a Convolution Neural Network for simple image (dogs and Cats) Classification
5. Use a Pre-trained Convolution Neural Network LeNet, Alex Net for image classification.
6. Implement One Hot Encoding and Word Embeddings on any real world dataset.
7. Create Sample list atleast10 words POS tagging and find the POS for any given word.
8. Write a Python program to

   i). Perform Morphological Analysis using NLTK library.

   ii) Generate n-grams using NLTK N-Grams library

   iii).Implement N-Grams Smoothing
9. Write a program to implement Named Entity Recognition (NER) for any corpus.
10. Using NLTK package to convert audio file to text and text file to audio files.
11. Write a program to perform Auto-Correction of spellings for any text.
12. Implement twitter sentiment analysis using NLP.

III Year - II Semester	Course Code: BT24DS3203	L	T	P	C
		0	0	3	1.5
BIG DATA ANALYTICS LAB					

Course Objectives:

- Provide a strong foundation in Java programming and fundamental data structures for large-scale data processing applications.
- Enable students to install, configure, and manage Hadoop clusters in different deployment modes.
- Develop proficiency in using HDFS for efficient storage and management of big data.

Course Outcomes:

At the end of the course students will be able to

CO1: Implement fundamental data structures such as linked lists, stacks, queues, sets, and maps using Java to build a strong programming foundation. (L3)

CO2: Install, configure, and monitor Hadoop in standalone, pseudo-distributed, and fully distributed modes using command-line and web-based tools. (L5)

CO3: Apply Hadoop Distributed File System (HDFS) commands to perform file and directory operations including uploading, retrieving, and deleting data. (L3)

CO4: Develop and execute MapReduce programs for data processing tasks such as word count, weather data analysis, and social network analytics. (L6)

CO5: Analyze and solve graph-based and iterative problems using MapReduce algorithms including shortest path, friends-of-friends, and PageRank. (L5)

CO6: Use higher-level Big Data tools such as Pig and Hive to perform data manipulation operations including sorting, grouping, joining, filtering, and managing databases. (L5)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	1	-	-	-	-	-	-	1
CO2	3	2	2	1	3	-	-	-	1	-	-	2
CO3	3	2	2	-	3	-	-	-	-	-	-	1
CO4	3	3	3	2	3	-	-	-	1	-	-	2
CO5	3	3	3	2	3	-	-	-	1	-	-	2
CO6	3	2	2	-	3	-	-	-	-	-	-	2

CO / PSO	PSO-1	PSO-2
CO1	2	1
CO2	2	3
CO3	2	3
CO4	3	3
CO5	3	3
CO6	2	3

Software Requirements:

1. **Hadoop** :https://hadoop.apache.org/release/2.7.6.html
2. **Java** :https://www.oracle.com/java/technologies/javase/javase8u211-later-archive-downloads.html
3. **Eclipse** :https://www.eclipse.org/downloads/

List of Experiments:

Experiment 1: Week 1, 2:

1. Implement the following Data structures in Java

   a) Linked Lists b) Stacks c) Queues d)Set e) Map

Experiment 2: Week 3:

2. (i) Perform setting up and Installing Hadoop in its three operating modes: Standalone, Pseudo distributed, Fully distributed

   (ii) Use web based tools to monitor your Hadoop setup.

Experiment 3: Week 4:

3. Implement the following file management tasks in Hadoop:
   - Adding files and directories
   - Retrieving files
   - Deleting files

   Hint: A typical Hadoop workflow creates data files (such as log files) elsewhere and copies them into HDFS using one of the above command line utilities.

Experiment 4: Week 5:

4. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm**.**

Experiment 5: Week 6:

5. Write a map reduce program that mines weather data.

   Weather sensors collecting data every hour at many locations across the globe gather a large volume of log data, which is a good candidate for analysis with Map Reduce, since it is semi structured and record-oriented.

Experiment 6: Week 7:

6. Use Map Reduce to find the shortest path between two people in a social graph.

Hint: Use an adjacency list to model a graph, and for each node store the distance from the original node, as well as a back pointer to the original node. Use the mappers to propagate the distance to the original node, and the reducer to restore the state of the graph. Iterate until the target node has been reached.

Experiment 7: Week 8:

7. Implement Friends – of – friends algorithm in Map Reduce.

Hint: Two Map Reduce jobs are required to calculate the FoFs for each user in asocial network .The first job calculates the common friends for each user, and the second job sorts the common friends by the number of connections to your friends.

Experiment 8: Week 9:

8. Implement an iterative Page Rank graph algorithm in Map Reduce.

Hint: Page Rank can be implemented by iterating a Map Reduce job until the graph has converged. The mappers are responsible for propagating node Page Rank values to their adjacent nodes, and the reducers are responsible for calculating new Page Rank values for each node, and for re-creating the original graph with the updated Page Rank values.

Experiment 9: Week 10:

9. Perform an efficient semi – join in Map Reduce.

Hint: Perform a semi-join by having the mappers load a Bloom filter from the Distributed Cache, and then filter results from the actual Map Reduce data source by performing membership queries against the Bloom filter to determine which data source records should be emitted to the reducers.

Experiment 10: Week 11:

10. Install and Run Pig then write Pig Latin scripts to sort, group, join, project, and filter your data.

Experiment 12: Week 12:

11. Install and Run Hive then use Hive to create, alter, and drop databases, tables, views, functions, and indexes

III Year - II Semester	Course Code: BT24BS3201	L	T	P	C
		0	1	2	2
SOFT SKILLS					

Course Objectives:

- To equip the students with the skills to effectively communicate in English.
- To train the students in interview skills, group discussions and presentation skills.
- To motivate the students to develop confidence.
- To enhance the students interpersonal skills.
- To improve the students writing skills.

Course Outcomes: At the end of the course student will be able to

CO1: Demonstrate effective verbal and non-verbal communication skills. (L3)

CO2: Develop analytical thinking, positive attitude, and self-awareness. (L6)

CO3: Apply self-management techniques including time, stress, and anger management.(L3)

CO4: Exhibit proper social, business, and telephone etiquette.(L5)

CO5: Prepare professional documents, resumes, emails, and perform well in group discussions and interviews. (L2)

CO6: Build and maintain effective interpersonal relationships in personal and professional contexts. (L5)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	–	–	2	1	1	–	2
CO2	3	2	2	2	2	–	–	2	1	1	–	2
CO3	3	2	2	2	2	–	–	2	2	1	–	2
CO4	3	2	2	2	2	–	–	2	2	2	–	2
CO5	3	2	2	2	2	–	–	2	2	2	–	2
CO6	3	2	2	2	2	–	–	2	2	2	–	2

CO / PSO	PSO-1	PSO-2
CO1	2	1
CO2	3	1
CO3	3	2
CO4	3	2
CO5	2	1
CO6	3	3

UNIT – I: Analytical Thinking & Listening Skills: Self-Introduction, Shaping Young Minds - A Talk by Azim Premji (Listening Activity), Self – Analysis, Developing Positive Attitude, Perception.

Communication Skills: Verbal Communication; Non Verbal Communication (Body Language)

UNIT – II: Self-Management Skills: Anger Management, Stress Management, Time Management, Six Thinking Hats, Team Building, Leadership Qualities

Etiquette: Social Etiquette, Business Etiquette, Telephone Etiquette, Dining Etiquette

UNIT – III: Standard Operation Methods: Basic Grammars, Tenses, Prepositions, Pronunciation, Letter Writing; Note Making, Note Taking, Minutes Preparation, Email & Letter Writing

UNIT - IV: Job-Oriented Skills: Group Discussion, Mock Group Discussions, Resume Preparation, Interview Skills, Mock Interviews

UNIT - V: Interpersonal relationships: Introduction, Importance, Types, Uses, Factors affecting interpersonal relationships, Accommodating different styles, Consequences of interpersonal relationships

Text Books:

1. Barun K. Mitra, Personality Development and Soft Skills, Oxford University Press, 2011.
2. S.P.Dhanavel, English and Soft Skills, Orient Blackswan, 2010.

Reference Books:

1. R. S. Aggarwal, A Modern Approach to Verbal & Non – Verbal Reasoning, S. Chand & Company Ltd., 2018.
2. Raman, Meenakshi & Sharma, Sangeeta, Technical Communication Principles and Practice, Oxford University Press, 2011.

E-resources:

1. https://swayam-plus.swayam2.ac.in/courses/course-details?id=P_CAMBR_01

III Year - II Semester	Course Code: BT24BS3202	L	T	P	C
		2	0	0	-
TECHNICAL PAPER WRITING & IPR					

Course Objective:

- The course will explain the basic related to writing the technical reports and understanding the concepts related to formatting and structuring the report. This will help students to comprehend the concept of proofreading, proposals and practice.

Course Outcomes: At the end of the course student will be able to

CO1: Demonstrate effective technical writing skills including sentence formation, transitions, and proper use of tenses. (L3)

CO2: Plan, structure, and draft technical reports tailored to target readers. (L2)

CO3: Apply editing, proofreading, and summarization techniques to improve readability and clarity. (L3)

CO4: Present technical reports effectively in written, printed, and verbal formats. (L2)

CO5: Utilize advanced word processing tools for professional document preparation, formatting, and collaboration. (L2)

CO6: Understand the fundamentals of Intellectual Property, patenting processes, and global IP practices. (L2)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	–	–	–	2	–	1	–	2
CO2	3	2	2	2	–	–	–	2	–	1	–	2
CO3	3	2	2	2	–	–	–	2	–	1	–	2
CO4	3	2	2	2	–	–	–	2	–	2	–	2
CO5	3	2	2	2	–	–	–	2	–	2	–	2
CO6	2	2	2	2	–	–	–	2	–	2	–	2

COs / PSOs	PSO-1	PSO-2
CO1	2	3
CO2	2	3
CO3	2	3
CO4	1	3
CO5	2	3
CO6	1	3

UNIT-I: Introduction: An introduction to writing technical reports, technical sentences formation, using transitions to join sentences, Using tenses for technical writing.
Planning and Structuring: Planning the report, identifying reader(s), Voice, Formatting and structuring the report, Sections of a technical report, Minutes of meeting writing.

UNIT-II: Drafting report and design issues: The use of drafts, Illustrations and graphics. **Final edits:** Grammar, spelling, readability and writing in plain English: Writing in plain English, Jargon and final lay out issues, Spelling, punctuation and Grammar, Padding, Paragraphs, Ambiguity.

UNIT-III: Proofreading and summaries: Proofreading, summaries, Activities on summaries. **Presenting final reports:** Printed presentation, Verbal presentation skills, Introduction to proposals and practice.

UNIT-IV: Using word processor: Adding a Table of Contents, Updating the Table of Contents, Deleting the Table of Contents, Adding an Index, Creating an Outline, Adding Comments, Tracking Changes, Viewing Changes, Additions, and Comments, Accepting and Rejecting Changes, Working with Footnotes and Endnotes, Inserting citations and Bibliography, Comparing Documents, Combining Documents, Mark documents final and make them read only., Password protect Microsoft Word documents., Using Macros,

UNIT-V: **Nature of Intellectual Property:** Patents, Designs, Trade and Copyright. Process of **Patenting and Development:** technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property

Text Books:

1. Kompal Bansal & Parshit Bansal, "Fundamentals of IPR for Beginner's", 1st Ed., BS Publications, 2016.
2. William S. P Feiffer and Kaye A. Adkins,"Technical Communication: A Practical Approach", Pearson.
3. Ramappa, T.,"Intellectual Property Rights Under WTO", 2nd Ed., S Chand, 2015.

Reference Books:

1. Adrian Wall work, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.
2. Day R, How to Write and Publish a Scientific Paper, Cambridge University Press(2006).

E-resources:

1. https://www.udemy.com/course/reportwriting/
2. https://www.udemy.com/course/professional-business-english-and-technical-report-writing/
3. https://www.udemy.com/course/betterbusinesswriting/