B. Tech. – III Year I Semester

S.No.	Category	Title	L	T	P	C
1	Professional Core	Data Warehousing and Data Mining	3	0	0	3
2	Professional Core	Principles of Machine Learning	3	0	0	3
3	Professional Core	Data Visualization	3	0	0	3
4	Professional Elective-I	1.Object Oriented Analysis and Design 2.Soft computing 3.Internet of Things 4.Exploratory Data Analysis with Python	3	0	0	3
5	Open Elective- I	OR Entrepreneurship Development & Venture Creation	3	0	0	3
6	Professional Core	Data Warehousing and Machine Learning Lab	0	0	3	1.5
7	Professional Core	Data Visualization Lab	0	0	3	1.5
8	Skill Enhancement course	Full Stack Development-2 / SWAYAM Plus – Data Engineer / AI Engineer	0	1	2	2
9	ES	Tinkering Lab *(User Interface design using Flutter)*	0	0	2	1
10	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

B. Tech.– III Year II Semester

S.No.	Category	Title	L	T	P	C
1	Professional Core	Big Data Analytics	3	0	0	3
2	Professional Core	Deep Learning	3	0	0	3
3	Professional Core	Natural Language Processing	3	0	0	3
4	Professional Elective-II	1. Cryptography & Network Security 2. Operating Systems 3. Recommender Systems 4. Computer Vision 5. Automata Theory & Compiler Design	3	0	0	3
5	Professional Elective-III	1. Quantum Computing 2. NoSQL databases 3. Cloud Computing 4. Social Media Analytics 5. Any of the 12-Week SWAYAM /NPTEL Course suggested by the BoS	3	0	0	3
6	Open Elective – II		3	0	0	3
7	Professional Core	Deep Learning & Natural Language Processing Lab	0	0	3	1.5
8	Professional Core	Big Data Analytics Lab	0	0	3	1.5
9	Skill Enhancement course	Soft skills / SWAYAM Plus - 21st Century Employability Skills	0	1	2	2
10	Audit Course	Technical Paper Writing & IPR	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 B. Tech I Semester	DATA WAREHOUSING AND DATA MINING	L	T	P	C
		3	0	0	3

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 warehousing 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.

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, Jiawei Han, 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 K Pujari, 3rd edition, Universities Press,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 B. Tech I Semester	PRINCIPLES OF MACHINE LEARNING	L	T	P	C
		3	0	0	3

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.

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

- Enumerate the Fundamentals of Machine Learning
- Build Nearest neighbour based models
- Apply Models based on decision trees and Bayes rule
- Make use of Linear discriminants for machine Learning
- Choose appropriate clustering technique

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", Tom M. Mitchell, McGraw-Hill Publication, 2017
2. "Machine Learning in Action",Peter Harrington, DreamTech
3. "Introduction to Data Mining", Pang-Ning Tan, Michel Stenbach, Vipin Kumar, 7th Edition, 2019.

III B. Tech I Semester	DATA VISUALIZATION	L	T	P	C
		3	0	0	3

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

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 B. Tech I Semester	OBJECT ORIENTED ANALYSIS AND DESIGN	L	T	P	C
		3	0	0	3

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.

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 Designin 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 B. Tech I Semester	SOFT COMPUTING	L	T	P	C
		3	0	0	3

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

- Learn soft computing techniques and their applications.
- Analyze various neural network architectures.
- Define the fuzzy systems.
- Understand the genetic algorithm concepts and their applications.
- Identify and select a suitable Soft Computing technology to solve the problem; construct a solution and implement a Soft Computing solution

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.
3. Driankov D., HellendoornH.andReinfrankM.,An Introduction to Fuzzy Control Narosa Pub., 2001.
4. BartKosko, Neural Network and Fuzzy Systems-Prentice Hall,Inc.,Englewood Cliffs, 1992
5. Goldberg D.E, Genetic Algorithms in Search, Optimization, and Machine Learning Addison Wesley, 1989

III B. Tech I Semester	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

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

- Explain in a concise manner how the general Internet as well as Internet of Things work.
- Understand constraints and opportunities of wireless and mobile networks for Internet of Things.
- Use basic sensing and measurement and tools to determine the real-time performance of network of devices.
- Develop prototype models for various applications using IoT technology.

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 Gateway 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, Cuno Pfister , Oreilly

III B. Tech I Semester	EXPLORATORY DATA ANALYSIS WITH PYTHON	L	T	P	C
		3	0	0	3

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

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 dataframe
4. Selecting rows and columns in the dataframe

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 seaborn library for iris 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 Dataframes b) Reshaping with Hierarchical Indexing
   c) 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
   c) 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
   b) 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. Ronald K. Pearson, Exploratory Data Analysis Using R, CRC Press, 2020
2. RadhikaDatar, Harish Garg, Hands-On Exploratory Data Analysis with R: Become an expert in exploratory data analysis using R packages, 1st Edition, Packt Publishing, 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 B. Tech I Semester	DATA WAREHOUSING AND DATA MINING LAB	L	T	P	C
		0	0	3	1.5

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 data sets using popular data mining tools such as WEKA, Python Libraries
- Develop ability to design various algorithms based on data mining tools.

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, Snowflake and Fact Constellation schemas for any one enterprise (ex. Banking, Insurance, Finance, Healthcare, manufacturing, Automobiles, sales etc).
   - Write ETL scripts and implement using data warehouse tools.
   - Perform Various OLAP operations such slice, dice, roll up, 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 toolkit.
   - Understand the features of WEKA toolkit 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)
   - Study the arff file format Explore the available data sets in WEKA. Load a data set (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

data sets

- 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 into Weka and run 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.
- Derive interesting insights and observe the effect of discretization in the rule generation process.

4. Demonstrate performing classification on data sets Weka/R
   - Load each dataset and run 1d3, 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 data sets
   - Load each dataset into Weka/R and 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 data sets 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 a cross validation using J48 algorithm
   - Demonstrate plotting multiple ROC curves in the same plot window by using j48 and Random forest tree
7. Demonstrate ZeroR 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 Naive 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.,)

		L	T	P	C
III B. Tech I Semester	DATA VISUALIZATION LAB	0	0	3	1.5

Course Objectives:

- To visualize the different datasets 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, heatmap and 3D graphs.

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

- Visualize the different datasets using histograms, line charts.
- Make use of bar charts and box plots on different datasets
- Apply Scatter plots, mosaic plots in R for different datasets
- Apply different Map visualizations in R
- Create advanced graphs such as correlogram, heatmap and 3D graphs.

List of Experiments:

1. a) Load VADeaths(Death Rates in Virginia)dataset in R and visualize the data using different histograms.
   b) Load air quality dataset in R and visualize La Guardia Airport's dialy maximum temperature using histogram.
2. Load AirPassengers 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 HairEyeColor dataset in R and plot categorical data using mosaic plot.
8. Load mtcars dataset in R and visualize data using heat map.
9. Install leaflet library in R and perform different map visualizations.
10. Visualize iris dataset using 3d graphs such as scatter3d, 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 B. Tech I Semester	FULL STACK DEVELOPMENT-2	L	T	P	C
		0	1	2	2

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: ExpressJS – Database, RESTful 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 RESTful 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 using react 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 13-15: Augmented Programs: (Any 2 must be completed)

13. Design a to-do list application using NodeJS and ExpressJS.
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 W Sebesta, 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 B. Tech I Semester	TINKERING LAB (USER INTERFACE DESIGN USING FLUTTER)	L	T	P	C
		0	0	2	1

Course Objectives:

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

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) Set up 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 framework.
   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 meaningful way 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. Marco L. Napoli, Beginning Flutter: A Hands-on Guide to App Development.
2. Rap Payne, Beginning App Development with Flutter: Create Cross-Platform Mobile
3. Apps 1st Edition, Apres

		L	T	P	C
III B. Tech II Semester	BIG DATA ANALYTICS	3	0	0	3

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 echo system.

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 forMap 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 EasierAdmiring 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 Java 4th Edition, Cay Horstmann, Wiley John Sons, INC
2. Hadoop: The Definitive Guide by Tom White, 3[rd.]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 Alex Holmes, MANNING Publ.
4. Big Data Analytics by Dr. A.Krishna Mohan and Dr.E.Laxmi Lydia
5. Hadoop Map Reduce Cookbook, SrinathPerera, ThilinaGunarathne

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

		L	T	P	C
III B. Tech II Semester	DEEP LEARNING	3	0	0	3

Course Objectives:

1. 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:

- Explore feed forward networks and Deep Neural networks
- Mathematically understand the deep learning approaches and paradigms
- Apply the deep learning techniques for various applications

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, Backpropagation, 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).

UNITIV: 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.

UNITV: 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 B. Tech II Semester	NATURAL LANGUAGE PROCESSING	L	T	P	C
		3	0	0	3

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

- Demonstrate a given text with basic Language features
- To design an innovative application using NLP components
- Explain a rule based system to tackle morphology/syntax of a language
- To design a tag set to be used for statistical processing for real-time applications
- To compare and contrast the use of different statistical approaches for different types of NLP applications.

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, Treebanks, 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. Handbook 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 B. Tech II Semester	CRYPTOGRAPHY & NETWORK SECURITY	L	T	P	C
		3	0	0	3

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
- Discuss the fundamental ideas of Symmetric and Asymmetric Cryptographic Algorithms
- Discusses the Network layer, Transport Layer and Application Layer Protocols Enhanced security mechanisms

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, Mc Graw Hill, 3rd Edition
2. Introduction to Cryptography with Coding Theory: Wade Trappe, Lawrence C. Washington, Pearson.
3. Modern Cryptography: Theory and Practice ByWenbo Mao. Pearson

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.
- Illustratedifferentconditionsfordeadlockandtheirpossiblesolutions.

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,10[th]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 B. Tech II Semester	RECOMMENDER SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

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

Course Outcomes:

- Describe basic concepts behind recommender systems
- Explain a variety of approaches for building recommender systems
- Describe system evaluation methods from both algorithmic and users' perspectives
- Describe applications of recommender systems in various domains

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 Handbook, Springer(2011), 1st ed.

References Books:

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

III B. Tech II Semester	COMPUTER VISION	L	T	P	C
		3	0	0	3

Course Objectives:

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

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.

UNITII: 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

UNITIII: TheNetworkLayer: 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

UNITIV: TheTransportLayer: The Transport Layer Services, Transport Layer Protocols: UDP, TCP and SCTP

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

Textbooks:

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 B .Tech II Semester	AUTOMATA THEORY & COMPILER DESIGN	L	T	P	C
		3	0	0	3

UNIT – I: Introduction to Finite Automata: Structural Representations, Automata and Complexity, the Central Concepts of Automata Theory – Alphabets, Strings, Languages, Problems. Nondeterministic 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: Introduction to Turing Machine, Formal Description, Instantaneous description, The language 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, Syntax Analysis: Introduction, Context-Free Grammars, Writing a Grammar, 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, SyntaxDirected 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, Ravi Sethi, 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.

III B. Tech II Semester	QUANTUM COMPUTING	L	T	P	C
		3	0	0	3

Course Objectives:

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

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, basics of 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. Yanofsky 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 B. Tech II Semester	B.TECH (AI&DS) (R23) III[rd] YEAR CURRICULUM STRUCTURE & SYLLABUS	L	T	P	C
		3	0	0	3

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

CO1: Explain and compare different types of NoSQL Databases

CO2: Compare and contrast RDBMS with different NoSQL databases.

CO3: Demonstrate the detailed architecture and performance tune of Document-oriented NoSQL databases.

CO4 : Explain performance tune of Key-Value Pair NoSQL databases.

CO5: Apply NoSQL development tools on different types of NoSQL Databases.

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 Use Cases, 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,NoSQLDistilled:ABriefGuidetotheEmergingWorldof PolyglotPersistence, 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 B. Tech II Semester	CLOUD COMPUTING	L	T	P	C
		3	0	0	3

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, server less computing and cloud-centric Internet of Things.

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, serverless computing architecture, public cloud (e.g. AWS Lambda) and open-source (e.g. OpenFaaS) 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, ShivanandaPoojara, 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, MK Elsevier, 2018.
2. Essentials of cloud Computing, K. Chandrasekhran, CRC press, 2014.
3. Online documentation and tutorials from cloud service providers (e.g., AWS, Azure, GCP)

III B. Tech II Semester	SOCIAL MEDIA ANALYTICS	L	T	P	C
		3	0	0	3

Course Objectives:

Knowledge on social media and its analytics Course

Course Outcomes:

1. Understanding characteristics and types of social media
2. Knowledge on layers of social media analytics
3. Apply text analysis tools on social media data
4. Understand the significance of action analytics
5. Detect viral topics on social media(YouTube)

UNIT-I: Introduction to Social Media World Wide Web, Web 1.0, Web 2.0, Web3.0, 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-More Group

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

Case Study: Hyperlinks And Viral YouTube Videos

Text Books:

1. Seven Layers Of Social Media Analytics Mining Business Insights From Social Media Text, Actions, Networks, Hyperlinks, Apps, SearchEngine, And Location 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,DreamtechPress,2015Edition.

III B. Tech II Semester	DEEP LEARNING AND NATURAL LANGUAGE PROCESSING LAB	L	T	P	C
		0	0	3	1.5

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

- Design Neural networks to solve real world problems
- Build RNN, CNN models for classification
- Choose appropriate pre-trained model to solve real time problem
- Apply different NLP techniques using NLTK package.
- Design solutions to real-world problems using NLP

Software Packages Required:

- Keras
- Tensorflow
- PyTorch
- NLTK

List of Experiments:

1. Implement Multilayer Perceptron algorithm for MNIST Handwritten 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, AlexNet for image classification.
6. Implement One Hot Encoding and Word Embeddings on any real world dataset.
7. Create Sample list at least 10 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 B. Tech II Semester	BIG DATA ANALYTICS LAB	L	T	P	C
		0	0	3	1.5

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 MapReduce.

Hint: Two MapReduce jobs are required to calculate the FoFs for each user in a social 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 PageRank graph algorithm in MapReduce.

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

Experiment 9: Week 10:

9. Perform an efficient semi-join in MapReduce.

Hint: Perform a semi-join by having the mappers load a Bloom filter from the Distributed Cache, and then filter results from the actual MapReduce 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 B. Tech II Semester	SOFT SKILLS	L	T	P	C
		0	1	2	2

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

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 B. Tech II Semester	TECHNICAL PAPER WRITING & IPR	L	T	P	C
		2	0	0	-

Course Objective:

1. 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

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 layout 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. Pfeiffer 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 Wallwork , 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/