COURSE STRUCTURE-M.Tech(Data Science)

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

I year –I Semester

Course Code	Type of course	Name of the course	Periods per week		Max. Marks		Credits
			Lect.	Lab.	Sess.	End sem	
MTDS111	Program Core-1	Mathematical Foundations for Computer Science	3	--	40	60	3
MTDS112	Program Core-2	Data warehousing and Data Mining	3	--	40	60	3
MTDS113	Elective-1	Elective-1	3	--	40	60	3
MTDS114	Elective-2	Elective-2	3	--	40	60	3
MTDS115	Mandatory Course	Research Methodologies& IPR	2	--	40	60	2
MTDS116	Audit Course	Audit Course-1	2	--	40	--	0
MTDS117	Laboratory Course	Knowledge Engineering -Lab	--	3	50	50	2
MTDS118	Laboratory Course	Elective- Lab	--	3	50	50	2
Total			**16**	**6**	**340**	**400**	**18**

Elective-1:

A. Data Pre-processing & Analysis
B. Artificial Intelligence
C. Information Security

Elective-2:

A. Big Data Analytics
B. Data Visualization
C. Neural Networks

Audit course 1& 2

1. Ethics
2. English for Research Paper Writing
3. Disaster Management
4. Sanskrit for Technical Knowledge
5. Value Education
6. Constitution of India
7. Pedagogy Studies
8. Stress Management by Yoga
9. Personality Development through Life Enlightenment Skills.

I year –II Semester

Course Code	Type of course	Name of the course	Periods per week		Max. Marks		Credits
			Lect.	Lab.	Sess.	End sem	
MTDS121	Program Core-3	Machine Learning with R	3	--	40	60	3
MTDS122	Program Core-4	Soft Computing Techniques	3	--	40	60	3
MTDS123	Elective-3	Elective-3	3	--	40	60	3
MTDS124	Elective-4	Elective-4	3	--	40	60	3
MTDS125	Audit Course	Audit Course-2	2	--	40		0
MTDS126	Laboratory Course	Machine learning with R –Lab	--	3	50	50	2
MTDS127	Laboratory Course	Elective- Lab	--	3	50	50	2
MTDS128	Laboratory Course	Mini Project with seminar	--	3	100	--	2
Total			**14**	**9**	**400**	**340**	**18**

Elective-3:

A. Advanced Web Technologies
B. Principles of Deep Learning
C. Natural Language Processing

Elective-4:

A. Text analytics
B. Internet of Things
C. NoSQL

II year –I Semester

Course Code	Type of course	Name of the course	Periods per week		Max. Marks		Credits
			Lect.	Lab.	Sess.	End sem	
MTDS211		Moocs-1	--	--	--	100	3
MTDS212		Moocs-2	--	--	--	100	3
MTDS213	Dissertation –I/ Industrial project		--	--	100	--	10
Total			**--**	**--**	**100**	**200**	**16**

II year –II Semester

Course Code	Type of course	Name of the course	Periods per week		Max. Marks		Credits
			Lect.	Lab.	Sess.	End sem	
MTDS221	Dissertation –II		--	--	100	100	16
Total			**--**	**--**	**100**	**100**	**16**

Mathematical Foundation of Computer Science	
MTDS111	**Credits : 3**
Instruction : 3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites: Discrete Mathematics, Probability and Statistics

Course Objectives:

1. To provide the foundations of probabilistic and statistical analysis that can be helpful in modelling applications like Pattern recognition, Computer networks, Machine learning, Programming language design etc.
2. To study various sampling and classification problems.
3. Use graph theory for solving real world problems.

Course outcomes:

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

1.	Familiarise concepts on Discrete, Continuous probability distributions and basic notions of central limit theorem and Markov chain.
2.	Infer the data by hypothesis testing procedure and explain method of moments ,maximum likelihood estimation.
3.	Analyze the regression model with hypothesis tests and interprets the results.
4.	Apply graph models in real time applications.
5.	Apply number theory to cryptography problems.

CO - PO mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	--	--	--	--	--	1	--	--	2		2
CO2	3	2	1	--	--	--	--	--	1	--	--	2		2
CO3	3	2	1	--	--	--	--	--	1	--	--	2		2
CO4	3	2	1	--	--	--	--	--	1	--	--	2		2
CO5	**3**	2	1	--	--	--	--	--	1	--	--	2		2

SYLLABUS

UNIT-1 14 periods

Fundamentals: Probability mass, density, and cumulative distribution functions, Parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central limit theorem, Probabilistic inequalities, Markov chains.

(Text Book – 1)

Learning outcome: at the end of this unit student are able to

1. Explain different measures of a random variable and properties of distribution functions.
2. Solve problems based on central limit theorem and Markov chain.

UNIT-2 14 periods

Statistical Inference: Introduction, Parameter estimation: The method of moments, Maximum – Likelihood Estimation. Hypothesis testing: Tests on the population mean, Hypotheses concerning two means, Hypotheses concerning variances, Goodness of fit tests.

(Text Book – 1)

Learning outcome: at the end of this unit student are able to

1. Perform and analyze hypotheses tests of means, variances and 2- test.
2. Explain the concepts of parameter estimation of a population and Maximum – Likelihood estimator.

UNIT-3 10 periods

Regression and Analysis of variance: Introduction, Least squares curve fitting, The coefficients of determination , Confidence intervals in linear regression, Trend detection and slope estimation, Correlation analysis and Analysis of variance.

(Text Book – 1)

Learning outcome: at the end of this unit student are able to

1. Recognize regression analysis applications for purposes of description and prediction.
2. Apply classification and regression techniques in real time data for analysis.

UNIT-4 12 Periods

Graphs: Graphs: Graphs and Graph Models, Special Types of Graphs, Applications of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest Path Problems, Planar Graphs, Graph Coloring, Applications of Graph Colorings, Spanning Trees.

(Text Book – 2)

Learning outcome: at the end of this unit student are able to

1. Analyze various types of graphs and their properties.
2. Use graph theory as a modelling tool.

UNIT-5 10 Periods

Number Theory and Cryptography: Fundamental algorithms involving numbers, cryptography computations, information security algorithms and protocols.

Computer Science and Engineering Applications: HMM, Routing algorithms, Bayes Theorem.

(Text Book – 3)

Learning outcome: at the end of this unit student are able to

1. Study fundamental algorithms for symmetric key and public-key cryptography.
2. Implement and analyze cryptographic and number-theoretic algorithms.

Text Book:

1. Kishor S. Trivedi, "*Probability & Statistics with Reliability, Queuing and Computer Science Applications",* 2nd Edition, John Wiley and Sons Ltd., 2016.
2. Kenneth H. Rosen, "*Discrete Mathematics and its Applications with Combinations and Graph Theory",* McGraw Hill Edition(India) Pvt. Ltd., 2011.
3. M. T. Goodrich, R. Tomasia, "*Algorithm design – Foundations, Analysis and Internet Examples" , John Wiley, 2011.*

Reference Books :

1. John Vince, "*Foundation Mathematics for Computer Science*", Springer, 2015.
2. M. Mitzenmacher and E. Upfal, " *Probability and Computing: Randomized Algorithms and Probabilistic Analysis*", Cambridge University Press.
3. Joe L Mott, Abraham Kandel, Theodore P. Baker, " *Discrete Mathematics for Computer Scientists & Mathematics",* 2nd Edition, 2008.

Data Warehousing and Data Mining	
MTDS 112	**Credits : 3**
Instruction : 3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites: Database management systems concepts, Probability and statistics

Course Objectives:

1. To know the data storage in data warehousing.
2. To handle real world data to pre-processing
3. The importance of data analysis through data mining.

Course Outcomes:

By the end of the course, the student will be able to:

1.	Extend the basics, challenging issues in Data Mining data warehousing.
2.	Apply data pre-processing approaches in real time data sets
3.	Analyse association rule mining in various dimensional databases.
4.	Apply classification by using decision tree induction, Bayesian, back propagation and prediction methods for data analysis.
5.	Interpret categorization of major clustering methods.

CO-PO Mapping:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO 1	**2**	1	-	**-**	1	-	-	1	1	-	**-**	2	-	1
CO 2	**1**	2	1	**-**	**2**	-	-	**1**	1	**-**	**-**	**2**	-	1
CO 3	**2**	3	1	2	**2**	**1**	--	2	2	-	2	**2**	3	2
CO 4	**2**	3	1	2	**2**	**1**	**--**	1	1	-	2	2	2	2
CO 5	**2**	2	2	1	**1**	**1**		1	-	-	-	-	2	2

SYLLABUS

UNIT-1 14 periods

Data warehouse: Introduction to Data warehouse, Difference between operational database systems and Data warehouses. Differences between operational databases systems and data warehouses. **Multidimensional data model**: From Tables and spreadsheets to Data Cubes, stars, Snowflakes, and Fact Constellations schemas for Multidimensional databases. Examples for defining star, snowflake and fact constellation schemas. **Data Warehouse Architecture:** Steps for the design and construction of data warehouses. A three-tier data warehouse architecture. **From Data warehousing to data mining**: Data warehouse usage, from on-line analytical processing to online analytical mining.

Learning outcome: at the end of this unit student are able to

1. Explain data storage in the data warehouse and multidimensional model
2. To know the architecture of data warehouse

UNIT-2 14 periods

Data Mining Introduction: Data mining-on what kind of data, Relational databases, data warehouses, transactional databases, advanced database systems and advanced database applications. Data mining functionalities, classification of data mining systems, Major issues in data mining.

Data Pre-processing: Data cleaning: Missing values, Noisy data, inconsistent Data, Data Integration and Transformation: Data Integration, Data transformation Data Reduction: Data cube aggregation, dimensionality reduction, data compression, Numerosity reduction.

Learning outcome: at the end of this unit student are able to

1. Motivate the importance of data mining, its functionalities and issues
2. Find the importance of data pre-processing methodologies

UNIT-3 12 periods

Association Rule mining in Large Databases: Association rule mining , mining single-dimensional Boolean association rules from transaction databases, Mining multilevel association rules from transaction databases. Mining multidimensional association rules from relational databases. From association mining to correlation analysis. Constraint based association mining.

Learning outcome: at the end of this unit student are able to

1. Generate association rules to given data and analyse market basket analysis
2. Analyse association mining to correlation analysis.

UNIT-4 12 Periods

Classification and Prediction: Issues regarding classification and prediction, Classification by decision tree induction, Bayesian classification, Classification by back propagation, Prediction, classification accuracy.

Mining Time series Data: Mining Time series Data, Periodicity Analysis for time related sequence data.

Learning outcome: at the end of this unit student are able to

1. Relate the importance of classification and prediction in data analysis.
2. Apply classification and regression techniques in real time data for analysis

UNIT-5 10 Periods

Cluster Analysis: Types of data in cluster analysis, a categorization of major clustering methods, Partition based methods: K-means, K-medoids. Hierarchical methods: BIRCH, CURE Density-based methods: DBSCAN.

Mining Data Streams: Methodologies for stream data processing and stream data systems,

Learning outcome: at the end of this unit student are able to

1. Outline various types of clustering methods
2. Apply and analyse various types of clustering methods to real time data set.

Text Book:

1. Data Mining Concepts and Techniques, Jiawei Han and Micheline Kamber, Morgan Kaufman Publications, 2nd edition

Reference Books:

1. Introduction to Data Mining - Pang-Ning Tan, Michael Steinbach, Addison Wesley,2nd Edition,
2. Introduction to data mining and soft computing- Dr.M.Ramarkrishna Murty , University science press. 1st edition.

E-Resources :

https://www.coursera.org/specializations/data-mining

https://www.udemy.com/course/data-mining/

Data Preparation and Analysis	
MTDS113(A)	**Credits : 3**
Instruction : 3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites: Normalization in DBMS

Course Objectives:

1. Learn pre-processing methods for multi- dimensional data.
2. Practice on data cleaning mechanisms
3. Learn various data exploratory analysis
4. Develop the visualizations for clusters or partitions

Course Outcomes:

By the end of the course, the student will be able to:

1.	Identify the data parsing and transformations techniques
2.	Analyse the basic concept of data cleaning for valuable information with a minimum consistency checking.
3.	Interpret statistical exploratory analysis with hypothesis generation
4.	Design visualizations for exploratory analysis and interpret the concept of correlations and connections for geolocated data.
5.	Apply R programming for investigating trends, patterns, and relationships using quantitative data

CO-PO Mapping:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO 1	2	1	1		1								2	1
CO 2	2	2	1	2	2								2	1
CO 3	2	3	1	2	2							1	2	1
CO 4	1	3	1	1	2							1	1	1
CO 5	2	2	2	1	1							1	1	1

SYLLABUS

Unit 1 **10 Periods**

Data Gathering and Preparation: Data formats, parsing and transformation, Scalability and real-time issues

Learning outcomes: At the end of this unit student are able to

1.Gain knowledge to identify the data parsing and transformations.

2. Identify the difference between data and information with formats.

Unit 2 **10 Periods**

Data Cleaning: Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation

Learning outcomes: At the end of this unit student are able to

1. Identify the missing and heterogenous data.

2. Know how data is transformation and segmentation techniques

Unit 3 **10 Periods**

Exploratory Analysis: Descriptive and comparative statistics, Clustering and association, Hypothesis generation

Learning outcomes: At the end of this unit student are able to

1. Interpret the statistical exploration analysis

2. Derive the hypothesis for association rules to discovery of strong association rules

Unit 4 **10 Periods**

Visualization: Designing visualizations, Time series, Geolocated data, Correlations and connections, Hierarchies and networks, interactivity.

Learning outcomes: At the end of this unit student are able to

1. Acknowledge the importance of data visualization and the design and use of many visual components

2. Recognize the relation between the correlation and connection for data

Unit 5 **14 Periods**

Visualizations using R: R Data Structures, Matrices, Arrays and Lists, Data Frames**.**

Descriptive Statistics: Vector to Matrix, Matrix Access, Data Frames, Types of Data, Measures of Central Tendency, Bar Chart, Pie Chart and Box Plot, Measures of Variability, Skewness and Kurtosis, Histogram, Stem and Leaf Diagram, Standard Error of Mean and Confidence Intervals.

Learning outcomes: At the end of this unit student are able to

1. Master the basics in R programming in terms of constructs, control statements, string functions
2. Apprehend key terminologies, concepts and techniques employed in Statistical Analysis.

Textbook(s):

1. Glenn J. Myatt, Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, John Wiley Publishers, 2007.
2. Norman Matloff," The Art of R Programming: A Tour of Statistical Software Design", No Starch Press, 2011

Reference:

1. Ken Black, 2013, Business Statistics, New Delhi, Wiley

Artificial Intelligence	
MTDS113(B)	**Credits : 3**
Instruction : 3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites: Data structures and algorithms.

Course Objectives:

1. Gain a historical perspective of AI and its foundations.
2. Become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning.
3. Investigate applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.

Course Outcomes:

By the end of the course, the student will be able to:

1.	Demonstrate the philosophical perspective of artificial intelligence
2.	Explore the Heuristic search techniques.
3.	Take part in proposition logic for knowledge based representation.
4.	Classify uncertainty, knowledge reasoning and learning system
5.	Functioning of expert systems and Natural language processing

CO-PO Mapping:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O 1**	**PS O 2**
CO1	2	2	1	2	2	1	-	-	1	-	-	1	2	3
CO2	2	2	1	2	2	1	-	-	1	-	-	1	2	3
CO3	2	2	2	2	2	1	-	-	1	-	-	1	2	3
CO4	2	2	2	2	2	1	-	-	1	-	-	1	2	3
CO5	2	2	1	2	2	1	-	-	1	-	-	1	2	3

SYLLABUS

UNIT-I 14 Periods

INTRODUCTION : Philosophy of artificial intelligence, Definitions - Evolution of AI - Applications of AI, Classification of AI- Intelligent Agents: Agents and Environment-Nature of Environment- Structure Environment SEARCHING BASED PROBLEM SOLVING : Problem Solving Agent - Blind Search- Performance measures - Informed Search: Introduction to Heuristics-Variants of heuristic search-uniform cost, A*,Greedy - Overview of Hill Climbing – Simulated Annealing – Genetic Algorithms – Adversarial Search – Minimax, Alpha beta pruning

Learning outcomes: At the end of this unit student are able to

1. Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.
2. Examine Different Heuristic search techniques.

UNIT-II 12 Periods

KNOWLEDGE REPRESENTATION AND REASONING: Logical systems – Knowledge Based systems, Propositional Logic – Constraints, Predicate Logic – First Order Logic, Inference in First Order Logic, Ontological Representations and applications Knowledge representation and reasoning through logic PLANNING :Planning Problem – Planning with State Space Search – Partial order Planning – Planning and Acting in the Real World: Conditional Planning – Re-planning Agents, Robotics-Action

Learning outcomes: At the end of this unit student are able to

1. Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.
2. Examine Different planning problems.

UNIT-III 12 Periods

UNCERTAINTY AND KNOWLEDGE REASONING: Overview – Definition of uncertainty, Utility Based System, -Bayes Rule – Inference, Belief Network, Markov decision processes, knowledge representation and reasoning through fuzzy logic and Bayesian networks

Learning outcomes: At the end of this unit student are able to

1. Demonstrate the concept of uncertainty and utility based systems.
2. Examine Different knowledge reasoning techniques..

UNIT-IV 12 Periods

LEARNING SYSTEMS Machine learning, Forms of Learning – Types - Supervised, unsupervised, reinforcement learning, Learning Decision Trees, soft computing- Artificial Neural Network.

Learning outcomes: At the end of this unit student are able to

1. Demonstrate awareness and a fundamental understanding of various applications of AI techniques in artificial neural networks and other machine learning models.
2. Demonstrate proficiency in applying scientific method to models of machine learning.

UNIT-V 12 Periods

EXPERT SYSTEMS & NLP: Introduction to Expert Systems- Architecture, Reasoning, and explanation-Knowledge Acquisition-Introduction to Natural Language Processing-Morphological Analysis-Syntax Analysis-Semantic Analysis.

Learning outcomes: At the end of this unit student are able to

1. Demonstrate awareness on expert system based AI solutions.
2. Theme the natural language processing procedure.

Text Book:

1. Artificial Intelligence, George F Luger, Pearson EducationPublications
2. Artificial Intelligence, Elaine Rich and Knight, Mcgraw-HillPublications

References:

1. Introduction To Artificial Intelligence & Expert Systems, Patterson, PHI
2. Multi Agent systems- a modern approach to Distributed Artificial intelligence, Weiss.G, MITPress.
3. Artificial Intelligence : A modern Approach, Russell and Norvig, PrinticeHall

Information Security	
MTDS113(C)	**Credits : 3**
Instruction : 3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Pre-Requisites:

- **Basic knowledge of Computer Networks.**

Course Objectives:

- Learn the fundamental concepts of Cryptography.
- Acquire the knowledge about the applications of Cryptography.
- Interpret the concepts of foot printing and reconnaissance with various tools.
- Analyse the working of sniffing tools for gaining access to the captured network traffic.
- Learn the significance of SQL Injection and its applications.

Course Outcomes:

By the end of the course, the student will be able to:

1.	Understand the fundamental concepts of Cryptography.
2.	Acquire the knowledge about the Cryptography algorithms.
3.	Memorize the concepts of foot printing and reconnaissance with various tools.
4.	Demonstrate the working of sniffing tools for gaining access to the captured network traffic.
5.	Understand the significance of SQL Injection and its applications.

CO-PO Mapping:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PS O 1**	**PS O 2**
CO 1	**1**	1	2	**-**	-	-	-	1	1	1	**-**	1	-	2
CO 2	**1**	-	1	**-**	**1**	-	-	**1**	1	**1**	**-**	**1**	-	2
CO 3	**1**	2	2	1	**3**	**1**	-	-	1	-	-	**2**	1	2
CO 4	**1**	2	3	3	**3**	**1**	**-**	1	1	-	-	2	1	2
CO 5	**1**	2	2	2	**3**	**1**	**-**	1	1	-	-	2	1	2

SYLLABUS

UNIT-1 **10 periods**

Security goals, attacks-passive and active attacks, services and mechanisms, techniques. Mathematics for cryptography: Integer Arithmetic, Modular Arithmetic, Linear Congruence. A model for network security, Internet Standards. Buffer overflow and format string vulnerabilities,

Learning outcome: At the end of this unit the student will be able to

1. Understand the basics of Cryptography.

UNIT-2 **12 periods**

Symmetric Cryptography: Introduction, Substitution ciphers, Transposition ciphers, Feistel Structure, DES-AES-RC4.

Public Key Cryptography: Encryption/Decryption using RSA, RSA with example.

TCP Session hijacking, ARP Attacks, man-in-the-middle attacks, SQL injection, Phishing attacks, Tools-Ettercap, Burpsuite.

Learning outcomes: At the end of this unit the student will be able to

1. Understand the Cryptographic Algorithms.
2. Able to implement Session hijacking.

UNIT-3 **12 Periods**

Gaining Access, Sniffers: System Hacking, password cracking, password cracking techniques, passive online attacks, active online attacks, offline attacks; Sniffers: Understanding Sniffers, Using a Sniffer, Sniffing Tools- Wireshark, TCP Dump, Reading Sniffer Output, Switched Network Sniffing, Detecting Sniffing Attacks.

(From Chapter 7 & 9 of Book 3)

Learning outcomes: At the end of this unit the student will be able to

1. Understand the types of attacks.
2. Able to implement the packet capturing.

UNIT-4 **14 Periods**

SQL Injection: Introducing SQL Injection, Results of SQL Injection, the Anatomy of a Web Application, Databases and Their Vulnerabilities, Anatomy of a SQL Injection Attack, Altering Data with a SQL, Injection Attack, Injecting Blind, Information Gathering, Evading Detection Mechanisms, SQL Injection Countermeasures.

(Chapters 13 & 14 of Book 3)

Learning outcomes: At the end of this unit the student will be able to

1. Implement the SQL Injection.

UNIT-5 **12 Periods**

System Intrusion Detection and Prevention: Basics, roles of IDS in network defence, IDS sensor placement, case study. IPS – basics, Limitations, NIPS, HIPS, Honey pots and Honey nets, Password protection, Password Selection Strategies, Malicious Programs, Types of viruses, worms, Trojan horses.

Learning outcomes: At the end of this unit the student will be able to

1. Understand the concepts of IDS and IPS.

Text Books:

1. Network security Essentials, Applications and standards, 3e, William Stallings, Pearson Education (for unit-1).
2. Cryptography and Network Security, Behrouz A. Forouzan, Tata McGraw Hill. (unit-2)
3. CEHv8 Certified Ethical Hacker Version 8 Study Guide, by Sean-Philip Oriyano, Sybex (A Wiley Brand) ISBN: 978-1-118-64767-7 (unit-3 and 4).
4. Cryptography and Network Security: Principles and Practice, William Stallings, 5th edition, Pearson.

Reference Books:

1. B. Menezes, Network security and Cryptography, Cengage Learning India, 2010.
2. Network Security Essentials (Applications and Standards) by William Stallings Pearson Education.
3. Principles of Information Security, Whitman, Thomson.

E-Resources :

1. https://www.nisc.go.jp/security-site/campaign/files/aj-sec/handbook-all_eng.pdf
2. https://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-100.pdf

Big Data Analytics	
MTDS114(A)	**Credits : 3**
Instruction : 3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Pre- requisites:
Should have knowledge of one Programming Language, Practice of SQL (queries and sub queries), and exposure to data mining techniques.

Course Objectives:
- Understand the Big Data Analytics and Life cycle.
- Review of Basic Data Analytic Methods
- Provide MapReduce Concepts and Interfacing with Hadoop
- Understand Time Series Analysis, Text Analysis

Course Outcomes:
The students will be able to:
1. Identify Big Data and its Business Implications and understand the Analytics life cycle.
2. Compute abstractions for real time analytics.
3. Apply tools and techniques to analyze Big Data using Hadoop and Map Reduce.
4. Perform analysis on Time series and textual data.
5. Exploring twitter and weather analysis

Mapping of Course Outcomes with Program Outcomes:

Mapping	PO													PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO	1	2	1	1	1	1	1			1	1		2	2	1
	2	2	1	1	1	1	1			1	1	1	2	2	1
	3	2	2	2	2	3	1			1	1			1	3
	4	2	2	2	2	3	1	1	1	2	1			1	3
	5	1	2	2	2	1	1	1	1	2	1	2	1	2	3

Syllabus

UNIT I **14 Periods**

Introduction to Big Data Analytics: Big Data Overview, Data Structures, Analyst Perspective on Data Repositories, State of the Practice in Analytics, BI Versus Data Science, Current Analytical Architecture, Drivers of Big Data, Emerging Big Data Ecosystem and a New Approach to Analytics, Key Roles for the New Big Data Ecosystem Examples of Big Data Analytics.

Data Analytics Lifecycle: Data Analytics Lifecycle Overview, Discovery, Data Preparation, Model Planning, Model Building, Communicate Results, Operationalize.

Learning outcome: at the end of this unit student are able to

1. Analyse the applications of Big data Analytics
2. Examine the Lifecycle of Analytics.

UNIT II **12 Periods**

Review of Basic Data Analytic Methods Using R: Introduction to R, Exploratory Data Analysis, And Statistical Methods for Evaluation.

Real-Time Analytics: Computing Abstractions for Real-Time Analytics, Real-Time Processing for Big Data — Concepts and Platforms, Data Stream Processing Platforms, Data Stream Analytics Platforms, Data Analysis and Analytic Techniques.

Learning outcome: at the end of this unit student are able to

1. Review the methods of analytics using R
2. Recognize the Real-time analytics.

UNIT III **10 Periods**

Advanced Analytics-Technology and Tools: MapReduce and Hadoop, In-Database Analytics

Learning outcome: at the end of this unit student are able to

1. Realize the importance of Hadoop and MapReduce
2. Implementing Hadoop and MapReduce

UNIT IV **10 Periods**

Advanced Analytical Theory and Methods: Time Series Analysis, Text Analysis.

Learning outcome: at the end of this unit student are able to

1. Explore analytical theory and methods.
2. Implementing Analysis on Time serie and textual data.

UNIT V **14 Periods**

Putting It All Together: Creating the Final Deliverables, Data Visualization Basics

Case Studies in Big Data Analytics: Exploring Twitter Sentiment Analysis and the Weather.

Learning outcome: at the end of this unit student are able to

1. Acquire the data visualization basics.

2. Explore the twitter analysis and weather using big data analytics

TEXT BOOKS:

1. David Dietrich, Barry Heller, Beibei Yang,“Data Science & Big Data Analytics Discovering, Analyzing, Visualizing and Presenting Data EMC Education Services”, WILEY.
2. Rajkumar Buyya, Rodrigo N. Calheiros, “Big Data Principles and Paradigms”, Elsevier.

REFERENCES:

1. Vignesh Prajapati ,“Big Data Analytics with R and Hadoop”, 2013 Packt Publishing.

2. Arvind Sathi, "Big Data Analytics: Disruptive Technologies for Changing the Game", IBM

Corporation, 2012.

3. Michael Minelli, Michehe Chambers, Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Business", Wiley CIO Series, 2013.

4. Tom White, "Hadoop: The Definitive Guide", 3rd Edition, O'Reilly, 2012.

5. Kevin Roebuck, "Storing and Managing Big Data - NoSql, Hadoop and more: High-Impact Strategies - What You Need to Know", Tebbo, 2011.

6. Bill Franks, "Taming The Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", 1st Edition, Wiley and SAS Business Series, 2012.

Data Visualization	
MTDS114(B)	**Credits : 3**
Instruction : 3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites: Basic Maths, Statistics, and Query processing.

Course Objectives:

1. Gain basics of visualization, data processing and metrics
2. Become familiar with foundation of visualization process and visualization techniques for spatial data & geospatial data
3. visualizing time-oriented data, multivariate data, trees, graphs and networks
4. Investigate data visualization process using Power BI.

Course Outcomes:

By the end of the course, the student will be able to:

1.	Describe the concepts of visualization and data processing techniques
2.	Illustrate visualization techniques for spatial data and geospatial data
3.	Apply different visualization techniques on time-oriented data, multivariate data, trees, graphs, and networks
4.	Design and create different data visualization reports using Power BI
5.	Design and create Dashboard for real time data using Power BI

CO-PO Mapping:

	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS O 1	PS O 2
CO1	2	2	1	1	2	1	-	-	1	-	-	1	2	3
CO2	2	2	1	2	3	1	-	-	1	-	-	1	2	3
CO3	2	2	2	2	3	1	-	-	1	-	-	1	2	3
CO4	2	2	2	2	3	1	-	-	1	-	-	1	2	3
CO5	2	2	1	2	3	1	-	-	1	-	-	1	2	3

SYLLABUS

UNIT – I 12 Periods

Introduction: What is visualization, History of visualization, Relationship between visualization and other fields, The visualization process, The role of perception, The role of cognition, Pseudo code conventions, The scatter plot, The role of the user. Data Foundations: Types of data, Structure within and between records, Data processing Human Perception and Information Processing: What is perception, Physiology, Perception in visualization, Metrics.

Learning outcomes: At the end of this unit student are able to

3. Demonstrate fundamental understanding of the history of visualization and significance of virilization plots.
4. Examine Different kinds of data, data processing and visualization metrics.

UNIT – II 12 Periods

Visualization Foundations: The visualization process in detail, Semiology of graphical symbols, The eight visual variables, Taxonomies. Visualization Techniques for Spatial Data: One-dimensional data, Two-dimensional data, Three-dimensional data, Dynamic data. Visualization Techniques for Geospatial Data: Visualizing spatial Data, Visualization of point data, Visualization of line data, Visualization of area data, other issues in geospatial data visualization.

Learning outcomes: At the end of this unit student are able to

1. Demonstrate fundamental understanding of graphical symbols, variables, and taxonomies.
2. Examine Different kinds of visualization techniques for geospatial and spatial data.

UNIT – III 14 Periods

Visualization Techniques for Time-oriented Data: Introduction, Definitions: Characterizing time-oriented data, Visualizing time-oriented data, Time bench: A data model and software library for visual analytics of time-oriented data. Visualization Techniques for Multivariate Data: Point-based techniques, Line based techniques, Region based techniques, Combinations of techniques. Visualization Techniques for Trees, Graphs and Networks: Displaying hierarchical structure, Displaying arbitrary graphs, other issues.

Learning outcomes: At the end of this unit student are able to

1. Demonstrate fundamental understanding of the Time-oriented data and Multivariate data.
2. Examine Different type of visualization techniques for Trees, Graphs, and Networks.

UNIT – IV 12 Periods

Visual Analytics with Power BI (Part1): Introduction and getting started, uploading data, Natural language queries, reports, Visual interactions, decorating and filtering the report.

Learning outcomes: At the end of this unit student are able to

1. Demonstrate fundamental understanding of the Power BI Tool usage.
2. Examine the process of uploading to generating reports.

UNIT – V 12 Periods

Visual Analytics with Power BI (Part2): Introduction to dashboard, creating a group workspace, Introducing data refresh, Introducing Power BI Desktop, Connecting to a database, Query Editor.

Learning outcomes: At the end of this unit student are able to

1. Demonstrate fundamental understanding of Dashboard.
2. Examine the process creating dashboard and explorative analysis of data.

Text Books:

[1] Matthew O Ward, Georges Grinstein and Daniel Keim, *Interactive Data Visualization: Foundations, Techniques and Applications*, 2nd ed., Florida USA:CRC Press Taylor and Francis Group, 2015. (*Chapters: 1 to 9*)

[2] Alberto Ferrari and Marco Russo, *Introducing Microsoft BI, Microsoft press,* ISBN: 978-1-5093-0228-4

Reference Books:

[1] Andy Krik, *Data Visualization: A Handbook for Data Driven Design*, 1st ed., New Delhi: SAGE Publications Ltd., 2016.

[2] Edward R. Tufte, *The Visual Display of Quantitative Information*, 2nd ed., Connecticut: Graphics Press, 2001.

[3] Murray Scott, *Interactive Data Visualization for the Web*, 1st ed., California: O'Reilly Publications, 2013.

Neural Networks	
MTDS114(C)	**Credits : 3**
Instruction : 3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites: Mathematical Concepts like Statistics, Calculus, Linear Algebra and Probability.

Course Objectives:

1. To understand the biological neural network and to model equivalent neuron models.
2. To understand the architecture, learning algorithms and issues of various feed forward and feedback neural networks.

Course Outcomes:

By the end of the course, the student will be able to:

1.	Examine different Neural Network Architectures and Learning Rules.
2.	Analyse and differentiate Single Layer Perceptron and Multi-layered Perceptron based on their capabilities.
3.	Apply Back Propagation and solve different Neural Network Problems.
4.	Apply Self Organizing Maps in solving different pattern classification tasks.
5.	Differentiate Neural Networks and Deep Learning Algorithms.

CO-PO Mapping:

	PO 1	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	2	1	2	2	-	-	-	1	-	-	1	2	3
CO2	2	2	1	2	2	-	-	-	1	-	-	1	2	3
CO3	2	2	2	2	2	-	-	-	1	-	-	1	2	3
CO4	2	2	2	2	2	-	-	-	1	-	-	1	2	3
CO5	2	2	1	2	2	-	-	-	1	-	-	1	2	3

SYLLABUS

UNIT-I 14 periods

Introduction: A Neural Network, Human Brain, Models of a Neuron,Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks

Learning Process: Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning .

Learning outcomes: At the end of this unit student are able to

1. Examine what a Neural Network is, its resemblance to the human brain and different Neural Network Architectures.
2. Examine Different Learning Rules and their Applications in different Applications.

UNIT-II 14 periods

Single Layer Perceptron: Unconstrained optimization, LMS algorithm, learning curves, perceptrons, convergence theorem, limitations of single-layer perceptron

Multilayer Perceptron: Back-propagation algorithm, XOR problem, feature detection, accelerated convergence of back-propagation algorithm, limitations

Learning outcomes: At the end of this unit student are able to

1. Analyze different concepts of Single Layer Perceptron and its relation to different Environments.
2. Identify the need for Multi-Layer Perceptron and its capabilities when compared to Single Layer Perceptron.

UNIT- III 12 periods

Back Propagation: Back Propagation and Differentiation, Hessian Matrix, Generalization, Cross Validation, Network Pruning Techniques, Virtues, and Limitations of Back Propagation Learning, Accelerated Convergence, Supervised Learning.

Learning outcomes: At the end of this unit student are able to

1. Apply the concept of Back Propagation in solving different Neural Network Problems.
2. Identify the Limitations of Back Propagation Learning.

UNIT-IV 14 periods

Self-Organizing Maps (SOM): Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of Feature Map, Learning Vector Quantization, Adaptive Pattern Classification.

Learning outcomes: At the end of this unit student are able to

1. Identify the Basic features of Self Organizing Maps.
2. Apply Self Organizing Maps in solving different pattern classification tasks.

UNIT-V 14 periods

Applications of Neural Networks: Recent trends in Neural Networks,Applications of Neural Networks,What is Deep Learning,Difference between Neural Networks and Deep Learning.
Case Study:Using Feed forward Neural Networks for Handwritten Digit Recognition.
Learning outcomes: At the end of this unit student are able to

1. Differentiate Neural Networks and Deep Learning Algorithms.
2. Analyse the working of Neural Networks for Handwritten Digit Recognition.

Text Books:

1. Neural Networks a Comprehensive Foundations, Simon Haykin, PHI edition.

Reference Books:

1. Artificial Neural Networks - B. Yegnanarayana Prentice Hall of India P Ltd 2005.

2. Neural Networks in Computer Intelligence, Li Min Fu TMH 2003.

3. Neural Networks -James A Freeman David M S Kapura Pearson Education 2004.

4. Introduction to Artificial Neural Systems Jacek M. Zurada, JAICO Publishing House Ed. 2006.

E-Resources:

1. http://cognet.mit.edu/book/introduction-to-neural-networks

2. https://www.udemy.com/course/deep-learning-convolutional-neural-networks-theano-tensorflow

3. https://www.coursera.org/learn/neural-networks-deep-learning

Research Methodology and IPR	
MTDS115	**Credits : 2**
Instruction : 2 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites: Nil

Course Outcomes:

Unit I:
Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

Unit II:
Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Unit III:
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. Procedure for grants of patents, Patenting under PCT.

Unit IV:
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit V:
New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

 Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”
 Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
 Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”
 Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
 Mayall, “Industrial Design”, McGraw Hill, 1992.
 Niebel, “Product Design”, McGraw Hill, 1974.
 Asimov, “Introduction to Design”, Prentice Hall, 1962.
 Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.
 T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

Audit course 1 :Professional Ethics and Human values	
MTDS116	**Credits : 0**
Instruction : 2 Periods /Week	**Sessional Marks : 40**
End Exam : --	**End Exam Marks : --**

UNIT – I

Human values:

Morals, values and Ethics. Human values – Integrity, work ethics, service learning, virtues, respect for others, living peacefully, caring, sharing, honesty, courage, valuing time, cooperation, commitment, empathy, self-confidence, challenges in work place, spirituality, case study.

UNIT – II

Engineering Ethics:

Senses of moral issues, variety of moral issues, types of enquiries, moral dilemma, moral autonomy, moral development, consensus and controversy, theories of right action, professional roles and responsibilities, Case study.

UNIT – III

Engineering as Social experimentation:

Engineering as social experimentation, engineers as responsible experimenters, code of ethics, industrial standards, a balanced outlook on law, Case study

UNIT – IV

Responsibilities and rights:

Collegiality and loyality, collective bargaining, confidentiality, conflicts of interest, occupational crime, human rights, employee rights, whistle blowing, intellectual property rights, case study.

UNIT – V

Global issues:

Globalization, environmental ethics, computer ethics, weapons development, engineers as managers, consulting engineers, engineers as expert witness, engineers as advisors in planning and policy making, moral leadership, case study.

Text Books:

1. R.S. Naagarazan, Professional ethics and Human values, New Age International (P) limited publishers (2006).

References:

1. K.R. Govindan and S.Senthil Kumar, Professional Ethics & Human Values, Anuradha Publications.
2. Mike Martin and Roland Schinzinger, Ethics in Engineering, 3 rd edition, McGraw Hill. New York (2012).

Knowledge Engineering-Lab	
MTDS117	**Credits : 2**
Instruction : 3 Hours lab/Week	Sessional Marks : 50
End Exam : 3 Hours	End Exam Marks : 50

Prerequisites: My SQL, Data Mining,

Course Objectives:

- Learn to perform data mining tasks using a data mining toolkit (such as open source WEKA).
- Understand the data sets and data pre-processing.
- Demonstrate the working of algorithms for data mining tasks such classification, clustering and regression.

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Course Outcomes:

After Successful Completion of Course, the student will be able to:

1.	Demonstrate data pre-processing task on real world data sets
2.	Demonstrate the classification, clustering in real time data sets.
3.	Ability to apply regression techniques on real time data.
4.	Discover interesting patterns and predict future trends

CO-PO Mapping:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PS O 1**	**PS O 2**
CO 1	2	3	2	1	2	1	-	-	-	-	-	-	1	2
CO 2	2	3	3	2	2	1	-	-	-	-	-	-	2	2
CO 3	2	3	3	2	2	1	-	-	1	-	-	-	3	2
CO 4	2	3	2	3	2	1	-	-	-	-	2	2	2	3

LIST OF EXPERIMENTS

Implement experiments using Python

1. Data Processing Techniques:

i. Data Cleaning (ii) Data Transformation-Normalization (iii) Data Integration. CO1

2. Classification of data using Bayesian approach CO2.
3. Classification of data using K-Nearest Neighbour approach CO2.
4. Implementation of K-Means clustering algorithm CO2
5. Demonstrate performing Regression on data sets CO3
6. Implementing the decision tree analysis and the training data in the data set.CO3
7. Construct decision tree for weather data using WEKA tool CO4
8. Implement Support Vector Machines using python CO4
9. Implement Principal Component Analysis for any standard data set CO4
10. Implement Random forest for any medical data set CO4

Data Preparation and Analysis Lab	
MTDS118(A)	**Credits : 2**
Instruction : 3 Hours lab/Week	Sessional Marks : 50
End Exam : 3 Hours	End Exam Marks : 50

Prerequisites:

- My SQL, Data Mining

Course Objectives:

1. Apply pre-processing methods for multi- dimensional data.
2. Practice on data cleaning mechanisms
3. Analyze various data exploratory analysis
4. Develop the visualizations for clusters or partitions

Course Outcomes:

By the end of the course, the student will be able to:	
1	Apply preprocessing methods and implement techniques for data cleaning
2	Develop the methodology for assessment of clusters and analyze association rule mining in dimensional databases.
3	Construct transformation techniques for numerical data.
4	Implement visualization techniques and clustering algorithms for any real time dataset.

Mapping of course outcomes with program outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO 1	1	2	2		1							1		1
CO 2	2	2	2	1	1							1	3	1
CO 3	2	2	2	1	1							1	2	1
CO 4	2	2	2	1	1							1	2	2

LIST OF EXPERIMENTS:

1. Data preprocessing methods on student and labor datasets Implement data cube for data warehouse on quantitative data. CO1

2. Implement various noisy handling mechanisms CO1

3.Design algorithms for association rule mining algorithms CO2

4.Derive the hypothesis for association rules to discovery of strong association rules; Use confidence and support thresholds. CO3

5. Construct Haar wavelet transformation for numerical data CO4

Implement binning visualizations for any real time dataset

6.Implement the program for converting the clusters into histograms CO4

7. Write a program to implement agglomerative clustering technique CO4

8. Implement OLAP-OLTP (Google related Open, Snow Flake tools)

TEXT BOOKS:

1.Sinan Ozdemir, "Principles of Data Science", Packt Publishers, 2016.

E-Resources:

1. https://paginas.fe.up.pt/~ec/files_1112/week_03_Data_Preparation.pdf
2. https://socialresearchmethods.net/kb/statprep.php
3. https://www.quest.com/solutions/data-preparation-and-analysis/

Artificial Intelligence –Lab	
MTDS118(B)	**Credits : 2**
Instruction : 3 Periods /Week	**Sessional Marks : 50**
End Exam : 3 Hours	**End Exam Marks : 50**

Prerequisites: Data Structures and Algorithms.

Course Objectives:

1. Distinguish the different algorithm design strategies.
2. Explore the Heuristic search techniques.
3. Demonstrate the problems associated with Iterative search methods and hill climbing.
4. Demonstrate the recursion problems, problem of decomposition, and methods of reasoning.

Course Outcomes: After Successful Completion of Course, the student will be able to:

1.	Compare the different types of algorithm strategies.
2.	Classification of Heuristic search techniques.
3.	Make use of iterative search methods and hill climbing methods.
4.	Importance of the recursion problems, problem of decomposition, and methods of reasoning.

CO-PO Mapping:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PS O 1**	**PS O2**
CO 1	2	2	2	2	1	1	-	-	-	-	-	1	2	2
CO 2	2	2	2	2	2	1	-	-	-	-	-	2	2	2
CO 3	2	2	3	2	2	1	-	-	-	-	-	2	2	2
CO 4	2	2	2	2	2	1	-	-	-	-	-	2	2	2

LIST OF EXPERIMENTS

1. Implementation of DFS for water jug problem CO-1
2. Implementation of BFS for tic-tac-toe problem CO-1
3. Implementation of TSP using heuristic approach CO-2
4. Implementation of Simulated Annealing Algorithm CO-2
5. Implementation of Hill-climbing to solve 8- Puzzle Problem Co-2
6. Implementation of Towers of Honoi Problem CO-3
7. Implementation of A* Algorithm CO-3
8. Implementation of Hill Climbing Algorithm CO-3
9. Implementation Expert System with forward chaining CO-4
10. Implementation Expert System with backward chaining CO-4

Text Book:

1. Artificial Intelligence, Elaine Rich and Knight, Mcgraw-HillPublications
2. Artificial Intelligence, George F Luger, Pearson EducationPublications

References:

1. Introduction To Artificial Intelligence & Expert Systems, Patterson, PHI
2. Artificial Intelligence : A modern Approach, Russell and Norvig, PrinticeHall
3. A First course in Artificial intelligence, Deepak Khemani, Mcgraw-hill Education

Information Security Lab	
MTDS118(C)	**Credits : 2**
Instruction : 3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Pre-Requisites:

- **Basic knowledge of Cryptography**
- **Basic knowledge of Packet Capturing**
- **Exposure to Problem solving techniques and programming skills**

Course Objectives:

- **Introducing different tools related to Network Security.**
- **Introducing tools related to Information Security.**

By the end of the course, the student will be able to:

1.	Demonstrate the buffer overflow and format string attacks.
2.	Analyse the packets captured using Wireshark.
3.	Demonstrate the tools nmap and IPtables for network security.
4.	Detect and implement SQL Injection attacks.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O 1	PS O 2
CO1	-	1	1	1	2	-	-	-	1	1	-	1	-	2
CO2	1	2	2	3	3	-	-	1	1	-	-	2	1	2
CO3	-	2	2	3	3	-	-	-	1	-	-	2	1	2
CO4	1	2	2	3	3	-	-	1	1	-	-	2	1	2

EXPERIMENTS

1. Understanding the buffer overflow and format string attacks. CO-1
2. Demonstrate the transposition and substitution ciphers. CO-1
3. To analyse the network packets using Wireshark. CO-2
4. Sniffing networks and analysis of TCP/IP using Wireshark . CO-2
5. Implement Testing for SQL Injection and detect it. CO-4
4. To perform the web penetration testing using BURPSUITE. CO-4
5. Use 'nmap' tool to perform vertical and horizontal scanning for checking open and closed ports. CO-3
6. Configuring IP Tables in Linux and setting the filtering rules. CO-3

Case Studies:

1.Use nmap commands for performing the following experiments: CO-3

a) Use ping sweeping to determine which hosts are running.
b) Check for vulnerable services available using TCP connect scans.
c) Perform OS Fingerprinting to determine the OS of target machine.
d) Choose different options under each category according to your creativity.

2.Network Packet analysis using WIRESHARK. Use Wireshark (Latest version) to solve the below scenarios: CO-2

1. You, as a SOC analyst noted that someone try to send information (PING) to unknown IP address and you are suspecting some malicious information might transferred in it. Analyse the log file and find the data. a) Find the source and destination IP of that log. b) Find the Data length (Bytes) and verify the checksum status on destination. 2. Now you have found that some kind of file is been downloaded by insider in unencrypted web traffic. Your task is to a) Find the type of file. b) Export that file from that web traffic, then analyse the file for any secret information. c) Find the hostname in which the file is stored.

TEXTBOOKS:

1)The Complete Reference Network Security By Robert Bragg, Mark Rhodes Ousley, Keith Strassberg, 1st Edition, McGraw Hill India (2004)Publication
2) The Unofficial Guide to Ethical Hacking by Ankit Fadia, Second edition(2006), Laxmi Publications.
3) Network Security Tools Writing, Hacking, and Modifying Security Tools by Nitesh Dhanjani, Justin Clarke, 2013 Edition, Publisher: O'Reilly Media.
4) Linux and UNIX Security Portable Reference Book by Nitesh Dhanjani,1st Edition, Mc GrawHill.

REFERENCE BOOKS:

1. Network Security Tools Writing, Hacking, and Modifying Security Tools By NiteshDhanjani, Justin Clarke,2nd Edition, Publisher: O'Reilly Media

WEB RESOURCES:

1. https://www.udemy.com/courses/it-and-software/network-and-security
2. https://online.stanford.edu/course/network-security
3. http://index-of.es/EBooks/SQLInjectionAttacksandDefense.pdf

Big Data Analytics Lab	
MTDS118(D)	**Credits : 2**
Instruction : 3 Periods /Week	**Sessional Marks : 50**
End Exam : 3 Hours	**End Exam Marks : 50**

Pre- requisites:
Should have knowledge of one Programming Language, Practice of SQL (queries and sub queries), and exposure to data mining techniques.

Course Objectives

- To understand the applications using Map Reduce Concepts.
- Imparting the architectural concepts of Hadoop and introducing map reduce paradigm.
- Derive business benefit from unstructured data.
- To learn to use various techniques for mining data stream.
- To introduce programming tools HIVE in creating databases.

Course Outcomes

CO1: Apply basics of File Management tasks in Hadoop and installation.
CO2: Implementing Applications using Map Reduce Paradigm.
CO3: Apply NoSQL on Unstructured Data.
CO4:Performing Database operations using HIVE tool.

Mapping of Course Outcomes with Program Outcomes:

Mapping	**PO**													**PSO**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO	**1**	**2**	**1**	**1**	**1**	**1**				**1**				**2**	**2**
	2	**2**	**2**	**1**	**1**	**1**				**1**				**2**	**2**
	3	**1**	**3**	**3**	**1**	**2**				**1**				**2**	**2**
	4	**1**	**2**	**2**	**2**	**2**				**2**				**2**	**2**

1. Perform setting up and Installing Hadoop in its three operating modes: CO1
   a) Standalone b) Pseudo distributed c) Fully distributed.

2. File Management tasks in Hadoop: CO1
   a) Adding files and directories.
   b) Copy a file from source to destination.
   c) Retrieving files.

3. Implement Matrix Multiplication with Hadoop Map Reduce. CO2

4. Word Count Map Reduce program to understand Map Reduce Paradigm. CO2

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 MapReduce, since it is semi structured and record- oriented. CO2

6. Unstructured data into NoSQL data and do all operations query with API. CO3

7. K-means clustering using map reduce. CO2

8. Install and Run Hive then use Hive to create, alter, and drop databases, tables, views, functions, and indexes. (Apache Spark) Kafka CO4

TEXT BOOKS:

1. Jay Liebowitz, ―Big Data And Business Analytics Laboratory, CRC Press
2. Kevin Roebuck, "Storing and Managing Big Data - NoSql, Hadoop and more: High-Impact Strategies - What You Need to Know", Tebbo, 2011.

REFERENCE BOOKS:

1. Vignesh Prajapati ,"Big Data Analytics with R and Hadoop", 2013 Packt Publishing.
2. Tom White, "Hadoop: The Definitive Guide", 3rd Edition, O'Reilly, 2012.

WEB-REFERENCES:

1.http://www.da.inf.ethz.ch/
2.http://delab.csd.auth.gr/courses/c_bigdata/2-hadooplab.pdf
3.https://bigdata.uga.edu/

Data Visualization Lab	
MTDS118(E)	**Credits : 2**
Instruction : 3 Periods /Week	**Sessional Marks : 50**
End Exam : 3 Hours	**End Exam Marks : 50**

Prerequisites: Basics of Python, Maths, Statistics, and Query processing .

Course Objectives:

1. Distinguish the different visualization techniques and metrics.
3. Explore the different kinds of python packages for visualization of data.
4. Demonstrate the problems associated with basic plots, measuring central tendency, text, geographical, animations, and 3D plotting.
5. Demonstrate the usage of style sheets and dashboard.

Course Outcomes:

After Successful Completion of Course, the student will be able to:

1.	Compare the different types of data visualization and metrics.
2.	Illustrate the usage of python packages and function for visualisation of data.
3.	Make use of plots, measuring central tendency, text, geographical, animations, and 3D plotting.
4.	Importance of style sheets and dashboard.

CO-PO Mapping:

	PO 1	**P2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PS O 1**	**PS O 2**
CO1	2	2	2	2	2	1	-	-	-	-	-	1	2	3
CO2	2	2	2	2	3	1	-	-	-	-	-	2	2	3
CO3	2	2	3	2	3	1	-	-	-	-	-	2	2	3
CO4	2	2	2	2	3	1	-	-	-	-	-	2	2	3

Data Visualization Lab

1.Visualize real world data in the following way : Lines, bars and markers

Stacked bar chart, Horizontal bar chart, Broken Barth, Cap Style, Plotting categorical variables, Lifestyles, Lines with a ticked path effect, Marker reference.

2. Visualize real world data in the following way : Subplots, axes and figures

Aligning labels, axes box, Axes Props, Broken Axis, Placing Colorbars, Adjacent subplots, Geographic projections, multiple subplots,

3.Visualize real world data in the following way: Statistics

Percentiles, Box plots with custom colors, Violin plots, Errorbar function, Histograms, Time series Histograms, Basic pie chart, Bar of pie, polar plot.

4.Visualize real world data in the following way : Text, labels and annotations

Accented text, Invarient angle label, Annotating Plots, Arrow, Auto wrapping text, date tick labels, convert texts to images, math text, Annotate Transform, Annotating a plot, Annotation polar.

5. Visualize real world data in the following way : Units

Annotation with units, Artist tests, Bar demo with units, Group bar chart with Units, Ellipse with Units, Evans test, Radian ticks, Inches and centimetre's, Unit handling

6.Visualize real world data in the following way : (Geographical Data)

Load map data Plot maps, Translation between spherical and Cartesian coordinates, Map projections for projecting into a plane, Plot points and lines, distance on a sphere Plot great circles on a map, Plot parallels and meridians, Add a scale to the maps, Change the background and resolution of maps.

7.Visualize real world data in the following way :

Animations Decay, Animated histogram, Pyplot animation, The bayes update, The double, animated image using precomputed list of images, frame grabbing, Rain simulation, Animated 3D random walk, animated line plot, Oscilloscope.

8. Visualize real world data in the following way (3d plotting) Plot 2D data on 3D plot, 3D bar charts, 2D bar graphs in different planes, contour curves in 3D, Filled contours, 3D error bars, 3D surface colormap.

9. Visualize real world data in the following way: Style sheets Bayesian method for Hackers style sheet, Dark background style sheet, FiveThirtyEight style sheet, ggplot style sheet, Grayscale style sheet, Solarized light stylesheet.

10. Visualize real world data in the following way:

Creating Dashboards with Plotly and Dash

Text Books:

[1] Matthew O Ward, Georges Grinstein and Daniel Keim, *Interactive Data Visualization: Foundations, Techniques and Applications*, 2nd ed., Florida USA:CRC Press Taylor and Francis Group, 2015. (*Chapters: 1 to 9*)

[2] Alberto Ferrari and Marco Russo, *Introducing Microsoft BI, Microsoft press,* ISBN: 978-1-5093-0228-4

Reference Books:

[1] Andy Krik, *Data Visualization: A Handbook for Data Driven Design*, 1st ed., New Delhi: SAGE Publications Ltd., 2016.

[2] Edward R. Tufte, *The Visual Display of Quantitative Information*, 2nd ed., Connecticut: Graphics Press, 2001.

[3] Murray Scott, *Interactive Data Visualization for the Web*, 1st ed., California: O'Reilly Publications, 2013.

NEURAL NETWORKS-LAB	
MTDS118(F)	**Credits :2**
Instruction : 3 Periods /Week	**Sessional Marks : 50**
End Exam : 3 Hours	**End Exam Marks : 50**

Prerequisites: Mathematical Concepts like Statistics, Calculus, Linear Algebra and Probability.

Course Objectives:

1. To understand the biological neural network and to model equivalent neuron models.
2. To understand the architecture, learning algorithms and issues of various feed forward and feedback neural networks.

Course Outcomes:

By the end of the course, the student will be able to:

1.	Examine the characteristics of Artificial Neural Networks, along with their activation functions.
2.	Apply learning algorithms on perceptron and apply back propagation learning on Neural Network.
3.	Design Convolutional Neural Network and examine the characteristics of Hopfield Networks and apply classification using Convolutional Neural Networks.
4.	Solve sequence learning problem and implement long short term memory and gated recurrent units.

CO-PO Mapping:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PS O 1**	**PS O 2**
CO 1	2	2	1	2	2	-	-	-	1	-	-	-	2	2
CO 2	2	2	1	2	2	-	-	-	1	-	-	-	2	2
CO 3	2	2	1	2	2	-	-	-	1	-	-	-	2	2
CO 4	2	2	1	2	2	-	-	-	1	-	-	-	2	2

LIST OF EXPERIMENTS:

1. Creating Simple Neural Network (CO1)

2. Implementing Different Activation Functions (CO1)

3. Implement Perceptron Algorithm for OR Logic Gate with 2-bit Binary Inputs. (CO2)

4. Program to implement Linearly Separable Data Using Perceptron. (CO2)

5. Implement the solution for XOR Problem using Multi-Layered Perceptron (CO2)

6. Implementing Backpropagation Concept. (CO2)

7. Implementing Hopfield Networks. (CO3)

8. To study and apply Convolutional Neural Networks(CNN) for image classification. (CO3)

9. To study Long Short Term Memory for Time Series Prediction (CO4)

10. To study the use of Long Short Term Memory / Gated Recurrent Units to predict the stock prices based on historic data. (CO4)

TEXT BOOKS:

1. Neural Networks a Comprehensive Foundations, Simon Haykin, PHI edition.

2. Artificial Neural Networks - B. Yegnanarayana Prentice Hall of India P Ltd 2005.

REFERENCE BOOKS:

1. Neural Networks in Computer Intelligence, Li Min Fu TMH 2003.

2. Neural Networks -James A Freeman David M S Kapura Pearson Education 2004.

3. Introduction to Artificial Neural Systems Jacek M. Zurada, JAICO Publishing House Ed. 2006.

E-Resources:

1. https://in.mathworks.com/help/deeplearning/ug/perceptron-neural-networks.html

2. https://en.wikipedia.org/wiki/OR_gate

3. https://en.wikipedia.org/wiki/Linear_separability

4. https://www.commonlounge.com/discussion/6caf49570d9c4d0789afbc544b32cdbf

I year –II Semester

Course Code	Type of course	Name of the course	Periods per week		Max. Marks		Credits
			Lect.	Lab.	Sess.	End sem	
MTDS121	Program Core-3	Machine Learning with R	3	--	40	60	3
MTDS122	Program Core-4	Soft Computing Techniques	3	--	40	60	3
MTDS123	Elective-3	Elective-3	3	--	40	60	3
MTDS124	Elective-4	Elective-4	3	--	40	60	3
MTDS125	Audit Course	Audit Course-2	2	--	40		0
MTDS126	Laboratory Course	Machine learning with R –Lab	--	3	50	50	2
MTDS127	Laboratory Course	Elective- Lab	--	3	50	50	2
MTDS128	Laboratory Course	Mini Project with seminar	--	3	100	--	2
Total			**14**	**9**	**400**	**340**	**18**

Elective-3:

D. Advanced Web Technologies
E. Principles of Deep Learning
F. Natural Language Processing

Elective-4:

D. Text analytics
E. Internet of Things
F. NoSQL

Machine Learning with R	
MTDS121	**Credits : 3**
Instruction : 3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites:

1. Strong Mathematical Background.
2. Basic Programming Skills.
3. Knowledge on Advanced Data Structures and Algorithms.

Course Objectives:

1. The course aims at providing an accessible introduction to various machine learning methods and applications in R.
2. The core of the courses focuses on Basics of Machine Learning Techniques unsupervised and supervised methods.
3. Acquire skills in developing as well as evaluating different machine learning models.

Course Outcomes:

	By the end of the course, the student will be able to:
1	Illustrate the basic concepts of Machine Learning and the applications of ML and group Various Libraries of R for ML.
2	Compare Supervised and Unsupervised Learning Techniques.
3	Illustrate Decision Trees, Random Forest, Analyse Regression and Classification using Decision Trees.
4	Compare Linear Regression and Logistic Regression and its Methods with Neural Networks.
5	Demonstrate advanced methods like Naive Bayes, k-NN, SVM for Classifications and regression.

Mapping of Course Outcomes with Program Outcomes:

S.No	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**
CO1	1	--	--	--	2	1	--	--	1	2	--	1	1	1
CO2	--	1	2	2	2	--	1		1	1	1	1	1	2
CO3	1	2	2	3	3	--	--	1	2	1	1	1	2	2
CO4	1	2	1	2	3	--	--	--	1	1	1	2	1	2
CO5	2	2		3	3	--	--	--	1	1	1	2	1	2

UNIT-I 12 Periods

Introducing Machine Learning: The origins of machine learning, Uses and abuses of machine learning, Ethical considerations, How do machines learn?, Abstraction and knowledge representation, Generalization, Assessing the success of learning, Steps to apply machine learning to your data, Choosing a machine learning algorithm, Thinking about the input data, Thinking about types of machine learning algorithms, Matching your data to an appropriate algorithm.
Using R for machine learning: Basics of R Language, Discuss Various Packages for Machine Learning.

Learning Outcomes: At the end of this unit, Students are able to

1. Demonstrate the concept of Machine Learning and the applications of ML.
2. Group various libraries of R for Machine Learning.

UNIT-II 15 Periods

Supervised and Unsupervised Machine Learning: Supervised Models, Regression, Training and Testing of Data, Bias, Classification: Logistic Regression, Supervised Clustering Methods. Mixed Methods: -Based Models, Random Forests, Neural Networks, and Support Vector Machines.
Unsupervised Machine Learning: Unsupervised Clustering Methods, PCA and kernel PCA, Generative Models (Gaussian Mixture Models and Hidden Markov Models).
Learning Outcomes: At the end of this unit, Students are able to

1. Summarise the Supervised and Unsupervised ML Techniques.
2. Compare Supervised and Unsupervised Learning Models.
3. Compare Generative Models (Gaussian Mixture Models and Hidden Markov Models).

UNIT-III 12 Periods

Tree-Based Methods: A Simple Tree Model, Deciding How to Split Trees: Tree Entropy and Information Gain, Pros and Cons of Decision Trees: Tree Overfitting, Pruning Trees, Decision Trees for Regression, Decision Trees for Classification. Conditional Inference Trees: Conditional Inference Tree Regression, Conditional Inference Tree Classification.
Random Forests: Random Forest Regression, Random Forest Classification.
Learning Outcomes: At the end of this unit, Students are able to

1. Demonstrate Decision Trees.
2. Analysis of Regression and Classification using Decision Trees.
3. Illustrate Random Forest Regression and Classification.

UNIT – IV 15 Periods

Regression
Linear Regression: Multivariate Regression, Regularization, Polynomial Regression, Goodness of Fit with Data-The Perils of Over-fitting, Root-Mean-Square Error, Model Simplicity and Goodness of Fit.
Logistic Regression: The Motivation for Classification, The Decision Boundary, The Sigmoid Function, Binary Classification, Multiclass Classification. Logistic Regression with Caret.
Learning Outcomes: At the end of this unit, Students are able to

1. Analyse and compare Linear Regression and Logistic Regression.
2. Illustrate Neural Networks on building a Neural Network and NN for Classification.

UNIT-V 12 Periods

Advanced Methods: Naive Bayes Classification, Bayesian Statistics in a Nutshell, Application of Naive Bayes Principal Component Analysis: Linear Discriminant Analysis, Support Vector Machines, k-Nearest Neighbors: Regression Using kNN, Classification Using kNN.

Learning Outcomes: At the end of this unit, Students are able to

1. Demonstrate Naive Bayes Classification Method and its Applications.
2. Demonstrate SVM and k-NN method for regression and Classification.

Text books:

1. Scott V. Burger, "Introduction to Machine Learning with R Rigorous Mathematical Analysis", Published by O'Reilly Media, Inc., First Edition-March-2018.
2. Brett Lantz, "Machine Learning with R" Published by Packt Publishing Ltd., ISBN 978-1-78216-214-8, First Edition- October 2013.

Reference Books:

1. Alex Smola and S.V.N. Vishwanathan, "Introduction to Machine Learning", published by the press syndicate of the University of Cambridge, UK, 2008.
2. Ethem Alpaydın "Introduction to Machine Learning", The MIT Press Cambridge, Massachusetts London, England, 2nd Edition.
3. Michael Clark, "An Introduction to Machine Learning with Applications in R".
4. Sebastian Palmas, Kevin Oluoch, "Introduction to Machine Learning in R",-2019.

Web Ref.:

1. https://www.cse.iitb.ac.in/~pjyothi/cs419_spr18/index.html.
2. https://lgatto.github.io/IntroMachineLearningWithR/an-introduction-to-machine-learning-with-r.html.
3. https://ocw.mit.edu/courses/sloan-school-of-management/15-097-prediction-machine-learning-and-statistics-spring-2012/lecture-notes/

Soft Computing Techniques	
MTDS122	**Credits : 3**
Instruction : 3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites: Basic knowledge of mathematics

Course Outcomes:

- To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario.
- To implement soft computing based solutions for real-world problems.
- To give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, genetic algorithms

By the end of the course, the student will be able to:

1.	Identify and describe soft computing techniques and their roles in building intelligent machines.
2.	Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering Problems.
3.	Apply Neural Networks to solve different real world Problems.
4.	Apply genetic algorithms to combinatorial optimization problems.
5.	Implement solutions by various soft computing approaches for a given problem.

CO-PO Mapping:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO 1	**2**	1	-	**-**	-	-	-			-	**-**	2	-	1
CO 2	**1**	2	1	**-**	**-**	-	-			**-**	**-**	**2**	-	1
CO 3	**2**	3	1	1	**-**	**1**	--			-	2	**2**	1	2
CO 4	**2**	3	1	1	**-**	**1**	**--**			-	2	2	1	2
CO 5	**2**	2	2	2	**3**	**1**	**-**			-	-	-	2	2

SYLLABUS

UNIT-I **9 Periods**

INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS:
Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics
Learning outcome: at the end of this unit student are able to

1. Describe the different types of computing styles.
2. Explain Machine Learning basics.

UNIT-II **14 Periods**

FUZZY LOGIC: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making
Learning outcome: at the end of this unit student are able to

1. Illustrate the steps in Fuzzy computing
2. apply fuzzy computing to solve real world problems

UNIT-III **12 Periods**

NEURAL NETWORKS: Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks : Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks

Learning outcome: at the end of this unit student are able to

1. Describe different types of Neural networks.
2. Apply neural networks to solve real world problems

UNIT-IV **5 Periods**

GENETIC ALGORITHMS: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning : Machine Learning Approach to Knowledge Acquisition

Learning outcome: at the end of this unit student are able to

1. Explain basics of Genetic Algorithms.
2. Apply machine learning approach for Knowledge Acquisition

UNIT-V **12 Periods**

Python Lib: Implementation of recently proposed soft computing techniques

Introduction to Python, Arrays and array operations, Functions and Files, Study of neural network libraries and fuzzy logic libraries, Simple implementation of Artificial Neural Network and Fuzzy Logic.
Recent Trends in deep learning, various classifiers, neural networks and genetic algorithm.

Learning outcome: at the end of this unit student are able to

1. explore the different libraries available in python programming language
2. Implement soft computing techniques in python to solve real world problems.

Text Book:

1. Jyh:Shing Roger Jang, Chuen:Tsai Sun, EijiMizutani, Neuro:Fuzzy and Soft Computing, Prentice:Hall of India, 2003.

2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic:Theory and Applications, Prentice Hall,1995

3. Zoran Gacovski ,SOFT COMPUTING AND MACHINE LEARNING WITH PYTHON, ARCLER P res s, e-book Edition 2019

Reference Books:

1. S. Rajasekaran and PG.A.V. Pai , "*Neural Networks, Fuzzy logic, and Genetic algorithms: synthesis and applications*", PHI Publication.

2. Simon Haykin , "*Neural Networks: A Comprehensive Foundation* ", PHI Publication

E-Resources :

https://nptel.ac.in/courses/106/105/106105173/

https://nptel.ac.in/courses/117/105/117105084/

Advanced Web Technologies	
MTDS123	**Credits : 3**
Instruction : 3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites: Basic knowledge of web technologies that relate to the interface between web servers and their clients. Students should be very knowledgeable in XHTML and CSS and have a solid understanding of JavaScript (Introduction to JavaScript and/or Intermediate JavaScript class).

Course Objectives:

1. To understand computer programming and application software, package/ suites.
2. Design static web application development and Students will gain the skills and front designs
3. Able to get project based experience needed for entry into web application and development careers

Course Outcomes:

By the end of the course, the student will be able to:

1.	Acquire the knowledge on basic concepts of HTML & CSS to design web pages and web site.
2.	Able to Develop dynamic web pages using JavaScript.
3.	Implementing the Node and React Js in web development
4.	Analyze a given problem and apply requisite appropriate tools for designing interactive web applications
5.	Comprehend the React js, explore React js components and life cycle.

CO-PO Mapping:

	PO1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PS O 1**	**PS O 2**
CO1	**1**	1	-	**-**	2	-	-	-	-	-	-	-	1	1
CO2	**1**	2	-	**-**	**2**	-	-	-	-	**-**	-	-	1	1
CO3	**2**	2	1	2	**2**	**-**	--	-	-	-	-	-	1	1
CO4	**2**	2	1	2	**2**	**-**	**--**	-	-	-	-	-	2	1
CO5	**2**	2	2	1	**2**	**-**	**-**	-	-	-	-	-	2	1

Syllabus

Unit I **12 Periods**

HTML 5 : Basics, Tags, Elements, Attributes, Input Type – email, url, number, range, Date Pickers, search. Events, Semantics, SVG, Google Maps, Migration, Audio, Video, Canvas, HTML API

Learning outcome: at the end of this unit student are able to

- Identify how to create a simple web page with google maps, Photos, and Dates.
- Develop web pages using HTML5's new Canvas element to create code-based animations.

Unit II **10 Periods**

CSS 3 : Introduction CSS, Applying CSS to HTML, Color gradients, Box Model, Margins, Padding, and Borders, Text and Font, Layouts, Grid, Bootstrap, design of responsive Webpages.

Learning outcome: at the end of this unit student are able to

- Create the web pages with CSS and CSS for styling text, font, and other properties.
- Design web pages effectively with Bootstrap and design of responsive webpages.

Unit III **14 Periods**

NodeJS :

Introduction to Node JS – Advantages, Traditional Web Server Model, Process Model. **Environment** – Installation, Working in REPL, Node JS Console. **Node JS Modules** – Functions, Buffer, Module Types, Module Exports. **Node Package Managers** – What is NPM, Installing Packages Locally and globally, Adding dependency in package.json, Updating packages. Creating Web server, File System, Debugging Node JS Application, Events.

Learning outcome: at the end of this unit student are able to

- Install Server to run the server environment in local machine
- Apply the API services in background to make web development.

Unit IV **12 Periods**

Express JS : Environment, Routing, Http Methods – Request, Response. Cookies, Sessions, File Uploading, URL Binding, Middleware, Scaffolding, Templating, Static files, Form data, Error Handling.

Learning outcome: at the end of this unit student are able to

- Find the difference between Nods JS to Express JS to develop applications.
- Solve the problems by developing the web applications.

Unit V **12 Periods**

ReactJS : Introduction, Environment setup, Templating using JSX, Components & API, State and Props, Lifecycle of Components, Rendering List and Portals, Events, Forms, Refs, Keys, Fragments, Routers, Flux, React CSS.

Learning outcome: at the end of this unit student are able to

- Create components to create static versions of applications.
- Apply the React JS components on web development.

Text Books:

1. HTML 5 Black Book, Covers CSS 3, JavaScript, XML, XHTML, AJAX, PHP and jQuery, 2ed, Dream Tech Black Book
2. React. Js Book: Learning React JavaScript Library from Scratch, Book by Greg Sidelnikov
3. Node.js in Action, by Alex Young , Bradley Meck , Mike Cantelon , Tim Oxley , Marc Harter , T.J. Holowaychuk , Nathan Rajlich

Reference Books:

1. Build Your Own Website The Right Way Using HTML & CSS, 3rd Edition by ge The WordPress Anthology
2. The Principles of Beautiful Web Design, 2nd Edition by Jason Beair
3. React in Action 1st Edition by Mark Tielens Thoma

E-Resources:

https://www.coursera.org/learn/web-design-wireframes-prototypes

https://www.coursera.org/learn/web-app

https://www.coursera.org/browse/computer-science/mobile-and-web-development

Principles of Deep Learning	
MTDS123(B)	**Credits : 3**
Instruction : 3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites: Basic fundaments of Artificial Neural Network and Machine Learning.

Course Objectives:

1. Introducing major deep learning algorithms.
2. To understand the problem settings and their applications to solve real- world problems.

Course Outcomes:

By the end of the course, the student will be able to:

1.	Differentiate between machine learning and deep learning.
2.	Focus on artificial neural network and their uses in deep learning.
3.	Analyze different deep learning models and parameters.
4.	Train a deep learning model.
5.	Implement a deep learning application to solve real-world problem.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	**2**	2	2	**2**	2	1	-	1	1	-	**-**	2	-	2
CO2	**2**	2	2	**2**	**2**	-	-	**1**	1	**-**	**-**	**2**	-	2
CO3	**2**	3	2	2	**2**	**1**	--	1	2	-	-	**2**	3	2
CO4	**2**	3	2	2	**2**	**1**	**--**	1	1	-	-	2	2	2
CO5	**2**	2	2	2	**1**	**1**	**-**	1	-	-	-	-	2	2

SYLLABUS

UNIT-I **10 Periods**

Introduction to Machine learning, Supervised and Unsupervised ML, Reinforcement learning , Linear regression ,Cost functions ,Overfitting Under-fitting, Hyper-parameter, Deep Learning vs Traditional Machine Learning**.**

Learning outcome: at the end of this unit student are able to

1. Recall basic machine learning algorithm.
2. Examine basic difference between deep learning vs traditional machine learning.

UNIT-II **12 Periods**

Artificial Neural Network Feed-forward neural network, Back propagation, optimization problem, Activation & Synaptic Dynamics, stability and convergence.

Learning outcome: at the end of this unit student are able to

1. Relate the importance of Artificial neural network
2. Implement various neural network based algorithm.

UNIT-III **14 Periods**

Introduction to deep learning, What is Deep Learning Algorithm, What is Deep Learning Algorithm, Convolutional Neural Networks (CNNs), Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), Generative Adversarial Networks (GANs).

Learning outcome: at the end of this unit student are able to

1. Implement Convolutional Neural Networks (CNN) for training.
2. Implement RNNs, GANs algorithms.

UNIT-IV **12 Periods**

Radial Basis Function Networks (RBFNs), Self-Organizing Maps (SOMs), Restricted Boltzmann Machines (RBMs), Deep Belief Networks (DBN), Gradient Descent Optimization Technique, Dropout, Transfer learning.

Learning outcome: at the end of this unit student are able to

1. Realize the training phases a deep neural network.
2. Apply various transfer learning concept for training.

UNIT-V **14 Periods**

Deep learning library, Keras backend, Tensorflow, Theano, Keras models and layers, Keras model class, Case studies on vision based object detection and human action detection using deep learning models.

Learning outcome: at the end of this unit student are able to

1. Implement deep learning algorithms and solve real-world problems.
2. Design projects using deep learning library.

Text Book:

1. T1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.
2. T2. Bishop, C. M., Pattern Recognition and Machine Learning, Springer, 2006.

Reference Books:

1. R1. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
2. R2. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.
3. R3. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

E-Resources :

https://www.tutorialspoint.com/python_deep_learning/index.htm

https://www.javatpoint.com/deep-learning

Natural Language Processing	
MTDS123(C)	**Credits : 3**
Instruction : 3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites: Mathematical Concepts like Calculus, Linear Algebra and Probability.

Course Objectives:

- To understand the steps involved in Natural language processing
- To learn about the lexical, syntactic and semantic analysis of natural language processing
- To explore the various parsing techniques for natural languages
- To understand the statistical models for Natural language processing
- To learn about the various applications involved in Natural language processing

Course Outcomes:

By the end of the course, the student will be able to:

1.	Justify the various steps necessary for processing natural language
2.	Suggest appropriate lexical and parsing techniques for a given natural language
3.	Apply appropriate statistical models for a given natural language application
4.	Modify existing algorithms to suit any natural language for processing
5.	Suggest appropriate pre-processing steps essential for the various applications involving natural language processing

CO-PO Mapping:

	PO 1	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	1		2		2	2			2		1			2
CO2		2			2				2	1				
CO3	2		2			1						2		2
CO4		2	2		2				2		1			2
CO5	1	1			2	1			2			2		1

SYLLABUS

UNIT-I 14 periods

Lexical Analysis - Regular expression and Automata for string matching - Words and Word Forms - Morphology fundamentals - Morphological Diversity of Indian Languages - Morphology Paradigms - Finite State Machine / Transducers Based Morphology - Automatic Morphology Learning - Parts of Speech - N-gram Models –

Learning outcomes: At the end of this unit student are able to

1. Understand various steps involved in natural language processing
2. Understand and apply appropriate different language models

UNIT- II 12 periods

Biology of Speech Processing - Place and Manner of Articulation - Word Boundary Detection - Argmax based computations - HMM and Speech Recognition - Text to Speech Synthesis - Rule based-Concatenative based approach.

Learning outcomes: At the end of this unit student are able to

1. Understand various techniques involved in speech processing
2. Apply the appropriate approach for speech processing

UNIT-III 12 periods

Theories of Parsing - Parsing Algorithms – Earley Parser - CYK Parser - Probabilistic Parsing - CYK - Resolving attachment and structural ambiguity - Shallow Parsing - Dependency Parsing - Named Entity Recognition - Maximum Entropy Models - Conditional Random Fields.

Learning outcomes: At the end of this unit student are able to

1. Understand various parsing techniques
2. Apply the suitable parsing techniques for the given language

UNIT-IV 12 periods

Meaning: Lexical Knowledge Networks - Wordnet Theory - Indian Language Wordnets and Multilingual Dictionaries - Semantic Roles - Word Sense Disambiguation - WSD and Multilinguality - Metaphors - Coreference and Anaphora Resolution.

Learning outcomes: At the end of this unit student are able to

1. Understand various lexical techniques
2. Apply the suitable lexical techniques for the given language

UNIT-V 10 periods

Applications: Sentiment Analysis - Text Entailment - Machine Translation - Question Answering System - Information Retrieval - Information Extraction - Cross Lingual Information Retrieval (CLIR)

Learning outcomes: At the end of this unit student are able to

1. Understand different applications of natural language processing
2. Use proper steps for pre-processing for various applications

Text Books:

1. Jurafsky Daniel, Martin James, “Speech and Language Processing”, Second Edition, Tenth Impression, Pearson Education, 2018.
2. Christopher Manning, Schutze Heinrich, “Foundations of Statistical Natural Language Processing”, MIT Press, 1999.

Reference Books:

1. Allen James, “Natural Language Understanding”, Second Edition, Benjamin Cumming, 1995.
2. Charniack Eugene, “Statistical Language Learning”, MIT Press, 1993.

E-Resources:

1. https://london.ac.uk/sites/default/files/study-guides/introduction-to-natural-language-processing.pdf
2. https://web.stanford.edu/~jurafsky/slp3/ed3book.pdf
3. http://www.datascienceassn.org/sites/default/files/Natural%20Language%20Processing%20with%20Python.pdf

TEXT ANALYTICS	
MTDS124(A)	**Credits : 3**
Instruction : 3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites: AI, Python Programming

Course Objectives:

1. To understand the basics of Natural language processing
2. To analyze the text syntactically and semantically
3. The know the importance of text analysis

Course Outcomes:

By the end of the course, the student will be able to:

1.	Explain the basics of Natural language processing
2.	Analyze the text syntactically
3.	Analyze the text content Semantically
4.	Implement recurrent network for language models
5.	Implement a sentiment classification and chatbot systems

CO - PO Mapping:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO 1	**2**	1	1	**-**	-	-	-	-	-	-	**-**	-	-	1
CO 2	**2**	2	1	**2**	**2**	-	-	**-**	1	**-**	**-**	**-**	1	2
CO 3	**2**	2	1	2	**2**	**-**	-	-	1	-	-	**-**	1	2
CO 4	**2**	2	1	2	**2**	**-**	**-**	-	1	-	-	-	1	2
CO 5	**2**	2	1	2	**2**	**-**	**-**	-	1	-	-	-	1	2

SYLLABUS

UNIT-I 12 periods

INTRODUCTION: Introduction to NLP, Regular Expressions, Words, Corpora, Text Normalization, Minimum Edit distance, N gram Language Models, Evaluating Language Models.

Learning outcome: at the end of this unit student are able to

1. Understand the Natural Language Processing basics
2. To evaluate language models

UNIT-II 12 periods

SYNTACTIC ANALYSIS: English Word Classes, The Penn Treebank Part-of-Speech Tagset, Part-of-Speech Tagging, HMM Part of-Speech Tagging, Maximum Entropy Markov Models, Grammar Rules for English, Tree banks, Grammar Equivalence and Normal form, Lexicalized Grammar.

Learning outcome: at the end of this unit student are able to

1. Analyze Part of Speech Tagging concepts
2. Find the importance of Grammar Rules and Grammar Equivalence

UNIT-III 12 periods

SEMANTIC ANALYSIS : Representation of Sentence Meaning: Computational Desiderata for Representations, Model - Theoretic Semantics, First-Order Logic, Event and State Representations, Description Logics, Semantic roles, Semantic role labeling.

Learning outcome: at the end of this unit student are able to

1. Represent sentence meaning
2. Analyse Semantic Analysis Models

UNIT- IV 12 Periods

SEQUENCE PARSING WITH RECURRENT NETWORKS: Simple Recurrent Networks, Applications of RNNs, Deep Networks: Stacked and Bidirectional RNNs, Managing Context in RNNs: LSTMs and GRUs, Words, Characters and Byte-Pairs.

Learning outcome: at the end of this unit student are able to

1. Understand Simple Recurrent Networks
2. Apply RNNs and various Deep Networks

UNIT- V 10 Periods

CASE STUDY: Sentiment Classification, Dialog Systems and Chatbots

Learning outcome: at the end of this unit student are able to

1. Study Sentiment Classification
2. Implement Dialog Systems and Chatbots

Text Book:

1. Dan Jurafsky and James H. Martin. Speech and Language Processing (3rd ed. draft), 2019.

Reference Books:

1. Steven Bird, Ewan Klein, and Edward Loper, Natural Language Processing with Python, First Edition, O'reilly, 2009

2. Steven Struhl, “Practical Text Analytics: Interpreting Text and Unstructured Data for Business Intelligence”, Kogan Page, 2015.

E-Resources :

https://www.coursera.org/learn/language-processing

https://www.nltk.org/book/

Internet Of Things	
MTDS 124(B)	**Credits : 3**
Instruction : 3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites: Basic Networking concepts, Electronic devices and Circuits.

Course Objectives:

1. Identify problems that are amenable to solution by AI methods, and which AI methods may be suited to solving a given problem.
2. Formalize a given problem in the framework of different AI methods (e.g., as a search problem, as a constraint satisfaction problem, as a planning problem, etc).
3. Implement basic AI algorithms (e.g., Search algorithms or dynamic programming).
4. Design and carry out an empirical evaluation of different algorithms on problem formalization, and state the conclusions that the evaluation supports.

Course Outcomes:

By the end of the course, the student will be able to:

1.	Demonstrate knowledge and understanding of the security and ethical issues of the Internet of Things.
2.	Conceptually identify vulnerabilities, including recent attacks, involving the IoT.
3.	Analyse the IoT protocols for efficient network communication.
4.	Applying protocols to build applications.
5.	Implementation of web based services and into the Cloud environment.

CO-PO Mapping:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO 1	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	2	2	2	-	-	-	-	-	-	-	-	-	-
CO 3	2	2	1	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	2	1	2	-	-	-	-	-	-	-	-	-	-
CO 5	2	3	3	3	3	-	-	-	-	-	2	2	2	2

SYLLABUS

UNIT- I 12 periods

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

Learning outcome: at the end of this unit student are able to

1. Understand the IoT Concepts and electronic devices like sensors.
2. To know the collection of sensors connected in network.

UNIT-II 12 periods

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.

Learning outcome: at the end of this unit student are able to

1. Motivate the importance of IoT, its functionalities and Industrial issues
2. Find the difference between OSI Layers and IoT Network layers.

UNIT-III 12 periods

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.

Internet Connectivity Principles, Application Layer Protocols: HTTP,HTTPS, FTP, Telnet.

Learning outcome: at the end of this unit student are able to

1. Develop the Application to control the devices
2. Analyse networking principles and issues while implementing applications.

UNIT-IV 12 Periods

Data link layer of IoT, Wireless Communication Technologies, Dynamic routing protocols for wireless adhoc networks Communication protocols for IoT, Service oriented protocol(COAP), Communication protocols based on the exchange of messages(MQTT), Service discovery protocols, Data Acquiring, Organizing and Analytics in IoT/M2M.

Learning outcome: at the end of this unit student are able to

1. Analyse the raw data which is coming from the real world sensing data.
2. Apply techniques on IoT data for presenting required data.

UNIT-V 12 Periods

IoT Cloud Platform: Introduction to Cloud Storage models IOT cloud-based services(Xively, Nimbits), Web server for IoT, Cloud for IoT, Web application framework Designing a RESTful web API.

Learning outcome: at the end of this unit student are able to

1. Configure the different tools to deploy the application in cloud.
2. Develop Smart applications for interacting smart devices.

Text Book:

1. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education,2017, 1st Edition.
2. Internet of Things, A.Bahgya and V.Madisetti, Univesity Press, 2015

Reference Books:

1. Designingthe Internet of Things, Adrian McEwen and Hakim Cassimally, Wiley
2. Getting Started with the Internet of Things CunoPfister , O'Reilly

E-Resources :

https://www.coursera.org/specializations/iot

NO SQL Databases	
MTDS 124(C)	**Credits : 3**
Instruction : 3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites: Knowledge on Relational Database management systems, Data structure concepts.

Course Objectives:

- To Construct Hands-on experience with a representative sample of open-source NoSQL databases .
- Applying rapid and efficient processing of data sets with a focus on performance, reliability, and agility.
- Demonstrate competency in selecting a particular NoSQL database for specific use cases .
- Demonstrate competency in selecting a particular NoSQL database for specific use cases.
- Demonstrate Document databases with MongoDB.

Course Outcomes:

After Successful Completion of Course, the student will be able to:

1.	Compare and contrast the uses of relational RDBMSs and NoSQL systems for different types of data and applications.
2.	Acquiring knowledge on different architecture on databases, Column-oriented NoSQL Databases to Process, load data, query data and performance tune Varieties of Data.
3.	Applying Advanced columnar data model functions for the real time applications identify right database models for real time applications
4.	Predict the insights using tools and methods of Hadoop Distributed File System (HDFS) as a foundation for NoSQL technologies.
5.	Develop approaches to applying with Graph Data model

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	2	1	2	-	1	-	-	-	-	-	-	-	2	1
CO2	2	2	3	-	2	-	-	-	-	-	-	2	2	0
CO3	2	-	3	-	2	-	-	-	1	-	-	2	3	0
CO4	2	1	3	-	2	1	-	-	2	-	3	2	1	0
CO5	**2**	1	1	3	**-**	**1**	**-**	-	2	2	3	2	2	1

SYLLABUS

UNIT-I **14 periods**

Introduction: Overview, and History of NoSQL Databases ,Managing Transactions and Data Integrity, ACID and BASE for reliable database transactions, Speeding performance by strategic use of RAM, SSD, and disk, Achieving horizontal scalability with database sharding, Brewers CAP theorem

Key-Value: From array to key value databases, Essential features of key value Databases, Properties of keys, Key-Value Architecture and implementation Terms, Designing Structured Values, Limitations of Key-Value Databases,.

Learning outcome: at the end of this unit student are able to Learn

- Understands that amount of data in many applications cannot be served affordably by a SQL database.
- The student will be able to use the way Operations used in Real Time applications.

UNIT-II **14 periods**

Distribution Models : Single Server – Sharding - Master-Slave Replication - Peer-to-Peer Replication – Combining Sharding and Replication Consistency: Update Consistency - Read Consistency - Relaxing Consistency - The CAP Theorem - Relaxing Durability

Document Database - Document, Collection, Naming, CRUD operation, querying, indexing, Replication, Sharding, Consistency Implementation: Distributed consistency, Eventual Consistency, Capped Collection,

Learning outcome: at the end of this unit student can

- Understand common scalability strategies used when designing server-side systems.
- Apply different key spaces to distribute data across multiple servers or partitions as well different databases.
- Understand semi structured, and hierarchical nature of documents ,apply non-relational databases to store and query data as JSON-like documents.

UNIT-III **12 periods**

Columnar data model- Column-store Architectures: C-Store and Vector-Wise, Column-store internals and, Inserts/updates/deletes, Indexing, Adaptive Indexing and Database Cracking.

Column-Family Data Store -Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Counters, Expiring Usage, When Not to Use.

Learning outcome: at the end of this unit student can

- Apply different Frameworks for fault-tolerant, efficient way of storing large quantities of sparse data.
- Create, maintain, and change website content without requiring specialist technical expertise.

UNIT- IV **12 Periods**

NoSQL Key/Value databases using Riak, Key-Value Databases, What Is a Key-Value Store, KeyValue Store Features, Consistency, Transactions, Query Features, Structure of Data, Scaling,

Suitable Use Cases, Storing Session Information, User Profiles, Relationships among Data, Multioperation Transactions, Query by Data, Operations by Sets

Learning outcome: at the end of this unit student can

- Work with fault tolerant data replication and automatic data distribution across the cluster.
- Apply different Relationships among Data
- Estimate queries on non-primary attributes using different Operations by sets.

UNIT-V **10 Periods**

Graph Databases - Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Connected Data, Routing, Dispatch, and Location-Based Services, Recommendation Engines, When Not to Use

Learning outcome: at the end of this unit student can

- Design for different transactional (OLTP) systems using graph database.
- Learn different routing with graph algorithms.
- Develop recommendation engines based on finding patterns.

Textbook:

1. The Design and Implementation of Modern Column-Oriented Database Systems, Daniel Abadi Yale University

Reference Books:

1. Redmond, E. &Wilson , Author: Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement Edition: 1st Edition.
2. Sadalage, P. & Fowler, M. (2012). NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence. (1st Ed.). Upper Saddle River, NJ: Pearson Education, Inc. ISBN- 13: 978-0321826626 ISBN-10: 0321826620
3. Next Generation database: NoSQL and big data by Guy Harrison
4. An introduction to Information Retrieval, Christopher D.manning, Prabhakar Raghavan, Hinrich Schutze.
5. Pramod J.Sadalag and Martin Fowler," NoSQL Distilled, A Brief Guide to the Emerging World of Polyglot Persistence" ,1st Edition, Addison Wesley

E-Resources :

https://www.udemy.com/course/sql-nosql-big-data-hadoop/
https://www.coursera.org/learn/introduction-to-nosql-databases
https://www.coursera.org/learn/nosql-databases
WEB RESOURCES
https://university.mongodb.com/

AUDIT Course 2: ENGLISH FOR RESEARCH PAPER WRITING	
MTDS125	**Credits : 0**
Instruction : 2 Periods /Week	**Sessional Marks: 40**
End Exam : 2 Hours	**End Exam Marks :00**

Prerequisites: Basic Knowledge in English language skills.

Course objectives:

Students will be able to:

1. Understand how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title
4. Ensure the good quality of paper at very first-time submission

Course Outcomes:

By the end of the course, the student will be able to:

1.	Develop writing skills and level of readability.
2.	Critically analyse the content and draft an outline of the abstract.
3.	Review the literature, discuss and learn methodology, write effective results, and conclusions.
4.	Demonstrate good writing skills and draft good quality paper using appropriate vocabulary and grammatically correct sentences.

CO-PO Mapping

	PO												**PSO**		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	1									3	1	1			
CO2		1							1	3	1	1			
CO3									1	3	1	1			
CO4										3	1	1			

SYLLABUS

UNIT I

5 Periods

PLANNING AND PREPARATION CO1

Reading: Reading the content, understanding the key words and theme.

Grammar: Arranging the word order in sentences, breaking up long sentences, structuring paragraphs and sentences, concision of content, removing redundancy, avoiding ambiguity and vagueness.

Learning Outcomes

At the end of the module, the learners will be able to

- Learn how to understand the text content
- Structure the sentences
- Concise the sentences and write well structured paragraphs on specific topics

UNIT-II

ABSTRACT PREPARATION CO2 5 Periods

Analysing the content- getting clarity on who did what, highlighting the findings, hedging and criticising the material.

Drafting- Writing abstracts and introductions of paper, learning Paraphrasing and checking Plagiarism.

Learning Outcomes

At the end of the module, the learners will be able to

- Learn how to Analyse and high light the findings.
- Write abstracts and introductions of paper
- Paraphrase the paper content
- Check Plagiarism

UNIT-III

DISCUSSION AND CONCLUSIONS CO3 5 Periods

Review of the Literature- Using methods to find results. Participating in discussions and bring out effective, conclusions. Learn the tips to draft the appropriate title of a paper.

Define the purpose and scope and its contribution to the field of research.

Learning Outcomes

At the end of the module, the learners will be able to

- Review the literature
- Discuss the work to bring out effective conclusions.
- Draft a title of a paper
- Identify the scope and its contribution to the field of research

UNIT-IV WRITING SKILLS AND QUALITY CO4 5 Periods

Vocabulary- Use of appropriate vocabulary; nouns, synonyms and phrases to write methods, results, discussion and Conclusions.

Grammar- Using grammatically correct sentences, using correct form of verbs- subject verb agreement, noun pronoun agreement and punctuations. Proof reading the research paper and submitting the quality work on time.

Learning Outcomes

At the end of the module, the learners will be able to

- Use appropriate vocabulary to write methods, results, discussion and Conclusions.
- Use grammatically correct sentences
- Proof read the research paper
- Submit the quality research paper on time

Suggested Studies:

Reference Books:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Machine Learning with R Lab	
MTDS 126	**Credits : 2**
Instruction : 3 Periods /Week	Sessional Marks : 50
End Exam : 3 Hours	End Exam Marks : 50

Prerequisites:

1. Strong Mathematical Knowledge.
2. Knowledge on Advanced Data Structures and Algorithms.
3. Logical thinking and Problem solving Skills.

Course Description:

R is a very popular open-source programming language for machine learning. Its interactive programming environment and powerful data analysis capabilities make R an ideal tool for machine learning. Introduction to the R programming language using R-Studio. In addition, we will demonstrate how we can use R to train a series of machine learning models. We'll cover supervised and unsupervised learning in the form of classification, regression, and clustering. Finally, we'll learn how to deploy these models to production.

Course Objectives:

The course should enable the students:

- Learn how to solve real-world problems with machine learning and R.
- Learn how we can use R to train a series of machine learning models.
- Learn supervised and unsupervised learning in the form of classification, regression, and clustering.

Course Outcomes:

By the end of the course, the student will be able to:	
1	Categorise R Language Basics, Install and loading R Packages for Machine Learning.
2	Implementation of Data Visualization and pre-processing Techniques using R.
3	Implementation of Classification and Regression problems using Tree Based Methods.
4	Implementation of Clustering using K-means clustering Algorithm.

Mapping of Course Outcomes with Program Outcomes & PSOs:

Mapping	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	--	2	--	2	3	--	2	1	3	1	--	1	3	1
CO2	--	3	--	2	3	1	1	2	1	2	--	1	3	1
CO3	--	2	1	2	3	1	--	2	3	2	1	1	3	1
CO4	--	2	2	2	3	2	--	2	2	2	1	1	3	1

List of Experiments

1. R Language Basics, Data Structures, Data Frames, Installing and Loading R Packages-

   a. caret: Classification And REgression Training.
   b. randomForest: specific for random forest algorithm.
   c. nnet: specific for neural networks.
   d. Rpart: Recursive Partitioning and Regression Trees.
   e. e1071: SVM training and testing models.
   f. gbm: Generalized boosting models.
   g. kernlab: also for SVM. CO-1

2.Perform Data exploration and pre-processing in R. CO-2

3. Implement regularized Linear regression. CO-3

4.Implement Naive Bayes classifier for dataset stored as CSV file. CO-3

5.Implement regularized logistic regression. CO-3

6.Build models using Decision trees. CO-4

7.Build model using SVM with different kernels.

8 Implement K-NN algorithm to classify a dataset. CO-5

9 Build model to perform Clustering using K-means after applying PCA and determining the value of K using Elbow method. Co-6

Text Book:

1. Scott V. Burger, "Introduction to Machine Learning with R Rigorous Mathematical Analysis", Published by O'Reilly Media, Inc., First Edition-March-2018.

Reference Book:

1. Michael Clark, "An Introduction to Machine Learning with Applications in R".
2. Sebastian Palmas, Kevin Oluoch, "Introduction to Machine Learning in R",-2019.
3. Matthew Renze, Practical Machine Learning with R,

https://matthewrenze.com/workshops/practical-machine-learning-with-r/

Advanced Web Technologies Lab	
MTDS127(A)	Credits : 2
Instruction : 3 Periods /Week	Sessional Marks : 50
End Exam : 3 Hours	End Exam Marks : 50

Prerequisites: Good knowledge of basic Web technologies such as HTML, CSS, JavaScript. High motivation and commitment.

COURSE OBJECTIVES:

1. Design static web application development and Students will gain the skills and front designs.
2. Able to get project-based experience needed for entry into web application and development careers using advanced technologies

COURSE OUTCOMES: By the end of the course, the student will be able to:

1	Understand the usage and designing of web pages using HTML &CSS.
2	Able to design the user interactive pages using Node Js and Express JS.
3	Analyze a given problem and apply requisite appropriate tools for designing interactive web applications.
4	Design and implement network based applications using React JS.

	PO1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PS O 1**	**PS O 2**
CO1	**2**	1	-	**-**	3	-	-	-	-	-	-	-	1	1
CO2	**1**	2	1	**-**	**3**	-	-	-	-	**-**	-	-	1	1
CO3	**2**	2	1	2	**3**	**-**	--	-	-	-	-	-	2	1
CO4	**2**	2	1	2	**3**	**-**	**--**	-	-	-	-	-	2	1

LIST OF EXPERIMENTS

S.No.	Name of the experiment	
1	Design Web page to illustrate the following for Educational Institution Home Page Login Page Registration page About Institution	CO-1
2	Design Web page to illustrate the following for Educational Institution College Video Sports Details Gallery Details Training and Placement ddetails Student Chapters	CO-1
3	Setup Node.js Development Environment, Run sample console programs	CO-2
4	Create different modules using Node JS(ex:Date)	CO-2
5	Create a form and Upload a file using Node.js	CO-3
6	Install Express JS environment and configure it. Display the parameters values using request and response modules.	CO-3
7	Create Cookie information for the login credentials(user id and password) and display it.	CO-4
8	Setup React JS Development Environment, Configure the Environment.	CO-4
9	Create different types of Forms using React JS	CO-4
10	Develop an event handling mechanism on Login Form using React JS.	CO-4

Text Books:

1. HTML 5 Black Book, Covers CSS 3, JavaScript, XML, XHTML, AJAX, PHP and jQuery, 2ed, Black Book Dream Tech
2. React. Js Book: Learning React JavaScript Library from Scratch, Book by Greg Sidelnikov
3. Node.js in Action, by Alex Young , Bradley Meck , Mike Cantelon , Tim Oxley , Marc Harter , T.J. Holowaychuk , Nathan Rajlich

Reference Books:

1. Build Your Own Website The Right Way Using HTML & CSS, 3rd Edition by ge The WordPress Anthology
2. The Principles of Beautiful Web Design, 2nd Edition by Jason Beair
3. React in Action 1st Edition by Mark Tielens Thoma

Principles of Deep Learning Lab	
MTDS127(B)	**Credits : 2**
Instruction : 3 Periods /Week	**Sessional Marks : 50**
End Exam : 3 Hours	**End Exam Marks : 50**

Prerequisites: Basic fundaments of Artificial Neural Network and Machine Learning and Problem solving Skills.

Course Objectives:

1. Learn how to implement deep learning algorithms.
2. Learn various parameter and settings to train deep learning models.

Course Outcomes:

By the end of the course, the student will be able to:

1.	Create a deep neural network.
2.	Design layers and various parameters of deep network.
3.	Analyse different deep learning models and parameters.
4.	Discriminative Learning models of a deep neural network.
5.	Implement a deep learning application to solve real-world problem.

CO-PO Mapping:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PS O 1**	**PS O 2**
CO1	**2**	2	2	**2**	2	1	-	1	1	-	**-**	2	-	2
CO2	**2**	2	2	**2**	**2**	-	-	**1**	1	**-**	**-**	**2**	-	2
CO3	**2**	3	2	2	**2**	**1**	-	1	2	-	-	**2**	3	2
CO4	**2**	3	2	2	**2**	**1**	**--**	1	1	-	-	2	2	2
CO5	**2**	2	2	2	**1**	**1**	**-**	1	-	-	-	-	2	2

List of Experiments

Note: The experiments need to be implemented using python and students can use any deep learning libraries in python.

1 Environment set up for Python Deep Learning. Co-1

Installation of Python , Scipy with Numpy, Matplotlib, Theano, Keras, TensorFlow.

2. Take any dataset (MNIST,IRIS) and by using Python and its libraries understand, explore and visualize your data. CO-2
3. Pre-process your data: split up your data in train and test sets and standardize your data. CO-3
4. Build a deep neural Network and compile, fit the data to model for classification tasks CO-3
5. Validate your model using confusion matrix, Precision, Recall and F1 Score. Co-4

Text Book:

1. T1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.

Reference Books:

1. R1. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.

E-Resources :

https://www.tutorialspoint.com/python_deep_learning/python_deep_learning_implementations.htm

https://www.datacamp.com/community/tutorials/deep-learning-python

NATURAL LANGUAGE PROCESSING LAB	
MTDS127(C)	**Credits : 2**
Instruction : 3 Hours lab/Week	Sessional Marks : 40
End Exam : 3 Hours	End Exam Marks : 60

Prerequisites:

- Python Programming

Course Objectives:

- To analyze the text syntactically and semantically
- To Implement recurrent network for language models and Develop sentiment classification models and chatbot systems

Course Outcomes:

By the end of the course, the student will be able to:	
1	Analyze the text syntactically
2	Analyze the text content Semantically
3	Implement language models
4	Implement a sentiment classification

Mapping of course outcomes with program outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO 1	2	2	1	2	2	-	-	-	1	-	-	-	2	2
CO 2	2	2	1	2	2	-	-	-	1	-	-	-	2	2
CO 3	2	2	1	2	2	-	-	-	1	-	-	-	2	2
CO 4	2	2	1	2	2	-	-	-	1	-	-	-	2	2

LIST OF EXPERIMENTS:

1. Convert the text into tokens and find the word frequency CO1
2. Demonstrate a bigram and trigram language model CO1
3. Perform Lemmatization and Stemming CO1
4. Identify parts-of Speech using Penn Treebank tag set. CO1
5. Implement HMM for POS tagging and Build a Chunker CO1
6. Find the synonym of a word and antonym of a word using WordNet CO2
7. Implement semantic role labeling to identify named entities CO2
8. Implement POS tagging using LSTM CO3
9. Implement Named Entity Recognizer CO3

10. Develop a movie review system (sentiment analysis on movie data) CO4

TEXT BOOKS:

1. Steven Bird, Ewan Klein, and Edward Loper, Natural Language Processing with Python, First Edition, O'reilly, 2009

REFERENCE BOOKS:

1. Yoav Goldberg, University of Toronto, Neural Network Methods for Natural language Processing, Morgan & Claypool, 2017
2. Christopher D. Manning, and Hinrich Schütze. Foundations of statistical natural language processing. First Edition, MIT press, 1999

E-Resources:

1. **https://www.coursera.org/learn/language-processing**
2. **https://www.nltk.org/book/**

TEXT ANALYTICS LAB	
MTDS127(D)	**Credits : 2**
Instruction : 3 Hours lab/Week	Sessional Marks : 50
End Exam : 3 Hours	End Exam Marks : 50

Prerequisites:

- Python Programming

Course Objectives:

- To analyze the text syntactically and semantically
- To Implement recurrent network for language models and Develop sentiment classification models and chatbot systems

Course Outcomes:

	By the end of the course, the student will be able to:
1	Analyze the text syntactically
2	Analyze the text content Semantically
3	Implement recurrent network for language models
4	Develop sentiment classification models and chatbot systems

Mapping of course outcomes with program outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	2	1	2	2	-	-	-	1	-	-	-	2	2
CO2	2	2	1	2	2	-	-	-	1	-	-	-	2	2
CO3	2	2	1	2	2	-	-	-	1	-	-	-	2	2
CO4	2	2	1	2	2	-	-	-	1	-	-	-	2	2

LIST OF EXPERIMENTS:

1. Demonstrate a bigram and trigram language model CO**1**
2. Implement HMM for POS tagging and Build a Chunker CO1
3. Implement semantic role labeling to identify named entities CO2
4. Resolve the ambiguity in text CO2
5. Implement RNN for sequence labeling CO3
6. Translate the text using First-Order Logic CO3
7. Develop a Movie review system CO4

8. Create a chatbot for HITS. CO4

TEXT BOOKS:

1. Steven Bird, Ewan Klein, and Edward Loper, Natural Language Processing with Python, First Edition, O'reilly, 2009

REFERENCE BOOKS:

1.Yoav Goldberg, University of Toronto, Neural Network Methods for Natural language Processing, Morgan & Claypool, 2017
2. Christopher D. Manning, and HinrichSchütze. Foundations of statistical natural language processing. First Edition, MIT press, 1999

E-Resources:

1. **https://www.coursera.org/learn/language-processing**
2. **https://www.nltk.org/book/**

Internet Of Things Lab	
MTDS127(E)	Credits : 2
Instruction : 3 Periods /Week	Sessional Marks : 50
End Exam : 3 Hours	End Exam Marks : 50

Prerequisites: Electronic Components, Devices, Microcontrollers, C Programming Basics

Course Objectives:

1. To Understand the connection between Sensors using Microcontrollers.
2. To handle the hardware components using Arduino and Python Programming.

Course Outcomes:

By the end of the course, the student will be able to:

1.	Knowledge on Installation tools and libraries for hardware components.
2.	Design the Circuit diagram and executing tasks.
3.	Analyse the data in Think Speak Cloud Platform
4.	Develop smart application using IoT.

CO-PO Mapping:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	1	1	-	-	-	-	-	-	-	-	-	-	-	-
2	2	2	-	-	2	-	-	-	-	-	-	-	2	2
3	2	2	2	2	3	-	-	-	-	-	-	-	2	2
4	2	3	3	3	3	-	-	-	-	2	-	-	3	3

Exp No.	**List of Practical Experiments Performed**	CO
1	Installations of all the supported tools and IDE and libraries	1
2	LED Pattern with Push Button Control	2
3	Display live room Temperature and Humidity information	2
4	Ultrasonic Distance Measurement	2
5	Soil Moisture Sensor for agriculture	2
6	A Heart Rate Monitoring System for Health	2
7	Display IoT data in Mobile Application	3
8	MQTT Protocol Configuration Using Arduino/Python	3

9	Think Speak Based DHT Sensor Monitoring	3
10	Traffic Monitoring System	4

Text Book:

1. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education,2017, 1st Edition.
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 , O'Reilly

NO SQL Database Lab	
MTDS127(F)	Credits : 2
Instruction : 3 Periods /Week	Sessional Marks : 50
End Exam : 3 Hours	End Exam Marks : 50

Prerequisites: Database management system, RDBMS concepts

Course Objectives:

- Distinguish and describing how NoSQL databases differ from relational databases from a theoretical perspective
- Explore the origins of NoSQL databases and the characteristics .
- Demonstrate competency in selecting a particular NoSQL database for specific use cases.
- Demonstrate Document databases with MongoDB.

Course Outcomes:

After Successful Completion of Course, the student will be able to:

1.	Compare and contrast the uses of relational RDBMSs and NoSQL systems for different types of data and applications
2.	Differentiate various data models.
3.	Recognize Key value Databases and document databases.
4.	Create a sample database using NoSq and using Mango DBl.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2	2	1	-	2	-	-	-	-	-	-	-	1	2
CO2	2	2	3	-	2	-	-	-	-	-	-	2	2	0
CO3	2	-	3	-	2	-	-	-	1	-	-	2	3	0
CO4	2	2	1	2	2	-	-	-	-	-	2	2	2	2

LIST OF EXPERIMENTS

1. Description of mongo Shell, Create database and show database **CO1**
2. Commands for MongoDB and to study operations in MongoDB – Insert, Query, Update, Delete and Projection **CO1**
3. Download a zip code dataset at http://media.mongodb.org/zips.json .Use mongo import to import the zip code dataset into MongoDB. After importing the data, answer the following questions by using aggregation pipelines: (1) Find all the states that have a city called ”BOSTON”. Find all the states and cities whose names include the string ”BOST”. Each city has several zip codes. Find the city in each state with the greatest number of zip

codes and rank those cities along with the states using the city populations. MongoDB can query on spatial information **CO2**

4. Where Clause equivalent in MongoDB **CO2**

   Write a MongoDB query to find the restaurants that achieved a score, more than 80 but less than 100.

5. Write a MongoDB query to find the restaurants which locate in latitude value less than -95.754168. **CO2**
6. To study operations in MongoDB – AND in MongoDB, OR in MongoDB, Limit Records and Sort Records. To study operations in MongoDB – Indexing, Advanced Indexing, Aggregation and Map Reduce. **CO3**
7. Column oriented databases study, queries, and practices . **CO4**
8. Create a database that stores road cars. Cars have a manufacturer ,a type. Each car has a maximum performance and a maximum torque value.

   Do the following: Test Cassandras replication schema and consistency models. **CO4**

Textbook:

1. Next Generation database: NoSQL and big data by Guy Harrison

Reference Books:

1. Redmond, E. &Wilson , Author: Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement Edition: 1st Edition.
2. Sadalage, P. & Fowler, M. (2012). NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence. (1st Ed.). Upper Saddle River, NJ: Pearson Education, Inc. ISBN- 13: 978-0321826626 ISBN-10: 0321826620
3. An introduction to Information Retrieval, Christopher D.manning, Prabhakar Raghavan, Hinrich Schutze.
4. The Design and Implementation of Modern Column-Oriented Database Systems, Daniel Abadi Yale University

E-Resources :

https://www.udemy.com/course/sql-nosql-big-data-hadoop/

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

https://www.coursera.org/learn/nosql-databases

II year –I Semester

Course Code	Type of course	Name of the course	Periods per week		Max. Marks		Credits
			Lect.	Lab.	Sess.	End sem	
MTDS211		Moocs-1	--	--	--	100	3
MTDS212		Moocs-2	--	--	--	100	3
MTDS213	Dissertation –I/ Industrial project		--	--	100	--	10
Total			**--**	**--**	**100**	**200**	**16**

II year –II Semester

Course Code	Type of course	Name of the course	Periods per week		Max. Marks		Credits
			Lect.	Lab.	Sess.	End sem	
MTDS221	Dissertation –II		--	--	100	100	16
Total			**--**	**--**	**100**	**100**	**16**