MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
B.Tech. in Computer Science & Engineering (Artificial Intelligence & Machine Learning)

Scheme of Instruction and Examination
(Choice Based Credit System)
Applicable from Academic Year 2022-23 Batch
V SEMESTER

Sl. No.	Course Code	Course Title	Instruction			Examination			Credits
			Hours Per Week			Max. Marks		Duration of SEE inHours	
			L	T	P/D	CIE	SEE		
1.	CM501PC	Design and Analysis of Algorithms	3	1	0	40	60	3	4
2.	CS502PC	Computer Networks	3	0	0	40	60	3	3
3.	CM502PC	Machine Learning	3	0	0	40	60	3	3
4.	MS501HS	Business Economics and Financial Analysis	3	0	0	40	60	3	3
5.		**Professional Elective – I**	3	0	0	40	60	3	3
6.	CS551PC	Computer Networks Lab	0	0	2	40	60	3	1
7.	CM551PC	Machine Learning Lab	0	0	2	40	60	3	1
8.	CS553PC	UI design- Flutter	0	0	2	40	60	3	1
9.	EN551HS	Advanced English Communication Skills Laboratory	0	0	2	40	60	3	1
10.	MC501HS	Intellectual Property Rights	3	0	0	40	60	3	0
		Total	**18**	**1**	**8**	**400**	**600**	**30**	**20**

L: Lecture   T: Tutorial   D: Drawing   P: Practical   CIE - Continuous Internal Evaluation   SEE - Semester End Examination

VI SEMESTER

S. No	Course Code	Course Title	Instruction			Examination			Credits
			Hours Per Week			Max. Marks		Duration of SEEin Hours	
			L	T	P/D	CIE	SEE		
	CM601PC	Knowledge Representation and Reasoning	3	0	0	40	60	3	3
1.	CM602PC	Data Analytics	3	0	0	40	60	3	3
2.	CM603PC	Natural Language Processing	3	0	0	40	60	3	3
3.		**Professional Elective – II**	3	0	0	40	60	3	3
4.		**Open Elective - I**	3	0	0	40	60	3	3
5.	CM651PC	Data Analytics Lab	0	0	3	40	60	3	1.5
6.	CM652PC	Natural Language Processing Lab	0	0	3	40	60	3	1.5
7.	CM653PC	Industrial Oriented Mini Project/ Internship/Skill Development Course (DevOps)	0	0	4	-	100	-	2
8.	MC602ES	Cyber Security	3	0	0	40	60	3	0
		Total	**18**	**0**	**10**	**320**	**580**	**24**	**20**
9.	MC601BS	Environmental Science (For Lateral Entry Students)	3	0	0	40	60	3	0

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B.Tech. in Computer Science & Engineering (Artificial Intelligence & Machine Learning)

Scheme of Instruction and Examination
(Choice Based Credit System)
Applicable from Academic Year 2022-23 Batch

VII SEMESTER

S. No	Course Code	Course Title	Instruction Hours Per Week			Examination Max. Marks		Examination Duration of SEE in Hours	Credits
			L	T	P/D	CIE	SEE		
1.	CM701PC	Deep Learning	3	0	0	40	60	3	3
2.	CM702PC	Nature Inspired Computing	2	0	0	40	60	2	2
3.		Professional Elective – III	3	0	0	40	60	3	3
4.		Professional Elective – IV	3	0	0	40	60	3	3
5.		Open Elective – II	3	0	0	40	60	3	3
6.	MS701HS	Professional Practice, Law and Ethics	2	0	0	40	60	3	2
7.	CM751PC	Deep Learning Lab	0	0	2	40	60	3	1
8.	CM752PC	Project Stage – I	0	0	6	100	-	-	3
		Total	**16**	**0**	**8**	**380**	**420**	**20**	**20**

L: Lecture   T: Tutorial   D: Drawing   P: Practical   CIE - Continuous Internal Evaluation   SEE - Semester End Examination

VIII SEMESTER

S. No	Course Code	Course Title	Instruction Hours Per Week			Examination Max. Marks		Examination Duration of SEE in Hours	Credits
			L	T	P/D	CIE	SEE		
1.		Professional Elective – V	3	0	0	40	60	3	3
2.		Professional Elective – VI	3	0	0	40	60	3	3
3.		Open Elective – III	3	0	0	40	60	3	3
4.	CM851PC	Project Stage – II including Seminar	0	0	22	40	60	-	11
		Total	**9**	**0**	**22**	**160**	**240**	**9**	**20**

L: Lecture   T: Tutorial   D: Drawing   P: Practical   CIE - Continuous Internal Evaluation   SEE - Semester End Examination

Professional Elective – I

CM511PE	Data Warehousing and Business Intelligence
CM512PE	Web Programming
CM513PE	Introduction to Data Science
CM514PE	Image Processing

Professional Elective – II

CM621PE	Graph Theory
CM622PE	Computer Vision and Robotics
CM623PE	Pattern Recognition
CS631PE	Full Stack Development

Professional Elective – III

CM731PE	Mobile Application Development
CM732PE	Data Mining
CM733PE	Scripting Languages
CD742PE	Internet of Things

Professional Elective – IV

CM741PE	Expert Systems
CM742PE	Semantic Web
CM743PE	Game Theory
CM744PE	Quantum Computing

Professional Elective – V

CM851PE	Web Security
CM852PE	Social Network Analysis
CM853PE	Federated Machine Learning
CM854PE	Augmented Reality and Virtual Reality

Professional Elective – VI

CM861PE	Speech and Video Processing
CM862PE	Robotic Process Automation
CM863PE	Randomized Algorithms
CM864PE	Cognitive Computing

Open Elective – I

CM621OE	Advanced Data Structures
CD621OE	Data Base Management Systems

Open Elective – II

CM721OE	Data Mining
CD722OE	R Programming

Open Elective – III

CM821OE	Machine Learning
CM822OE	Introduction to Natural Language Processing

L	T	P	C
3	1	0	4

B.Tech. in Computer Science & Engineering (AI&ML)
V Semester Syllabus
CM501PC: DESIGN AND ANALYSIS OF ALGORITHMS

Prerequisites:

- A course on "Computer Programming and Data Structures"
- A course on "Advanced Data Structures"

Course Objectives:

- Introduces the notations for analysis of the performance of algorithms.
- Introduces the data structure disjoint sets.
- Describes major algorithmic techniques (divide-and-conquer, Greedy, Dynamic Programming, Backtracking and Branch and Bound methods) and mention problems for which each technique is appropriate.
- Describes how to evaluate and compare different algorithms using worst, average, and best case analysis.
- Explains the difference between tractable and intractable problems, and introduces the
- Problems that are P, NP and NP complete.

Course Outcomes:

Student will be able to:

- Acquire the knowledge of algorithm analysis and its notations that are applied on the problems solved by divide and conquer paradigm.
- Use greedy approach to solve an appropriate problem for optimal solution.
- Apply dynamic programming approach to solve suitable problems
- Apply the concept of back tracking, branch and bound paradigm for real time problems.
- Analyze the complexity of problems and differentiate them in terms of P and NP problems with examples.

Unit I
Introduction: Algorithm, Pseudo code for expressing algorithms, Performance Analysis-Space complexity, Time complexity, Asymptotic Notation- Big oh notation, Omega notation, Theta notation and Little oh notation.
Divide and conquer: General method, applications-Binary search, Quick sort, Merge sort, Strassen's matrix multiplication.
Unit II
Sets and Disjoint Set Unions: Introduction, Union and Find Operations with algorithms.
Greedy method: General method, applications-Job sequencing with dead lines, knapsack problem, Minimum cost spanning trees-Prim's and kruskal's Algorithm, Single source shortest path problem.
Unit III
Dynamic Programming: General method, applications- Multistage Graphs, Optimal binary search trees, 0/1 knapsack problem, All pairs shortest path problem, The Traveling sales person problem, Reliability design.
Unit IV
Backtracking: General method, applications- The 8-Queens problem, sum of subsets problem, graph coloring, Hamiltonian cycles.
Branch and Bound: General method, applications - 0/1 knapsack problem- LC Branch and Bound solution, FIFO Branch and Bound solution, Travelling sales person problem.
Unit V
NP-Hard and NP-Complete problems: Basic concepts, Nondeterministic algorithms, The classes NP - Hard and NP-Complete, Cook's theorem, NP-Hard Graph Problems-Clique Decision Problem(CDP), Node cover decision problem.

TEXT BOOKS:

1. Ellis Horowitz, Satraj Sahni and Sanguthevar Rajasekharam, Fundamentals of Computer Algorithms, , Galgotia publications Pvt. Ltd, Second Edition, 2007.
2. Aho, Ullman and Hopcroft, Design and Analysis of algorithms, Pearson education, Reprint 2002.
3. Introduction to Algorithms, 3rd Ed, T. H. Cormen, C.E. Leiserson, R. L. Rivest, and Clifford Stein, PHI Pvt. Ltd., Pearson Education.

REFERENCE BOOKS:

1. R.C.T.Lee, S.S.Tseng, R.C.Chang and T.T Sai, Introduction to Design and Analysis of Algorithms A strategic approach, Mc Graw Hill,2005.
2. Algorithm Design: Foundations, Analysis and Internet Examples, M.T. Goodrich and R.Tamassia, John Wiley and sons.

L	T	P	C
3	0	0	3

B.Tech. in Computer Science & Engineering (AI&ML)
V Semester Syllabus
CS502PC: COMPUTER NETWORKS
(Common to CSE, CSBS, CSE(AI&ML), CSE (Data Science))

Course Objectives:

- The objective of the course is to equip the students with a general overview of the concepts and fundamentals of computer networks.
- Familiarize the students with the standard models for the layered approach to communication between machines in a network and the protocols of the various layers.

Course Outcomes:

- Gain the knowledge of the basic computer network technology.
- Gain the knowledge of the functions of each layer in the OSI and TCP/IP reference model.
- Identify and analyze various routing algorithms, congestion control algorithms.
- Outline the transport layer protocols like TCP and UDP.
- List and examine the applications of HTTP, WWW, DNS, Email, FTP and the underlying protocols.

UNIT - I

Network Hardware: Local Area Networks, Metropolitan Area Networks, Wide Area Networks, Internetwork. Network software: Protocol Hierarchies, Design Issues for the Layers, Connection-Oriented and Connectionless Services. **Reference Models:** OSI, TCP/IP Reference models, Comparison of OSI and TCP/IP Models Example Networks: ARPANET, Internet. **Physical Layer: Guided Transmission media:** Magnetic Media, Twisted pairs, Coaxial Cable, Fiber Optics, Unguided Transmission Media: Radio waves, Microwaves, Infrared.

UNIT - II

Data link layer: Design issues, Framing: Character Count, Character Stuffing, Bit Stuffing Error Detection and Correction: Block Codes, Simple Parity Check, LRC, Hamming Distance, Checksum, Hamming Code, CRC, **Elementary data link protocols:** simplex protocol, A simplex stop and wait protocol for an error-free channel, A simplex stop and wait protocol for noisy channel. **Sliding Window protocols:** Pipelining, Piggybacking, A one-bit sliding window protocol, A protocol using Go-Back-N, A protocol using Selective Repeat.

Medium Access sub layer: The channel allocation problem, Multiple access protocols: ALOHA, Carrier sense multiple access protocols, collision free protocols. Wireless LANs, Connecting devices at the data link layer.

UNIT - III

Network Layer: Design issues, Routing algorithms: shortest path routing, Flooding, Hierarchical routing, Broadcast, Multicast, distance vector routing, Link State Routing, **Congestion Control Algorithms:** Approaches to Congestion Control, Traffic aware routing, Admission Control, Traffic throttling, Load shedding. **Quality of Service:** Traffic Shaping, Packet scheduling, Admission Control, Integrated services, Differentiated Services, Internetworking, **Network layer in the Internet:** IPv4 protocol, IP Addresses, IPv6 protocol, Internet Control Protocols: ICMP, ARP, RARP, BOOTP, and DHCP.

UNIT - IV

Transport Layer: Transport Services: Services provided to Upper layer, Transport service primitives, Berkeley Sockets Elements of Transport protocols: Addressing, Error and Flow Control, Multiplexing, Crash Recovery, Connection management. **Internet Transport Protocols: TCP:** Service Model, TCP Protocol, Segment header, TCP Connection establishment and Release, TCP Connection management, TCP Sliding Window, Timer management, TCP Congestion Control. **UDP:** Protocol, UDP Header

UNIT - V

Application Layer: Domain name system- DNS Name Space, Resource records, Name Servers. SNMP, Electronic Mail: Architecture and Services, User Agent, Message Formats, Message Transfer, Final Delivery. SMTP, POP3, ICMP. File transfers: FTP, TFTP, Telnet.

TEXT BOOKS:
1. Computer Networks -- Andrew S Tanenbaum, David. j. Wetherall, 5th Edition. Pearson Education/PHI, 2011.
2. Data Communications and Networking – Behrouz A. Forouzan. Fifth Edition TMH, 2017.

REFERENCE BOOKS:
1. An Engineering Approach to Computer Networks-S. Keshav, 2nd Edition, Pearson Education
2. "Data and Computer Communications" by William Stallings 9th Edition, Pearson Education 2010.TCP/IP Illustrated" by W. Richard Stevens, Addison-Wesley Professional 2nd edition 2011.

L	T	P	C
3	0	0	3

B.Tech. in Computer Science & Engineering (AI&ML)
V Semester Syllabus
CM502PC: MACHINE LEARNING
(Common to IT & CSE (AI & ML))

Prerequisites:
- Data Structures
- Knowledge on statistical methods

Course Objectives

- This course explains machine learning techniques such as decision tree learning, Bayesianlearning etc.
- To understand computational learning theory.
- To study the pattern comparison techniques.

Course Outcomes

- Understand the concepts of computational intelligence like machine learning
- Ability to get the skill to apply machine learning techniques to address the real time problemsin different areas
- Understand the Neural Networks and its usage in machine learning application.

UNIT - I

Introduction: Learning- types of machine learning, Perspectives and issues in machine learning, bias variance trades off, testing machine learning algorithms, confusion matrix, accuracy metrics, turning data into probabilities. Dimensionality reduction- Linear discriminant analysis, principal component analysis, Factor analysis, independent component analysis.

UNIT - II

Supervised Learning: Decision Tree Learning – Introduction, decision tree representation, appropriate problems for decision tree learning, the basic decision tree learning algorithm, Information Gain, Gini Index. issues in decision tree learning, overfitting, pruning.

Instance-Based Learning- Introduction, k-nearest neighbors' algorithm, remarks on lazy and eager learning.

UNIT – III

Neural Networks: The perceptron- learning rate, bias, perceptron learning algorithm, linear separability-Exclusive-OR function, backpropagation algorithm, initialization of weights, MLP in practice, deriving back propagation, radial basis functions. An illustrative example: face recognition.

UNIT- IV

Bayesian learning – Introduction, Conditional probability, Joint probability, Bayes theorem, maximum likelihood hypotheses for predicting probabilities, Bayes optimal classifier, Naïve Bayes classifier, an example: learning to classify text, Bayesian belief networks.

Support vector machines, optimal separation kernels, SVM algorithm.

UNIT - V

Unsupervised learning- Clustering, Hierarchical and partitional clustering, k means algorithm, ensemble learning-Boosting Bagging. Reinforcement Learning – Introduction, the learning task, Q–learning, non-deterministic, rewards and actions, temporal difference learning.

TESXT BOOKS:

1. Machine Learning – Tom M. Mitchell, - MGH
2. Ethem Alpaydin, Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press, 2015

REFERENCE BOOKS:

1. Machine Learning: An Algorithmic Perspective, Stephen Marshland, Taylor & Francis.

L	T	P	C
3	0	0	3

B.Tech. in Computer Science & Engineering (AI&ML)
V Semester Syllabus
MS501HS: Business Economics and Financial Analysis
(Common to CIVIL, EEE, MEC, ECE, MCT, MME & CSE (AI & ML))

Course Objectives: The Objective of the course are:

1. Students will understand various forms of Business and the impact of economic variables on the business, concepts of Business Economics and its significance.
2. Gain the knowledge on various market dynamics namely Demand, elasticity of demand, and demand forecasting.
3. To disseminate the knowledge on production function, Laws of production, Market structures, while dealing with the concept of cost and breakeven analysis.
4. To acquaint the students regarding Accounting and various books of accounts.
5. To enable the students to analyze a company's financial statements through ratios and come to a reasoned conclusion about the financial situation of the company.

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

1. Select a suitable business organization with available resources.
2. Analyze various aspects of Demand, Elasticity of demand and Demand Forecasting.
3. Gain knowledge on different market structures, production theories, cost variables and pricing methods.
4. Prepare Books of accounts and Financial Statements.
5. Analyze financial well-being of the business while using ratios.

UNIT – I: INTRODUCTION TO BUSINESS AND ECONOMICS
Economics: Significance of Economics, Micro and Macro Economic Concepts, National Income - Concepts and Importance, Inflation, Business Cycle - Features and Phases.
Business: Structure of Business Firm, Types of Business Entities – Sole Proprietorship – Partnership – Cooperative Societies - Limited Liability Companies, Sources of Capital – Conventional sources and Non - Conventional Sources of Finance.
Business Economics: Nature and Scope of Business Economics, Role of Business Economist, Multidisciplinary nature of Business Economics.

UNIT – II: DEMAND AND SUPPLY ANALYSIS
Demand Analysis: Demand **-** Meaning, Determinants of Demand, Law of Demand, Exceptions of Law of Demand, Demand Function, Changes in Demand – Increase and decrease in Demand - Extension and Contraction in Demand.
Elasticity of Demand: Elasticity – Meaning, Types of Elasticity – Price Elasticity – Income Elasticity – Cross Elasticity–Advertising Elasticity of Demand, Factors affecting Elasticity of Demand, Measurement and Significance of Elasticity of Demand, Elasticity of Demand in decision making.
Demand Forecasting: Characteristics of Good Demand Forecasting, Steps in Demand Forecasting, Methods of Demand Forecasting – Survey methods, Statistical methods.
Supply Analysis: Supply – Meaning, Determinants of Supply, Supply Function & Law of Supply.

Unit III: PRODUCTION, COST, MARKET STRUCTURES & PRICING
Production Analysis: Production – Meaning, Factors of Production, Production Function, Production Function with one variable input, two variable inputs, Returns to Scale, Cobb-Douglas production function.
Cost analysis: Cost–Meaning, Types of Costs, Short run and Long run Cost Functions.
Market Structures: Nature of Competition, Features of Perfect competition, Monopoly, Oligopoly, Monopolistic Competition.
Pricing: Pricing -Meaning, Objectives of pricing, pricing methods – Cost based pricing methods – Demand based pricing methods – Competition based pricing methods – Strategy based pricing methods - Product Life Cycle based Pricing, Break Even Analysis (simple problems), Cost Volume Profit Analysis.

Unit IV: FINANCIAL ACCOUNTING
Accounting concepts and Conventions, Accounting Equation, Double-Entry system of Accounting, Rules for maintaining Books of Accounts, Journal, Posting to Ledger, Preparation of Trial Balance, Elements of Financial Statements, Preparation of Final Accounts along with adjustments– Trading account – Profit and loss account – Balance sheet (simple problems).

UNIT – V: FINANCIAL ANALYSIS THROUGH RATIOS
Concept of Ratio Analysis, Importance, Liquidity Ratios- Current Ratio – Quick Ratio – Absolute Liquid Ratio, Profitability Ratios – Gross Profit Ratio – Net Profit Ratio – Operating Ratio, Turnover Ratios – Stock Turnover Ratio – Debtors Turnover Ratio – Creditors Turnover Ratio, Leverage Ratios – Debt-to-Assets Ratio - Debt-Equity Ratio - Proprietary Ratios and interpretation (simple problems).

TEXT BOOKS:

1. Geethika Ghosh, Piyali Gosh, Purba Roy Choudhury,"Managerial Economics", 2e, Tata McGraw Hill Education Pvt. Ltd. 2012.
2. Dhanesh K Khatri, "Financial Accounting", Tata McGraw Hill, 2011.
3. Ramachandra Aryasri. A, "Business Economics and Financial Analysis", McGraw Hill Education India Pvt. Ltd. 2020.

REFERENCE BOOKS:

1. P. L. Mehta, Managerial Economics, Analysis, Problems & Cases, 8th Edition, Sultan Chand & Sons, 2001.
2. S.N. Maheshwari, Sunil K Maheshwari, Sharad K Maheshwari, Financial Accounting, 5e, Vikas Publications, 2013.
3. D.D. Chaturvedi, S.L. Gupta, "Business Economics - Theory and Applications", International Book House Pvt. Ltd. 2013.

L	T	P	C
3	0	0	3

B.Tech. in Computer Science & Engineering (AI&ML)
V Semester Syllabus
CM511PE: DATA WAREHOUSING AND BUSINESS INTELLIGENCE (PE-1)
(Common to CSE (AI &ML) & CSE (Data Science))

Course Objectives

The student should be able to:

● This course is concerned with extracting data from the information systems that deal with the day-to-day operations and transforming it into data that can be used by businesses to drive high-level decision making
● Students will learn how to design and create a data warehouse, and how to utilize the process of extracting, transforming, and loading (ETL) data into data warehouses.

Course Outcomes

Students will be able to:

● Understand architecture of data warehouse and OLAP operations.
● Understand Fundamental concepts of BI and Analytics
● Application of BI Key Performance indicators
● Design of Dashboards, Implementation of Web Analytics
● Understand Utilization of Advanced BI Tools and their Implementation.
● Implementation of BI Techniques and BI Ethics.

UNIT - I
DATA WAREHOUSE: Data Warehouse-Data Warehouse Architecture- Multidimensional Data Model-Data cube and OLAP Technology-Data Warehouse Implementation -DBMS schemas for Decision support - Efficient methods for Data cube computation.

UNIT - II
Business Intelligence: Introduction – Definition, Leveraging Data and Knowledge for BI, BI Components, BI Dimensions, Information Hierarchy, Business Intelligence and Business Analytics. BI Life Cycle. Data for BI - Data Issues and Data Quality for BI.

UNIT - III
BI Implementation - Key Drivers, Key Performance Indicators and Performance Metrics, BI Architecture/Framework,Best Practices, Business Decision Making, Styles of BI-vent-Driven alerts-A cyclic process of Intelligence Creation. The value of Business intelligence -Value driven and Information use.

UNIT - IV
Advanced BI – Big Data and BI, Social Networks, Mobile BI, emerging trends, Description of different BI-Tools (Pentaho, KNIME)

UNIT - V
Business intelligence implementation-Business Intelligence and integration implementation-connecting in BI systems- Issues of legality- Privacy and ethics- Social networking and BI.

TEXT BOOKS:

1. Data Mining – Concepts and Techniques - JIAWEI HAN & MICHELINE KAMBER, Elsevier.
2. Rajiv Sabherwal "Business Intelligence" Wiley Publications, 2012.

REFERENCE BOOKS:

1. Efraim Turban, Ramesh Sharda, Jay Aronson, David King, Decision Support and Business Intelligence Systems,9th Edition, Pearson Education, 2009.
2. David Loshin, Business Intelligence - The Savy Manager's Guide Getting Onboard with Emerging IT, Morgan Kaufmann Publishers, 2009.
3. Philo Janus, Stacia Misner, Building Integrated Business Intelligence Solutions with SQLServer, 2008 R2 & Office 2010, TMH, 2011.
4. Business Intelligence Data Mining and Optimization for decision making [Author: Carlo-Verellis] [Publication:(Wiley)]
5. Data Warehousing, Data Mining & OLAP- Alex Berson and Stephen J. Smith- Tata McGraw-Hill Edition, Tenth reprint 2007
6. Building the Data Warehouse- W. H. Inmon, Wiley Dreamtech India Pvt. Ltd.
7. Data Mining Introductory and Advanced topics –MARGARET H DUNHAM, PEA.

L	T	P	C
3	0	0	3

B.Tech. in Computer Science & Engineering (AI&ML)
V Semester Syllabus
CM512PE: WEB PROGRAMMING (PE-I)
(Common to CSE (AI &ML) & CSE (Data Science))

Course Objectives

The student should be able to:
- Understand the technologies used in Web Programming.
- Know the importance of object-oriented aspects of Scripting.
- Understand creating database connectivity using JDBC.
- Learn the concepts of web-based application using sockets.

Course Outcomes

Upon Completion of the course, the students will be able to

- Understand the technologies used in web programming to design web pages.
- Apply the Object-oriented aspects of scripting
- Create databases with connectivity using JDBC.
- Understanding server-side programming using Servlets.
- Build web-based applications using sockets.

UNIT - I

SCRIPTING: Web page Designing using HTML, Scripting basics- Client side and server side scripting. Java Script- Object, names, literals, operators and expressions- statements and features- events - windows - documents - frames - data types - built-in functions- Browser object model - Verifying forms.-HTML 5- CSS3- HTML 5 canvas - Web site creation using tools.

UNIT – II

JAVA: Introduction to object-oriented programming-Features of Java – Data types, variables and arrays –Operators – Control statements – Classes and Methods – Inheritance. Packages and Interfaces – Exception Handling – Multithreaded Programming – Input/ Output – Files – Utility Classes – String Handling.

UNIT – III

JDBC: JDBC Overview – JDBC implementation – Connection class – Statements - Catching DatabaseResults, handling database Queries. Networking– Inet Address class – URL class- TCP sockets – UDPsockets, Java Beans –RMI.

UNIT – IV

APPLETS: Java applets- Life cycle of an applet – Adding images to an applet – Adding sound to an applet. Passing parameters to an applet. Event Handling. Introducing AWT: Working with Windows Graphics and Text. Using AWT Controls, Layout Managers and Menus. Servlet – life cycle of a servlet.The Servlet API, Handling HTTP Request and Response, using Cookies, Session Tracking. Introduction to JSP.

UNIT – V

XML AND WEB SERVICES: Xml – Introduction-Form Navigation-XML Documents- XSL – XSLT-Webservices-UDDI-WSDL-Java web services – Web resources.

TEXT BOOKS:
1. Harvey Deitel, Abbey Deitel, Internet and World Wide Web: How To Program 5th Edition.
2. Herbert Schildt, Java - The Complete Reference, 7th Edition. Tata McGraw- Hill Edition.
3. Michael Morrison XML Unleashed Tech media SAMS.

REFERENCE BOOKS:
1. John Pollock, Javascript - A Beginners Guide, 3rd Edition –- Tata McGraw-Hill Edition.
2. Keyur Shah, Gateway to Java Programmer Sun Certification, Tata McGraw Hill, 2002.

L	T	P	C
3	0	0	3

B.Tech. in Computer Science & Engineering (AI&ML)
V Semester Syllabus
CM513PE: INTRODUCTION TO DATA SCIENCE (PE – I)

Course Objectives
- Learn concepts, techniques and tools they need to deal with various facets of data sciencepractice, includingdata collection and integration.
- Understand the basic types of data and basic statistics.
- Identify the importance of data reduction and data visualization techniques.

Course Outcomes

After completion of the course, the student should be able to
- Understand basic terms of Data science and Statistical Inference means.
- Identifying different types of data and statistical descriptions of data.
- Utilize R elements for data handling.
- Understanding conditionals and control flow through R elements.
- Perform data reduction and apply visualization techniques.

UNIT - I
Introduction: Definition of Data Science- Big Data and Data Science hype – and getting past the hype
- Datafication - Current landscape of perspectives - Statistical Inference - Populations and samples - Statistical modeling, probability distributions, fitting a model – Over fitting. **Basics of R:** Introduction, R-Environment Setup, Programming with R, Basic Data Types.

UNIT - II
Data Types & Statistical Description

Types of Data: Attributes and Measurement, What is an Attribute? The Type of an Attribute, The Different Types of Attributes, Describing Attributes by the Number of Values, Asymmetric Attributes, Binary Attribute, Nominal Attributes, Ordinal Attributes, Numeric Attributes, Discrete versus Continuous Attributes. Basic Statistical Descriptions of Data: Measuring the Central Tendency: Mean, Median, and Mode, Measuring the Dispersion of Data: Range, Quartiles, Variance, Standard Deviation, and Inter-quartile Range, Graphic Displays of Basic Statistical Descriptions ofData.

UNIT - III
Vectors: Creating and Naming Vectors, Vector Arithmetic, Vector sub setting, **Matrices:** Creating and Naming Matrices, Matrix Sub setting, Arrays, Class. **Factors and Data Frames:** Introduction to Factors: Factor Levels, Summarizing a Factor, Ordered Factors, Comparing Ordered Factors, Introduction to Data Frame, subsetting of Data Frames, Extending Data Frames, Sorting Data Frames.
Lists: Introduction, creating a List: Creating a Named List, Accessing List Elements, Manipulating List Elements, Merging Lists, Converting Lists to Vectors

UNIT - IV
Conditionals and Control Flow: Relational Operators, Relational Operators and Vectors, Logical Operators, Logical Operators and Vectors, Conditional Statements. **Iterative Programming in R:** Introduction, While Loop, For Loop, Looping Over List. **Functions in R:** Introduction, writing a Function in R, Nested Functions, Function Scoping, Recursion, Loading an R Package, Mathematical Functions in R.

UNIT - V

Charts and Graphs: Introduction, Pie Chart: Chart Legend, Bar Chart, Box Plot, Histogram, Line Graph: Multiple Lines in Line Graph, Scatter Plot.

Regression: Linear Regression Analysis, Multiple Linear regression

TEXT BOOKS:
1. Doing Data Science, Straight Talk from The Frontline. Cathy O'Neil and Rachel Schutt, O'Reilly,2014
2. Jiawei Han, Micheline Kamber and Jian Pei. Data Mining: Concepts and Techniques, 3rd ed. The MorganKaufmann Series in Data Management Systems.
3. K G Srinivas, G M Siddesh, "Statistical programming in R", Oxford Publications.

REFERENCE BOOKS:
1. Introduction to Data Mining, Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, PearsonEducation.
2. Brain S. Everitt, "A Handbook of Statistical Analysis Using R", Second Edition, 4 LLC, 2014.
3. Dalgaard, Peter, "Introductory statistics with R", Springer Science & Business Media, 2008.
4. Paul Teetor, "R Cookbook", O'Reilly, 2011.

L	T	P	C
3	0	0	3

B.Tech. in Computer Science & Engineering (AI&ML)
V Semester Syllabus
CM514PE: IMAGE PROCESSING (PE –I)
(Common to CSE(AI &ML), CSE(Data Science))

Prerequisites
- Students are expected to have knowledge in linear signals and systems, Fourier Transform, basic linear algebra,basic probability theory and basic programming techniques; knowledge of Digital Signal Processing is desirable.
- A course on "Computational Mathematics"
- A course on "Computer Oriented Statistical Methods"

Course Objectives
The student should be able to:
- Provide a theoretical and mathematical foundation of fundamental Digital Image Processing concepts.
- The topics include image acquisition; sampling and quantization; preprocessing; enhancement; restoration; segmentation; and compression.

Course Outcomes
Upon Completion of the course, the students will be able to
- Demonstrate the knowledge of the basic concepts of two-dimensional signal acquisition, sampling, and quantization.
- Demonstrate the knowledge of filtering techniques.
- Demonstrate the knowledge of 2D transformation techniques.
- Demonstrate the knowledge of image enhancement, segmentation, restoration and compression techniques.

UNIT - I
Digital Image Fundamentals: Digital Image through Scanner, Digital Camera. Concept of Gray Levels. Gray Level to Binary Image Conversion, Sampling and Quantization, Relationship between Pixels, Imaging Geometry. 2D
Transformations-DFT, DCT, KLT and SVD.

UNIT - II
Image Enhancement in Spatial Domain Point Processing, Histogram Processing, Spatial Filtering, Enhancement in Frequency Domain, Image Smoothing, Image Sharpening.

UNIT - III
Image Restoration Degradation Model, Algebraic Approach to Restoration, Inverse Filtering, Least Mean Square Filters, Constrained Least Squares Restoration, Interactive Restoration.

UNIT - IV
Image Segmentation Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region Oriented Segmentation.

UNIT - V
Image Compression Redundancies and their Removal Methods, Fidelity Criteria, Image Compression Models, Source Encoder and Decoder, Error Free Compression, Lossy Compression.

TEXT BOOK:
1. Digital Image Processing: R.C. Gonzalez & R. E. Woods, Addison Wesley/ Pearson Education,2nd Ed, 2004.
2. Rafael C G., Woods R E. and Eddins S L, Digital Image Processing, Prentice Hall, 3rd edition, 2008.

REFERENCE BOOKS:
1. Fundamentals of Digital Image Processing: A. K. Jain, PHI.
2. Digital Image Processing using MAT LAB: Rafael C. Gonzalez, Richard E. Woods, Steven L.Eddins: Pearson Education India, 2004.
3. Digital Image Processing: William K. Pratt, John Wilely, 3rd Edition, 2004.

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B.Tech. in Computer Science & Engineering (AI&ML)
V Semester Syllabus
CS551PC: COMPUTER NETWORKS LAB
(Common to CSE, CSBS, CSE(AI&ML), CSE (Data Science))

Course Objectives:

- To understand the working principle of various communication protocols.
- To understand the network simulator environment and visualize a network topology and observe its performance
- To analyze the traffic flow and the contents of protocol frames

Course Outcomes:

- Implement data link layer farming methods
- Analyze error detection and error correction codes.
- Implement and analyze routing and congestion issues in network design.
- Implement Encoding and Decoding techniques used in presentation layer.
- To be able to work with different network tools.

List of Experiments:

1.　　Write a program to implement framing.
　　　i.　Fixed framing,　　ii. Variable framings
2.　　Write a program to implement stuffing techniques.
　　　i.　Bit-stuffing　　　ii. Character stuffing
3.　　Write a program to implement checksum
4.　　Write a program to compute CRC code for the polynomial CRC-12
5.　　Develop a simple data link layer that performs the flow control using the sliding window protocol, and loss recovery using the Go-Back-N mechanism.
6.　　Write a program to implement classful addressing.
7.　　Write a program to implement classless addressing.
8.　　Write a program to implement Dijsktra's algorithm to compute the shortest path through a network
9.　　Write a program to divide a given network into n-sub networks using CISCO Packet Tracer.
10.　Implement distance vector routing algorithm for obtaining routing tables at each node.
11.　Write a program to implement Link state routing
12.　Write a program for congestion control using Leaky bucket algorithm
13.　Implement data encryption and data decryption.
14.　Basic Trouble shooting commands ipconfig,ping ,tracert,nslookup,arp etc.

TEXT BOOK:

1. Computer Networks—Andrew S Tanenbaum, David. j. Wetherall, 5th Edition. Pearson Education/PHI,2011.

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B.Tech. in Computer Science & Engineering (AI&ML)
V Semester Syllabus
CM551PC: MACHINE LEARNING LAB
(Common to IT & CSE (AI & ML))

Course Objective:

- The objective of this lab is to get an overview of the various machine learning techniques andcan demonstrate them using python.

Course Outcomes:
- Understand modern notions in predictive data analysis
- Select data, model selection, model complexity and identify the trends
- Understand a range of machine learning algorithms along with their strengths andweaknesses
- Build predictive models from data and analyze their performance

List of Experiments
1. Write a python program to compute Central Tendency Measures: Mean, Median,Mode Measure of Dispersion: Variance, Standard Deviation
2. Study of Python Basic Libraries such as Statistics, Math, Numpy and Scipy
3. Study of Python Libraries for ML application such as Pandas and Matplotlib
4. Write a Python program to implement Simple Linear Regression
5. Implementation of Multiple Linear Regression for House Price Prediction using sklearn
6. Implementation of Decision tree using sklearn and its parameter tuning
7. Implementation of KNN using sklearn
8. Implementation of Logistic Regression using sklearn
9. Implementation of K-Means Clustering
10. Performance analysis of Classification Algorithms on a specific dataset (Mini Project)

TEXT BOOK:
1. Machine Learning – Tom M. Mitchell, - MGH.

REFERENCE BOOK:
1. Machine Learning: An Algorithmic Perspective, Stephen Marshland, Taylor & Francis.

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B.Tech. in Computer Science & Engineering (AI&ML)
V Semester Syllabus
CS553PC- UI-DESIGN-FLUTTER
(Common to CSE, IT, CSBS, CSE (AI&ML))

Course Objectives:

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

Course Outcomes:

- Implements Flutter Widgets and Layouts
- Responsive UI Design and with Navigation in Flutter
- Create custom widgets for specific UI elements and also Apply   styling using themes and custom styles.
- Design a form with various input fields, along with validation and error handling
- Fetches data and write code for unit Test for UI components and also animation

List of Experiments: Students need to implement the following experiments

1. a) Install Flutter and Dart SDK.
   b) Write a simple Dart program to understand the language basics.

2. a) Explore various Flutter widgets (Text, Image, Container, etc.).
   b) Implement different layout structures using Row, Column, and Stack widgets.

3. a) Design a responsive UI that adapts to different screen sizes.
   b) Implement media queries and breakpoints for responsiveness.

4. a) Set up navigation between different screens using Navigator.
   b) Implement navigation with named routes.

5. a) Learn about statefull and stateless widgets.
   b) Implement state management using set State and Provider.

6. a) Create custom widgets for specific UI elements.
   b) Apply styling using themes and custom styles.

7. a) Design a form with various input fields.
   b) Implement form validation and error handling.

8. a) Add animations to UI elements using Flutter's animation framework.
   b) Experiment with different types of animations (fade, slide, etc.).

9. a) Fetch data from a REST API.
    b) Display the fetched data in a meaningful way in the UI.

10. a) Write unit tests for UI components.
    b) Use Flutter's debugging tools to identify and fix issues.

TEXT BOOK:
1. Marco L. Napoli, Beginning Flutter: A Hands-on Guide to App Development.

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B.Tech. in Computer Science & Engineering (AI&ML)
V Semester Syllabus
EN551HS: Advanced English Communication Skills Laboratory
(Common to CSE, IT, CSBS, CSE (AI&ML) & CSE (Data Science))

Introduction:

The introduction of the Advanced English Communication Skills Lab is considered essential at the B.Tech 3rd year level. At this stage, the students need to prepare themselves for their career which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalized context.

The proposed course should be a laboratory course to enable students to use appropriate English and perform the following:

1. Gathering ideas and information to organize ideas relevantly and coherently.
2. Making oral presentations.
3. Writing formal letters.
4. Transferring information from non-verbal to verbal texts and vice-versa.
5. Writing project/research reports/technical reports.
6. Participating in group discussions.
7. Engaging in debates.
8. Facing interviews.
9. Taking part in social and professional communication.

Course Objectives:

This Lab focuses on using multi-media instruction for language development to meet the following targets:

1. Improve the students' fluency in English, with a focus on vocabulary.
2. Enable them to listen to English spoken at normal conversational speed by educated English speakers.
3. Respond appropriately in different socio-cultural and professional contexts.
4. Communicate their ideas relevantly and coherently in writing.
5. Prepare the students for placements.

Course Outcomes:

Students will be able to:

1. Enhance listening proficiency and reading comprehension and cultivate critical thinking ability.
2. Acquire essential vocabulary and develop strategic planning skills for effective technical writing and gain expertise in E-Correspondence and (N) etiquette.
3. Understand the nuances of oral skills (Speaking skills), gain competence in delivering effective presentations, employing suitable language and body language.
4. Communicate confidently in group discussions and enhance the employability skills of students.
5. Apply effective techniques and strategies for successful job interviews.

Syllabus:

The following course content to conduct the activities is prescribed for the Advanced English Communication Skills (AECS) Lab:

1. **Activities on Listening and Reading Comprehension:** Active Listening – Development of Listening Skills Through Audio clips - Benefits of Reading – Methods and Techniques of Reading – Basic Steps to Effective Reading – Common Obstacles – Discourse Markers or Linkers - Sub-skills of reading - Reading for facts, negative facts and Specific Details- Guessing Meanings from Context, Inferring Meaning - Critical Reading — Reading Comprehension – Exercises for Practice.

2. **Activities on Writing Skills**: Vocabulary for Competitive Examinations - Planning for Writing – Improving Writing Skills - Structure and presentation of different types of writing – Free Writing and Structured Writing - Letter Writing –Writing a Letter of Application –Resume vs. Curriculum Vitae – Writing a Résumé **–** Styles of Résumé - e-Correspondence – Emails – Blog Writing - (N)etiquette – Report Writing – Importance of Reports – Types and Formats of Reports– Technical Report Writing– Exercises for Practice.

3. **Activities on Presentation Skills –** Dealing with Glossophobia or stage fear, starting a conversation – responding appropriately and relevantly – using the right language and body language – Role Play in different situations including Seeking Clarification, Making a Request, Asking for and Refusing Permission, Participating in a Small Talk – Oral presentations (individual and group) through JAM sessions- PPTs – Importance of Presentation Skills – Planning, Preparing, Rehearsing and Making a Presentation - Understanding Nuances of Delivery - Presentations through Posters/Projects/Reports – Checklist for Making a Presentation and Rubrics of Evaluation.

4. **Activities on Group Discussion (GD):** Types of GD and GD as a part of a Selection Procedure - Dynamics of Group Discussion - myths and facts (Dos and Don'ts) of GD - Intervention, Summarizing - Modulation of Voice, Body Language, Relevance, Fluency and Organization of Ideas - GD Strategies – Exercises for Practice.

5. **Activities on Interview Skills**: Concept and Process - Interview Preparation Techniques - Types of Interview Questions – Pre-interview Planning, Opening Strategies, Answering Strategies - Interview Through Tele-conference & Video-conference - Mock Interviews.

Suggested Books:

1. Effective Technical Communication by M Ashraf Rizvi. McGraw Hill Education (India) Pvt. Ltd. 2nd Edition.
2. Academic Writing: A Handbook for International Students by Stephen Bailey, Routledge, 5th Edition.

Reference Books:

1. Rizvi, M. Ashraf (2018). *Effective Technical Communication*. (2nd ed). McGraw Hill Education (India) Pvt. Ltd.
2. Suresh Kumar, E. (2015). *Engineering English.* Orient BlackSwan Pvt. Ltd.
3. Bailey, Stephen. (2018). Academic *Writing: A Handbook for International Students.* (5th Edition). Routledge.
4. Koneru, Aruna. (2016). *Professional Communication*. McGraw Hill Education (India) Pvt. Ltd.
5. Raman, Meenakshi & Sharma, Sangeeta. (2015). *Technical Communication, 3E: Principles and Practice.* Oxford University Press.
6. Anderson, Paul V. (2007). *Technical Communication*. Cengage Learning Pvt. Ltd. New Delhi.
7. McCarthy, Michael; O'Dell, Felicity & Redman, Stuart. (2017). *English Vocabulary in Use* Series. Cambridge University Press.
8. Sen, Leela. (2009). *Communication Skills.* PHI Learning Pvt Ltd., New Delhi.
9. Elbow, Peter. (1998). *Writing with Power.* Oxford University Press.
10. Goleman, Daniel. (2013). *Emotional Intelligence*: *Why it can matter more than IQ.* Bloomsbury Publishing.
11. Professional Communication by Aruna Koneru, McGraw Hill Education (India) Pvt. Ltd, 2016.
12. Technical Communication by Meenakshi Raman & Sangeeta Sharma, Oxford University Press 2009.
13. How to Write and Speak Better, Reader's Digest, 2003.
14. TOEFL Reading & Writing Workout, The Princeton Review.
15. How to prepare for Group Discussions and Interviews by Harimohan Prasad and Rajneesh Prasad, TataMcgrawHill.
16. Keep Talking, Frederick Klippel, Cambridge University Press, South Asian edition (6 May 2010).
17. Objective English, Edgar Thorpe & Showick Thorpe, Pearson; 5th edition (1 August 2013).
18. Communication Skills for Engineers, Sunitha Mishra, C.Murali Krishna, Pearson; 4th Edition.

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B.Tech. in Computer Science & Engineering (AI&ML)
V Semester Syllabus
MC501HS: Intellectual Property Rights
(Common to EEE, CSE, IT, CSBS, CSE (AI&ML) & CSE (Data Science))

Course Objectives: The objectives of the course are:

- To enable the students to have an overview of Intellectual Property Rights.
- To provide comprehensive knowledge to the students regarding Trademarks Registration process and law related to it.
- To disseminate knowledge on Copyrights, its related rights and recent developments.
- To make the students understand Patent Regime in India and abroad.
- To understand the framework of Trade secrets.

Course Outcomes: By the end of the course students shall:

- Gain knowledge on Intellectual property rights and their importance.
- Understand Indian and International Trademark Law and procedure for registration of Trademarks.
- Acquire knowledge on Copyright Law, and the privileges awarded to the copyright owners.
- Familiarized with the process of acquiring the patent and relevant laws.
- Learn the importance of trade secrets for business sustainability.

UNIT – I: INTRODUCTION TO INTELLECTUAL PROPERTY
Introduction of IPR-Meaning of intellectual property, types of intellectual property-trademarks, copyrights, patents, trade secrets, importance of intellectual property rights, International organizations-WTO-WIPO-USPTO-INTA, International Conventions, agencies and treaties- Paris Convention-Berne Convention- Madrid Protocol-NAFTA-PCT-GATT-TRIPS.

UNIT – II: TRADEMARKS
Trademarks: Purpose and functions of Trademarks-Categories of marks, acquisition of trademark rights - Protectable matter - Selecting and evaluating Trademark- Trademark registration process – Trademark Infringement - Remedies for infringement of Trademarks-New developments in Trademark Law- International Trademarks Law.

UNIT III: COPYRIGHT
Copyrights-Fundamentals of Copyright Law - Requirements of Copyrightability - Originality of material, fixation of material, Authorship works, exclusions from copyright protection- Rights of Copyright Owner-Right of reproduction of copyrighted work, right to do derivative works ,right to distribute copies of the copyrighted work, right to perform the work publicly, right to display the copyrighted work, – Copyright Ownership issues – Joint Works, Works made for Hire, Specially commissioned works, Copyright Registration - Notice of Copyright – Copyright Infringement - Remedies for infringement in Copyrights- New developments in Copyright Law- International Copyright Law.

UNIT IV: PATENTS
Concept of Patent - Classification – Utility Patents – Design Patents and Plant Patents, Patent searching process-Types of Patent Applications-Patent Registration Process, Ownership, Transfer, Assignment and Licensing of Patent-Patent Infringement, Remedies for Infringement of Patents, New developments in Patent Law-International Patent Law.

UNIT – V: TRADE SECRETS & LAW OF UNFAIR COMPETITION

Trade Secrets: Trade secret law, determination of trade secret status, measures for protecting trade secret status-Liability for misappropriation of trade secrets, protection for submissions, trade secret litigation. New developments in Trade secrets Law - International Trade Secret law.

Law of Unfair Competition: Passing off, Misappropriation, Right of publicity, Dilution of trademarks, Product disparagement, False advertising, Internet Piracy.

TEXT BOOKS:

1. Deborah. E.Bouchoux, Intellectual property, Cengage learning India Pvt.Ltd., 4th edition, 2013.
2. Prabuddha Ganguli, Intellectual property right, Tata McGraw Hill Publishing Company, 8th edition, 2016.

REFERENCES

1. Richard Stim, Intellectual Property, Cengage learning India Pvt. Ltd. 3rd edition, 2017
2. Vinod.V. Sope, Managing Intellectual Property, Asoka K. Ghosh, 2nd edition, 2010.

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B.Tech. in Computer Science & Engineering (AI&ML)
VI Semester Syllabus
CM601PC: KNOWLEDGE REPRESENTATION AND REASONING

Course Objectives:

- To investigate the key concepts of knowledge representation (KR) techniques and different notations.
- To integrate the KR view as a knowledge engineering approach to model organizational knowledge.
- To introduce the study of ontologies as a KR paradigm and applications of ontologies.
- To understand various KR techniques.
- To understand process, knowledge acquisition and sharing of ontology.

Course Outcomes:

- Analyze and design knowledge-based systems intended for computer implementation.
- Acquire theoretical knowledge about principles for logic-based representation and reasoning.
- Ability to understand knowledge-engineering process
- Ability to implement production systems, frames, inheritance systems and approaches to handle uncertain or incomplete knowledge.

UNIT - I:

The Key Concepts: Knowledge, Representation, Reasoning, Why knowledge representation and reasoning, Role of logic

Logic: Historical background, Representing knowledge in logic, Varieties of logic, Name, Type, Measures, Unity Amidst diversity

UNIT - II:

Ontology: Ontological categories, Philosophical background, Top-level categories, describing physical entities, Defining abstractions, Sets, Collections, Types and Categories, Space and Time.

UNIT - III:

Knowledge Representations: Knowledge Engineering, Representing structure in frames, Rules and data, Object-oriented systems, Natural language Semantics, Levels of representation

UNIT - IV:

Processes: Times, Events and Situations, Classification of processes, Procedures, Processes and Histories, Concurrent processes, Computation, Constraint satisfaction,

Change Contexts: Syntax of contexts, Semantics of contexts, First-order reasoning in contexts, Modal reasoning in contexts, Encapsulating objects in contexts.

UNIT - V:

Knowledge Soup: Vagueness, Uncertainty, Randomness and Ignorance, Limitations of logic,

Fuzzy logic, Nonmonotonic Logic, Theories, Models and the world, Semiotics Knowledge Acquisition and Sharing: Sharing Ontologies, Conceptual schema, accommodating multiple paradigms, Relating different knowledge representations, Language patterns, Tools for knowledge acquisition

TEXT BOOKS:

1. Knowledge Representation logical, Philosophical, and Computational Foundations by John F. Sowa, Thomson Learning.
2. Knowledge Representation and Reasoning by Ronald J. Brachman, Hector J. Levesque, Elsevier.

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B.Tech. in Computer Science & Engineering (AI&ML)
VI Semester Syllabus
CM602PC: DATA ANALYTICS

Prerequisites:

- A course on "Database Management Systems"
- Knowledge of probability and statistics

Course Objectives

- To explore the fundamental concepts of data analytics.
- To learn the principles and methods of statistical analysis
- Discover interesting patterns and understand the various search methods and visualization techniques.

Course Outcomes

- Understand the impact of data analytics for business decisions and strategy
- Carry out data analysis/statistical analysis
- To carry out standard data visualization and formal inference procedures

UNIT - I

Data Management: Design Data Architecture and manage the data for analysis, understand various sources of Data like Sensors/Signals/GPS etc. Data Management, Data Quality(noise, outliers, missing values, duplicate data) and Data Processing & Processing.

UNIT - II

Data Analytics: Introduction to Analytics, Introduction to Tools and Environment, Application of Modelling in Business, Databases & Types of Data and Variables, Data Modeling Techniques, Missing Imputations etc. Need for Business Modelling.

UNIT - III

Regression – Concepts, Blue property assumptions, Least Square Estimation, Variable Rationalization, and Model Building etc.
Logistic Regression: Model Theory, Model fit Statistics, Model Construction, Analytics applications to various Business Domains etc.

UNIT - IV

Object Segmentation: Regression Vs Segmentation – Supervised and Unsupervised Learning, Tree Building – Regression, Classification, Overfitting, Pruning and Complexity, Multiple Decision Trees etc. Time Series Methods: Arima, Measures of Forecast Accuracy, STL approach, Extract features from generated model as Height, Average Energy etc and Analyze for prediction

UNIT - V

Data Visualization: Pixel-Oriented Visualization Techniques, Geometric Projection Visualization Techniques, Icon-Based Visualization Techniques, Hierarchical Visualization Techniques, Visualizing Complex Data and Relations.

TEXT BOOKS:

1. Sanjeev J.Wagh, Manisha S.Bhende, Anuradha D.Thakare, Fundamentals of Datascience.
2. Practical statistics for Data Scientiest,Peter & Andrew Bruce, O'Reilly publications

Reference Books:

1. Jiawei Han, Micheline Kamber and Jian Pei. Data Mining: Concepts and Techniques, 3rd ed.
2. The Morgan Kaufmann Series in Data Management Systems.

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B.Tech. in Computer Science & Engineering (AI&ML)
VI Semester Syllabus
CM603PC: NATURAL LANGUAGE PROCESSING

Prerequisites: Data structures, finite automata and probability theory

Course Objectives:

• To introduce the fundamental concepts and techniques of natural language processing (NLP).
• To gain an in-depth understanding of the computational properties of natural languages.
• To study commonly used algorithms for processing linguistic information.
• To examine NLP models and algorithms using both the traditional and the more recent approaches.
• To Introduce to some of the problems and solutions of NLP and their relation to linguistics and statistics.

Course Outcomes:

• Show sensitivity to linguistic phenomena and an ability to model them with formal grammars.
• To carry out proper experimental methodology for training and evaluating empirical NLP systems
• Able to manipulate probabilities, construct statistical models over strings and trees, and estimate parameters using supervised and unsupervised training methods.
• Able to design, implement, and analyze NLP algorithms
• Able to design different language modeling Techniques.

UNIT – I

Finding the Structure of Words: Words and Their Components, Issues and Challenges, Morphological Models

Finding the Structure of Documents: Introduction, Methods, Complexity of the Approaches, Performances of the Approaches

UNIT – II

Syntax Analysis: Parsing Natural Language, Treebanks: A Data-Driven Approach to Syntax, Representation of Syntactic Structure, Parsing Algorithms

UNIT – III

Models for Ambiguity Resolution in Parsing, Multilingual Issues

Semantic Parsing-I: Introduction, Semantic Interpretation, System Paradigms, Word Sense Systems.

UNIT – IV

Semantic Parsing-II: Predicate-Argument Structure, Meaning Representation Systems.

UNIT – V

Language Modelling: Introduction, N-Gram Models, Language Model Evaluation, Parameter Estimation, Language Model Adaptation, Types of Language Models, Language-Specific Modelling Problems, Multilingual and Cross lingual Language Modelling

TEXT BOOKS:

1. Multilingual natural Language Processing Applications: From Theory to Practice –Daniel M. Bikel and Imed Zitouni, Pearson Publication
2. Natural Language Processing and Information Retrieval: Tanvier Siddiqui, U.S. Tiwary, Oxford University Press

REFERENCE BOOKS:

1. Speech and Natural Language Processing - Daniel Jurafsky & James H Martin,   Pearson Publications
2. Python Natural Language Processing Cookbook –Zhenya Antic, Pearson Publications, IBM Press
3. Natural Language Processing – Ela Kumar, I.K. International publishing house pvt. Ltd.

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B.Tech. in Computer Science & Engineering (AI&ML)
VI Semester Syllabus
CM621PE: GRAPH THEORY
(PE-II)

Prerequisites

- An understanding of Mathematics in general is sufficient.

Course Outcomes

- Know some important classes of graph theoretic problems;
- Be able to formulate and prove central theorems about trees, matching, connectivity, colouring and planar graphs;
- Be able to describe and apply some basic algorithms for graphs;
- Be able to use graph theory as a modelling tool.

UNIT - I

Introduction-Discovery of graphs, Definitions, Subgraphs, Isomorphic graphs, Matrix representations of graphs ,Degree of a vertex, Directed walks, paths and cycles, Connectivity in digraphs, Eulerian and Hamilton digraphs, Eulerian digraphs, Hamilton digraphs, Special graphs, Complements, Larger graphs from smaller graphs, Union, Sum, Cartesian Product, Composition, Graphic sequences, Graph theoretic model of the LAN problem, Havel-Hakimi criterion,Realization of a graphic sequence.

UNIT - II

Connected graphs and shortest paths - Walks, trails, paths, cycles, Connected graphs, Distance, Cut-vertices and cut edges, Blocks, Connectivity, Weighted graphs and shortest paths, Weighted graphs, Dijkstra"s shortest path algorithm,Floyd-Warshall shortest path algorithm.

UNIT - III

Trees- Definitions and characterizations, Number of trees, Cayley"s formula, Kircho-matrix-tree theorem, Minimum spanning trees, Kruskal"s algorithm, Prim"s algorithm, Special classes of graphs, Bipartite Graphs, Line Graphs, Chordal Graphs, Eulerian Graphs, Fleury"s algorithm, Chinese Postman problem, Hamilton Graphs, Introduction, Necessary conditions and sufficient conditions

UNIT - IV

Independent sets coverings and matchings – Introduction, Independent sets and coverings: basic equations Matchings in bipartite graphs, Hall"s Theorem, K¨onig"s Theorem, Perfect matchings in graphs, Greedy and approximation algorithms.

UNIT - V

Vertex Colorings- Basic definitions, Cliques and chromatic number, Mycielski"s theorem, Greedy coloring algorithm,Coloring of chordal graphs, Brooks theorem, Edge Colorings, Introduction and Basics, Gupta-Vizing theorem, Class-1and Class-2 graphs, Edge-coloring of bipartite graphs, Class-2graphs, Hajos union and Class-2 graphs, A scheduling problem and equitable edge-coloring.

TEXT BOOKS:

1. J. A. Bondy and U. S. R. Murty. Graph Theory, volume 244 of Graduate Texts in Mathematics. Springer, 1stedition, 2008.

2. J. A. Bondy and U. S. R. Murty. Graph Theory with Applications.

REFERENCE BOOKS:

1. Lecture Videos: http://nptel.ac.in/courses/111106050/13.

2. Introduction to Graph Theory, Douglas B. West, Pearson.

3. Schaum's Outlines Graph Theory, Balakrishnan, TMH.

4. Introduction to Graph Theory, Wilson Robin j, PHI.

5. Graph Theory with Applications to Engineering and Computer Science, Narsing Deo, PHI.

6. Graphs - An Introductory Approach, Wilson and Watkins.

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B.Tech. in Computer Science & Engineering (AI&ML)
VI Semester Syllabus
CM622PE: COMPUTER VISION AND ROBOTICS
(PE-II)

Pre-Requisites: UG level Course in Linear Algebra and Probability.

Course Objectives:
- To understand the Fundamental Concepts Related To sources, shadows and shading.
- To understand the The Geometry of Multiple Views.

Course Outcomes:
- Implement fundamental image processing techniques required for computer vision.
- Implement boundary tracking techniques.
- Apply chain codes and other region descriptors, Hough Transform for line, circle, and ellipse detections.
- Apply 3D vision techniques and Implement motion related techniques.
- Develop applications using computer vision techniques.

UNIT - I
CAMERAS: Pinhole Cameras.
Radiometry – Measuring Light: Light in Space, Light Surfaces, Important Special Cases.
Sources, Shadows, And Shading: Qualitative Radiometry, Sources and Their Effects, Local Shading Models, Application: Photometric Stereo, Interreflections: Global Shading Models.
Color: The Physics of Color, Human Color Perception, Representing Color, A Model for Image Color, Surface Color from Image Color.

UNIT - II
Linear Filters: Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms, Sampling and Aliasing, Filters as Templates.
Edge Detection: Noise, Estimating Derivatives, Detecting Edges.
Texture: Representing Texture, Analysis (and Synthesis) Using Oriented Pyramids, Application: Synthesis by Sampling Local Models, Shape from Texture.

UNIT - III
The Geometry of Multiple Views: Two Views
Stereopsis: Reconstruction, Human Stereposis, Binocular Fusion, Using More Cameras Segmentation by
Clustering: What Is Segmentation? Human Vision: Grouping and Getstalt, Applications: Shot Boundary Detection and Background Subtraction, Image Segmentation by Clustering Pixels, Segmentation by Graph-Theoretic Clustering,

UNIT - IV
Segmentation by Fitting a Model: The Hough Transform, Fitting Lines, Fitting Curves, Fitting as a Probabilistic Inference Problem, Robustness Segmentation and Fitting Using Probabilistic Methods: Missing Data Problems, Fitting, and Segmentation, The EM Algorithm in Practice. Tracking With Linear
Dynamic Models: Tracking as an Abstract Inference Problem, Linear Dynamic Models, Kalman Filtering, Data Association, Applications and Examples

UNIT - V

Geometric Camera Models: Elements of Analytical Euclidean Geometry, Camera Parameters and the Perspective Projection, Affine Cameras and Affine Projection Equations.

Geometric Camera Calibration: Least-Squares Parameter Estimation, A Linear Approach to Camera Calibration, Taking Radial Distortion into Account, Analytical Photogrammetry, An Application: Mobile Robot Localization.

Model-Based Vision: Initial Assumptions, Obtaining Hypotheses by Pose Consistency, Obtaining Hypotheses by pose Clustering, Obtaining Hypotheses Using Invariants, Verification, Application: Registration In Medical Imaging Systems, Curved Surfaces and Alignment.

TEXT BOOKS:

1. David A. Forsyth and Jean Ponce: Computer Vision – A Modern Approach, PHI Learning (Indian Edition), 2009.
2. Robin Murphy, Introduction to AI Robotics, MIT Press

REFERENCE BOOKS:

1. E. R. Davies: Computer and Machine Vision – Theory, Algorithms and Practicalities, Elsevier (Academic Press), 4th edition, 2013.
2. R. C. Gonzalez and R. E. Woods "Digital Image Processing" Addison Wesley 2008.
3. Richard Szeliski "Computer Vision: Algorithms and Applications" Springer-Verlag London Limited 2011.

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B.Tech. in Computer Science & Engineering (AI&ML)
VI Semester Syllabus
CM623PE: PATTERN RECOGNITION
(PE-II)

Prerequisites:

- Programming for problem solving
- Computer Oriented Statistical Methods

Course Objectives:
- Introducing fundamental concepts, theories, and algorithms for pattern recognition and machine learning.

Course Outcomes:
- Understand the importance of pattern recognition and its representation
- Analyze the variants of NN algorithm
- Understand the necessity of Hidden markov models, decision tree and SVM for classification
- Understand different types of clustering algorithms

UNIT - I

Introduction: What is Pattern Recognition, Data Sets for Pattern Recognition, Different Paradigms for Pattern Recognition. Representation: Data Structures for Pattern Representation, Representation of Clusters, Proximity Measures, Size of Patterns, Abstractions of the Data Set, Feature Extraction, Feature Selection, Evaluation of Classifier, Evaluation of Clustering.

UNIT - II

Nearest Neighbor Based Classifier: Nearest Neighbor Algorithm, Variants of the NN Algorithm use of the Nearest Neighbor Algorithm for Transaction Databases, Efficient Algorithms, Data Reduction, Prototype Selection. Bayes Classifier: Bayes Theorem, Minimum Error Rate Classifier, Estimation of Probabilities, Comparison with the NNC, Naïve Bayes Classifier, Bayesian Belief Network.

UNIT - III

Hidden Markov Models: Markov Models for Classification, Hidden Morkov Models, Classification using HMMs. Decision Trees: Introduction, Decision Tree for Pattern Classification, Construction of Decision Trees, Splitting at the Nodes, Overfitting and Pruning, Examples of Decision Tree Induction.

UNIT - IV

Support Vector Machines: Introduction, Learning the Linear Discriminant Functions, Neural Networks, SVM for Classification. Combination of Classifiers: Introduction, Methods for Constructing Ensembles of Classifiers, Methods for Combining Classifiers.

UNIT - V

Clustering: Why is Clustering Important, Hierarchical Algorithms, Partitional Clustering, Clustering Large Data Sets. An Application-Hand Written Digit Recognition: Description of the Digit Data, Preprocessing of Data, Classification Algorithms, Selection of Representative Patterns, Results.

TEXT BOOK:

1. Pattern Recognition: An Algorithmic Approach: Murty, M. Narasimha, Devi, V. Susheela, Spinger Pub, 1st Ed.

REFERENCE BOOKS:

1. Machine Learning - Mc Graw Hill, Tom M. Mitchell.

2. Fundamentals Of Speech Recognition: Lawrence Rabiner and Biing- Hwang Juang. PrenticeHall Pub.

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B.Tech. in Computer Science & Engineering (AI&ML)
VI Semester Syllabus
CS631PE – Full Stack Development
Professional Elective – III
(Common to CSE, IT, CSE(AI&ML) (PE-II), CSE (Data Science)

Pre-Requisites:

- Object Oriented Programming
- Web Technologies

Course Objectives:

- Students will become familiar to implement fast, efficient, interactive and scalable web applications using run time environment provided by the full stack development.

Course Outcomes:

- Understand Full stack components for developing web application.
- Apply packages of NodeJS to work with Data, Files, Http Requests and Responses.
- Use MongoDB data base for storing and processing huge data and connects with NodeJS application.
- Design faster and effective single page applications using Express and Angular.
- Create interactive user interfaces with react components.

UNIT-I

Introduction to Full Stack Development:

Understanding the Basic Web Development Framework- User, Browser, Webserver, Backend Services, Full Stack Components - Node.js, MongoDB, Express, React, Angular. Java Script Fundamentals, NodeJS- Understanding Node.js, Installing Node.js, Working with Node Packages, creating a Node.js Application, Understanding the Node.js Event Model, Adding Work to the Event Queue, Implementing Call backs.

UNIT-II

Node.js:

Working with JSON, Using the Buffer Module to Buffer Data, Using the Stream Module to Stream Data, Accessing the File System from Node.js- Opening, Closing, Writing, Reading Files and other File System Tasks. Implementing HTTP Services in Node.js- Processing URLs, Processing Query Strings and Form Parameters, Understanding Request, Response, and Server Objects, Implementing HTTP Clients and Servers in Node.js, Implementing HTTPS Servers and Clients. Using Additional Node.js Modules-Using the os Module, Using the util Module, Using the dns Module, Using the crypto Module.

UNIT-III

MongoDB:

Need of NoSQL, Understanding MongoDB, MongoDB Data Types, Planning Your Data Model, Building the MongoDB Environment, Administering User Accounts, Configuring Access Control, Administering Databases, Managing Collections, Adding the MongoDB Driver to Node.js, Connecting to MongoDB from Node.js, Understanding the Objects Used in the MongoDB Node.js Driver, Accessing and Manipulating Databases, Accessing and Manipulating Collections

39

UNIT-IV

Express and Angular:

Getting Started with Express, Configuring Routes, Using Requests Objects, Using Response Objects. Angular: importance of Angular, Understanding Angular, creating a Basic Angular Application, Angular Components, Expressions, Data Binding, Built-in Directives, Custom Directives, Implementing Angular Services in Web Applications.

UNIT-V

React:

Need of React, Simple React Structure, The Virtual DOM, React Components, Introducing React Components, Creating Components in React, Data and Data Flow in React, Rendering and Life Cycle Methods in React, Working with forms in React, integrating third party libraries, Routing in React.

TEXT BOOKS:

1. Brad Dayley, Brendan Dayley, Caleb Dayley., Node.js, MongoDB and Angular Web Development, 2nd Edition, Addison-Wesley, 2019.
2. Mark Tielens Thomas, React in Action, 1st Edition, Manning Publications.

REFERENCE BOOKS:

1. Vasan Subramanian, Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node, 2nd Edition, Apress, 2019.
2. Chris Northwood, The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer', 1st edition, Apress, 2018.
3. Kirupa Chinnathambi, Learning React: A Hands-On Guide to Building Web Applications Using React and Redux, 2nd edition, Addison-Wesley Professional, 2018.

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B.Tech. in Computer Science & Engineering (AI&ML)
VI Semester Syllabus
CM621OE: ADVANCED DATA STRUCTURES

(Open Elective – I)

Prerequisites: Programming for Problem Solving

Course Objectives
- Exploring basic data structures such as stacks and queues.
- Introduces a variety of data structures such as hash tables, search trees, tries, heaps, graphs.
- Introduces sorting and pattern matching algorithms

Course Outcomes
- Ability to select the data structures that efficiently model the information in a problem.
- Ability to assess efficiency trade-offs among different data structure implementations or combinations.
- Implement and know the application of algorithms for sorting and pattern matching.
- Design programs using a variety of data structures, including hash tables, binary and general tree structures, search trees, tries, heaps, graphs, and AVL-trees.

UNIT - I
Introduction to Data Structures, abstract data types, Linear list – singly linked list implementation, insertion, deletion and searching operations on linear list, Double Linked list implementation, insertion, deletion and searching operations, Circular Linked List implementation, insertion, deletion and searching operations.

UNIT - II
Stacks- Operations, array and linked representations of stacks, stack applications, Queues- operations, array and linked representations.
Hash Table Representation: hash functions, collision resolution-separate chaining, open addressing-linear probing, quadratic probing, double hashing, rehashing.

UNIT - III
Search Trees: Binary Search Trees, Definition, Implementation, Operations- Searching, Insertion and Deletion, B- Trees, AVL Trees, Definition, Height of an AVL Tree, Operations – Insertion, Deletion and Searching.

UNIT - IV
Graphs: Graph Implementation Methods. Graph Traversal Methods.Sorting: Quick Sort, Heap Sort, Merge Sort.

UNIT - V
Pattern Matching and Tries: Pattern matching algorithms-Brute force, the Boyer –Moore algorithm, the Knuth-Morris-Pratt algorithm, Standard Tries, Compressed Tries, Suffix tries.

TEXT BOOKS:
1. Fundamentals of Data Structures in C, 2 nd Edition, E. Horowitz, S. Sahni and Susan Anderson Freed, Universities Press.
2. Data Structures using C – A. S.Tanenbaum, Y. Langsam, and M.J. Augenstein, PHI/Pearson Education.

REFERENCE BOOK:
1. Data Structures: A Pseudocode Approach with C, 2 nd Edition, R. F. Gilberg and B.A.Forouzan, Cengage Learning.

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B.Tech. in Computer Science & Engineering (AI&ML)
VI Semester Syllabus
CD621OE: DATA BASE MANAGEMENT SYSTEMS

(Open Elective – I)

Prerequisites: A course on "Data Structures".

Course Objectives:
- To understand the basic concepts and the applications of database systems.
- To master the basics of SQL and construct queries using SQL.
- Topics include data models, database design, relational model, relational algebra, transaction control, concurrency control, storage structures and access techniques.

Course Outcomes:
- Gain knowledge of fundamentals of DBMS, database design and normal forms
- Master the basics of SQL for retrieval and management of data.
- Be acquainted with the basics of transaction processing and concurrency control.
- Familiarity with database storage structures and access techniques

UNIT - I
Database System Applications: A Historical Perspective, File Systems versus a DBMS, the Data Model, Levels of Abstraction in a DBMS, Data Independence, Structure of a DBMS
Introduction to Database Design: Database Design and ER Diagrams, Entities, Attributes, and Entity Sets, Relationships and Relationship Sets, Additional Features of the ER Model, Conceptual Design With the ER Model

UNIT - II
Introduction to the Relational Model: Integrity constraint over relations, enforcing integrity constraints, querying relational data, logical database design, introduction to views, destroying/altering tables and views. Relational Algebra.

UNIT - III
SQL: QUERIES, CONSTRAINTS, TRIGGERS: form of basic SQL query, UNION, INTERSECT, and EXCEPT, Nested Queries, aggregation operators, NULL values, complex integrity constraints in SQL, triggers and active databases.
Schema Refinement: Problems caused by redundancy, decompositions, problems related to decomposition, reasoning about functional dependencies, First, Second, Third normal forms, BCNF, lossless join decomposition, multivalued dependencies, Fourth normal form, Fifth normal form.

UNIT - IV
Transaction Concept, Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for serializability, Lock Based Protocols, Timestamp Based Protocols, Validation- Based Protocols, Multiple Granularity, Recovery and Atomicity, Log–Based Recovery, Recovery with Concurrent Transactions.

UNIT - V
Data on External Storage, File Organization and Indexing, Cluster Indexes, Primary and Secondary Indexes, Index data Structures, Hash Based Indexing, Tree based Indexing, Comparison of File Organizations, Indexes-Intuitions for tree Indexes, Indexed Sequential Access Methods (ISAM),
B+ Trees: A Dynamic Index Structure.

Text Books:

1. Database Management Systems, Raghurama Krishnan, Johannes Gehrke, Tata Mc Graw Hill 3rd Edition
2. Database System Concepts, Silberschatz, Korth, Mc Graw hill, V edition

Reference Books:

1. Database Systems design, Implementation, and Management, Peter Rob & Carlos Coronel 7th Edition.
2. Fundamentals of Database Systems, Elmasri Navrate, Pearson Education
3. Introduction to Database Systems, C. J. Date, Pearson Education
4. Oracle for Professionals, The X Team, S.Shah and V. Shah, SPD.
5. Database Systems Using Oracle: A Simplified guide to SQL and PL/SQL,Shah, PHI.
6. Fundamentals of Database Management Systems, M. L. Gillenson, Wiley Student Edition.

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B.Tech. in Computer Science & Engineering (AI&ML)
VI Semester Syllabus
CM651PC: DATA ANALYTICS LAB

Course Objectives:

- To explore the fundamental concepts of data analytics.
- To learn the principles and methods of statistical analysis
- Discover interesting patterns, analyze supervised and unsupervised models and estimate the accuracy of the algorithms.
- To understand the various search methods and visualization techniques.

Course Outcomes:

- Understand linear regression and logistic regression
- Understand the functionality of different classifiers
- Implement visualization techniques using different graphs
- Apply descriptive and predictive analytics for different types of data

List of Experiments:

1. Data Preprocessing
   a. Handling missing values
   b. Noise detection removal
   c. Identifying data redundancy and elimination
2. Implement any one imputation model
3. Implement Linear Regression
4. Implement Logistic Regression
5. Implement Decision Tree Induction for classification
6. Implement Random Forest Classifier
7. Implement ARIMA on Time Series data
8. Object segmentation using hierarchical based methods
9. Perform Visualization techniques (types of maps - Bar, Colum, Line, Scatter, 3D Cubes etc)
10. Perform Descriptive analytics on healthcare data
11. Perform Predictive analytics on Product Sales data
12. Apply Predictive analytics for Weather forecasting.

TEXT BOOKS:

1. Student's Handbook for Associate Analytics – II, III.
2. Data Mining Concepts and Techniques, Han, Kamber, 3rd Edition, Morgan Kaufmann Publishers.

REFERENCE BOOKS:

1. Introduction to Data Mining, Tan, Steinbach and Kumar, Addison Wesley, 2006.
2. Data Mining Analysis and Concepts, M. Zaki and W. Meira
3. Mining of Massive Datasets, Jure Leskovec Stanford Univ. Anand Rajaraman Milliway Labs Jeffrey D Ullman Stanford Univ.

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B.Tech. in Computer Science & Engineering (AI&ML)
VI Semester Syllabus
CM652PC: NATURAL LANGUAGE PROCESSING LAB

Prerequisites:

- Data structures, finite automata and probability theory.

Course Objectives:
- To Develop and explore the problems and solutions of NLP

Course Outcomes:
- Show sensitivity to linguistic phenomena and an ability to model them with formal grammars.
- Knowledge on NLTK Library implementation
- Work on strings and trees, and estimate parameters using supervised and unsupervisedtraining methods.

List of Experiments

1. Write a Python Program to perform following tasks on text
   a) Tokenization   b) Stop word Removal
2. Write a Python program to implement Porter stemmer algorithm for stemming
3. Write Python Program for a) Word Analysis   b) Word Generation
4. Create a Sample list for at least 5 words with ambiguous sense and Write a Python programto implement WSD
5. Install NLTK tool kit and perform stemming
6. Create Sample list of at least 10 words POS tagging and find the POS for any given word
7. Write a Python program to
   a) Perform Morphological Analysis using NLTK library
   b) Generate n-grams using NLTK N-Grams library
   c) Implement N-Grams Smoothing
8. Using NLTK package to convert audio file to text and text file to audio files.

TEXT BOOKS:

1. Multilingual natural Language Processing Applications: From Theory to Practice – Daniel M. Bikel and Imed Zitouni, Pearson Publication.
2. Oreilly Practical natural Language Processing, A Comprehensive Guide to Building Real World NLP Systems.
3. Daniel Jurafsky, James H. Martin―Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.

REFERENCE BOOKS:

1. Steven Bird, Ewan Klein and Edward Loper, ―Natural Language Processing with Python, FirstEdition, O'Reilly Media, 2009.

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B.Tech. in Computer Science & Engineering (AI&ML)
VI Semester Syllabus
CM653PC : DEVOPS

Course Objectives:

- Develop a sustainable infrastructure for applications and ensure high scalability. DevOps aimsto shorten the software development lifecycle to provide continuous delivery with high-quality.

Course Outcomes:
- Understand the need of DevOps tools.
- Understand the environment for a software application development.
- Apply different project management, integration, and development tools.
- Use Selenium tool for automated testing of application.

List of Experiments:
1. Write code for a simple user registration form for an event.
2. Explore Git and GitHub commands.
3. Practice Source code management on GitHub. Experiment with the source code in exercise 1.
4. Jenkins installation and setup, explore the environment.
5. Demonstrate continuous integration and development using Jenkins.
6. Explore Docker commands for content management.
7. Develop a simple containerized application using Docker.
8. Integrate Kubernetes and Docker
9. Automate the process of running containerized application for exercise 7 using Kubernetes.
10. Install and Explore Selenium for automated testing.
11. Write a simple program in JavaScript and perform testing using Selenium.
12. Develop test cases for the above containerized application using selenium.

TEXT BOOKS:
1. Joakim Verona., Practical DevOps, Packt Publishing, 2016.

REFERENCE BOOKS:
1. Deepak Gaikwad, Viral Thakkar. DevOps Tools from Practitioner's Viewpoint. Wileypublications.
2. Len Bass, Ingo Weber, Liming Zhu. DevOps: A Software Architect's Perspective. AddisonWesley.

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B.Tech. in Computer Science & Engineering (AI&ML)
VI Semester Syllabus
MC602ES – CYBER SECURITY

(Common to all branches except CSE, IT, CSBS)

Course objectives:
- To familiarize various types of cyber-attacks and cyber-crimes
- To give an overview of the cyber laws
- To study the defensive techniques against these attacks

Course Outcomes:

- The students will be able to understand cyber-attacks, types of cybercrimes, cyber laws and how to protect them self and ultimately the entire Internet community from such attacks.

UNIT - I

Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Spectrum of attacks, Taxonomy of various attacks, IP spoofing, Methods of defence, Security Models, risk management, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.

UNIT - II

Cyberspace and the Law & Cyber Forensics: Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy. Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics, Special Techniques for Forensics Auditing.

UNIT - III

Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

UNIT- IV

Cyber Security: Organizational Implications: Introduction cost of cybercrimes and IPR issues, web Threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing, and the associated challenges for organizations.
Cybercrime and Cyber terrorism: Introduction, intellectual property in cyberspace, the ethical dimension of cybercrimes the psychology, mindset and skills of hackers and other cyber criminals.

UNIT - V

Privacy Issues: Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Data linking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains-medical, financial, etc.

Cybercrime: Examples and Mini-Cases Examples: Official Website of Maharashtra Government Hacked, Indian Banks Lose Millions of Rupees, Parliament Attack, Pune City Police Bust Nigerian Racket, e-mail spoofing instances.

Mini-Cases: The Indian Case of online Gambling, An Indian Case of Intellectual Property Crime, Financial Frauds in Cyber Domain.

TEXT BOOKS:

1. Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley
2. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335, 2018.

REFERENCES:

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. Introduction to Cyber Security, Chwan-Hwa(john) Wu,J. David Irwin, CRC Press T&F Group.

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B.Tech. in Computer Science & Engineering (AI&ML)
VI Semester Syllabus
MC601BS : ENVIRONMENTAL SCIENCE

(Common to all branches)

Course Objectives:

- To understand the natural resources and their conservation.
- To understand the importance of ecosystem, biodiversity and ecological balance for sustainable development.
- To gain knowledge about environmental pollution, effects and controlling measures.
- To study about global environmental problems and global issues.
- To understand the environmental policies, regulations, and sustainable development.

Course Outcomes:

After completing the course, the student will be able to:

- Learn about different types of natural resources and take up the measures to protect the resources.
- Get the information about ecosystem, biodiversity and their usage and conservation.
- Get the information about the types of pollution, understand their effects and controlling measures.
- Gain the knowledge about current global environmental issues and initiations to be taken to protect the environment.
- Gain the knowledge about environmental acts, EIA, sustainable development and follow the rules and regulations.

UNIT-I

Ecosystems: Definition, Scope, and Importance of ecosystem. Classification, structure, and function of an ecosystem, Food chains, food webs, and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Biomagnification, ecosystem value, services and carrying capacity.

UNIT-II

Natural Resources: Classification of Resources: Living and Non-Living resources, water resources: use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. Mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, Land resources: Forest resources, Energy resources: growing energy needs, renewable and non-renewable energy sources, use of alternate energy source, case studies.

UNIT-III

Biodiversity and Biotic Resources: Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Hot spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situ conservation. National Biodiversity act.

UNIT-IV

Environmental Pollution and Control Technologies: Environmental Pollution: Classification of pollution, Air Pollution: Primary and secondary pollutants, causes and effects, Ambient air quality standards. Soil Pollution: Sources and types, Impacts of modern agriculture, degradation of soil. Solid waste: Municipal Solid Waste management, composition and characteristics of e-Waste and its management. Pollution control technologies: Wastewater Treatment methods: Primary, secondary and Tertiary.

UNIT-V

Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects Air Act- 1981, Water Act, biomedical waste management and handling rules, hazardous waste management and handling rules. Environmental Impact of Assessment (EIA): structure, methods of baseline data acquisition. Concepts of Environmental Management Plan (EMP).
Towards Sustainable Future: Concept of Sustainable Development Goals, Population and its explosion, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building, Green chemistry principles, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon life style.

TEXT BOOKS:

1 Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
2. Environmental Studies by Anubha Kaushik, 4 th Edition, New age international publishers

REFERENCE BOOKS:

1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008 PHI Learning Pvt. Ltd.
3. Environmental Studies by R. Rajagopalan, Oxford University Press.
4. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
5. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications.
6. Introduction to Environmental Science by Y. Anjaneyulu, BS. Publications.

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B.Tech. in Computer Science & Engineering (AI&ML)
VII Semester Syllabus
CM701PC: DEEP LEARNING

Course Objectives:

- To understand deep Learning algorithms and their applications in real-world data

Course Outcomes:
- Understand machine learning basics and neural networks
- Understand optimal usage of data for training deep models
- Apply CNN and RNN models for real-world data
- Evaluate deep models
- Develop deep models for real-world problems

UNIT - I
Machine Learning Basics
Learning Algorithms, Capacity, Overfitting and Underfitting, Hyperparameters and Validation Sets, Estimators, Bias and Variance, Maximum Likelihood Estimation, Bayesian Statistics, Supervised Learning Algorithms, Unsupervised Learning Algorithms, Stochastic Gradient Descent, Building a Machine Learning Algorithm, Challenges Motivating Deep Learning
Deep Feedforward Networks Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation and Other Differentiation Algorithms

UNIT - II
Regularization for Deep Learning
Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging and Other Ensemble Methods, Dropout, Adversarial Training, Tangent Distance, Tangent Prop, and Manifold Tangent Classifier, Optimization for Training Deep Models, Learning vs Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates

UNIT - III
Convolutional Networks
The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features

UNIT - IV
Recurrent and Recursive Nets
Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, The Challenge of Long-Term Dependencies, Echo State Networks, Leaky Units and Other Strategies for Multiple Time Scales, The Long Short-Term Memory and Other Gated RNNs, Optimization for Long-Term Dependencies, Explicit Memory

UNIT - V
Practical Methodology: Performance Metrics, Default Baseline Models, Determining Whether to Gather More Data, Selecting Hyperparameters, Debugging Strategies, Example: Multi-Digit Number Recognition
Applications: Large-Scale Deep Learning, Computer Vision, Speech Recognition, Natural Language Processing, Other Applications.

TEXT BOOK:
1. Deep Learning by Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press.

REFERENCE BOOKS:
1. The Elements of Statistical Learning. Hastie, R. Tibshirani, and J. Friedman, Springer.
2. Probabilistic Graphical Models. Koller, and N. Friedman, MIT Press.
3. Bishop. C.M., Pattern Recognition and Machine Learning, Springer, 2006.
4. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
5. Golub, G.,H., and Van Loan, C.,F., Matrix Computations, JHU Press, 2013.
6. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

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B.Tech. in Computer Science & Engineering (AI&ML)
VII Semester Syllabus
CM702PC: NATURE INSPIRED COMPUTING

Course Objectives:

- Knowledge on significance of evolutionary computing, neuro computing and swarmintelligence

Course Outcomes:
- Familiar with Evolutionary Computing algorithms
- Understand scope of neuro computing
- Compare different Ant Colony Optimization algorithmic models.
- Understand the scope of artificial immune systems
- Tackle different real world problems

UNIT - I
Evolutionary Computing

Problem Solving as a Search Task, Hill Climbing and Simulated Annealing, Evolutionary Biology, Evolutionary Computing, The Other Main Evolutionary Algorithms, From Evolutionary Biology to Computing, Scope of Evolutionary Computing

UNIT - II
Neuro computing

The Nervous System, Artificial Neural Networks, Typical ANNS and Learning Algorithms, FromNatural to Artificial Neural Networks, Scope of Neuro computing

UNIT - III
Swarm Intelligence

Ant Colonies, Swarm Robotics, Social Adaptation of Knowledge

UNIT - IV
Immuno computing

The Immune System, Artificial Immune Systems, Bone Marrow Models, Negative Selection Algorithms, Clonal Selection and Affinity Maturation, Artificial Immune Networks, From Natural toArtificial Immune Systems, Scope of Artificial Immune Systems

UNIT - V
Case Studies- Bioinformatics, Information Display

TEXT BOOKS:
1. Leandro Nunes de Castro - " Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications", Chapman & Hall/ CRC, Taylor and Francis Group, 2007
2. Albert Y.Zomaya - "Handbook of Nature-Inspired and Innovative Computing", Springer, 2006

REFERENCE BOOKS:
1. Floreano, D. and C. Mattiussi -"Bio-Inspired Artificial Intelligence: The oriesethods, andTechnologies" IT Press, 2008
2. Marco Dorrigo, Thomas Stutzle -" Ant Colony Optimization", Prentice Hall of India, New Delhi,2005
3. Vinod Chandra S S, Anand H S - "Machine Learning: A Practitioner's Approach", Prentice Hallof India, New Delhi, 2020

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B.Tech. in Computer Science & Engineering (AI&ML)
VII Semester Syllabus
CM731PE: MOBILE APPLICATION DEVELOPMENT
(PE – III)

Prerequisites

- Acquaintance with JAVA programming
- A Course on DBMS

Course Objectives
- To demonstrate their understanding of the fundamentals of Android operating systems
- To improves their skills of using Android software development tools
- To demonstrate their ability to develop software with reasonable complexity on mobileplatform
- To demonstrate their ability to deploy software to mobile devices
- To demonstrate their ability to debug programs running on mobile devices

Course Outcomes
- Understand the working of Android OS Practically.
- Develop Android user interfaces
- Develop, deploy and maintain the Android Applications.

UNIT - I
Introduction to Android Operating System: Android OS design and Features – Android development framework, SDK features, Installing and running applications on Android Studio, Creating AVDs, Types of Android applications, Best practices in Android programming, Android tools Android application components – Android Manifest file, Externalizing resources like values, themes, layouts, Menus etc, Resources for different devices and languages, Runtime Configuration Changes.
Android Application Lifecycle – Activities, Activity lifecycle, activity states, monitoring state changes

UNIT - II
Android User Interface: Measurements – Device and pixel density independent measuring unit - s Layouts – Linear, Relative, Grid and Table Layouts
User Interface (UI) Components –Editable and non-editable TextViews, Buttons, Radio and Toggle Buttons, Checkboxes, Spinners, Dialog and pickers
Event Handling – Handling clicks or changes of various UI components
Fragments – Creating fragments, Lifecycle of fragments, Fragment states, Adding fragments to Activity, adding, removing and replacing fragments with fragment transactions, interfacing between fragments and Activities, Multi-screen Activities

UNIT - III
Intents and Broadcasts: Intent – Using intents to launch Activities, Explicitly starting new Activity, Implicit Intents, Passing data to Intents, Getting results from Activities, Native Actions, using Intent to dial a number or to send SMS
Broadcast Receivers – Using Intent filters to service implicit Intents, Resolving Intent filters, finding andusing Intents received within an Activity
Notifications – Creating and Displaying notifications, Displaying Toasts

UNIT - IV

Persistent Storage: Files – Using application specific folders and files, creating files, reading data from files, listing contents of a directory Shared Preferences – Creating shared preferences, saving and retrieving data using Shared Preference

UNIT - V

Database – Introduction to SQLite database, creating and opening a database, creating tables, inserting retrieving and etindelg data, Registering Content Providers, Using content Providers (insert, delete, retrieve and update)

TEXT BOOK:

1. Professional Android 4 Application Development, Reto Meier, Wiley India, (Wrox), 2012.

REFERENCE BOOKS:

1. Android Application Development for Java Programmers, James C Sheusi, Cengage Learning, 2013.
2. Beginning Android 4 Application Development, Wei-Meng Lee, Wiley India (Wrox), 2013.

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B.Tech. in Computer Science & Engineering (AI&ML)
VII Semester Syllabus
CM732PE: DATA MINING
(PE – III)

Pre-Requisites:

- Database Management System
- Probability and Statistics

Course Objectives:

- Students will become acquainted with both the strengths and limitations of various data mining techniques like Association, Classification, Cluster and Outlier analysis.

Course Outcomes:

- Understand the need of data mining and pre-processing techniques.
- Perform market basket analysis using association rule mining.
- Utilize classification techniques for analysis and interpretation of data.
- Identify appropriate clustering and outlier detection techniques to handle complex data.
- Understand the mining of data from web, text and time series data.

UNIT - I
Introduction to Data Mining:

What Data mining? Kinds of Data, Knowledge Discovery process, Data Mining Functionalities, Kinds of Patterns, Major Issues in Data Mining. Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity and Dissimilarity, Data Pre-processing**:** Major Tasks in Data Pre-processing, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization.

UNIT - II
Association Analysis: Basic Concepts, Market Basket Analysis, Apriori Algorithm, FP-growth, From Association Analysis to Correlation Analysis, Pattern Mining in Multilevel Associations and Multidimensional Associations.

UNIT - III
Classification: Basic Concepts, Decision Tree Induction, Bayes Classification Methods, Rule-Based Classification, Metrics for Evaluating Classifier Performance, Ensemble Methods, Multilayer Feed- Forward Neural Network, Support Vector Machines, k-Nearest-Neighbor Classifiers.

UNIT - IV
Cluster Analysis: Requirements for Cluster Analysis, Overview of Basic Clustering Methods, Partitioning Methods-k-Means, k-Medoids, Hierarchical Methods-AGENES, DIANA, BIRCH, Density- Based Method-DBSCAN, Outlier Analysis: Types of Outliers, Challenges of Outlier Detection, and Overview of Outlier Detection Methods

UNIT - V
Advanced Concepts: Web Mining- Web Content Mining, Web Structure Mining, Web Usage Mining, Spatial Mining- Spatial Data Overview, Spatial Data Mining Primitives, Spatial Rules, Spatial Classification Algorithm, Spatial Clustering Algorithms, Temporal Mining- Modeling Temporal Events, Time Series, Pattern Detection, Sequences, Temporal Association Rules.

TEXT BOOKS:

1. Jiawei Han, Micheline Kamber, Jian Pei., Data Mining: Concepts and Techniques, 3rd Edition, Morgan Kaufmann/Elsevier, 2012.
2. Margaret H Dunham, Data Mining Introductory and Advanced Topics, 2nd Edition, Pearson Education, India, 2006.

REFERENCE BOOKS:
1. Data Mining Techniques, Arun K Pujari, 3rd Edition, Universities Press.
2. Pang-Ning Tan, Michael Steinbach, Anuj Karpatne and Vipin Kumar, Introduction to Data mining, 2nd Edition, Pearson Education India, 2021.
3. Amitesh Sinha, Data Warehousing, Thomson Learning, India, 2007.

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B.Tech. in Computer Science & Engineering (AI&ML)
VII Semester Syllabus
CM733PE: SCRIPTING LANGUAGES
(PE – III)

Prerequisites
- A course on "Computer Programming and Data Structures"
- A course on "Object Oriented Programming Concepts"

Course Objectives

- This course provides an introduction to the script programming paradigm
- Introduces scripting languages such as Perl, Ruby and TCL.
- Learning TCL

Course Outcomes

- Comprehend the differences between typical scripting languages and typical system and application programming languages.
- Gain knowledge of the strengths and weakness of Perl, TCL and Ruby; and select an appropriate language for solving a given problem.
- Acquire programming skills in scripting language

UNIT - I
Introduction: Ruby, Rails, The structure and Execution of Ruby Programs, Package Management with RUBYGEMS, Ruby and web: Writing CGI scripts, cookies, Choice of Webservers, S O A P and web services
RubyTk – Simple Tk Application ,widgets , Binding events , Canvas ,scrolling

UNIT - II
Extending Ruby : Ruby Objects in C , the Jukebox extension, Memory allocation ,Ruby Type System , Embedding Ruby to Other Languages , Embedding a Ruby Interperter

UNIT - III
Introduction to PERL and Scripting
Scripts and Programs, Origin of Scripting , Scripting Today, Characteristics of Scripting Languages,Uses for Scripting Languages, Web Scripting, and the universe of Scripting Languages. PERL- Names and Values, Variables, Scalar Expressions, Control Structures, arrays, list, hashes, strings, pattern and regular expressions, subroutines.

UNIT - IV
Advanced perl
Finer points of looping, pack and unpack, filesystem, eval, datastructures, packages, modules, objects, interfacing to the operating system, Creating Internet ware applications, Dirty Hands Internet Programming, security Isses.

UNIT - V
TCL
TCL Structure, syntax, Variables and Data in TCL, Control Flow, Data Structures, input/output, procedures, strings , patterns, files, Advance TCL- eval, source, exec and uplevel commands, Name spaces, trapping errors, event driven programs, making applications internet aware, Nuts and Bolts Internet Programming, Security Issues, C Interface.

Tk
Tk-Visual Tool Kits, Fundamental Concepts of Tk, Tk by example, Events and Binding , Perl-Tk.

Textbooks:

1. The World of Scripting Languages , David Barron,Wiley Publications.
2. Ruby Programming language by David Flanagan and Yukihiro Matsumoto O'Reilly
3. "Programming Ruby" The Pramatic Programmers guide by Dabve Thomas Second edition

References:

1. Open Source Web Development with LAMP using Linux Apache, MySQL, Perl and HP,J.Lee and B.Ware(Addison Wesley) Pearson Education.

2. Perl by Example, E.Quigley, Pearson Education.

3. Programming Perl,Larry Wall,T.Christiansen and J.Orwant, O'Reilly, SPD.

4. Tcl and the Tk Tool kit, Ousterhout, Pearson Education.

5. Perl Power, J.P.Flynt, Cengage Learning.

B.Tech. in Computer Science & Engineering (AI&ML)
VII Semester Syllabus
CD742PE: INTERNET OF THINGS
(Common to CSE (AI&ML)(PE-III) & CSE (Data Science)(PE-IV))

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Prerequisites

- Computer organization, Computer Networks Course.

Course Objectives:

- To introduce the terminology, technology and its applications
- To introduce the concept of M2M (machine to machine) with necessary protocols
- To introduce the Python Scripting Language which is used in many IoT devices
- To introduce the Raspberry PI platform, that is widely used in IoT applications
- To introduce the implementation of web-based services on IoT devices.

Course Outcomes:

- Interpret the impact and challenges posed by IoT networks leading to new architectural models.
- Compare and contrast the deployment of smart objects and the technologies to connect them to network.
- Appraise the role of IoT protocols for efficient network communication.
- Identify the applications of IoT in Industry.

UNIT-I:

Introduction to Internet of Things –Definition and Characteristics of IoT, Physical Design of IoT, Logical Design of IoT, IoT Enabling Technologies, IoT Levels and Deployment Templates Domain Specific IoTs – Home automation, Environment, Agriculture, Health and Lifestyle.

UNIT-II:
IoT and M2M – M2M, Difference between IoT and M2M, SDN and NFV for IoT, IoT System Management with NETCOZF, YANG- Need for IoT system Management, Simple Network management protocol, Network operator requirements, NETCONF, YANG, IoT Systems Management with NETCONF-YANG.

UNIT-III:
IoT Systems – Logical design using Python-Introduction to Python – Python Data types & Data structures, Control flow, Functions, Modules, Packaging, File handling, Data/Time operations, Classes, Exception, Python packages of Interest for IoT.

UNIT-IV:
IoT Physical Devices and Endpoints - Raspberry Pi, Linux on Raspberry Pi, Raspberry Pi Interfaces, Programming Raspberry PI with Python, Other IoT devices.

IoT Physical Servers and Cloud Offerings – Introduction to Cloud Storage models and communication APIs, WAMP-AutoBahn for IoT, Xively Cloud for IoT, Python web application framework –Django, Designing a RESTful web API.

UNIT-V:
Case studies- Home Automation, Environment-weather monitoring-weather reporting- air pollution monitoring, Agriculture.

Text Books:
1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547

Reference Books:
1. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759.

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B.Tech. in Computer Science & Engineering (AI&ML)
VII Semester Syllabus
CM741PE: EXPERT SYSTEMS
(PE-IV)

Course Objectives:

- Understand the basic techniques of artificial intelligence.
- Understand the Non-monotonic reasoning and statistical reasoning.

Course Outcomes:

- Apply the basic techniques of artificial intelligence.
- Discuss the architecture of an expert system and its tools.
- Understand the importance of building an expert systems
- Understand various problems with an expert systems

UNIT- I

Introduction to AI programming languages, Blind search strategies, Breadth-first – Depth-first – Heuristic search techniques Hill Climbing – Best first – A Algorithms AO* algorithm – game trees, Min-max algorithms, game playing – Alpha-beta pruning.

UNIT- II

Knowledge representation issues predicate logic – logic programming Semantic nets- frames and inheritance, constraint propagation; Representing Knowledge using rules, Rules-based deduction systems.

UNIT- III

Introduction to Expert Systems, Architecture of expert systems, Representation and organization of knowledge, Basics characteristics, and types of problems handled by expert systems.

UNIT- IV

Expert System Tools: Techniques of knowledge representations in expert systems, knowledge engineering, system-building aids, support facilities, stages in the development of expert systems.

UNIT- V

Building an Expert System: Expert system development, Selection of the tool, Acquiring Knowledge, Building process.
Problems with Expert Systems: Difficulties, common pitfalls in planning, dealing with domain experts, difficulties during development.

TEXT BOOKS:
1. Elain Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw-Hill, New Delhi.
2. Waterman D.A., "A Guide to Expert Systems", Addison Wesley Longman.

REFERENCE BOOKS:
1. Stuart Russel and other Peter Norvig, "Artificial Intelligence – A Modern Approach", Prentice-Hall,
2. Patrick Henry Winston, "Artificial Intelligence", Addison Wesley,
3. Patterson, Artificial Intelligence & Expert System, Prentice Hall India, 1999.
4. Hayes-Roth, Lenat, and Waterman: Building Expert Systems, Addison Wesley,
5. Weiss S.M. and Kulikowski C.A., "A Practical Guide to Designing Expert Systems", Rowman &Allanheld, New Jersey.

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B.Tech. in Computer Science & Engineering (AI&ML)
VII Semester Syllabus
CM742PE: SEMANTIC WEB
(PE-IV)

Course Objectives:
- To learn Web Intelligence.
- To learn Knowledge Representation for the Semantic Web.
- To learn Ontology Engineering.
- To learn Semantic Web Applications, Services and Technology.

Course Outcomes:
- Understand the characteristics of Semantic Web.
- Apply SOAP and UDDI to web services.
- Handle multiple web services using Orchestration.
- Create documents using XML.
- Construct and use Ontologies.

UNIT - I
Introduction: Introduction to Semantic Web, the Business Case for the Semantic Web, XML and Its Impact on the Enterprise.

UNIT - II
Web Services: Uses, Basics of Web Services, SOAP, UDDI, Orchestrating Web Services, Securing Web Services, Grid Enabled and Semantic Web of Web Services.

UNIT - III
Resource Description Framework: Features, Capturing Knowledge with RDF.
XML Technologies: XPath, The Style Sheet Family: XSL, XSLT, and XSL FO, XQuery, XLink, XPointer, XInclude, XMLBase, XHTML, XForms, SVG.

UNIT - IV
Taxonomies and Ontologies: Overview of Taxonomies, Defining the Ontology Spectrum, Topic Maps,Overview of Ontologies, Syntax, Structure, Semantics, and Pragmatics, Expressing Ontologies Logically, Knowledge Representation.

UNIT - V
Semantic Web Application: Semantic Web Services, e-Learning, Semantic Bioinformatics, Enterprise Application Integration, Knowledge Base. **Semantic Search Technology:** Search Engines, Semantic Search, Semantic Search Technology, Web Search Agents, Semantic Methods, Latent Semantic Index Search, TAP, Swoogle.

TEXT BOOK:
1. Thinking on the Web - Berners Lee, Godel and Turing, Wiley Interscience.

REFERENCE BOOKS:
1. The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management by Michael C. Daconta, Leo J. Obrst, Kevin T. Smith, Wiley Publishing, Inc.
2. Semantic Web Technologies, Trends and Research in Ontology Based Systems, J.Davies,R.Studer, P.Warren, John Wiley & Sons.
3. Semantic Web and Semantic Web Services - Liyang Lu Chapman and Hall/CRC Publishers,(Taylor & Francis Group)
4. Information Sharing on the semantic Web - Heiner Stuckenschmidt; Frank Van Harmelen,Springer Publications.
5. Programming the Semantic Web, T.Segaran, C.Evans,J.Taylor, O'Reilly,SPD.

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B.Tech. in Computer Science & Engineering (AI&ML)
VII Semester Syllabus
CM743PE: GAME THEORY
(PE-IV)

Course Objectives:

The course will explain in depth the standard equilibrium concepts (such as Nash equilibrium, Subgame-Perfect Nash Equilibrium, and others) in Game Theory.

Course Outcomes:

- Understand the basic concepts of game theory and solutions
- Understand different types of equilibrium interpretations
- Understand and analyze knowledge and solution concepts
- Analyze extensive games with perfect information

UNIT - I
Introduction- Game Theory, Games and Solutions Game Theory and the Theory of Competitive Equilibrium, Rational Behavior, The Steady State and Deductive Interpretations, Bounded Rationality Terminology and Notation. Nash Equilibrium- Strategic Games, Nash Equilibrium Examples Existence of a Nash Equilibrium, Strictly Competitive Games, Bayesian Games: Strategic Games with Imperfect Information.

UNIT - II
Mixed, Correlated, and Evolutionary Equilibrium - Mixed Strategy Nash Equilibrium, Interpretations of Mixed Strategy Nash Equilibrium, Correlated Equilibrium, Evolutionary Equilibrium, Rationalizability and Iterated Elimination of Dominated Actions -Rationalizability Iterated Elimination of Strictly Dominated Actions, Iterated Elimination of Weakly Dominated Actions.

UNIT - III
Knowledge and Equilibrium -A Model of Knowledge Common Knowledge, Can People Agree to Disagree? Knowledge and Solution Concepts, The Electronic Mail Game

UNIT - IV
Extensive Games with Perfect Information -Extensive Games with Perfect Information Subgame Perfect Equilibrium Two Extensions of the Definition of a Game The Interpretation of a Strategy, Two Notable Finite Horizon Games, Iterated Elimination of Weakly Dominated, Strategies Bargaining Games - Bargaining and Game Theory, A Bargaining Game of Alternating Offers Subgame Perfect Equilibrium Variations and Extensions.

UNIT - V
Repeated Games - The Basic Idea Infinitely Repeated Games vs.\ Finitely Repeated Games, Infinitely Repeated Games: Definitions Strategies as Machines Trigger Strategies: Nash Folk, Theorems Punishing for a Limited Length of Time: A Perfect Folk Theorem for the Limit of Means Criterion Punishing the Punisher: A Perfect Folk Theorem for the Overtaking Criterion, Rewarding Players Who Punish: A Perfect Folk Theorem for the Discounting Criterion The Structure of Subgame Perfect Equilibria Under the Discounting Criterion Finitely Repeated Game.

TEXT BOOKS:

1. A course in Game Theory, M. J. Osborne and A. Rubinstein, MIT Press
2. Game Theory, Roger Myerson, Harvard University Press
3. Game Theory, D. Fudenberg and J. Tirole, MIT Press

REFERENCE BOOKS:

1. Theory of Games and Economic Behavior, J. von Neumann and O. Morgenstern, New York: John Wiley and Sons.
2. Games and Decisions, R.D. Luce and H. Raiffa, New York: John Wiley and Sons.
3. Game Theory, G. Owen, 2nd Edition, New York: Academic Press.

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B.Tech. in Computer Science & Engineering (AI&ML)
VII Semester Syllabus
CM744PE: QUANTUM COMPUTING
(PE-IV)

Course Objectives

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

Course Outcomes
- Understand basics of quantum computing
- Understand physical implementation of Qubit
- Understand Quantum algorithms and their implementation
- Understand The Impact of Quantum Computing on Cryptography

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

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

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

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

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

TEXT BOOK:
1. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge.

REFERENCE BOOKS:
1. Quantum Computing for Computer Scientists by Noson S. Yanofsky and Mirco A. Mannucci
2. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol.I: Basic Concepts, Vol II.

3. Basic Tools and Special Topics, World Scientific. Pittenger A. O., An Introduction to QuantumComputing Algorithms.

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B.Tech. in Computer Science & Engineering (AI&ML)
VII Semester Syllabus
CM721OE: DATA MINING
(OPEN ELECTIVE-II)

Pre-Requisites:
- Database Management System
- Probability and Statistics

Course Objectives:
- Students will become acquainted with both the strengths and limitations of various data miningtechniques like Association, Classification, Cluster and Outlier analysis.

Course Outcomes:
- Understand the need of data mining and pre-processing techniques.
- Perform market basket analysis using association rule mining.
- Utilize classification techniques for analysis and interpretation of data.
- Identify appropriate clustering and outlier detection techniques to handle complex data.
- Understand the mining of data from web, text and time series data.

UNIT - I
Introduction to Data Mining:

What Data mining? Kinds of Data, Knowledge Discovery process, Data Mining Functionalities, Kinds of Patterns, Major Issues in Data Mining. Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity and Dissimilarity, Data Pre-processing**:** Major Tasks in Data Pre-processing, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization.

UNIT - II
Association Analysis: Basic Concepts, Market Basket Analysis, Apriori Algorithm, FP-growth, From Association Analysis to Correlation Analysis, Pattern Mining in Multilevel Associations and Multidimensional Associations.

UNIT - III
Classification: Basic Concepts, Decision Tree Induction, Bayes Classification Methods, Rule-Based Classification, Metrics for Evaluating Classifier Performance, Ensemble Methods, Multilayer Feed- Forward Neural Network, Support Vector Machines, k-Nearest-Neighbor Classifiers.

UNIT - IV
Cluster Analysis: Requirements for Cluster Analysis, Overview of Basic Clustering Methods, Partitioning Methods-k-Means, k-Medoids, Hierarchical Methods-AGENES, DIANA, BIRCH, Density- Based Method-DBSCAN, Outlier Analysis: Types of Outliers, Challenges of Outlier Detection, and Overview of Outlier Detection Methods

UNIT - V
Advanced Concepts: Web Mining- Web Content Mining, Web Structure Mining, Web Usage Mining, Spatial Mining- Spatial Data Overview, Spatial Data Mining Primitives, Spatial Rules, Spatial Classification

Algorithm, Spatial Clustering Algorithms, Temporal Mining- Modeling Temporal Events, Time Series, Pattern Detection, Sequences, Temporal Association Rules.

TEXT BOOKS:

1. Jiawei Han, Micheline Kamber, Jian Pei., Data Mining: Concepts and Techniques, 3rd Edition, Morgan Kaufmann/Elsevier, 2012.
2. Margaret H Dunham, Data Mining Introductory and Advanced Topics, 2nd Edition, Pearson Education, India, 2006.

REFERENCE BOOKS:

1. Data Mining Techniques, Arun K Pujari, 3rd Edition, Universities Press.
2. Pang-Ning Tan, Michael Steinbach, Anuj Karpatne and Vipin Kumar, Introduction to Data Mining, 2nd Edition, Pearson Education India, 2021.
3. Amitesh Sinha, Data Warehousing, Thomson Learning, India, 2007.

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B.Tech. in Computer Science & Engineering (AI&ML)
VII Semester Syllabus
CD722OE- R PROGRAMMING
(OPEN ELECTIVE-II)

Prerequisites

- Basic programming

Course Objectives

- Understanding and being able to use basic programming concepts
- Automate data analysis
- Working collaboratively and openly on code
- Knowing how to generate dynamic documents
- Being able to use a continuous test-driven development approach.

Course Outcomes

- Understand to use and program in the programming language R
- Understand to use R to solve statistical problems
- Implement and describe Monte Carlo the technology
- Implement minimize and maximize functions using R.

UNIT-I:

Introduction: Overview of R, R data types and objects, reading and writing data, sub setting R Objects, Essentials of the R Language, Installing R, Running R, Packages in R, Calculations, Complex numbers in R, Rounding, Arithmetic, Modulo and integer quotients, Variable names and assignment, Operators, Integers, Factors, Logical operations.

UNIT-II:

Control structures, functions, scoping rules, dates and times, Introduction to Functions, preview of Some Important R Data Structures, Vectors, Character Strings, Matrices, Lists, Data Frames, Classes Vectors: Generating sequences, Vectors and subscripts, Extracting elements of a vector using subscripts, Working with logical subscripts, Scalars, Vectors, Arrays, and Matrices, Adding and Deleting Vector Elements, Obtaining the Length of a Vector, Matrices and Arrays as Vectors Vector Arithmetic and Logical Operations, Vector Indexing, Common Vector Operations.

UNIT-III:

Lists: Creating Lists, General List Operations, List Indexing Adding and Deleting List Elements, Getting the Size of a List, Extended Example: Text Concordance Accessing List Components and Values Applying Functions to Lists, DATA FRAMES, Creating Data Frames, Accessing Data Frames, Other Matrix-Like Operations.

UNIT-IV:

Factors And Tables: Factors and Levels, Common Functions Used with Factors, Working with Tables, Matrix/Array-Like Operations on Tables, Extracting a Subtable, Finding the Largest Cells in a Table, Math Functions, Calculating a Probability, Cumulative Sums and Products, Minima and Maxima, Calculus, Functions for Statistical Distributions.

UNIT-V:
Graphics: Creating Graphs, Customizing Graphs, Saving Graphs to Files, Customizing Graphs, Creating Three-Dimensional Plots.
Debugging: Fundamental Principles of Debugging, Why Use a Debugging Tool?, Using R Debugging Facilities, Moving Up in the World: More Convenient Debugging Tools, Ensuring Consistency in Debugging Simulation Code, Syntax and Runtime Errors, Running GDB on R Itself.

Text Books:
1. The Art of R Programming, Norman Matloff, Cengage Learning

Reference Books:
1. R Programming for Data Science by Roger D. Peng
2. Hadley Wickham, Garrett Grolemund, R for Data Science: Import, Tidy, Transform, Visualize, and Model Data 1st Edition, O'Reilly
3. Tilman M. Davies, The book of R a first course in programming and statistics, no starch press.

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B.Tech. in Computer Science & Engineering (AI&ML)
VII Semester Syllabus
MS701HS: Professional Practice, Law & Ethics
(Common to ECE & CSE (AI&ML))

Course Objectives: The objectives of the course are:

1. To create awareness on professional ethics, professional responsibility, whistle blowing, GST.
2. To learn the basics of Law of Contract.
3. To discuss the Alternative Dispute Resolution mechanisms.
4. To familiarize with Industrial relations and Labour laws in India
5. To introduce different types of IPRs and laws relating to copyrights and patents in India.

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

1. Understand the importance of professional practice, Law and Ethics in their personal lives and professional careers.
2. Analyze the law of Contracts and special contracts
3. Evaluate the alternative dispute resolution systems in India
4. Gain knowledge about the Industrial relations and Labour laws in India
5. Appreciate about the types of IPRs and laws relating to copyrights and patents in India.

UNIT I: PROFESSIONAL PRACTICE AND ETHICS
Definition of Ethics, Professional Ethics - Engineering Ethics, Personal Ethics; Code of Ethics - Profession, Professionalism, Professional Responsibility, Conflict of Interest, Gift vs Bribery, Environmental breaches, Professional negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistle blowing and protected disclosures. Introduction to GST - Roles of Various Stake holders.

UNIT II: LAW OF CONTRACT
Nature of Contract Essential elements of valid contract: Offer and Acceptance, Consideration, Capacity to contract and Free Consent, Legality of Object. Unlawful and illegal agreements, Contingent Contracts, Performance and Discharge of Contracts and Remedies for breach of contract. Contracts-II: Indemnity and Guarantee, Contract of Agency, Bailment and Pledge.

UNIT III: ARBITRATION, CONCILIATION AND ALTERNATIVE DISPUTE RESOLUTION (ADR) SYSTEM
Arbitration – meaning and scope. Arbitration and Conciliation Act, 1996;UNCITRAL model law–Arbitration and expert determination; Extent of judicial intervention; International commercial arbitration; Arbitration agreements– essential and kinds, validity, reference and interim measuresbycourt;Arbitrationtribunal– appointment,challenge,jurisdiction of arbitral tribunal, powers, grounds of challenge, procedure and Court assistance; Distinction between conciliation, negotiation, mediation and arbitration, confidentiality, resort to judicial proceedings, costs; Dispute Resolution Boards; Lok Adalats.

UNIT IV: LABOUR LAWS AND CYBER LAW
Industrial Disputes Act,1947;Collective bargaining; Industrial Employment (Standing Orders) Act, 1946; Workmen's Compensation Act, 1923; Minimum Wages Act 1948; RERA Act 2017; IT Act, 2000.

UNIT V: LAW RELATING TO INTELLECTUAL PROPERTY
Introduction – meaning of intellectual property, Main forms of IP - Copyright, Trademarks, Patents and Designs, Secrets; Law relating to Copyrights under Copyrights Act,1957, Meaning of copyright – computer programs, Ownership of copyrights and assignment, Criteria of infringement, Piracy in Internet – Remedies and procedures

in India; Law relating to Patents under Patents Act, 1970.

TEXT BOOKS:
1. R. Subramanian, Professional Ethics, Oxford University Press, 2nd Edition, 2017.
2. Ravinder Kaur, Legal Aspects of Business, Cengage Learning, 4th Edition, 2016.
3. Anupam Kurlwal, An Introduction to Alternative Dispute Resolution System (ADR), 4thEdition, Central Law Publications, 2022.
4. T.Ramappa, Intellectual Property Rights Law in India, 1stEdition, Asia Law House, 2010.

REFERENCE BOOKS:
1. Wadhera, Intellectual Property Rights, 5thEdition, Universal Law Publishing Co, 2004
2. O.P. Malhotra, Law of Industrial Disputes, N.M. Tripathi Publishers.
3. S C Srivastava, Industrial Relations and Labor Laws, 7thEdition, Vikas Publications, 2020.

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B.Tech. in Computer Science & Engineering (AI&ML)
VII Semester Syllabus
CM751PC: DEEP LEARNING LAB

Course Objectives:

- To Build the Foundation of Deep Learning.
- To Understand How to Build the Neural Network.
- To enable students to develop successful machine learning concepts.

Course Outcomes:

- Upon the Successful Completion of the Course, the Students would be able to:
- Learn the Fundamental Principles of Deep Learning.
- Identify the Deep Learning Algorithms for Various Types of Learning Tasks in various domains.
- Implement Deep Learning Algorithms and Solve Real-world problems.

LIST OF EXPERIMENTS:

1. Setting up the Spyder IDE Environment and Executing a Python Program
2. Installing Keras, Tensorflow and Pytorch libraries and making use of them
3. Applying the Convolution Neural Network on computer vision problems
4. Image classification on MNIST dataset (CNN model with Fully connected layer)
5. Applying the Deep Learning Models in the field of Natural Language Processing
6. Train a sentiment analysis model on IMDB dataset, use RNN layers with LSTM/GRU notes
7. Applying the Autoencoder algorithms for encoding the real-world data
8. Applying Generative Adversial Networks for image generation and unsupervised tasks.

TEXT BOOKS:

1. Deep Learning by Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press.
2. The Elements of Statistical Learning by T. Hastie, R. Tibshirani, and J. Friedman, Springer.
3. Probabilistic Graphical Models. Koller, and N. Friedman, MIT Press.

REFERENCES:

1. Bishop, C.M., Pattern Recognition and Machine Learning, Springer, 2006.
2. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
3. Golub, G.H., and Van Loan, C.F., Matrix Computations, JHU Press, 2013.
4. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw Hill Education, 2004.

EXTENSIVE READING:

1. http://www.deeplearning.net
2. https://www.deeplearningbook.org/
3. https://developers.google.com/machine-learning/crash-course/ml-intro
4. www.cs.toronto.edu/~fritz/absps/imagenet.pdf
5. http://neuralnetworksanddeeplearning.com/

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B.Tech. in Computer Science & Engineering (AI&ML)
VIII Semester Syllabus
CM851PE: WEB SECURITY
(Common to CSE (AI&ML) PE-V, CSE(Data Science) PE – VI)

Course Objectives:

- Give an Overview of information security
- Give an overview of Access control of relational databases

Course Outcomes: Students should be able to

- Understand the Web architecture and applications
- Understand client side and service side programming
- Understand how common mistakes can be bypassed and exploit the application
- Identify common application vulnerabilities

UNIT - I
The Web Security, The Web Security Problem, Risk Analysis and Best Practices.
Cryptography and the Web: Cryptography and Web Security, Working Cryptographic Systems and Protocols, Legal Restrictions on Cryptography, Digital Identification.

UNIT - II
The Web's War on Your Privacy, Privacy-Protecting Techniques, Backups and Antitheft, Web Server Security, Physical Security for Servers, Host Security for Servers, Securing Web Applications.

UNIT - III
Database Security: Recent Advances in Access Control, Access Control Models for XML, Database Issues in Trust Management and Trust Negotiation, Security in Data Warehouses and OLAP Systems.

UNIT - IV
Security Re-engineering for Databases: Concepts and Techniques, Database Watermarking for Copyright Protection, Trustworthy Records Retention, Damage Quarantine and Recovery in Data Processing Systems, Hippocratic Databases: Current Capabilities and Future Trends.

UNIT - V
Privacy in Database Publishing: A Bayesian Perspective, Privacy-enhanced Location-based Access Control, Efficiently Enforcing the Security and Privacy Policies in a Mobile Environment.

TEXT BOOKS:
1. Web Security, Privacy and Commerce Simson G Arfinkel, Gene Spafford, O'Reilly.

2.   Handbook on Database security applications and trends Michael Gertz, Sushil Jajodia

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B.Tech. in Computer Science & Engineering (AI&ML)
VIII Semester Syllabus
CM852PE: SOCIAL NETWORK ANALYSIS
(PE – V)

Prerequisites
- A course on "Web Technologies".
- A course on "Computer Networks".
- A course on "Data Warehousing and Data Mining".

Course Objectives:
- It introduces the concepts of social media
- It provides the mechanisms for social network analysis
- Includes the concepts that allow for better visualization and analysis of widely used services such as email, Wikis, Twitter, flickr, YouTube, etc.

Course Outcomes:
- Ability to construct social network maps easily
- Gain skills in tracking the content flow through the social media
- Use NodeXL to perform social network analysis

UNIT - I:
Introduction: Social Media and Social Networks**. Social Media:** New Technologies of Collaboration.
Social Network Analysis: Measuring, Mapping, and Modelling collections of Connections.

UNIT - II:
NodeXL, Layout, Visual Design, and Labeling, Calculating and Visualizing Network Metrics, PreparingData and Filtering, Clustering and Grouping.

UNIT - III:
CASE STUDIES - I:
Email: The lifeblood of Modern Communication**. Thread Networks:** Mapping Message Boards andEmail Lists.
Twitter: Conversation, Entertainment and Information.

UNIT - IV:
CASE STUDIES - II: Visualizing and Interpreting Facebook Networks, WWW Hyperlink Networks

UNIT-V:
CASE STUDIES - III:
You Tube: Contrasting Patterns of Content Interaction, and Prominence**. Wiki Networks:** Connectionsof Creativity and Collaboration.

TEXT BOOKS:
1.   Hansen, Derek, Ben Sheiderman, Marc Smith, Analyzing Social Media Networks with NodeXL:Insights from a Connected World, Morgan Kaufmann, 2011.

2. Avinash Kaushik, Web Analytics 2.0: The Art of Online Accountability, Sybex, 2009.

REFERENCE BOOK:
1. Marshall Sponder, Social Media Analytics: Effective Tools for Building, Interpreting and UsingMetrics, 1st Edition, MGH, 2011.

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B.Tech. in Computer Science & Engineering (AI&ML)
VIII Semester Syllabus
CM853PE: FEDERATED MACHINE LEARNING
(PE – V)

Prerequisites: The prerequisite knowledge for this course includes machine learning, basic computer systems and basic programming skills.

Course Objectives
- Understand the key concepts and issues behind Federated Learning
- Get familiar with key theoretical results of Federated Learning

Course Outcomes
- Knowledge of the basic concepts, architecture, and applications of FL.
- Understanding of new research and application trends in FL.
- Analyse horizontal federated learning
- Understand the significance of Federated Learning for Vision, Language, and Recommendation.

UNIT - I

Introduction: Motivation, Federated Learning as a Solution, The Definition of Federated Learning, Categories of Federated Learning, Current Development in Federated Learning, Research Issues in Federated Learning, Open-Source Projects, Standardization Efforts, The Federated AI Ecosystem Background: Privacy-Preserving Machine Learning, PPML and Secure ML, Threat and Security Models, Privacy Threat Models, Adversary and Security Models, Privacy Preservation Techniques, Secure Multi-Party Computation, Homomorphic Encryption, Differential Privacy.

UNIT - II

Distributed Machine Learning: Introduction to DML, The Definition of DML, DML Platforms, Scalability Motivated DML, Large-Scale Machine Learning, Scalability-Oriented DML Schemes, Privacy-Motivated DML, Privacy-Preserving Decision Trees, Privacy-Preserving Techniques, Privacy-Preserving DML Schemes, Privacy-Preserving Gradient Descent, Vanilla Federated Learning, Privacy-Preserving Methods.

UNIT - III

Horizontal Federated Learning: The Definition of HFL, Architecture of HFL, The Client- Server Architecture, The Peer-to-Peer Architecture, Global Model Evaluation, The Federated Averaging Algorithm, Federated Optimization, The FedAvg Algorithm, The Secured FedAvg Algorithm, Improvement of the FedAvg Algorithm, Communication Efficiency, Client Selection Vertical Federated Learning: The Definition of VFL, Architecture of VFL, Algorithms of VFL, Secure Federated Linear Regression, Secure Federated Tree-Boosting.

UNIT - IV

Federated Transfer Learning: Heterogeneous Federated Learning, Federated Transfer Learning, The FTL Framework, Additively Homomorphic Encryption, The FTL Training Process, The FTL Prediction Process, Security Analysis, Secret Sharing-Based FTL Incentive Mechanism Design for Federated Learning: Paying for Contributions, Profit-Sharing Games, Reverse Auctions, A Fairness-Aware Profit Sharing Framework, Modeling Contribution, Modeling Cost, Modeling Regret, Modeling Temporal Regret, The Policy Orchestrator, Computing Payoff Weightage.

UNIT - V

Federated Learning for Vision, Language, and Recommendation: Federated Learning for Computer Vision, Federated CV, Federated Learning for NLP, Federated NLP, Federated Learning for R18 B.Tech. CSE (AIML) III & IV Year JNTU Hyderabad Recommendation Systems, Recommendation Model, Federated Recommendation System Federated Reinforcement Learning: Introduction to Reinforcement Learning, Policy, Reward, Value Function, Model of the Environment, RL Background Example, Reinforcement Learning Algorithms, Distributed Reinforcement Learning, Asynchronous Distributed Reinforcement Learning, Synchronous Distributed

Reinforcement Learning, Federated Reinforcement Learning, Background and Categorization.

TEXT BOOK:

1. Federated Learning, Qiang Yang, Yang Liu, Yong Cheng, Yan Kang, Tianjian Chen, and Han Yu -Synthesis Lectures on Artificial Intelligence and Machine Learning 2019.

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B.Tech. in Computer Science & Engineering (AI&ML)
VIII Semester Syllabus
CM854PE: AUGMENTED REALITY AND VIRTUAL REALITY
(PE – V)

Course Objectives:
- Provide a foundation to the fast growing field of AR and make the students aware of thevarious AR concepts**.**
- To give historical and modern overviews and perspectives on virtual reality. It describes the fundamentals of sensation, perception, technical and engineering aspects of virtual reality systems.

Course Outcomes:
- Describe how AR systems work and list the applications of AR.
- Understand the software architectures of AR.
- Understand the Visual perception and rendering in VR
- Understand the interaction, auditory perception and rendering in VR

UNIT - I
Introduction to Augmented Reality: Augmented Reality - Defining augmented reality, history of augmented reality, Examples, Related fields
Displays: Multimodal Displays, Visual Perception, Requirements and Characteristics, Spatial Display Model, Visual Displays
Tracking: Tracking, Calibration, and Registration, Coordinate Systems, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors

UNIT - II
Computer Vision for Augmented Reality: Marker Tracking, Multiple-Camera Infrared Tracking,Natural Feature Tracking by Detection, Outdoor Tracking.
Interaction: Output Modalities, Input Modalities, Tangible Interfaces, Virtual User Interfaces on Real Surfaces, Augmented Paper, Multi-view Interfaces, Haptic Interaction
Software Architectures: AR Application Requirements, Software Engineering Requirements,

Distributed Object Systems, Dataflow, Scene Graphs

UNIT - III
Introduction to Virtual Reality: Defining Virtual Reality, History of VR, Human Physiology and Perception
The Geometry of Virtual Worlds: Geometric Models, Axis-Angle Representations of Rotation, Viewing Transformations

Light and Optics: Basic Behavior of Light, Lenses, Optical Aberrations, The Human Eye, Cameras, Displays

UNIT - IV

The Physiology of Human Vision: From the Cornea to Photoreceptors, From Photoreceptors to the Visual Cortex, Eye Movements, Implications for VR

Visual Perception: Visual Perception - Perception of Depth, Perception of Motion, Perception of Color **Visual Rendering:** Visual Rendering -Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates, Immersive Photos and Videos

UNIT - V

Motion in Real and Virtual Worlds: Velocities and Accelerations, The Vestibular System, Physics inthe Virtual World, Mismatched Motion and Vection

Interaction: Motor Programs and Remapping, Locomotion, Social Interaction

Audio: The Physics of Sound, The Physiology of Human Hearing, Auditory Perception, Auditory Rendering

TEXT BOOKS:

1. Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson EducationIndia;First edition (12 October 2016),ISBN-10: 9332578494
2. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016

REFERENCE BOOKS:

1. Allan Fowler-AR Game Development‖, 1st Edition, A press Publications, 2018, ISBN 978- 1484236178
2. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and AlanB Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002
3. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, WilliamR Sherman and Jeffrey D Will, Morgan Kaufmann, 2009
4. Designing for Mixed Reality, Kharis O'Connell Published by O'Reilly Media, Inc., 2016, ISBN: 9781491962381
5. Sanni Siltanen- Theory and applications of marker-based augmented reality. Julkaisija — Utgivare Publisher. 2012. ISBN 978-951-38-7449-0
6. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005

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B.Tech. in Computer Science & Engineering (AI&ML)
VIII Semester Syllabus
CM861PE: SPEECH AND VIDEO PROCESSING
(PE - VI)

Course Objectives:

- To make students understand speech and video processing techniques

Course Outcomes:
- Describe the mechanisms of human speech production systems and methods forspeech feature extraction.
- Understand basic algorithms of speech analysis and speech recognition.
- Explain basic techniques in digital video processing, including imaging characteristicsand sensors.
- Apply motion estimation and object tracking algorithms on video.

UNIT - I

Speech processing concepts
The speech production mechanism, Discrete time speech signals, Pole-Zero modeling of speech, relevant properties of the fast Fourier transform for speech recognition, convolution, linear and non linear filter banks, spectral estimation of speech using DFT.
Linear Prediction analysis of speech.

UNIT - II

Speech recognition
Feature extraction for speech, static and dynamic feature for speech recognition, MFCC, LPCC,Distance measures, vector quantization models, Gaussian Mixture model, HMM.

UNIT - III

Multi-Dimensional Signals and Systems

Multi-Dimensional Signals, Multi-Dimensional Transforms, Multi-Dimensional Systems, Multi-Dimensional Sampling Theory, Sampling Structure Conversion
Digital Images and Video: Human Visual System and Color, Digital Video

UNIT - IV

Motion Estimation
Image Formation, Motion Models, 2D Apparent-Motion Estimation, Differential Methods, Matching Methods, Nonlinear Optimization Methods, Transform-Domain Methods, 3D Motion and Structure Estimation

UNIT - V

Video Segmentation and Tracking
Image Segmentation, Change Detection, Motion Segmentation, Motion Tracking, Image and Video Matting, Performance Evaluation

TEXT BOOKS:
1. Fundamentals of Speech recognition – L. Rabiner and B. Juang, Prentice Hall signal processing series
2. Digital Video processing, A Murat Tekalp, 2nd edition,Prentice Hall.

REFERENCE BOOKS:

1. Discrete-time speech signal processing: principles and practice, Thomas F. Quatieri, Coth.
2. Video Processing and Communications, Yao Wang, J. Osternann and Qin Zhang, PearsonEducation
3. "Speech and Audio Signal Processing", B.Gold and N. Morgan, Wiley.
4. "Digital image sequence processing, Compression, and analysis", Todd R. Reed, CRC Press
5. "Handbook of Image and Video processing", Al Bovik, Academic press, second Edition.

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B.Tech. in Computer Science & Engineering (AI&ML)
VIII Semester Syllabus
CM862PE: ROBOTIC PROCESS AUTOMATION
(PE – VI)

Course Objectives:
Aim of the course is to make learners familiar with the concepts of Robotic Process Automation

Course Outcomes:
- Describe RPA, where it can be applied and how it's implemented.
- Identify and understand Web Control Room and Client Introduction.
- Understand how to handle various devices and the workload.
- Understand Bot creators, Web recorders and task editors.

UNIT - I

Introduction to Robotic Process Automation & Bot Creation Introduction to RPA and Use cases – Automation Anywhere Enterprise Platform – Advanced features and capabilities – Ways to create Bots.

UNIT - II

Web Control Room and Client Introduction - Features Panel - Dashboard (Home, Bots, Devices, Audit, Workload, Insights) - Features Panel – Activity (View Tasks in Progress and Scheduled Tasks) - Bots (View Bots Uploaded and Credentials)

UNIT - III

Devices (View Development and Runtime Clients and Device Pools) - Workload (Queues and SLA Calculator) - Audit Log (View Activities Logged which are associated with Web CR) - Administration (Configure Settings, Users, Roles, License and Migration) - Demo of Exposed API's – Conclusion – Client introduction and Conclusion.

UNIT - IV

Bot Creator Introduction – Recorders – Smart Recorders – Web Recorders – Screen Recorders - Task Editor – Variables - Command Library – Loop Command – Excel Command – Database Command - String Operation Command - XML Command.

UNIT - V

Terminal Emulator Command - PDF Integration Command - FTP Command - PGP Command - Object Cloning Command - Error Handling Command - Manage Windows Control Command - Workflow Designer - Report Designer.

TEXT BOOKS:

1. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath: Create Software robots. with the leading RPA tool – UiPath Kindle Edition.

REFERENCE BOOKS:

1. Robotic Process Automation A Complete Guide - 2020 Edition Kindle Edition.

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B.Tech. in Computer Science & Engineering (AI&ML)
VIII Semester Syllabus
CM863PE: RANDOMIZED ALGORITHMS
(PE – VI)

Course Objective:
- To introduce the power of randomization in the design and analysis of algorithms.

Course Outcomes:
- Appreciate the fundamentals of randomized algorithm design.
- Understand the fundamentals of Markov chains and the Monte Carlo method.
- Apply high probability analysis to selected randomized algorithms.
- Understand the Comparison of Fingerprinting Techniques and Pattern Matching

UNIT - I

Introduction, A Min – Cut algorithm, Las Vegas and Monte Carlo, Binary Planar Partitions, A Probabilistic Recurrence. Game – Theoretic Techniques: Game Tree Evaluation, The Minimax Principle

UNIT - II

Moments and Deviations: Occupancy Problems, The Markov and Chebyshev Inequalities, Randomized Selection. Markov Chains and Random Walks: A 2-SAT example, Markov Chains, Random Walks on Graphs, Graph Connectivity

UNIT - III

Algebraic Techniques: Fingerprinting and Freivald's Technique, Verifying Polynomial Identities, Perfect Matching in Graphs, Verifying Equality of Strings, A Comparison of Fingerprinting Techniques, Pattern Matching

UNIT - IV

Data Structures: The Fundamental Data-structuring Problem, Random Treaps, Skip Lists, Hashtables,Hashing with O(1) Search Time. Graph Algorithms: All Pairs Shortest Paths, The Min- Cut Problem, Minimum Spanning Trees

UNIT - V

Geometric Algorithms: Randomized Incremental Construction, Convex Hulls in the Plane, Duality, Half-Space Intersections, Dalaunay Triangulations, Trapezoidal Decompositions. Parallel and Distributed Algorithms: The PRAM Model, Sorting on a PRAM, Maximal Independent Sets, Perfect Matchings

TEXT BOOKS:
1. Randomized Algorithms: Rajeev Motwani, Prabhakar Raghavan.
2. Probability and Computing: Randomization and Probabilistic Techniques in Algorithms andData Analysis by Eli Upfal and Michael Mitzenmacher.

REFERENCE BOOK:
1. Rajeev Motwani, Prabhakar Raghavan, Randomized Algorithms, Cambridge University Press.

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B.Tech. in Computer Science & Engineering (AI&ML)
VIII Semester Syllabus
CM864PE: COGNITIVE COMPUTING

(PE – VI)

Prerequisites: Probability theory

Course Objectives:
- To provide an understanding of the central challenges in realizing aspects of human cognition.
- To provide a basic exposition to the goals and methods of human cognition.
- To develop algorithms that use AI and machine learning along with human interaction and feedback to help humans make choices/decisions.
- To support human reasoning by evaluating data in context and presenting relevant findings along with the evidence that justifies the answers.

Course Outcomes:
- Understand cognitive computing
- Plan and use the primary tools associated with cognitive computing.
- Plan and execute a project that leverages cognitive computing.
- Understand and develop the business implications of cognitive computing.

UNIT - I
Introduction to Cognitive Science: Understanding Cognition, IBM's Watson, Design for Human Cognition, Augmented Intelligence, Cognition Modeling Paradigms: Declarative/ logic-based computational cognitive modeling, connectionist models of cognition, Bayesian models of cognition, a dynamical systems approach to cognition.

UNIT - II
Cognitive Models of memory and language, computational models of episodic and semantic memory, modeling psycholinguistics.

UNIT - III
Cognitive Modeling: modeling the interaction of language, memory and learning, Modeling select aspects of cognition classical models of rationality, symbolic reasoning and decision making.

UNIT - IV
Formal models of inductive generalization, causality, categorization and similarity, the role of analogy in problem solving, Cognitive Development Child concept acquisition. Cognition and Artificial cognitive architectures such as ACT-R, SOAR, OpenCog, CopyCat, Memory Networks.

UNIT - V
DeepQA Architecture, Unstructured Information Management Architecture (UIMA), Structured Knowledge, Business Implications, Building Cognitive Applications, Application of Cognitive Computing and Systems.

TEXT BOOK:
1. The Cambridge Handbook of Computational Psychology by Ron Sun (ed.), Cambridge University Press.

REFERENCE BOOKS:
1. Judith S. Hurwitz, Marcia Kaufman, Adrian Bowles Cognitive Computing and Big Data Analytics, Wiley
2. Vijay V Raghavan, Venkat N. Gudivada, Venu Govindaraju, Cognitive Computing: Theory and Applications: Volume 35 (Handbook of Statistics), North Hollan.

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B.Tech. in Computer Science & Engineering (AI&ML)
VIII Semester Syllabus
CM821OE: MACHINE LEARNING
(Open Elective – III)

Course Objectives:

- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the Supervised and Unsupervised learning techniques
- To study the various probability-based learning techniques

Course Outcomes:
- Distinguish between, supervised, unsupervised and semi-supervised learning.
- Understand algorithms for building classifiers applied on datasets of non-linearly separable classes
- Understand the principles of evolutionary computing algorithms
- Design an ensembler to increase the classification accuracy

UNIT - I
Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants: – Perceptron – Linear Separability – Linear Regression.

UNIT - II
Multi-layer Perceptron– Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation

UNIT - III
Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – NearestNeighbor Methods – Unsupervised Learning – K means Algorithms

UNIT - IV
Support Vector Machines
Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms

UNIT - V
Reinforcement Learning – Overview – Getting Lost Example
Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo– Hidden Markov Models

TEXT BOOKS:
1. Stephen Marsland, ―Machine Learning ― An Algorithmic Perspective, SecondEdition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.

REFERENCE BOOKS:
1. Tom M Mitchell, ―Machine Learning, First Edition, McGraw Hill Education, 2013.
2. Peter Flach, ―Machine Learning: The Art and Science of Algorithms that Make Sense of Data‖, First Edition, Cambridge University Press, 2012.
3. Jason Bell, ―Machine learning – Hands on for Developers and Technical Professionals‖, First Edition, Wiley, 2014
4. Ethem Alpaydin, ―Introduction to Machine Learning 3e (Adaptive Computation and MachineLearning Series), Third Edition, MIT Press, 2014.

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B.Tech. in Computer Science & Engineering (AI&ML)
VIII Semester Syllabus
CM822OE: INTRODUCTION TO NATURAL LANGUAGE PROCESSING
(Open Elective – III)

Prerequisites:
- Data structures and compiler design

Course Objectives:
- Introduction to some of the problems and solutions of NLP and their relation to linguistics andstatistics.

Course Outcomes:
- Show sensitivity to linguistic phenomena and an ability to model them with formal grammars.
- Understand and carry out proper experimental methodology for training and evaluating empirical NLP systems
- Able to manipulate probabilities, construct statistical models over strings and trees, andestimate parameters using supervised and unsupervised training methods.
- Able to design, implement, and analyze NLP algorithms; and design different language modeling Techniques.

UNIT - I
Finding the Structure of Words: Words and Their Components, Issues and Challenges, Morphological Models
Finding the Structure of Documents: Introduction, Methods, Complexity of the Approaches, Performances of the Approaches, Features

UNIT - II
Syntax I: Parsing Natural Language, Treebanks: A Data-Driven Approach to Syntax, Representation of Syntactic Structure, Parsing Algorithms

UNIT – III
Syntax II: Models for Ambiguity Resolution in Parsing, Multilingual Issues
Semantic Parsing I: Introduction, Semantic Interpretation, System Paradigms, Word Sense

UNIT - IV
Semantic Parsing II: Predicate-Argument Structure, Meaning Representation Systems

UNIT - V
Language Modeling: Introduction, N-Gram Models, Language Model Evaluation, Bayesian parameter estimation, Language Model Adaptation, Language Models- class based, variable length, Bayesian topic based, Multilingual and Cross Lingual Language Modeling

TEXT BOOKS:
1. Multilingual natural Language Processing Applications: From Theory to Practice – Daniel M. Bikel and Imed Zitouni, Pearson Publication

REFERENCE BOOK:
1. Speech and Natural Language Processing - Daniel Jurafsky& James H Martin, Pearson Publications.
2. Natural Language Processing and Information Retrieval: Tanvier Siddiqui, U.S. Tiwary.