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(Permanent Affiliation by Andhra University & Approved by AICTE
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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

M.TECH-CSE (AI & ML) for Working Professionals

CURRICULUM & SYLLABUS

REGULATION-R23

AY 2023-24

ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY & SCIENCES (AUTONOMOUS)
DEPARTMENT OF COMPUTER SCIENCEAND ENGINEERING -CURRICULUM
R23 for the AY 2023-24

I Year

I Semester

Course Code	Title of the Course	Category	Periods			Max. marks		Total Marks	Credits
			L	P	Total	Sess.	End Exam		
23AM111	Mathematical Foundation for Machine Learning	BS	3	0	3	40	60	100	3
23AM112	Machine Learning	PC	3	0	3	40	60	100	3
23AM113	Professional Elective – I (MOOCs)	PE	-	-	-	-	-	-	3
23AM114	Professional Elective – II	PE	3	0	3	40	60	100	3
23AM115	Research Methodology and IPR (MOOCs)	MC	-	-	-	-	-	-	2
23AM116	Machine Learning using Python Lab	PC	0	3	3	50	50	100	2
23AM117	Professional Elective-II Lab	PE	0	3	3	50	50	100	2
Total			**9**	**6**	**15**	**220**	**280**	**500**	**18**

I Year

II Semester

Course Code	Title of the Course	Category	Periods			Max. marks		Total Marks	Credits
			L	P	Total	Sess.	End Exam		
23 AM121	Deep Learning	PC	3	0	3	40	60	100	3
23 AM122	Computational Intelligence (MOOCs)	PC	-	-	-	-	-	-	3
23 AM123	Professional Elective – III (MOOCs)	PE	-	-	-	-	-	-	3
23 AM124	Professional Elective – IV	PE	3	0	3	40	60	100	3
23 AM125	Deep Learning Lab	PC	0	3	3	50	50	100	2
23 AM126	Professional Elective-IV Lab	PE	0	3	3	50	50	100	2
23 AM127	seminar-I	SC	0	3	3	100	--	100	2
Total			**6**	**9**	**15**	**280**	**220**	**500**	**18**

ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY & SCIENCES (AUTONOMOUS)
DEPARTMENT OF COMPUTER SCIENCEAND ENGINEERING -CURRICULUM
R23 for the AY 2023-24

II Year
I Semester

Course Code	Title of the Course	Category	Periods			Max. marks		Total Marks	Credits
			L	P	Total	Sess.	End Exam		
23 AM 211	MOOCs-I	OE	-	-	-	-	—	-	3
23 AM 212	MOOCs-II	OE	-	-	-	-	—	-	3
23 AM 213	Dissertation Phase-I/ Project Phase-I	PR	0	20	20	100	—	100	10
Total			**0**	**20**	**20**	**100**	**—**	**100**	**16**

II Year
II Semester

Course Code	Title of the Course	Category	Periods			Max. marks		Total Marks	Credits
			L	P	Total	Sess.	End Exam		
23AM 221	Dissertation Phase-II / Project Phase-II	PR	0	32	32	100	100	200	16
Total			**0**	**32**	**32**	**100**	**100**	**200**	**16**

Total Credits	**68**

***The prerequisite for submission of the M Tech thesis is that one should communicate his/her work to any referred journal or Publication in a conference/journal.**

Open Electives List	
23 AM 211	MOOCs-I - SWAYAM/NPTEL/Infosys Spring Board
23 AM 212	MOOCs-II - SWAYAM/NPTEL/Infosys Spring Board

MOOCs	
23AM115	Research Methodology and IPR - SWAYAM/NPTEL
23 AM122	Computational Intelligence - SWAYAM/NPTEL

Professional Electives List		
Professional Elective–I: (SWAYAM/NPTEL/Infosys Spring Board)	23AM113(A)	Problem solving methods in Artificial Intelligence
	23AM113(B)	Image Processing
	23AM113(C)	Expert Systems
Professional Elective–II:	23AM114(A)	Information Security
	23AM114(B)	Data Analytics
	23AM114(C)	Neural Networks
Professional Elective–II Lab:	23AM117(A)	Information Security Lab
	23AM117(B)	Data Analytics Lab
	23AM117(C)	Neural Networks Lab
Professional Elective–III: (SWAYAM/NPTEL/Infosys Spring Board)	23AM123(A)	Information Retrieval System
	23AM123(B)	Internet of Things and Drones
	23AM123(C)	Pattern Recognition
Professional Elective – IV:	23AM124(A)	Artificial Intelligence in Robotics
	23AM124(B)	No SQL
	23AM124(C)	Natural Language Processing
Professional Elective – IV Lab:	23AM126(A)	Artificial Intelligence in Robotics Lab
	23AM126(B)	No SQL Lab
	23AM126(C)	Natural Language Processing Lab

MATHEMATICAL FOUNDATION FOR MACHINE LEARNING	
Code: 23AM111	**Credits: 3**
Instruction : 3 periods /Week	**Sessional Marks: 40**
End Exam : 3 Hours	**End Exam Marks: 60**

Prerequisites: Matrices, Differentiation.

Course Objectives:

To provide the basic knowledge of fundamental concepts in linear algebra, vectors, probability and statistics required for a program in artificial intelligence.

Course Outcomes: By the end of the course, students will be able to

1.	Understand the concepts of vector spaces.
2.	Understand the concepts of inner product spaces.
3.	Understand the concepts Eigen values, Eigen vectors and singular value decompositions.
4.	Understand the concepts of vector calculus.
5.	Apply the knowledge of probability and distributions in multivariate analysis.

Mapping of Course Outcomes with Program Outcomes:

CO	PO			PSO	
	1	2	3	1	2
1	1	-	2	1	1
2	2	-	2	2	2
3	2	1	2	2	2
4	1	-	2	2	2
5	2	1	2	2	2

Correlation levels 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS

UNIT I **10 Periods**

Linear Algebra : Systems of linear equations – Matrices – Solving systems of linear equations – Vector spaces – Linear independence – Basis and Rank – Linear mappings – Affine spaces.

UNIT II **10 Periods**

Analytic Geometry: Norms – Inner products – Lengths and Distances – Angles and Orthogonality – Orthonormal Basis - Orthogonal complement – Inner product of functions – Orthogonal projections – Rotations.

UNIT III **10 Periods**

Matrix Decompositions: Determinant and trace – Eigen values and Eigen vectors – Cholesky decomposition – Eigen decomposition and diagonalization – Singular value decomposition – Matrix approximation.

UNIT IV **10 Periods**

Vector Calculus : Differentiation of univariate functions – Partial differentiation and Gradients – Gradients of vector valued functions – Gradients of matrices – Useful identities for computing gradients – Backpropagation and automatic differentiation – Higher order derivatives – Linearization and multivariate Taylor series.

UNIT V **10 Periods**

Probability and Distributions: Construction of a probability space – Discrete and Continuous probabilities – Sum rule, Product rule, and Baye's theorem – Gaussian distribution – Conjugacy and the exponential family – Change of variables/Inverse transform.

TEXT BOOKS:

1. **M. P. Deisenroth, A. A. Faisal and C. S. Ong,** Mathematics for Machine Learning, Cambridge University Press (1st Edition).

REFERENCES:

1. **Stephen Boyd and Lieven Vandenberghe,** Introduction to Applied Linear Algebar – Vectors, Matrices, and Least squares, Cambridge Univ. Press (2018).
2. **S. Axler,** Linear algebra done right, Springer International Publishing (3rd Edition).
3. **E. Keryszig,** Advanced Engineering Mathematics, John Wiley and Sons, Inc., U. K. (10th Edition).
4. **Kishore S. Trivedi,** Probability & Statistics with Reliability, Queuing and Computer Applications, 2nd Edition, John Wiley and Sons Ltd., 2016.

MACHINE LEARNING	
CODE: 23AM112	**Credits: 3**
Instruction : 3 Periods / Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites:

1. Python programming skill.
2. Preliminary concepts of probability, algebra and statistics.

Course Objectives:

1. Understand the main categories and fundamental concepts of Machine Learning systems
2. Familiarize the main steps in a typical Machine Learning project
3. Effective utilization of regression, clustering and classification algorithms.
4. Ability to apply machine learning techniques to solve real world problems

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Define the machine learning, types of ML and challenges of ML.
2.	Describe the extraction of data, withdraw insights of data and fine tune the data for applying ML model.
3.	Implementation of Classification models on MNIST Data set and Regression models.
4.	Apply SVM, DT and Ensemble Learning techniques for solving Real world problems.
5.	Solve curse of dimensionality problem and Apply K-Means, DBSCAN and Gaussian Mixtures to solve Unlabeled data.

Mapping of course outcomes with program outcomes:

CO	**PO**			**PSO**	
	1	**2**	**3**	**1**	**2**
1	2	-	-	1	1
2	3	1	2	3	3
3	3	1	3	3	3
4	3	1	3	3	3
5	3	-	3	3	3

SYLLABUS

UNIT-I: **8 Hours**

Machine learning landscape:

What Is Machine learning?, Why Use Machine Learning?, Types of Machine Learning Systems, Main Challenges of Machine Learning, Testing and Validating.

UNIT-II: **8 Hours**

End-to-End Machine learning Project:

Working with Real Data, Get the Data, Discover and Visualize the Data to Gain Insights, Prepare the Data for Machine Learning Algorithms, Select and Train a Model, Fine-Tune Your Model.

UNIT-III: **14 Hours**

Training Model and MNIST Data set Classification:

Linear Regression, Gradient Descent, Polynomial Regression, Logistic Regression.

MNIST, Training a Binary Classifier, Performance Measures, Multiclass Classification, Error Analysis, Multilabel Classification, Multioutput Classification.

UNIT-IV: **12 Hours**

SVM, Decision Trees and Ensemble Learning:

Linear SVM Classification, Nonlinear SVM Classification, SVM Regression.

Training and Visualizing a Decision Tree, Making Predictions, Estimating Class Probabilities, The CART Training Algorithm, Computational Complexity, Gini Impurity or Entropy?, Regularization Hyperparameters.

Voting Classifiers, Bagging and Pasting, Random Patches and Random Subspaces, Random Forests, Boosting, Stacking.

UNIT-V: **8 Hours**

Dimensionality Reduction and Clustering:

The Curse of Dimensionality, Main Approaches for Dimensionality Reduction, PCA, Kernel PCA, LLE, Other Dimensionality Reduction Techniques.

Clustering, K-Means, Clustering for image segmentation, Clustering for Pre-processing, Clustering for Semi-Supervised Learning, DBSCAN, Gaussian Mixtures.

Text Books:

1. AurelionGeron, “Hands-on Machine Learning with Scikit-Learn, Keras, and Tensor Flow: Concepts, Tools and Techniques to build Intelligent Systems”, 2/e, O’Reilly Media, 2019.
2. Sebastian Raschka, “Python Machine Learning” Packt Publishing 2015.

Reference Books:

1. Tom M. Mitchell, “Machine Learning” First Edition by Tata McGraw- Hill Education.
2. Ethem Alpaydin,”Introduction to Machine Learning ” 2nd Edition, The MIT Press, 2009

Web Resources:

1. https://nptel.ac.in/courses/106106139
2. https://www.youtube.com/watch?v=PPLop4L2eGk

PROBLEM SOLVING METHODS IN ARTIFICIAL INTELLIGENCE	
23AM113(A)	**Credits:3**
Instruction : 3 Periods / Week	Sessional Marks : 40
End Exam : 3 Hours	End Exam Marks : 60

Prerequisites:

1. Data Structures, Algorithms

Course Objectives:

1. Provide a solid understanding of Artificial Intelligence's history, concepts, and applications.
2. Develop problem-solving skills using various search algorithms and constraint satisfaction methods.
3. Familiarize students with adversarial search and reasoning under uncertainty using probability and Bayesian networks.

Course Outcome:

By the end of the course, the student will be able to:	
1.	Demonstrate an understanding of the foundational concepts and historical development of Artificial Intelligence.
2.	Apply various problem-solving methods and search algorithms to find solutions efficiently in different problem domains.
3.	Develop strategies and make optimal decisions in competitive environments using adversarial search techniques.
4.	Design and implement constraint satisfaction algorithms to solve real-world problems efficiently.
5.	Apply probabilistic reasoning and Bayesian networks to handle uncertainty and make informed decisions in uncertain domains.

Mapping of course outcomes with program outcomes:

CO	PO			PSO	
	1	**2**	**3**	**1**	**2**
1	-	-	1	1	1
2	3	1		2	2
3	3		3	2	2
4	3	1		2	2
5	3	1	2	2	2

UNIT- I: INTRODUCTION **10 Periods**

Introduction, Foundation of Artificial Intelligence, History of Artificial Intelligence, Application of Artificial Intelligence, Intelligent Agents–Agents and Environments, Concept of Rationality, Nature of Environments, Structure of Agents.

UNIT- II: SEARCH AND PROBLEM SOLVING **10 Periods**

Problem solving Methods, Search for solutions, Uninformed Search Strategies, Informed Search Strategies, Heuristics Functions, Local Search Algorithms and Optimization, Local Search in Continuous Spaces, Searching with Non-deterministic Actions, Searching with Partial Observations, Online Search Agents and Unknown Environments.

UNIT-III: ADVERSARIAL SEARCH **10 Periods**

Games, Optimal Decisions in Games, Alpha–Beta Pruning, Imperfect Real-Time Decisions, Stochastic Games, Partially Observable Games, State-of-the-Art Game Programs, Alternative Approaches.

UNIT-IV: CONSTRAINT SATISFACTION PROBLEMS **10 Periods**

Defining Constraint Satisfaction Problems, Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs, Local Search for CSPs, Structure of Problem.

UNIT-V UNCERTAIN KNOWLEDGE AND REASONING **10 Periods**

Quantifying Uncertainty: Acting under Uncertainty, Basic Probability Notation, Inference using Full Joint Distributions, Independence, Bayes' Rule and its use, Probability Reasoning: Representing Knowledge in an Uncertain Domain, Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions.

Text Books:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence A Modern Approach", Third edition, Pearson Education.

Reference Books:

1. Rich E & Knight K, "Artificial Intelligence", 4th Edition, Tata McGraw hill.
2. George F Luger, "Artificial Intelligence: Structure and strategies of complex problem solving", 6th Edition, Addison Wisley.

IMAGE PROCESSING	
23 AM113 (B)	**Credits:3**
Instruction: 3 Periods & 1 Tut/Week	**Sessional Marks: 40**
Final Exam: 3 Hours	**End Exam Marks: 60**

Pre requisites: Knowledge of linear algebra, basic probability and statistics, knowledge of basic programming language.

Course Objectives:

1. To understand the fundamentals of image processing
2. To explain various image restoration and enhancement techniques
3. To understand image segmentation techniques

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Describe the fundamentals of image processing
2.	Apply the image enhancement techniques
3.	Describe image restoration procedures.
4.	Categorize various compression techniques
5.	Apply the image segmentation techniques

Mapping of Course Outcomes with Program Outcomes:

CO	PO			PSO	
	1	2	3	1	2
1	1	-	2	1	1
2	2	-	2	2	2
3	2	1	2	2	2
4	1	-	2	2	2
5	2	1	2	2	2

SYLLABUS

UNIT-I **10 Periods**

INTRODUCTION: Examples of fields that use digital image processing, fundamental steps in digital image processing,components of image processing system.

DIGITAL IMAGE FUNDAMENTALS: Image sensing and acquisition, image sampling and quantization, some basic relationships between pixels, Introduction to the basic mathematical tools used in digital image processing

UNIT- II **10 Periods**

INTENSITY TRANSFORMATIONS AND SPATIALFILTERING: Some basic intensity transformation functions, histogram processing, fundamentals of spatial filtering,basic smoothing and sharpening spatial filters.

UNIT-III **10 Periods**

IMAGE RESTORATION: A model of the image degradation/ restoration process, noise models, restoration in the presence of noise– only spatial filtering, periodic noise reduction using frequency domain filtering.

UNIT-IV **10 Periods**

IMAGE COMPRESSION: Fundamentals, Huffman coding, Golomb coding, arithmetic coding, LZW coding, run-length coding,symbol-based coding, bit-plane coding

UNIT-V **10 Periods**

IMAGE SEGMENTATION: Fundamentals, Point, Line, And Edge Detection, Thresholding, Segmentation By Region Growing and by Region Splitting And Merging, Region Segmentation using Clustering and Super pixels, Region Segmentation using Graph Cuts.

Text Books:

RafealC.Gonzalez, Richard E.Woods, Digital *Image Processing*, 3rd Edition, Pearson Education/PHI, 2017

Reference Books:

1. Milan Sonka, Vaclav Hlavac and Roger Boyle, “Image Processing, Analysis, andMachineVision”, 2nd Edition, Thomson Learning, 2010.
2. Alasdair McAndrew, “Introduction to Digital Image Processing with Matlab”,1stEdition,Thomson Course Technology,2010.

EXPERT SYSTEMS	
23AM113(C)	**Credits:3**
Instruction : 3 Periods /Week	Sessional Marks :40
End Exam : 3 Hours	End Exam Marks : 60

Prerequisites:

1. Knowledge on Artificial Intelligence

Course Objectives:

In this course the student will learn the methodology used to transfer the knowledge of a human expert into an intelligent program that can be used to solve problems.

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Apply the methodology to transfer human knowledge into an expert system
2.	Apply knowledge representation
3.	Design a knowledge base and Implement a rule-based expert System
4.	Evaluate Expert System tools
5.	Apply CLIPS for the implementation of an expert system

Mapping of course outcomes with program outcomes:

CO	**PO**			**PSO**	
	1	**2**	**3**	**1**	**2**
1	2	1	2	2	2
2	2	-	2	3	2
3	3	-	3	2	2
4	3	2	2	3	2
5	2	-	3	3	2

SYLLABUS

UNIT-I : Knowledge Representation: 10 Periods

Data and knowledge: Data representation and data items in traditional databases, Data representation and data items in relational databases. Rules: Logical operations, Syntax and semantics of rules, Data log rule sets ,The dependence graph of data log rule sets, Objects

UNIT II: Solving problems by reasoning 10 Periods

Solving problems by reasoning: The structure of the knowledge base, The reasoning algorithm, Conflict resolution, Explanation of the reasoning.

UNIT III: Rule Based Systems: 10 Periods

Forward reasoning: The method of forward reasoning, A simple case study of forward reasoning,Backward reasoning: Solving problems by reduction, The method of backward reasoning, A simple case study of backward reasoning, Bidirectional reasoning. Contradiction freeness: The notion of contradiction freeness, Testing contradiction freeness, The search problem of contradiction freeness

UNIT-IV: Tools for Representation and Reasoning: 10 Periods

The Lisp programming language: The fundamental data types in Lisp, Expressions and their evaluation, some useful Lisp primitives, some simple examples in Lisp, The Prolog programming language: The elements of Prolog programs, The execution of Prolog programs, Built-in predicates, and Some simple examples in Prolog.

UNIT V: Real-Time Expert Systems: 10 Periods

The architecture of real-time expert systems: The real-time subsystem, The intelligent subsystem Synchronization and communication between real-time and intelligent subsystems: Synchronization and communication primitives, Priority handling and time-out.

Text Books:

1. Intelligent Control Systems-An Introduction with Examples by Katalin M. Hangos, Rozália Lakner , Miklós Gerzson, Kluwer Academic Publishers.
2. Intelligent Systems and Control: Principles and Applications Paperback – 12 Nov 2009 by Laxmidhar Behera, Indrani Kar by OXFORD.

References Books:

1. Intelligent Systems and Technologies Methods and Applications by Springer publications.
2. Intelligent Systems - Modeling, Optimization and Control, by Yung C. Shin and Chengying Xu, CRC Press, Taylor & Francis Group, 2009.

INFORMATION SECURITY	
23 AM114(A)	**Credits : 3**
Instruction : 3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Pre-Requisites:

1. **Basic knowledge of Computer Networks.**

Course Objectives:

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

Course Outcomes:

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

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

CO-PO Mapping:

CO	PO			PSO	
	1	**2**	**3**	**1**	**2**
1	1	1	2	2	-
2	2	-	2	2	1
3	2	2	2	2	-
4	3	1	2	2	1
5	2	-	2	2	1

SYLLABUS

UNIT-1 **10 periods**

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

UNIT-2 **10 periods**

Symmetric Cryptography: Introduction, Substitution ciphers, Transposition ciphers, Feistel Structure, DES-AES-RC4.
Public Key Cryptography: Encryption/Decryption using RSA, RSA with example.
TCP Session hijacking, ARP Attacks, man-in-the-middle attacks, SQL injection, Phishing attacks,Tools-Ettercap, Burpsuite.

UNIT-3 **10 periods**

Gaining Access, Sniffers: System Hacking, password cracking, password cracking techniques, passive online attacks, active online attacks, offline attacks; Sniffers: Understanding Sniffers, Using a Sniffer, Sniffing Tools-Wireshark, TCP Dump, Reading Sniffer Output, Switched Network Sniffing, Detecting Sniffing Attacks.
(From Chapter 7 & 9 of Book 3)

UNIT-4 **10 periods**

SQL Injection: Introducing SQL Injection, Results of SQL Injection, the Anatomy of a Web Application, Databases and Their Vulnerabilities, Anatomy of a SQL Injection Attack, Altering Data with a SQL, Injection Attack, Injecting Blind, Information Gathering, Evading Detection Mechanisms, SQL Injection Countermeasures.
(Chapters 13 & 14 of Book 3)

UNIT-5 **10 periods**

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

Text Books:

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

Reference Books:

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

E-Resources :

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

DATA ANALYTICS	
Course Code: 23 AM114(B)	**Credits: 3**
Instruction: 3 Periods /Week	**Sessional Marks: 40**
End Exam: 3 Hours	**End Exam Marks: 60**

Prerequisites:

1. Basics on Probability and statistics.
2. Fundamentals of Python programming.

Course Objectives:

1. To familiarize with basics data analytics and data analytics in Python.
2. Equip the students with core statistical models and visualization techniques to perform exploratory data analysis using Python.
3. Exploring the importance of analysis of variance and multivariate analysis of variance (MANOVA) and implementing them in Python with different kinds of data sets.

Course Outcomes:

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

1.	Understand the basic principles of data analytics for performing basic data analysis on given data.
2.	Apply the data visualization methods in Python for exploratory data analysis.
3.	Apply Simple Statistical Techniques for Univariate and Bivariate Analyses
4.	Apply the nature and logic of the analysis of variance.
5.	Apply linear and multi linear regression models.

CO-PO Mapping:

CO	PO			PSO	
	1	2	3	1	2
1	2		2	2	1
2	3	1	2	2	1
3	3		3	2	1
4	3	1	2	2	1
5	3	1	2	2	1

SYLLABUS

UNIT-1 **10 periods**

Introduction and Overview of Applied Statistics: How Statistical Inference Works, Statistics and Decision-Making, Data Analysis, Data Science, Machine Learning, Big Data. The Scatter plot, Correlograms, Histograms and Bar Graphs, Heatmaps, Line Charts.

UNIT-2 **10 periods**

Simple Statistical Techniques for Univariate and Bivariate Analyses: Pearson Product-Moment Correlation, Computing Correlation in Python, T-Tests for Comparing Means, Paired-Samples t-Test in Python, Binomial Test, The Chi-Squared Distribution.

UNIT-3 **10 periods**

Analysis of Variance (ANOVA): T-Tests for Means as a Special Case of ANOVA, Analysis of Variance (one-way classification), ANOVA in Python, Analysis of Variance (two-way classification).

UNIT-4 **10 periods**

Simple and Multiple Linear Regression: Regression, Regression in Python, The Least-Squares Principle, The Population Least-Squares Regression Line, **Multiple Linear Regression**, How to Assess Goodness of Fit.

UNIT-5 **10 periods**

Multivariate Analysis of Variance (MANOVA): Why Technically Most Univariate Models are Actually Multivariate, Multivariate Model and Running a Multivariate Model, Multivariate Tests of Significance: Why They Are Different from the F-Ratio. Performing MANOVA in Python.

Text Book:

1. Applied Univariate, Bivariate, and Multivariate Statistics Using Python, Daniel J. Denis, Wiley, First Edition.

Reference Books:

1. Applied Multivariate Statistical Analysis, Richard. A. Johnson and Dean.W. Wichern, Pearson Prentice Hall, 6th Edition, 2007.
2. An Introduction to Multivariate Statistical Analysis, T.W. Anderson, Wiley, 3rd Edition, 2003.

Web Resource:

1. https://www.westga.edu/academics/research/vrc/univariate-bivariate-analyses.php

NEURAL NETWORKS	
23AM114(C)	**Credits: 3**
Instruction : 3 Periods/Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites:

1. Mathematical Concepts like Statistics, Calculus, Linear Algebra and Probability.

Course Objectives:

1. To understand the biological neural network and to model equivalent neuron models.
2. To analyze the architecture, learning algorithms and issues of various Neural Network Architectures.
3. To Provide application oriented knowledge to build neural networks for different problems.

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Examine different Neural Network Architectures and Learning Rules.
2.	Analyse and differentiate Single Layer Perceptron and Multi-layered Perceptron based on their capabilities.
3.	Apply Back Propagation and solve different Neural Network Problems.
4.	Apply Self Organizing Maps in solving different pattern classification tasks.
5.	Differentiate Neural Networks and Deep Learning Algorithms.

Mapping of Course Outcomes with Program Outcomes:

CO-PO Mapping:

CO	PO			PSO	
	1	**2**	**3**	**1**	**2**
1	3	-	2	2	2
2	3	1	3	2	2
3	3	1	3	2	2
4	3	1	3	2	2
5	2	-	2	2	2

SYLLABUS

UNIT- I **10 Periods**

Introduction: A Neural Network, Human Brain, Models of a Neuron, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks
Learning Process: Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning.

UNIT-II: **10 Periods**
Single Layer Perceptron: Unconstrained optimization, LMS algorithm, learning curves, perceptrons, convergence theorem, limitations of single-layer perceptron
Multilayer Perceptron: Back-propagation algorithm, XOR problem, feature detection, accelerated convergence of back-propagation algorithm, limitations

UNIT-III: **10 Periods**
Back Propagation: Back Propagation and Differentiation, Hessian Matrix, Generalization, Cross Validation, Network Pruning Techniques, Virtues, and Limitations of Back Propagation Learning, Accelerated Convergence, Supervised Learning.

UNIT-IV: **10 Periods**
Self-Organizing Maps (SOM): Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of Feature Map, Learning Vector Quantization, Adaptive Pattern Classification.

UNIT-V: **10 Periods**
Applications of Neural Networks: Recent trends in Neural Networks, Applications of Neural Networks, What is Deep Learning, Difference between Neural Networks and Deep Learning. Case Study: Using Feed forward Neural Networks for Handwritten Digit Recognition.

Text Books:

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

Reference Books :

1. Artificial Neural Networks - B. Yegnanarayana Prentice Hall of India P Ltd 2005.
2. Neural Networks in Computer Intelligence, Li Min Fu TMH 2003.
3. Neural Networks -James A Freeman David M S Kapura Pearson Education 2004.
4. Introduction to Artificial Neural Systems Jacek M. Zurada, JAICO Publishing House Ed. 2006.

E-Resources:

1. http://cognet.mit.edu/book/introduction-to-neural-networks
2. https://www.udemy.com/course/deep-learning-convolutional-neural-networks-theanotensorflow
3. https://www.coursera.org/learn/neural-networks-deep-learning

Research Methodology and IPR	
23AM115	**Credits: 3**
Instruction : 3 Periods/Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

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

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasise the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

SYLLABUS:

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

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

Unit-III: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

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

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

REFERENCES:

1. *Stuart Melville and Wayne Goddard, "Research Methodology: An Introduction for Science & Engineering Students'"*
2. *Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"*
3. *Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"*
4. *Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.*
5. *Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.*
6. *T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008*

MACHINE LEARNING USING PYTHON LAB	
Code: 23 AM116	**Credits : 2**
Instruction : 3 Periods /Week	**Sessional Marks : 50**
End Exam : 3 Hours	**End Exam Marks : 50**

Prerequisites: C and data Structures

Course objectives:

1. Learn to manipulate data to apply ML algorithms using Numpy, Pandas,Matplotlib and SciKit Learn
2. Solve real world problems using ML Techniques.

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Manipulate basic functions in Numpy, Pandas, Matplotlib SciKit Learn
2.	Apply the concepts of Regression (Linear, Quadratic and Logistic) to predict dependent variables.
3.	Feature recognition and classification using SVM, DT and RF techniques.
4.	Testing & validating ML models and evaluation of accuracy measures.

Mapping of Course Outcomes with Program Outcomes:

CO	PO			PSO	
	1	2	3	1	2
1	2	2	2	3	3
2	2	2	2	3	3
3	2	2	2	3	3
4	2	2	2	3	3

List of Experiments

1. Implement the matrices operations using both Numpy and pandas
2. Using matplotlib perform data visualization on the standard dataset
3. Implement Linear Regression using ordinary least square(OLS) and Gradient Descent methods
4. Implement quadratic Regression
5. Implement Logistic Regression
6. Evaluate performance measures on regression models (Linear, quadratic and Logistic).
7. Implement classification using SVM
8. Implement Decision Tree learning
9. Implement Bagging using Random Forests
10. Implement K-means Clustering to Find Natural Patterns in Data
11. Implement DBSCAN clustering
12. Implement Gaussian Mixture Model
13. Solve the curse of dimensionality by implementing PCA algorithm on a high dimensional
14. Comparison of Machine Learning algorithms

Text Books:

1. AurelionGeron, "Hands-on Machine Learning with Scikit-Learn, Keras, and Tensor Flow: Concepts, Tools and Techniques to build Intelligent Systems", 2/e, O'Reilly Media, 2019.
2. Sebastian Raschka, "Python Machine Learning" Packt Publishing 2015.

Reference Books:

1. Tom M. Mitchell, "Machine Learning" First Edition by Tata McGraw- Hill Education.
2. Ethem Alpaydin,"Introduction to Machine Learning " 2nd Edition, The MIT Press, 2009

Web Resources:

1. https://nptel.ac.in/courses/106106139
2. https://www.youtube.com/watch?v=PPLop4L2eGk

INFORMATION SECURITY LAB	
23 AM117(A)	**Credits : 2**
Instruction : 3 Periods /Week	**Sessional Marks : 50**
End Exam : 3 Hours	**End Exam Marks : 50**

Pre-Requisites:

1. Basic knowledge of Cryptography
2. Basic knowledge of Packet Capturing
3. Exposure to Problem solving techniques and programming skills

Course Objectives:

1. Introducing different tools related to Network Security.
2. Introducing tools related to Information Security.

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

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

CO-PO Mapping:

CO	PO			PSO	
	1	2	3	1	2
1	1	1	1	2	2
2	2	1	1	1	1
3	1	2	1	2	1
4	1	1	1	1	2

EXPERIMENTS

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

Case Study:

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

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

TEXTBOOKS:

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

REFERENCE BOOKS:

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

WEB RESOURCES:

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

DATA ANALYTICS LAB	
Course : 23 AM117(B)	**Credits:2**
Instruction **: 3 Periods/week**	Sessional Marks : 50
End Exam : 3 Hours	End Exam Marks : 50

Prerequisites:

- Basic knowledge on Probability and statistics.
- Basics of Python Programming.

Course Objectives:

- To train the students to apply the principles of data analytics to analyze and effectively visualize the data.
- Train the students to gain the knowledge of computational statistical approaches and their application to a variety of datasets.
- Practical way of Understanding the nature of analysis of variance and Multivariate statistical models.

Course Outcomes:

By the end of the course, the student will be able to:	
1	Explore Pandas, matplotlib and seaborn packages. Write example programs to visualize the data.
2	Work with Linear Regression and Multiple Regression models in Python
3	Understanding of the ANOVA that can used to test a given hypothesis and to verify the experimental results are significant.
4	Work with multivariate statistical methods in Python and interpret the results.

Co-Po Mapping

CO	PO			PSO	
	1	2	3	1	2
1	2	1	2	1	1
2	3	1	3	-	1
3	2	1	2	2	-
4	3	1	3	1	1

List of Experiments

1. Write a Program in Python to Manipulate, Aggregate and Analyze data using Numpy.
2. Write a Program in Python to Handle and Analyze data using Pandas.
3. Apply basic statistical methods on Sample Datasets like Mushroom (Data sets from https://www.kaggle.com/datasets, https://archive.ics.uci.edu/ml/datasets.php etc.,)
4. Working with matplotlib and seaborn packages in Python.
5. Write a Program in Python to add an indeed field, changing misleading data fields, Re-expressing categorical data as numerical data, standardizing numerical fields and identifying outliers for data preparation phase. for bank marketing data set.
6. (https://www.kaggle.com/datasets/janiobachmann/bank-marketing-dataset)
7. Write a Program in Python to Classifying MNIST digits using Logistic Regression
8. Write a Program in Python to predict House rent using linear regression.
9. Write a Program in Python to implement Correlation.
10. Write a Program to apply Multivariate analysis of variance and co-variance (MANOVA).
11. Write a Program to apply Analysis of Variance (one-way classification) in Python.
12. Write a Program to apply Analysis of Variance (two-way classification) in Python.
13. Write a Program to apply Linear Discriminant analysis for multivariate data.
14. Write a Program to apply Principle component analysis for multivariate data.
15. Implement Factor Analysis for multivariate data in Python.

Text Books:

1. Applied Univariate, Bivariate, and Multivariate Statistics Using Python, Daniel J. Denis, Wiley, First Edition.

Reference Books:

1. Applied Multivariate Statistical Analysis, Richard. A. Johnson and Dean.W. Wichern, Pearson Prentice Hall, 6th Edition, 2007.
2. An Introduction to Multivariate Statistical Analysis, T.W. Anderson, Wiley, 3rd Edition, 2003.

Web Resource:

- https://www.westga.edu/academics/research/vrc/univariate-bivariate-analyses.php

NEURAL NETWORKS LAB	
23AM117(C)	**Credits: 2**
Instruction : 3 Periods/Week	**Sessional Marks : 50**
End Exam : 3 Hours	**End Exam Marks : 50**

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

Course Objectives:

1. To understand the biological neural network and to model equivalent neuron models.
2. To understand the architecture, learning algorithms and issues of various Neural Network Architectures.
3. Provide application oriented knowledge to build neural networks for different problems.

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Design neural networks with different layers and appropriate activation functions.
2.	Identify the network errors and implement different optimization techniques.
3.	Apply the concepts of derivatives in implementing the backpropagation concept.
4.	Apply different optimizers, test and validate datasets along with regularization techniques.

Mapping of Course Outcomes with Program Outcomes:

CO	PO			PSO	
	1	2	3	1	2
1	2	1	3	2	2
2	2	1	2	1	2
3	2	1	2	1	3
4	3	1	3	2	2

LIST OF EXPERIMENTS

1. Creating a simple neuron	(CO 1)
2. Adding different layers to the existing neuron	(CO 1)
3. Working with activation functions	(CO 1)
4. Calculating network error with loss	(CO 2)
5. Implementing different optimizing techniques	(CO 2)
6. Implementing derivatives for neural networks	(CO 3)
7. Implementing backpropagation for neural networks	(CO 3)
8. Implementing different optimizers for neural networks	(CO 4)
9. Testing data, validating data	(CO 4)
10. Training dataset, L1 and L2 Regularization	(CO 4)

Text Books:

1. Neural Networks from Scratch in Python (Harrison Kinsley, Daniel Kukieła), 2020.

Reference Books :

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

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

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

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

E-Resources:

1. http://cognet.mit.edu/book/introduction-to-neural-networks
2. https://www.udemy.com/course/deep-learning-convolutional-neural-networks-theanotensorflow
3. https://www.coursera.org/learn/neural-networks-deep-learning
4. https://github.com/Sentdex/nnfs_book/tree/main/

DEEP LEARNING	
23AM121	**Credits: 3**
Instruction : 3 Periods/Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites:

1. Mathematical Concepts like Statistics, Calculus, Linear Algebra and Probability.

Course Objectives:

1. Introduce the basics of Deep neural networks
2. Cover various deep learning algorithms, such as convolutional neural networks (CNNs), recurrent neural networks (RNNs)
3. Familiarize students with popular deep learning frameworks and libraries like TensorFlow, PyTorch, and Keras, enabling them to implement deep learning models effectively.
4. Teach students how to train deep neural networks using various optimization techniques, weight initialization, regularization, and hyperparameter tuning.

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Identify the importance for Deep Learning Algorithms and Categorize different real world problems
2.	Identify the need for Multilayer Perceptrons and analyze how backpropagation works.
3.	Identify the need for convolutional neural network and Examine the Various Architectures of Convolution Neural Network.
4.	Examine the Various Architectures of Recurrent Neural Networks.
5.	Identify the need for Modern Recurrent Neural Networks and Apply machine translation using different architectures.

Mapping of Course Outcomes with Program Outcomes:

CO-PO Mapping:

CO	PO			PSO	
	1	**2**	**3**	**1**	**2**
1	2	-	2	2	2
2	3	1	2	2	2
3	3	1	3	2	3
4	3	1	3	2	3
5	3	1	3	2	3

SYLLABUS

UNIT- I **10 Periods**

Introduction to Deep Learning: A Motivating Example, Key Components, Kinds of Machine Learning Problems, Roots, The Road to Deep Learning, Success Stories, The Essence of Deep Learning, Activation Functions.

UNIT-II:

12 Periods

Multilayer Perceptrons: Introduction to Multilayer Perceptrons, implementation of Multilayer Perceptrons, Forward Propagation, Backward Propagation and Computational Graphs, Numerical Stability and Initialization, Generalization in Deep Learning, Dropout, Predicting House Prices on Kaggle.

UNIT-III: **12 Periods**

Convolution Neural Network: From Fully-Connected Layers to Convolutions, Convolutions for Images, Padding and Stride, Multiple Inputs and Outputs Channels, Pooling, Different Deep Convolutional Neural Network Architectures-LeNet, AlexNet,VGG

UNIT-IV: **13 Periods**

Recurrent Neural Networks: Working with Sequences, Converting Raw Text into Sequence Data, Language Models, Recurrent Neural Networks, Recurrent Neural Network Implementation from scratch, Concise Implementation of Recurrent Neural Networks, Backpropagation through Time.

UNIT-V: **13 Periods**

Modern Recurrent Neural Networks: Long Short-Term Memory (LSTM), Gated Recurrent Units (GRU), Deep Recurrent Neural Networks, Bidirectional Recurrent Neural Networks, Machine Translation and the Dataset, The Encoder-Decoder Architecture, Encoder-Decoder Seq2Seq for Machine Translation.

Text Books:

1. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, “Dive into Deep Learning”, 2021

Reference Books:

1. Satish Kumar, “Neural Networks: A Classroom Approach”, Tata McGraw-Hill Education, 2004.
2. Simon Haykin, “Neural Networks-A comprehensive Foundation” Second edition
3. Charu C. Aggarwal, “Neural Networks and Deep Learning-A Textbook”, Springer, 2018.

E-Resources:

1. https://www.analyticsvidhya.com/blog/2021/10/a-comprehensive-guide-on-deeplearning-optimizers/
2. https://www.analyticsvidhya.com/blog/2018/04/fundamentals-deep-learningregularization-techniques/
3. https://www.analyticsvidhya.com/blog/2021/05/a-comprehensive-tutorial-on-deeplearning-part-1/
4. https://viso.ai/deep-learning/deep-reinforcement-learning/
5. Michael Nielsen, Neural Networks and Deep Learning, http://neuralnetworksanddeeplearning.com/
6. Introduction to Deep Learning, MIT 6.S191 Alexander Amini January 28, 2019, http://introtodeeplearning.com/

COMPUTATIONAL INTELLIGENCE	
23 AM122	**Credits: 3**
Instruction : 3 Periods & 0 Tutorial /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites:

1. Some programming skills and a good background in Statistics, Probability, and discrete mathematics probability will be very helpful.

Course Objectives:

1 Students will realize the importance and challenges.
2 Student will learn the basic concepts of fuzzy
3 Student can acquire the knowledge on different algorithms.
4 Student will able to choose optimization algorithm for different problems.

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Discuss the paradigm, approaches and applications with challenges
2.	Explore fuzzy logic and its mechanisms.
3.	Apply the algorithms and design strategies to solve problems
4.	Analyze the Evolutionary Computation algorithms in different domains
5.	Illustrate the collaborative and agglomerative combinations.

Mapping of Course Outcomes with Program Outcomes:

CO	**PO**			**PSO**	
	1	**2**	**3**	**1**	**2**
1	2	-	2	1	1
2	3	1	3	2	2
3	3	1	3	2	2
4	3	1	3	2	2
5	3	1	2	2	1

SYLLABUS

UNIT- I **12 Periods**

Introduction to Computational Intelligence:

Computational Intelligence, paradigms of Computational Intelligence, Approaches to computational intelligence, Synergies of Computational Intelligence Techniques, Applications of Computational Intelligence, and grand challenges of Computational Intelligence.

UNIT-II: **14 Periods**

Introduction to fuzzy logic: Fuzzy logic, fuzzy sets, member functions, Features of MFs, Operations of Fuzzy sets, Linguistic Variables, Fuzzy Relations, Fuzzy If-Then Rules, Fuzzification, Defuzzification, and Inference Mechanism.

UNIT-III: **12 Periods**

Fuzzy Systems and Applications:

Fuzzy system, Fuzzy Modelling, Fuzzy control, Design of Fuzzy Controller, Modular Fuzzy Controller.

Neural Network Systems and Applications:

Learning Neural Networks, Recurrent Neural Networks, System Identification and Control, neural networks for control

UNIT-IV: **12 Periods**

Evolutionary Computation: Evolutionary Computation, Terminologies of Evolutionary computing, Genetic Operators, Performance Measure of EA, Evolutionary Algorithms

Evolutionary Systems:

Multi-objective Optimization, Co-evolution, parallel Evolutionary Algorithms

UNIT-V: **12 Periods**

Evolutionary Fuzzy Systems:

Evolutionary Adaptive Fuzzy Systems, Objective Functions and evaluation, and Fuzzy Adaptive Evolutionary Algorithms

Evolutionary Neural Network:

Support Combinations, Collaborative combinations, amalgamated combinations.

Text Books:

1. Nazmul Siddique, Hojjat Adeli, Computational intelligence, 2013, Wiley.
2. Rudolf Kruse, Christian Borgelt, Frank Klawonn, Christian Moewes, Matthias Steinbrecher, Pascal Held, Computational Intelligence A Methodological Introduction,2013, Springer.

Reference Books:

1. Amit Konar, Computational Intelligence Principles, Techniques and Applications, 2006, Springer

INFORMATION RETRIEVAL SYSTEM	
23 AM123 (A)	**Credits: 3**
Instruction : 3 Periods	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites:

Data Structures, Relational Database Systems.

Course Objectives:

1. Student will able to choose appropriate design strategies for different problems.
2. Study fundamentals of DBMS, Data Warehouse and Digital Libraries.
3. Learn various pre-processing techniques and indexing approaches in text mining
4. Understand various clustering approaches and similarity measures
5. Study various search techniques in information retrieval systems
6. Explore various cognitive approaches used in text retrieval systems and evaluation approaches

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Demonstrate the functional overview and capabilities of the Information Retrieval System.
2.	Apply indexing and various types of data structures for Information Retrieval.
3.	Demonstrate and analyze the Automatic Indexing and Clustering.
4.	Explain different user search techniques.
5.	Describe the Text Searching Techniques and measures that can be used in evaluating Information Retrieval Systems

Mapping of Course Outcomes with Program Outcomes:

CO	**PO**			**PSO**	
	1	**2**	**3**	**1**	**2**
1	2	-	2	2	1
2	2	1	3	2	2
3	3	2	3	2	2
4	2	2	1	1	2
5	2	1	2	2	3

SYLLABUS

UNIT- I **10 Periods**

Introduction:
Introduction to Information Retrieval Systems: Definition of Information Retrieval System, Objectives of Information Retrieval Systems, Functional Overview, Relationship to Database Management System, Digital Libraries and Data Warehouses. Information Retrieval System Capabilities: Search Capabilities, Browse Capabilities, Miscellaneous Capabilities.

UNIT-II: **10 Periods**

Cataloging and Indexing: History and Objectives of Indexing, Indexing Process, Automatic Indexing, Information Extraction. Data Structure: Introduction to Data Structure, Stemming Algorithms, Inverted File Structure, N-Gram Data Structures, Signature File Structure, Hypertext and XML Data Structures, Hidden Markov Models

UNIT-III: **10 Periods**

Automatic Indexing: Classes of Automatic Indexing, Statistical Indexing, Natural Language, Concept Indexing, Hypertext Linkages. Document and Term Clustering: Introduction to Clustering, Thesaurus Generation, Item Clustering, Hierarchy of Clusters.

UNIT-IV: **10 Periods**

User Search Techniques: Search statements and binding, Similarity measures and ranking, Relevance feedback, Selective dissemination of information search, weighted searches of Boolean systems, Searching the Internet and hypertext.

UNIT-V: **10 Periods**

Text Search Algorithms: Introduction to Text Search Techniques, Software Text Search Algorithms, Hardware Text Search Systems. Information System Evaluation: Introduction, Measures used in system evaluation, Measurement example – TREC results.

Text Books:

1. Kowalski, Gerald, Mark T May bury: Information Storage and Retrieval Systems: Theory and Implementation, Second Edition, Kluwer Academic Press, 2002.

Reference Books :

1. Finding Out About: Search Engine Technology from a cognitive Perspective, by Richard, K. Belew, Cambridge University Press, 2000. (for Case Studies)
2. Frakes, W.B., Ricardo Baeza-Yates: Information Retrieval data Structures and Algorithms, Prentice Hall, 1992.

INTERNET OF THINGS AND DRONES	
23 AM123(B)	**Credits: 3**
Instruction:3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites: Micro Processor and Micro Controller programming, Fundamentals of IoT and Robotics

Course Objectives:

1. Assess the genesis and impact of IoT applications, architectures in real world.
2. Illustrate diverse methods of deploying smart objects and connect them to network.
3. Compare different Application protocols for IoT.
4. The main objective of this course is to understand the basics of Unmanned Arial Vehicles (Drones) and its connected sensor through various applications.
5. The course imparts the working principle of the drone and explains the components that are usedto build the drone devices

Course Outcomes:

By the end of the course, the student will be able to:	
1	Discuss the foundations of IoT, challenges and issues, architectures and its functionality
2	Apply and use of Sensors, actuators and its connected components in designing models
3	Explain various protocols and configurations of IoT and discuss different layers and its protocols.
4	Describe the development of unmanned aircraft systems (UAS) and design and fabrication of Drones
5	Describe drone concepts, terminology and vocabulary

Mapping of Course Outcomes with Program Outcomes:

CO-PO Mapping:

CO	**PO**			**PSO**	
	1	**2**	**3**	**1**	**2**
1	1	-	1	1	1
2	2	1	3	3	3
3	2	1	2	2	2
4	3	1	2	2	3
5	2	-	2	2	2

SYLLABUS

UNIT I **10 Periods**

What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.

UNIT II **10 Periods**

Smart Objects: The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies.

UNIT III **10 Periods**

IP as the IoT Network Layer, The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods.

UNIT IV: INTRODUCTION TO DRONE TECHNOLOGY **10 Periods**

Introduction - Basics of Flights, Different types of flight vehicles, Components and functions of an airplane, Forces acting on Airplane, Physical properties and structure of the atmosphere, UAV (Unmanned Aerial Vehicle- Drone), Definition, History of UAV , Characteristics of UAV, Applications of UAV (Defence, Civil, Environmental monitoring), Difference between Aircraft and UAV

UNIT V: (COMPONENTS OF DRONES) - DRONE DESIGN AND FABRICATION **10 Periods**

Types of Drones, Components of a Drone, Frames: Lightweight and sold material, Working principles of Electromagnetic Motors, Types of Motors (Brushed DC motor, Brushless DC motor, Induction Motor), Microcontroller/microprocessor (Arducopter Flight Controller), Working principles of Electromagnetic radiations, Radio Transmitter and Receiver, Li-ion Battery, Electric Speed Controller, Global Positioning System, Camera

Text Books:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet ofThings", 1 stEdition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978- 9386873743)
2. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill Education, 2017. (ISBN: 978-9352605224).
3. Mohammad H. Sadraey, Unmanned Aircraft Design A Review of Fundamentals, MORGAN & CLAYPOOL PUBLISHERS, 2017

Reference Books:

1. Adrian McEwen,"Designing the Internet of Things", Wiley Publishers,2013,ISBN: 978-1-118-43062-0
2. Srinivasa K G, "Internet of Things", CENGAGE Leaning India, 2017
3. Andrew J. Keane and James P. Scanlan, Small Unmanned Fixed-wing Aircraft Design: A Practical Approach,

ONLINE WEB RESOURCES:

https://www.coursera.org/specializations/iot
https://dgt.gov.in/sites/default/files/DRONE%20_TECHNICIAN%20_NSQF%20_LEVEL_4. pdf

PATTERN RECOGNITION	
23 AM123 (C)	**Credits:3**
Instruction: 3 Periods	**Sessional Marks: 40**
Final Exam: 3 Hours	**End Exam Marks: 60**

Pre requisites: Number Theory and Linear Algebra, Data Structures, Artificial Intelligence

Course Objectives: To analyze and apply the foundations of pattern recognition, various classification and clustering techniques, ensemble classifiers used in Pattern Recognitions

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Discuss the basic foundations of Pattern Recognition, mathematical concepts and Bayesian decision theory and parameter estimation methods
2.	Illustrate data transformation and dimensionality reduction techniques
3.	Describe probability density functions
4.	Apply linear classifiers
5.	Apply non-linear classifiers

Mapping of Course Outcomes with Program Outcomes:

CO	**PO**			**PSO**	
	1	**2**	**3**	**1**	**2**
1	2	1	1	1	2
2	2	1	2	2	3
3	1	1	2	3	3
4	2	1	2	3	3
5	2	1	2	3	3

SYLLABUS

UNIT-I **10 Periods**

Introduction: Importance of pattern recognition, Features, Feature Vectors, and Classifiers, Supervised, Unsupervised, and Semi-supervised learning, Introduction to Bayes Decision Theory, Discriminant Functions and Decision Surfaces, Gaussian PDF and Bayesian Classification for Normal Distributions.

UNIT- II **10 Periods**

Data Transformation and Dimensionality Reduction: Introduction, Basis Vectors, The Karhunen Loeve (KL) Transformation, Singular Value Decomposition, Independent Component Analysis (Introduction only). Nonlinear Dimensionality Reduction, Kernel PCA.

UNIT-III **10 Periods**

Estimation of Unknown Probability Density Functions: Maximum Likelihood Parameter Estimation, Maximum a Posteriori Probability estimation, Bayesian Interference, Maximum Entropy Estimation, Mixture Models, Naive-Bayes Classifier, The Nearest Neighbor Rule.

UNIT-IV **10 Periods**

Linear Classifiers: Introduction, Linear Discriminant Functions and Decision Hyperplanes, The Perceptron Algorithm, Mean Square Error Estimate, Stochastic Approximation of LMS Algorithm, Sum of Error Estimate.

UNIT-V **10 Periods**

Nonlinear Classifiers: The XOR Problem, The two Layer Perceptron, Three Layer Perceptron, Back propagation Algorithm, Basic Concepts of Clustering, Introduction to Clustering , Proximity Measures.

Text Books:

Pattern Recognition: Sergios Theodoridis, Konstantinos Koutroumbas, Elsevier India Pvt. Ltd (Paper Back), 4th edition.

Reference Books:

1. The Elements of Statistical Learning: Trevor Hastie, Springer-Verlag New York, LLC (Paper Back), 2009.
2. Pattern Classification: Richard O. Duda, Peter E. Hart, David G. Stork. John Wiley & Sons, 2012.

ARTIFICIAL INTELLIGENCE IN ROBOTICS	
23 AM124(A)	**Credits: 3**
Instruction: 3 Periods	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisite:

1 Basic Engineering Mathematics, Kinematics of Machinery, Basic Electrical and electronics engineering

Course Objectives:

1 The objective of this course is to impart knowledge about robots for their control and design in various industrial and general applications

Course Outcomes:

At the end of the course the student will be able to:	
CO-1	Explain the anatomy of robots, workspaces, robot types, end effector functions, and principles of actuation and drive systems.
CO-2	Apply kinematics, DH parameters, obstacle-aware trajectory planning, and control systems for accurate, adaptable, and safe robot motion.
CO-3	Describe various sensors, feedback systems and image processing techniques in robot.
CO-4	Apply programming languages to develop robotic systems and control their behavior.
CO-5	Comprehend the application of AI and ML concepts for operation of robots

Mapping of Course Outcomes with Program Outcomes:

CO	**PO**			**PSO**	
	1	**2**	**3**	**1**	**2**
1	2	-	2	2	2
2	2	1	3	2	3
3	2	-	2	2	2
4	2	1	3	2	3
5	1	-	2	2	2

SYLLABUS

UNIT - I **10 Periods**

Basics of Robotics

Definition and scope of robotics, Historical overview of robotics, Laws of robotics, overview of robotic systems and components, Robot workspaces and configurations, Types of robots and their applications, End effectors and grippers for different tasks and selection criteria. Actuation and drive systems in robot

UNIT - II **10 Periods**

Kinematics and Control of Robot

Kinematics: Scaling, Rotation and homogenous transformation matrix, Forward kinematics and inverse kinematics, Denavit Hartenberg (DH) parameters,

Trajectory planning: Trajectory planning and path generation for robot motion- steps in trajectory planning, Joint Space Techniques, Cartesian Space Techniques.

Robot Control: P,I,D, PD, PI, PID control, adaptive control.

UNIT - III **10 Periods**

Sensors and Computer Vision in Robot

Feedback System: Open and closed loop feedback systems.

Robot sensors: Sensor types and characteristics (Range, proximity, vision, force and torque), Sensor fusion and filtering techniques.

Computer Vision in Robotics: Image processing and feature extraction, Object detection, tracking, and recognition, Visual servoing and robot vision applications.

UNIT - IV **10 Periods**

Robotic Programming and simulation

Programming languages for robotics (C++, Python, ROS), Behavior-based programming and robot architectures, Robot simulation and visualization tools.

Applications: Robotics at Agriculture, Automotive, Supply Chain, Healthcare, Warehouses - material Transfer, Material handling, loading and unloading; Processing - spot and continuous welding

UNIT - V **10 Periods**

AI Powered Robotics

AI and Machine Learning for Robotics: Reinforcement learning for robot control, Deep learning in perception and decision-making,

Advanced Topics in Robotics: Human-robot interaction and collaboration, Mobile robots and navigation, Swarm robotics and multi-robot systems.

TEXT BOOKS:

1. Robert J. Schilling, “Fundamentals of Robotics Analysis and Control”, PHI Learning,
2. Francis X. Govers , “Artificial Intelligence for Robotics: Build intelligent robots that perform human tasks using AI techniques".
3. Groover M P, “Industrial Robotics”, Pearson Edu.
4. Mittal R K & Nagrath I J, “Robotics and Control”, TMH.

REFERENCE BOOKS:

1. Fu K S, Robotics, McGraw Hill.
2. Rich and Knight, Artificial Intelligence, 3rd Edition, Tata McGraw Hill, 2014.

WEB RESOURCES:

1 http://ecoursesonline.iasri.res.in/course/view.php?id=82

2 https://www.robotplatform.com/knowledge/sensors/types_of_robot_sensors.html

3 https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_robotics.htm

4 https://www.iiitdmj.ac.in/ict.iiitdmj.ac.in/summer-courses-2020/R-AI/

5 https://ocw.snu.ac.kr/sites/default/files/NOTE/Chap12_Robot%20programming%20languages.pdf

6 https://www.plyrotech.com/blog/artificial-intelligence-machine-learning-and-robotics/#:~:text=Robotic%20Process%20Automation%20is%20an,scale%20Internet%20companies%20are%20built.

NO SQL	
23 AM124(B)	**Credits:3**
Instruction : 3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks :60**

Prerequisites:

1. Knowledge on Relational Database management systems.

Course Objectives:

1 Distinguish and describing how NoSQL databases differ from relational databases fromtheoretical perspective.
2. Explore the origins of NoSQL databases and the characteristics .
3. Demonstrate competency in selecting a particular NoSQL database for specific usecases.
4. Demonstrate Document databases with MongoDB.

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Compare and contrast the uses of relational RDBMSs and NoSQL systems for different types of data and applications.
2.	Differentiate various data models.
3.	Recognize Key value Databases and document databases.
4.	Create a sample database using NoSql.
5.	Apply the Query concepts in MongoDB database

Mapping of course outcomes with program outcomes:

CO	**PO**			**PSO**	
	1	**2**	**3**	**1**	**2**
1	1	-	1	2	1
2	2	1	2	2	2
3	2	1	2	1	2
4	2	1	3	2	3
5	3	1	3	2	3

SYLLABUS

UNIT-I : **10 Periods**

Why NoSQL?
The value of relational databases – Impedance mismatch – Application and integrationdatabases – Attack of the cluster.

UNIT-II : **10 Periods**

Aggregate Data Models :
Aggregates - Example of Relations and Aggregates – Consequences of Aggregate Orientation -Key-Value and Document Data Models - Column-Family Stores
More Details on Data Models :
Relationships - Graph Databases – Schema less Databases - Materialized Views - Modeling forData Access.

UNIT –III : **10 Periods**

Distribution Models :
Single Server – Shading - Master-Slave Replication - Peer-to-Peer Replication – CombiningShading and Replication
Consistency:
Update Consistency - Read Consistency - Relaxing Consistency - The CAP Theorem - RelaxingDurability.

UNIT-IV : **10 Periods**

Key-Value Databases:
What Is a Key-Value Store - Key-Value Store Features – Consistency – Transactions - Query Features - Structure of Data – Scaling - Suitable Use Cases - Storing Session Information - User Profiles, Preferences - Shopping Cart Data - When Not to Use - Relationships among Data - Multioperation Transactions - Query by Data - Operations by Sets.

UNIT-V : **10 Periods**
Document Databases:
What Is a Document Database? – Features – Consistency – Transactions – Availability - Query Features – Scaling - Suitable Use Cases - Event Logging - Content Management Systems - Blogging Platforms - Web Analytics or Real-Time Analytics - E-Commerce Applications - When Not to Use - Complex Transactions Spanning Different Operations - Queries against Varying Aggregate Structure.

Text Book:

1. Pramod J.Sadalag and Martin Fowler," NoSQL Distilled, A Brief Guide to the EmergingWorld of Polyglot Persistence" ,1st Edition, Addison Wesley
2. David Hows, Eelco Plugge, Peter Membrey , and Tim Hawkins, "The definitive guide toMongoDB", "A complete guide to dealing with big data using MongoDB". 1st Edition, Apress

Reference Books:

1. Shashank Tiwari, Professional NoSQL, Wrox Press, Wiley, 2011, ISBN: 978-0-470-94224-6
2. Gaurav Vaish, Getting Started with NoSQL, Packt Publishing, 2013.

Web Resources:

1. http://allvideolectures.com/courses/course/96uv57kBOZ.
2. https://university.mongodb.com/

NATURAL LANGUAGE PROCESSING	
23 AM124 (C)	**Credits : 3**
Instruction : 3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

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

Course Objectives:

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

Course Outcomes:

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

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

CO-PO Mapping:

CO	PO			PSO	
	1	**2**	**3**	**1**	**2**
1	2	1	2	3	2
2	2	1	3	2	3
3	3	1	3	2	3
4	3	-	3	3	2
5	3	1	3	3	3

SYLLABUS

UNIT-I **10 periods**

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

UNIT- II **10 periods**

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

UNIT-III **10 periods**

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

UNIT-IV **10 periods**

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

UNIT-V **10 periods**

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

E-Resources:

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

DEEP LEARNING LAB	
23AM125	**Credits: 2**
Instruction : 3 Periods/Week	**Sessional Marks : 50**
End Exam : 3 Hours	**End Exam Marks : 50**

Prerequisites:

1. Mathematical Concepts like Statistics, Calculus, Linear Algebra and Probability.

Course Objectives:

1. Introduce the basics of Deep neural networks
2. Cover various deep learning algorithms, such as convolutional neural networks (CNNs), recurrent neural networks (RNNs)
3. Familiarize students with popular deep learning frameworks and libraries like TensorFlow, PyTorch, and Keras, enabling them to implement deep learning models effectively.
4. Teach students how to train deep neural networks using various optimization techniques, weight initialization, regularization, and hyperparameter tuning.

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Build a neuron from the scratch, Understand and implement the concepts of neural networks using pytorch, tensorflow and keras
2.	Implement different activation functions and loss function
3.	Implement the concepts of different gradient descent approaches and accuracy measures.
4.	Perform Image classification and word embeddings.

Mapping of Course Outcomes with Program Outcomes:

CO	**PO**			**PSO**	
	1	**2**	**3**	**1**	**2**
1	2	1	3	2	2
2	3	1	2	2	2
3	3	1	3	3	3
4	3	2	3	3	2

LIST OF EXPERIMENTS

1. Realizing logistic regression as a neuron (use insurance dataset) (CO 1)

2. Installing tensorflow on local machine, differentiating pytorch, tensorflow and keras (CO 1)

3. Build a neural network in tensorflow and python for handwritten digits classification (CO 1)

4. Implementing different activation functions. (CO 2)

5. Implement matrices, loss function. (CO 2)

6. Implement Gradient Descent For Neural Network(CO 3)

7. Implement Stochastic gradient descent, batch gradient descent and mini batch gradient descent for a neural network. (CO 3)

8. Case study of customer churn prediction using a dataset from Kaggle. (CO 3)

9. Implementing the concepts of true positive, false positive, true negative, false negative, precision and recall, F1 score. (CO 3)

10. Image classification using CIFAR10 dataset in tensorflow using CNN(CO 4)

11. Computing word embeddings(CO 4)

12. Implement word2vec model in python gensim library for amazon product reviews(CO 4)

Text Books:

1. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, "Dive into Deep Learning", 2021

Reference Books :

1. Satish Kumar, "Neural Networks: A Classroom Approach", Tata McGraw-Hill Education, 2004.
2. Simon Haykin, "Neural Networks-A comprehensive Foundation" Second edition
3. Charu C. Aggarwal, "Neural Networks and Deep Learning-A Textbook", Springer, 2018.

E-Resources:

1. https://www.youtube.com/playlist?list=PLeo1K3hjS3uu7CxAacxVndI4bE_o3BDtO

2. https://www.analyticsvidhya.com/blog/2018/04/fundamentals-deep-learningregularization-techniques/

3. https://www.analyticsvidhya.com/blog/2021/05/a-comprehensive-tutorial-on-deeplearning-part-1/

4. https://viso.ai/deep-learning/deep-reinforcement-learning/

5. Michael Nielsen, Neural Networks and Deep Learning, http://neuralnetworksanddeeplearning.com/

6. Introduction to Deep Learning, MIT 6.S191 Alexander Amini January 28, 2019, http://introtodeeplearning.com/

ARTIFICIAL INTELLIGENCE IN ROBOTICS LAB	
23 AM126(A)	**Credits: 2**
Instruction:3 Periods /Week	**Sessional Marks : 50**
End Exam : 3 Hours	**End Exam Marks : 50**

Cycle – I

1. Introduction to Robot Analyzer Software
2. Perform the Forward kinematics of a 2-DOF planar robot, 3-DOF anthropomorphic arm & a 3-DOF wrist and KUKA KR5 Arc Robot.
3. Perform the Inverse kinematics of a 2-DOF planar robot, 3-DOF anthropomorphic arm & a 3-DOF wrist and KUKA KR5 Arc Robot.
4. Workspace Analysis of a 6 axis Robot
5. Inverse and Forward Dynamics of Robots
6. Creating Robot Joint Trajectories

Cycle – II

1. Introduction to Firebird V wheeled Robot- sensors actuator
2. IO Buzzer Programming using embedded C
3. Motion Control of Firebird V
4. Velocity Control of Firebird V using PWM
5. LCD Interfacing for Firebird V
6. Programming Firebird V to Follow the White Line

TEXT BOOKS:

1. Robert J. Schilling, “Fundamentals of Robotics Analysis and Control”, PHI Learning,
2. Francis X. Govers , “Artificial Intelligence for Robotics: Build intelligent robots that perform human tasks using AI techniques".
3. Groover M P, “Industrial Robotics”, Pearson Edu.
4. Mittal R K & Nagrath I J, “Robotics and Control”, TMH.

REFERENCE BOOKS:

1. Fu K S, Robotics, McGraw Hill.
2. Rich and Knight, Artificial Intelligence, 3rd Edition, Tata McGraw Hill, 2014.

WEB RESOURCES:

1. http://ecoursesonline.iasri.res.in/course/view.php?id=82
2. https://www.robotplatform.com/knowledge/sensors/types_of_robot_sensors.html
3. https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_robotics.htm
4. https://www.iiitdmj.ac.in/ict.iiitdmj.ac.in/summer-courses-2020/R-AI/
5. https://ocw.snu.ac.kr/sites/default/files/NOTE/Chap12_Robot%20programming%20languages.pdf
6. https://www.plyrotech.com/blog/artificial-intelligence-machine-learning-and-robotics/#:~:text=Robotic%20Process%20Automation%20is%20an,scale%20Internet%20companies%20are%20built.

No SQL LAB	
23 AM126(B)	**Credits : 2**
Instruction : 3 Periods /Week	**Sessional Marks : 50**
End Exam : 3 Hours	**End Exam Marks : 50**

Prerequisites: DBMS

Course Objectives:

- Distinguish and describing how NoSQL databases differ from relational databases fromtheoretical perspective.
- Explore the origins of NoSQL databases and the characteristics.

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Apply Neo4J techniques for record data.
2.	Apply Redis techniques for key value databases.
3.	Apply Mongo DB techniques for Document stores.
4.	Apply Cassandra techniques for Column Family Stores.

Mapping of Course Outcomes with Program Outcomes:

CO	PO			PSO	
	1	2	3	1	2
1	2	1	2	1	1
2	2	1	2	1	1
3	2	1	2	2	2
4	2	1	3	2	2

Experiment 1: Introduction / NoSQL Database:

ImporttheHubwaydataintoNeo4jandconfigureNeo4j.Then, answer the following questions using the Cypher Query Language:

a) List top 10 stations with most outbound trips (Show station name and number of trips)

b) List top10 stations with most in bound trips (Show station name and number of trips)

Experiment 2: Key-Value Databases Redis Lab

Redis lab using sets ,lists,hashes

Experiment 3: Document Stores MongoDB Lab

Download a zip code dataset at http://media.mongodb.org/zips.json .Use mongo import to import the zip code dataset into Mongo DB. After importing the data, answer the following questions by using aggregation pipelines:

a. Find all the states that have a city called ”BOSTON”. Find all the states and cities whose names include the string ”BOST”.
b. Each city has several zip codes. Find the city in each state with the most number of zip codes and rank those cities along with the states using the city populations. Mongo DB can query on spatial information.

Experiment 4 :Column Family Stores Cassandra Lab

Create a any databasefor example that stores road cars. Cars have a manufacturer, a type. Each car has a maximum performance and a maximum torque value. Do the following: Test Cassandras replication schema and Consistency models.

Text Book:

1. Pramod J.Sadalag and Martin Fowler,” NoSQL Distilled, A Brief Guide to the Emerging World of Polyglot Persistence” ,1st Edition, Addison Wesley
2. David Hows, Eelco Plugge, Peter Membrey , and Tim Hawkins, “The definitive guide to MongoDB”, “A complete guide to dealing with big data using MongoDB”. 1st Edition, Apress

Reference Books:

1. Shashank Tiwari, Professional NoSQL, Wrox Press, Wiley, 2011, ISBN: 978-0-470-94224-6
2. Gaurav Vaish, Getting Started with NoSQL, Packt Publishing, 2013.

Web Resources:

1. http://allvideolectures.com/courses/course/96uv57kBOZ.
2. https://university.mongodb.com/

NATURAL LANGUAGE PROCESSING LAB	
23 AM126 (C)	**Credits : 2**
Instruction : 3 Hours lab/Week	**Sessional Marks : 50**
End Exam : 3 Hours	**End Exam Marks : 50**

Prerequisites:

1. Python Programming

Course Objectives:

1. To analyze the text syntactically and semantically
2. To Implement recurrent network for language models and Develop sentiment classification modelsand chatbot systems

Course Outcomes:

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

Mapping of course outcomes with program outcomes:

CO	**PO**			**PSO**	
	1	**2**	**3**	**1**	**2**
1	3	1	2	3	2
2	3	1	3	3	2
3	3	1	3	3	3
4	3	1	3	3	3

LIST OF EXPERIMENTS:

1. Convert the text into tokens and find the word frequency	CO1
2. Demonstrate a bigram and trigram language model	CO1
3. Perform Lemmatization and Stemming	CO1
4. Identify parts-of Speech using Penn Treebank tag set.	CO1
5. Implement HMM for POS tagging and Build a Chunker	CO1
6. Find the synonym of a word and antonym of a word using WordNet	CO2
7. Implement semantic role labeling to identify named entities	CO2
8. Implement POS tagging using LSTM	CO3
9. Implement Named Entity Recognizer	CO3
10. Develop a movie review system (sentiment analysis on movie data)	CO4

TEXT BOOKS:

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

REFERENCE BOOKS:

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

E-Resources:

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