

R24 Curriculum

M. Tech. in Computer Science and Engineering

(Artificial Intelligence and Machine Learning)



UNIVERSITY

JIS University
Agarpara, Kolkata

SEMESTER-1							
Sl. No.	Type	Course No.	Course Name	L	T	P	Credits
THEORY							
1	BS	PMT1003	Computational Mathematics	3	0	0	3
2	CS	PAM1001	Fundamentals of Data Sciences	3	1	0	4
3	CS	PAM1002	Artificial Intelligence and Machine Learning	3	1	0	4
4	CS	PAM1003	Human Computer Interaction	3	1	0	4
5	ES	PAM1004A	Cyber Security Or Blockchain Technology	3	0	0	3
6	HS	JSC1001	Research Methodology and IPR	2	0	0	2
PRACTICAL							
7	CS	PAM1101	Data Sciences Laboratory	0	0	3	1.5
8	CS	PAM1102	Artificial Intelligence and Machine Learning Laboratory	0	0	3	1.5
9	CS	PAM1104A	Cyber Security Laboratory Or Blockchain Technology Laboratory	0	0	3	1.5
TOTAL				17	3	9	24.5

SEMESTER-2							
Sl. No.	Type	Course No.	Course Name	L	T	P	Credits
THEORY							
1	BS	PAM2005	Introduction to Deep Learning(NPTEL)	3	0	0	3
2	CS	PAM2001	Network and Information Security	3	1	0	4
3	CS	PAM2002	Machine Learning	3	0	0	3
3	CS	PAM2003	Data and Web Mining	3	1	0	4
4	CS	PAM2004	Generative AI	3	1	0	4
PRACTICAL							
5	CS	PAM2101	Network Laboratory	0	0	3	1.5
6	CS	PAM2102	Machine Learning Laboratory	0	0	3	1.5
7	CS	PAM2103	Data and Web Mining Laboratory	0	0	3	1.5
SESSIONAL							
8	ES	PAM2301	Term Paper	2	0	0	1
9	MC		Internship	0	0	0	1
SWAYAM-NPTEL							
3		NPTEL		3	0	0	3
TOTAL				17	3	9	24.5

Note : Internship to be done between end of 2nd semester and beginning of 3rd semester.

SEMESTER-3							
Sl. No.	Type	Course No.	Course Name	L	T	P	Credits
THEORY							
1	CS	PAM3001	Neuro Fuzzy and Soft Computing	3	1	0	4
2	PECS	PAM302X	Professional Elective I	3	0	0	3
3	PECS	PAM303Y	Professional Elective II	3	0	0	3
PRACTICAL							
4	CS	PAM3101	Soft Computing Laboratory	0	0	3	1.5
5	PROJ	PAM3201	Thesis I	0	0	17	8.5
TOTAL				9	1	18	20

Course Code under (PAM302X) (ELECTIVE-1)	Course title	Course Code under (PAM3002Y) (ELECTIVE-2)	Course title
PAM302A	Pattern Recognition	PAM303A	Natural Language Processing
PAM302B	Speech Processing	PAM303B	Computer Vision
PAM302C	Cyber Security and Cyber law	PAM303C	Agile Technologies

SEMESTER-4							
Sl. No.	Type	Course No.	Course Name	L	T	P	Credits
SESSIONAL (ONLY INTERNAL EVALUATION)							
1	PROJ	PAM4201	Thesis II	0	0	30	15
2	SEMINER	PAM4202	SEMINER	0	0	0	5
TOTAL				0	0	15	20



**M. Tech. in Computer Science and
Engineering**

**(Artificial Intelligence and Machine
Learning)**

1st Year 1st Semester Curriculum



Course Code	PAT1001			
Course Title	Computational Mathematics			
Category	BS			
LTP& Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites				

Learning Objective:

To understand the mathematical fundamentals that is prerequisites for a variety of courses like Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning To develop the understanding of the mathematical and logical basis to many modern techniques in information technology like machine learning, programming language design, and concurrency. To study various sampling and classification problems.

Course Outcome:

On completion of this course, students are able to:

- CO1:** Understand the numerical methods to solve and find the roots of the equations.
- CO2:** Apply the technique of singular value decomposition for data compression, least square approximation in solving inconsistent linear systems
- CO3:** Understand vector spaces and related topics arising in magnification and rotation of images.
- CO4:** Utilize the statistical tools in multi variable distributions.
- CO5:** Use probability formulations for new predictions with discrete and continuous RVs.

Course Content:

Module 1:

[6L]

Vector Spaces: Vector spaces; subspaces Linearly independent and dependent vectors Basis and dimension; coordinate vectors-Illustrative examples. Linear transformations, Representation of transformations by matrices;

Module 2:

[9L]

Orthogonality and least squares: Inner product, orthogonal sets, orthogonal projections, orthogonal bases. Gram-Schmidt orthogonalization process. QR factorizations of a matrices, least square problems, applications to linear models (least square lines and least square fitting of other curves).



Module 3: [7L]
 Symmetric and Quadratic Forms: Diagonalization, Quadratic forms, Constrained Optimization, The Singular value decomposition. Applications to image processing and statistics, Principal Component Analysis

Module 4: [6L]
 Statistical Inference: Introduction to multivariate statistical models: Correlation and Regression analysis, Curve fitting (Linear and Non-linear)

Module 5: [8L]
 Probability Theory: Random variable (discrete and continuous), Probability mass function (pmf), Probability density function (pdf), Mathematical expectation, Sampling theory: testing of hypothesis by ttest, χ^2 - test

Text/Reference Books:

1. Linear Algebra and its Applications David C.Lay, Steven R.Lay and J.J.McDonald Pearson Education Ltd 5 th Edition 2015.
2. Numerical methods for Scientific and Engg. Computation M K Jain, S.R.K Iyengar, R K. Jain New Age International 6 th Ed., 2014
3. Probability, Statistics and Random Process T.Veerarajan Tata Mc-Graw Hill Co 3 rd Edition 2016
4. Optimization: Theory & Applications Techniques Rao. S.S Wiley Eastern Ltd New Delhi.
5. Signals, Systems, and Inference Alan V. Oppenheim and George C. Verghese Spring 2010.
6. Higher Engineering Mathematics B.S. Grewal Khanna Publishers 44th Ed., 2017

CO-PO Mapping

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



Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	PAM1001			
Course Title	Fundamentals of Data Sciences			
Category	CS			
LTP& Credits	L	T	P	Credits
	3	1	0	4
Total Contact Hours	48			
Pre-requisites	a)Design and Analysis of Algorithms			

Learning Objectives:

Programming data science concepts and Big Data, modeling using R language. Analyze Basic tools of EDA, Data science process with case studies and Different algorithms. Optimize & solve real life problems with different spam filter. Explore Feature Generation and Feature Selection.

Course Outcome:

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

- CO1:** Define data science and its fundamentals
- CO2:** Demonstrate the process in data science
- CO3:** Explain machine learning algorithms necessary for data sciences
- CO4:** Illustrate the process of feature selection and analysis of data analysis algorithms
- CO5:** Visualize the data and follow of ethics

Module 1:

[8L]

Introduction: What is Data Science? Big Data and Data Science hype – and getting past the hype, Why now? – Datafication, Current landscape of perspectives, A data Science Profile, Skill sets. Statistical Inference, Populations and samples, Big Data, new kinds of data, modeling, statistical modeling probability distributions, fitting a model, - Introduction to R.

Module 2:

[10L]

Exploratory Data Analysis and the Data Science Process: Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA, The Data Science Process, Case Study: Real direct (online real estate firm). Algorithms, machine Learning Algorithms, Three Basic Algorithms: Linear Regression, k-Nearest Neighbors (kNN), k-means, R Programs for the algorithms.

Module 3:

[10L]



Spam Filter, Linear Regression and Spam Filter, K-NN and spam Filter,, Naïve Bayes Algorithm, Spam Filter using Naïve Bayes, Laplace Smoothing,, Comparing Naïve Bayes to K-NN, Scraping the Web, introduction to Logical Regression and M6D case study.

Module 4: **[12L]**

Feature Generation and Feature Selection (Extracting Meaning from Data): Motivating application: user (customer) retention. Feature Generation (brainstorming, role of domain expertise, and place for imagination), Feature Selection algorithms. Filters; Wrappers; Decision Trees; Random Forests. Recommendation Systems: Building a User-Facing Data Product, Algorithmic ingredients of a Recommendation Engine, Dimensionality Reduction, Singular Value Decomposition, Principal Component Analysis, Exercise: build your own recommendation system.

Module 5: **[8L]**

Data Engineering, Map reduce, Word Frequency Problem,, Map Reduce Solution, Other Examples of Map Reduce, Pregel-An Introduction. Data Visualization: Basic principles, ideas and tools for data visualization. Mining Social Network Graphs: Social networks as graphs, Clustering of graphs, Direct discovery of communities in graphs, Partitioning

Text/ Reference Books:

1. Doing Data Science Cathy O’Neil and Rachel Schutt Straight Talk from The Frontline.O’Reilly 2014
2. Mining of Massive Datasets. V2.1 Jure Leskovek, Anand Rajaraman and Jeffrey Ullman Cambridge University Press 2014
3. Data Mining: Concepts and Techniques Jiawei Han, Micheline Kamber and Jian Pei Third Edition 2012.
4. Machine Learning: A Probabilistic Perspective Kevin P. Murphy 2013

CO-PO Mapping:

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



Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	PAM1002			
Course Title	Artificial Intelligence and Machine Learning			
Category	CS			
LTP& Credits	L	T	P	Credits
	3	1	0	3
Total Contact Hours	48			
Pre-requisites	a)Design and Analysis of Algorithms			

Learning Objectives:

Gain a historical perspective of Artificial Intelligence (AI) and its foundations. Become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning. Investigate applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models. Experience AI development tools such as an 'AI language', expert system shell, and/or datamining tool. Experiment with a machine learning model for simulation and analysis. Explore the current scope, potential, limitations, and implications of intelligent systems.

Course Outcomes:

- At the end of the course, student will be able to
- CO1:** Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents.
 - CO2:** Analyze and formalize the problem as a state space, graph, design heuristics and select among different search or game based techniques to solve them.
 - CO3:** Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing.
 - CO4:** Attain the capability to represent various real life problem domains using logic based techniques and use this to perform inference or planning.
 - CO5:** Solve problems with uncertain information using Bayesian approaches.

Module 1:

[6L]

Introduction to artificial intelligence: Introduction, history, intelligent systems,



Turing Test, Role of Knowledge, AI applications, tic-tac-tie game playing, current trends in AI,

Problem solving: state-space search and control strategies: Introduction, general problem solving, characteristics of problem, AI problem solving as state space search, exhaustive searches, heuristic search techniques, Hill climbing , A* algorithms,

Module 2: [7L]

Logic and Theorem Proving concepts: Introduction, propositional calculus, propositional logic, natural deduction system, axiomatic system, semantic tableau system in propositional logic, resolution refutation in propositional logic, predicate logic

Module 3: [7L]

Problem reduction and game playing: Introduction to problem reduction, AO* algorithm, constraint satisfaction algorithm, Cryptarithmic Problem solving, Means Ends analysis, game playing, Min-Max algorithm for game playing, alpha-beta pruning, iterative-deepening, two- player perfect information games,

Module 4: [6L]

Representation of Knowledge with Rules: Production System, Forward versus Backward chaining, Rule Matching and chain control, Non-Monotonic reasoning, Truth maintenancesystems,

Module 5: [7L]

Uncertain Reasoning: Probability theory: Introduction, probability theory, Bayes theorem, Bayesian belief networks, certainty factor theory, Dempster-Shafer theory, Statistical Inference

Module 6: [8L]

Knowledge representation: Introduction, approaches to knowledge representation, knowledge representation using semantic network, extended semantic networks for KR, knowledge representation using frames, **advanced knowledge representation techniques:** Introduction, conceptual dependency theory, script structure, cyc theory, case grammars, semantic web.

Module 7: [7L]

Planning: Overview, Blocks world as example, components of planning system, Goal stack planning, Nonlinear planning, Hierarchical planning, Reactive Systems
Expert Systems: Representing and using Domain knowledge, examples of expert systems, Expert system Architectures, Components, Building an expert system, Expert system shells

Text / Reference Books:

1. Artificial intelligence, A modern Approach, 2nded, Stuart Russel, Peter Norvig, Prentice



Hall

2. Artificial Intelligence- 3rd Edition, Rich, Kevin Knight, Shiv Shankar B Nair, TMH
3. Introduction To Artificial Intelligence And Expert Systems, 1st Edition, Patterson, PearsonIndia, 2015
4. Artificial intelligence, structures and Strategies for Complex problem solving, 5th Edition, George F Lugar, PEA
5. Introduction to Artificial Intelligence, Ertel, Wolf Gang, Springer, 2017
6. Artificial Intelligence, SarojKaushik, 1st Edition, CENGAGE Learning, 2011

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	PAM1003			
Course Title	Human Computer Interaction			
Category	CS			
LTP& Credits	L	T	P	Credits
	3		0	4
Total Contact Hours	48			
Pre-requisites	a)Design and Analysis of Algorithms			

Learning Objectives:

Develop ability to demonstrate an understanding of guidelines, principles, and theories influencing human computer interaction. Recognize how a computer system may be modified to include human diversity. Be aware of mobile HCI. Learn the guidelines for user interface.

Course Outcomes:

After completion of the course, student would be able to

CO1: Design effective dialog for HCI.



CO2: Design effective HCI for individuals and persons with disabilities.

CO3: Assess the importance of user feedback.

CO4: Explain the HCI implications for designing multimedia/ ecommerce/ e-learning Websites.

CO5: Develop meaningful user interface.

Module 1:

[10L]

FOUNDATIONS OF HCI: The Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms.

Module 2:

[11L]

DESIGN & SOFTWARE PROCESS: Interactive Design basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process – software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules – principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.

Module 3:

[8L]

MODELS AND THEORIES :Cognitive models –Socio-Organizational issues and stake holder requirements –Communication and collaboration model

Module 4:

[10L]

MOBILE HCI: Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.

Module 5:

[9L]

WEB INTERFACE DESIGN: Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow.

Text/Reference Books:

1. Human Computer Interaction, Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, 3rd Edition, Pearson Education, 2004.
2. Mobile Design and Development, Brian Fling, 1st Edition, O'Reilly Media Inc., 2009
3. Designing Web Interfaces, Bill Scott and Theresa Neil, 1st Edition, O'Reilly, 2009. REFERENCE BOOK(S).
4. Laurel, B, S. Joy Mountford, The art of human-computer interface design, Addison Wesley Publishing Company, Inc.,
5. Jenny Preece, Helen Sharp, David Benyon, Simon Holland and Tom Carey, Human computer interaction, Addison-Wesley Publishing Company, Inc



CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	PAM1004A			
Course Title	Cyber Security			
Category	CS			
LTP& Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites				

Learning Objectives:

To learn threats and risks within context of the cyber security architecture. Student should learn and identify security tools and hardening techniques. To learn types of incidents including categories, responses and timelines for response.

Course Outcomes:

- CO 1:** Apply cyber security architecture principles.
- CO 2:** Describe risk management processes and practices.
- CO 3:** Appraise cyber security incidents to apply appropriate response
- CO 4:** Distinguish system and application security threats and vulnerabilities.
- CO 5:** Identify security tools and hardening techniques

Course Contents:

Module 1: Introduction

[7L]

Introduction to Cyber security- Cyber security objectives, Cyber security roles, Differences between Information Security & Cyber security, Cyber security Principles Confidentiality, integrity, & availability Authentication & non-repudiation



Module 2: [8L]

Information Security (IS) within Lifecycle Management-Lifecycle management landscape, Security architecture processes, Security architecture tools, Intermediate lifecycle management concepts, Risks & Vulnerabilities-Basics of risk management, Operational threat environments, Classes of attacks.

Module 3: [8L]

Incident Response- Incident categories, Incident response Incident recovery, and Operational security protection: Digital and data assets, ports and protocols, Protection technologies, Identity and access Management, configuration management

Module 4: [7L]

Threat Detection and Evaluation (DE): Monitoring- Vulnerability Management, Security Logs and Alerts, Monitoring Tools and Appliances. Analysis- Network traffic Analysis, packet capture and analysis

Module 5: [6L]

Introduction to backdoor System and security-Introduction to metasploit, Backdoor, demilitarized zone(DMZ),Digital Signature, Brief study on Harding of operating system.

Text / Reference Books:

1. NASSCOM: Security Analyst Student Hand Book Dec 2015.
2. Information Security Management Principles Updated Edition by David Alexander, Amanda Finch, David Sutton ,Published by BCS, June 2013.
3. CSX- cyber security fundamentals 2 nd edition, Published by ISACA, Cyber security, Network Security, Data Governance Security.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0



Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	PAM1004A			
Course Title	Block chain Technology			
Category	CS			
LTP& Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites				

Learning Objectives:

Blockchain is an emerging technology platform for developing decentralized applications and data storage, over and beyond its role as the technology underlying the crypto currencies. The basic tenet of this platform is that it allows one to create a distributed and replicated ledger of events, transactions, and data generated through various IT processes with strong cryptographic guarantees of tamper resistance, immutability, and verifiability. Public blockchain platforms allow us to guarantee these properties with overwhelming probabilities even when entrusted users are participants of distributed applications with ability to transact on the platform. Even though, blockchain technology has become popularly known because of its use in the implementation of Crypto currencies such as BitCoin, Ethereum, etc.

Course Outcomes:

- CO 1:** Describe the basic concepts and technology used for blockchain
- CO 2:** Describe the primitives of the distributed computing and cryptography related to blockchain.
- CO 3:** . Illustrate the concepts of Bitcoin and their usage
- CO 4:** Implement Ethereum block chain contract.
- CO 5:** Apply security features in blockchain technologies

Course Contents:

Module 1: Introduction

[4L]

Need for Distributed Record Keeping .Modeling faults and adversaries. Byzantine Generals problem.



Consensus algorithms and their scalability problems. Why Nakamoto Came up with Block chain based crypto currency? Technologies Borrowed in Block chain – hash pointers, consensus, byzantine fault-

tolerant distributed computing, digital cash etc.

Module 2: Basic Distributed Computing [4L]

Atomic Broadcast, Consensus, Byzantine Models of fault tolerance

Module 3: Basic Crypto primitives [6L]

Hash functions, Puzzle friendly Hash, Collision resistant hash, digital signatures, public key crypto, verifiable random functions, Zero-knowledge systems

Module 4: Blockchain 1.0 [5L]

Bitcoin block chain, the challenges, and solutions, proof of work, Proof of stake, alternatives to Bitcoin consensus, Bitcoin scripting language and their use

Module 5: Blockchain 2.0 [6L]

Ethereum and Smart Contracts, The Turing Completeness of Smart Contract Languages and verification challenges, Using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum Smart Contracts

Module 5: Blockchain 3.0 [5L]

Hyperledger fabric, the plug and play platform and mechanisms in permissioned blockchain

Module 6: Privacy, Security issues in Block chain [6L]

Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Block chains – such as Sybil attacks, selfish mining, 51% attacks - -advent of algor and, and Sharding based consensus algorithms to prevent these

Text / Reference Books:



1. Josh Thompson, 'Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing Platform, 2017.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	JSC1001			
Course Title	Research Methodology and IPR			
Category	BS			
LTP& Credits	L	T	P	Credits
	2	0	0	2
Total Contact Hours	24			
Pre-requisites				

Learning Objectives:

The main objective of the IPR is to make the students aware of their rights for the protection of their invention done in their project work.

Course Outcomes:

- CO1:** Understand research problem formulation. Analyze research related information
- CO2:** Follow research ethics
- CO3:** Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- CO4:** Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.



CO5: 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.

Module 1: [4L]

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

Module 2: [2L]

Effective literature studies approaches, analysis Plagiarism, Research ethics,

Module 3: [4L]

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Module 4: [6L]

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.

Module 5: [4L]

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

Module 6: [4L]

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.

Text/References Books:

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, 2 ndEdition, “Research Methodology: A Step by Step Guide forbeginners”
4. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd,2007.
5. Mayall, “Industrial Design”, McGraw Hill, 1992.
6. Niebel, “Product Design”, McGraw Hill, 1974.
7. Asimov, “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in NewTechnological Age”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	PAM1101			
Course Title	Data Sciences Laboratory			
Category	CS			
LTP& Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	a)Design and Analysis of Algorithms			

Learning Objectives:

In Data Science Lab our steady focus is to find the solutions of data-driven problems of Data Engineering, Data Analysis, Data Science, Artificial Intelligence and Machine Learning so that data can be transformed into valuable insights.

Course Outcome:

CO1: To understand the python libraries for data science

CO2:To understand the basic Statistical and Probability measures for data



Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	PAM1102				
Course Title	Artificial Intelligence and Machine Learning Laboratory				
Category	CS				
LTP& Credits	L	T	P	Credits	
	0	0	3	1.5	
Total Contact Hours	36				
Pre-requisites	a)Design and Analysis of Algorithms				

Learning Objectives:

This course provides a strong foundation of fundamental concepts in Artificial Intelligence. Which provide a basic exposition to the goals and methods of Artificial Intelligence; apply the techniques in applications which involve perception, reasoning and learning.

Course Outcomes:

CO1: Apply the basic principles of AI in problem solving using LISP/PROLOG/ PYTHON

CO2: Implement different state space search algorithms for Game playing using LISP/PROLOG

CO3: Develop an Expert System using JESS/PROLOG

CO4: Discuss about the practical Robot Design Process

CO5: Discuss Object Recognition Using Neural Networks and Supervised Learning

List of Experiments:

1. Implementation of DFS for water jug problem using LISP/PROLOG/PYTHON
2. Implementation of BFS for tic-tac-toe problem using LISP/PROLOG/Java
3. Implementation of TSP using heuristic approach using Java/LISP/Prolog
4. Implementation of Simulated Annealing Algorithm using LISP/PROLOG/ PYTHON
5. Implementation of Hill-climbing to solve 8- Puzzle Problem using PYTHON/JAVA



6. Implementation of Monkey Banana Problem using LISP/PROLOG/ PYTHON
7. Implementation of A* Algorithm using LISP/PROLOG/ PYTHON
8. Implementation of AO* Algorithm using LISP/PROLOG/ PYTHON
9. Implementation of Min-Max Game playing algorithm using LISP/PROLOG/ PYTHON
10. Implementation Expert System with forward chaining using JESS/CLIPS
11. Implementation Expert System with backward chaining using RVD/PROLOG

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	PAM1104A			
Course Title	Cyber Security Laboratory			
Category	CS			
LTP& Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	a)Design and Analysis of Algorithms			

Learning Objectives:

It aims to educate individuals about potential cyber threats, best practices for safeguarding sensitive information, and how to respond effectively in case of a security incident.

Course Outcomes:

CO1: Analyze and evaluate the cyber security needs of an organization.

CO2: Determine and analyze software vulnerabilities and security solutions to reduce the risk of exploitation

CO3: Measure the performance and troubleshoot cyber security systems.



CO4: Design and develop a security architecture for an organization

CO5: Design operational and strategic cyber security strategies and policies.

Course Contents:

List Of Experiments:

Week 1: TCP scanning using NMAP

Week 2: Port scanning using NMAP

Week 3: TCP / UDP connectivity using Netcat

Week 4: Network vulnerability using OpenVAS

Week 5: Web application testing using DVWA

Week 6: Manual SQL injection using DVWA

Week 7: XSS using DVWA

Week 8: Automated SQL injection with SqlMap

Text/Reference Books:

1. Pfleeger, C.P., Security in Computing 5th Edition, Prentice Hall, Copyright 2010 ISBN 0-13-239077-9.
2. Schneier, Bruce. Applied Cryptography, Second Edition, John Wiley & Sons, 1996.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3



Course Code	PAM1104A			
Course Title	Block chain Laboratory			
Category	CS			
LTP& Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	a)Design and Analysis of Algorithms			

Learning Objectives:

This course will enable the students to understanding Block chain Fundamentals and creating basic blocks and able to Develop Block chain Applications in a structured manner.Ability to create own crypto currency and get familiarity with future currencies. Able to Evaluate and Analyze Block chain Systems

Course Outcomes:

- CO1: Knowledge of Blockchain Concepts and creating basic blocks.
- CO2: Proficiency in Blockchain Development.
- CO3: Ability to Design and Implement Blockchain Applications.
- CO4: Evaluation and Analysis of Blockchain Systems.
- CO5: Knowledge of crypto currency and creating a basic form of it.

Course Contents:

List of Experiments:

Week 1: Creating Merkle tree

Week 2: Creation of Block

Week 3: Block chain Implementation Programming code

Week 4: Creating ERC20 token

Week 5: Java code to implement block chain in Merkle Trees

Week 6: Java Code to implement Mining using block chain



Week 7: Java Code to implement peer-to-peer using block chain

Week 8: Creating a Crypto-currency Wallet

Text/Reference Books:

1. Cryptoassets by Chris Burniske and Jack Tatar.
2. Blockchain Revolution by Don and Alex Tapscott.
3. The Book of Satoshi by Phil Champagne.
4. The Basics of Bitcoins and Blockchains by Antony Lewis.
5. The Blockchain Developer by Elad Elrom.
6. Josh Thompson, 'Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing Platform, 2017.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3



**M. Tech. in Computer Science and
Engineering**

**(Artificial Intelligence and Machine
Learning)**

1st Year 2nd Semester Curriculum



Course Code	PAM2005			
Course Title	Introduction to Deep Learning(NPTEL)			
Category	BS			
LTP& Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites				

Learning Objectives:

This course will provide basic understanding of deep learning and how to solve classification problems having large amount of data. In this course several public domain tools will be demonstrated to build deep learning network.

Course Outcome:

CO1: Recall the distinctive characteristics of matrix algebra and calculus.

CO2: Understand the theoretical concept of vector space and apply to address problems.

CO3: Understand concept of definite and improper integral and apply to address problems in their disciplines

CO4: Understand the concept of functions of several variables and apply to address problems in their disciplines

CO5: Apply matrix algebra, vector spaces, definite and improper integrals, and functions of several variables to solve engineering problems, demonstrating a comprehensive understanding of the mathematical concepts and their practical applications.

Course Content:

Module 1:

[8L]

Brief introduction of big data problem, Overview of linear algebra, probability, numerical computation Scalars, vectors, matrix, tensors, norms, eigen value, eigenvector, singular value decomposition, determinant.

**Module 2:****[6L]**

Probability distribution, bayes rule, conditional probability, variance, covariance, Overflow, underflow, gradient based optimization, least square.

Module 3:**[6L]**

Neural network - Perceptron, Multi-level perceptron, Universal approximation theorem,-- Tutorial for Tools, Keras, Theano, Tensor flow, Demo using MNIST. Deep learning network, Shallow vs Deep network, Deep feedforward network.

Module 4:**[6L]**

Gradient based learning - Cost function, soft max, sigmoid function, Hidden unit - ReLU, Logistic sigmoid, hyperbolic tangent, Architecture design, Back propagation algorithm - Chain rule of calculus

Module 5:**[10L]**

SGD, Regularization - parameter norm penalties, drop out, noise robustness, early stopping, Batch normalization, Optimization for training deep model- Adagrad, Nesterov momentum. Advanced topics: Convolutional Neural Network, Recurrent Neural Network/ Sequence modeling, Practical applications - MNIST, etc.

Texts/References:

1. Ian Goodfellow, YoshuaBengio and Aaron Courville, “Deep Learning”
2. Richard S. Sutton & Andrew G. Barto, Reinforcement Learning: An Introduction” (available online)
3. Jerome H. Friedman, Robert Tibshirani, and Trevor Hastie, “The elements of statistical learning”.

PO-CO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3



Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	PAM2001			
Course Title	Network and Information Security			
Category	CS			
LTP& Credits	L	T	P	Credits
	3	1	0	4
Total Contact Hours	48			
Pre-requisites	Linear Algebra, Probability Theory,			

Learning Objective:

The main objectives of InfoSec are typically related to ensuring confidentiality, integrity, and availability of company information. Security of computer networks and systems is almost always discussed within information security that has three fundamental objectives, namely confidentiality, integrity, and availability. Apply critical thinking and problem-solving skills to detect current and future attacks on an organization's computer systems and networks. Effectively communicate in a professional setting to address information security issues.

Course Outcomes:

- CO1:** Develop Concept of Security needed in Communication of data through computers and networks along with Various Possible Attacks
- CO2:** Understand Various Encryption mechanisms for secure transmission of data.
- CO3:** Understand management of key required for required for encryption
- CO4:** Understand authentication requirements and study various authentication mechanisms
- CO5:** Understand network security concepts and study different Web security mechanisms.

Course Contents:

Module 1: Security Concepts [10L]



Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security Cryptography Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, steganography, key range and key size, possible types of attacks.

Module 2: Symmetric key Ciphers [8L]

Block Cipher principles, DES, AES, Blowfish, RC5, IDEA, Block cipher operation, Stream ciphers, RC4. Asymmetric key Ciphers: Principles of public key cryptosystems, RSA algorithm, Elgamal Cryptography, Diffie-Hellman Key Exchange, Knapsack Algorithm.

Module 3: Cryptographic Hash Functions [10L]

Message Authentication, Secure Hash Algorithm (SHA-512), Message authentication codes: Authentication requirements, HMAC, CMAC, Digital signatures, Elgamal Digital Signature Scheme. Key Management and Distribution: Symmetric Key Distribution Using Symmetric & Asymmetric Encryption, Distribution of Public Keys, Kerberos, X.509 Authentication Service, Public – Key Infrastructure

Module 4: Transport-level Security [8L]

Web security considerations, Secure Socket Layer and Transport Layer Security, HTTPS, Secure Shell (SSH) Wireless Network Security: Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN, IEEE 802.11i Wireless LAN Security

Module 5: E-Mail Security [7L]

Pretty Good Privacy, S/MIME IP Security: IP Security overview, IP Security architecture, Authentication Header, Encapsulating security payload, combining security associations, Internet Key Exchange Case Studies on Cryptography and security: Secure Multiparty Calculation, Virtual Elections, Single sign On, Secure Inter-branch Payment Transactions, Cross site Scripting Vulnerability.

Module 6: Network Security[5L]

Firewalls, IP Security, VPN, Intrusion Detection, Web Security, SSL, TLS

Text/Reference Books:

1. Cryptography & Network Security”, PHI William Stalling “
2. Cryptography & Network Security”, Mc Graw Hill AtulKahate “
3. Cryptography & Network Security”, PHI 4 Forouzan “



4. Modern Cryptography, Theory & Practice", Pearson Education. Wenbo Mao "
5. An Introduction to Mathematical Cryptography", Springer. Hoffstein, Pipher, Silvermman. "
6. The Design of Rijndael", Springer. J. Daemen, V. Rijmen. "
7. Algorithmic Cryptanalysis", CRC Press. A. Joux "
8. Number Theory", Tata Mc Graw Hill. S. G. Telang "
9. Protocols for Authentication and Key Establishment", Springer. C. Boyd, A. Mathuria. "

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	PAM2002			
Course Title	Machine Learning			
Category	CS			
LTP& Credits	L	T	P	Credits
	3	1	0	4
Total Contact Hours	48			
Pre-requisites				

Learning Objectives:

This course explains Machine Learning techniques such as Validation Techniques, Reinforcement Learning etc. Create ML solutions for various business problems. Build and deploy production grade ML applications.

Course Outcomes:

At the end of this course, students should be able to:

CO1: Demonstrate what is Machine Learning & it's applications

CO2: Classify Supervised, Unsupervised and Reinforcement Machine Learning

CO3: Make use of Important Machine Learning Algorithms

CO4: Analyze different Machine Learning tools



CO5: Demonstrate Neural Networks and its usage in machine learning application.

Course Contents:

Module 1:

Supervised Learning (Regression/Classification): Distance-based methods, Nearest-Neighbors, Decision Trees, Nave Bayes. Linear models: Linear Regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, Nonlinearity and Kernel Methods Beyond Binary Classification: Multi-class/Structured Outputs, Ranking

Module 2:

Unsupervised Learning: Clustering: K-means/Kernel K-means Dimensionality Reduction: PCA and kernel PCA, Matrix Factorization and Matrix Completion, Generative Models (mixture models and latent factor models)

Module 3:

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)

Module 4:

Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning

Module 5:

Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference. Recent trends in various learning techniques of machine learning and classification methods for IOT applications. Various models for IOT applications.

Text /Reference Book:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.

CO-PO Mapping

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0



Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	PAM2003			
Course Title	Data And Web Mining			
Category	CS			
LTP& Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	48			
Pre-requisites	Application knowledge, data engineering, statistics, and probability			

Learning Objective:

The objective of this course is to introduce basic concepts, tasks, methods, and techniques in data mining. The emphasis is on various data mining problems and their solutions with application on the web. Students will develop an understanding of the data mining process and issues, learn various techniques for data mining, and apply the techniques in solving data mining problems using data mining tools and systems. The course will also introduce major web mining techniques and develop knowledge and skills to discover useful information from data effectively. More specifically, web usage mining techniques for Web site management, user profiling, and personalization, as well as Web content and structure mining techniques, such as Web information retrieval and link analysis, aiming at supporting search engines will be explained and discussed.

Course Outcomes:

- CO1:** Explain what Data Mining is and what problems it can address
- CO2:** Carry out various data preprocessing actions
- CO3:** Explain and exemplify what classification and prediction is in the context of data mining
- CO4:** Classify data using the methods of decision tree induction, Bayesian methods, rule based classification and using the method of back propagation
- CO5:** Evaluate the accuracy of a classifier and predictor



Course Contents:

Module 1:[6L]

Introduction. What is Data Mining, What kind of data can be mined, What kind of patterns can be mined. Data preprocessing. Descriptive Data characterization, Data cleaning, Data integration and transformation, Data Reduction.

Module 2:[10L]

Classification: Basic Concepts, Decision Trees, and Model Evaluation, General Approach to Solving a Classification Problem, Decision Tree Induction, Model Over fitting, Evaluating the Performance of a Classifier Classification: Alternative Techniques: Rule-Based Classifier, nearest-Neighbor Classifiers, Bayesian Classifiers, Artificial Neural Network (ANN), Support Vector Machine (SVM), Ensemble Methods, Class Imbalance Problem

Module 3:[10L]

Cluster Analysis: Basic Concepts and Algorithms: Overview, K-means, and Agglomerative Hierarchical Clustering, DBSCAN, Cluster Evaluation Cluster Analysis: Additional Issues and Algorithms: Characteristics of Data, Clusters, and Clustering Algorithms, Prototype-Based Clustering, Density-Based Clustering, Graph Based Cluster in, Scalable Clustering Algorithms

Module 4:[6L]

Association Analysis: Basic Concepts and Algorithms: Problem Definition, Frequent Item set Generation, Rule Generation, Compact Representation of Frequent Item sets, Alternative Methods for Generating Frequent Item sets, FP-Growth Algorithm, Evaluation of Association Patterns.

Module 5:[4L]

Information Retrieval and Web Search: Basic Concepts of Information Retrieval, Information Retrieval Models: Boolean, Vector Space, Statistical Language Model. Evaluation Measures, Text and Web Page Pre-Processing, Inverted Index and Its Compression, Latent Semantic Indexing, Web Search, Meta-Search, Web Spamming.

Module 6:[2L]

Social Network Analysis, Co-Citation and Bibliographic Coupling, Page Rank, HITS Algorithm



Module 7:[4L]

Web Crawling: A Basic Crawler Algorithm, Breadth-First Crawlers, Preferential Crawlers, Universal, topical Crawlers.

Module 8:[6L]

Structured Data Extraction: Wrapper Generation. Web Usage Mining, Data Collection and Pre-Processing, Sources and Types of Data, Data Modeling for Web Usage Mining, Discovery and Analysis of Web Usage Patterns, Recommender

Systems and Collaborative Filtering

Text/Reference Books:

1. Introduction to Data Mining: International Edition PangNing Tan, Michael Steinbach, Vipin Kumar, Pearson, 2005.
2. Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data, Bing Liu, Springer, 2011
3. Mining of Massive Datasets, AnandRajaraman and Jeffrey Ullman, Cambridge University Press, 2011.
4. Han, J. and Kamber, M., Data Mining: Concepts and Techniques, 2nd Edition, Morgan Kaufmann, 2001

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	PAM2004
Course Title	Generative AI



Category	CS			
LTP& Credits	L	T	P	Credits
	3	1	0	4
TotalContact Hours	48			
Pre-requisites	Linear Algebra, Probability Theory,			

Learning Objectives:

The objective of this Generative AI focuses on creating new and original content, chat responses, designs, synthetic data or even deepfakes

Course Outcomes:

CO1: Gain experience in how artificial intelligence, machine learning, and generative AI can be used to improve content, productivity, and business processes

CO2: Explore generative AI use cases for text, image, and code generation, chatbots, and search

CO3: Generate text using OpenAI and Google large language models for writing, coding, translation, language processing, and chat

CO4: Create images and content for marketing campaigns, presentations, and more

CO5: Harness AI tools for speech-to-text, text-to-speech, and music generation

Course Contents:

Module 1: Introduction to Generative AI [10]

- GANs Fundamentals
- Types of Generative AI Models
- Ethical Considerations for using AI
- Synthetic Data Generation
- Applications of Generative AI in Different Industries
- Generative AI in Business

Module 2: Generative AI in Software Development [10L]

- Code Generation Techniques
 - Code-to-Code Synthesis
 - Natural Language to Code



Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	PAM2101			
Course Title	Network Laboratory			
Category	CS			
LTP& Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	Application knowledge, data engineering, statistics, and probability			

Learning Objectives:

Students will learn to apply networking principles through the set-up, configuration, and testing of actual network switches, routers, and other networking and computing equipment. The main goal of computer networking is to link devices and enable smooth communication and data exchange between them. Resource sharing: By allowing linked devices to share hardware, software, and data resources, networking maximizes resource usage and fosters cooperation.

Course Outcomes:

CO1: Understand and apply networking principles to set up and configure point-to-point networks, Ethernet LANs, and wireless LANs.

CO2: Analyze and evaluate network performance metrics such as bandwidth, queue size, and congestion window to optimize network efficiency.

CO3: Implement and analyze error detection codes (CRC-CCITT), shortest path algorithms (Bellman-Ford), and congestion control algorithms (leaky bucket) in networking scenarios.

CO4: Develop client-server programs using TCP/IP sockets and datagram sockets to enable communication and file transfer over networks.

CO5: Demonstrate knowledge and understanding of advanced networking concepts



such as GSM and CDMA, and their performance analysis using simulation tools like NS2/NS3.

Course Contents:

Lab Experiments:

PART A

1. Implement three nodes point – to – point network with duplex links between them. Set the queue size, vary the bandwidth and find the number of packets dropped.
2. Implement transmission of ping messages/trace route over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion.
3. Implement an Ethernet LAN using n nodes and set multiple traffic nodes and plot congestion window for different source / destination.
4. Implement simple ESS and with transmitting nodes in wire-less LAN by simulation and determine the performance with respect to transmission of packets.
5. Implement and study the performance of GSM on NS2/NS3 (Using MAC layer) or equivalent environment.
6. Implement and study the performance of CDMA on NS2/NS3 (Using stack called Call net) or equivalent environment. P

PART B

Implement the following in Java:

7. Write a program for error detecting code using CRC-CCITT (16- bits).
8. Write a program to find the shortest path between vertices using bellman-ford algorithm.
9. Using TCP/IP sockets, write a client – server program to make the client send the file name and to make the server send back the contents of the requested file if present.
10. Write a program on datagram socket for client/server to display the messages on client side, typed at the server side.
11. Write a program for simple RSA algorithm to encrypt and decrypt the data.
12. Write a program for congestion control using leaky bucket algorithm.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3



Course Code	PAM2102			
Course Title	Machine Learning Laboratory			
Category	CS			
LTP& Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	Application knowledge, data engineering, statistics, and probability			

Learning objectives:

This course will enable students to make use of Data sets in implementing the machine learning algorithms . Implement the machine learning concepts and algorithms in any suitable language of choice

Course Outcomes:

- CO1:** Understand the implementation procedures for the machine learning algorithms.
- CO2:** Design Java/Python programs for various Learning algorithms.
- CO3:** Apply appropriate data sets to the Machine Learning algorithms.
- CO4:** Identify and apply Machine Learning algorithms to solve real world problems.
- CO5:** Implement and evaluate machine learning models using standard machine learning libraries.

Course Contents:

Lab Experiments:

1. Implement and demonstrate the FIND-Algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
4. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
5. Write a program to implement the naïve Bayesian classifier for a sample training data set



stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.

6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.

7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.

8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

9. Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.

10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3



Course Code	PAM2103			
Course Title	Data And Web Mining Laboratory			
Category	CS			
LTP& Credits	L	T	P	Credits
	0	0	3	
Total Contact Hours	36			
Pre-requisites	Application knowledge, data engineering, statistics, and probability			

Learning Objectives:

Upon successful completion of this Lab the student will be able to Practical exposure on implementation of well known data mining Experiments. Exposure to real life data sets for analysis and prediction. Learning performance evaluation of data mining algorithms in a supervised and an unsupervised setting. Handling a small data mining project for a given practical domain. This lab course is intended to introduce data mining techniques including predictive, descriptive and visualization modeling and their effective use in discovering interesting hidden patterns in large volume of data generated by businesses, science, web, and other sources.

Course Outcomes:

CO1: The data mining process and important issues around data cleaning, preprocessing and integration.

CO2: The principle algorithms and techniques used in data mining, such as clustering, association mining, classification and prediction.

CO3: After undergoing the course students will be able to Synthesize the data mining fundamental concepts and techniques from multiple perspectives.

CO4: Develop skills and apply data mining tools for solving practical problems Advance relevant programming skills.

CO5: Evaluate the ethical implications of data mining practices, including issues related to privacy, bias, and transparency, and propose solutions to mitigate these concerns in a real-world scenario.

Course Contents:

List of Experiments:

Experiment 1: List all the categorical (or nominal) attributes and the real-valued attributes separately.

Experiment 2: What attributes do you think might be crucial in making the credit assessment? Come up with some simple rules in plain English using your selected attributes.

Experiment 3: One type of model that you can create is a Decision Tree - train a Decision Tree using the complete dataset as the training data. Report the model obtained after training.

Experiment 4: Suppose you use your above model trained on the complete dataset, and classify credit good/bad for each of the examples in the dataset. What % of examples can you classify correctly? (This is also called testing on the training set) Why do you think you cannot get 100 % training accuracy?

Experiment 5: Is testing on the training set as you did above a good idea? Why or Why not? 6. One approach for solving the problem encountered in the previous question is using cross validation? Describe what cross-validation is briefly. Train a Decision Tree again using cross validation and report your results. Does your accuracy increase/decrease? Why?

Experiment 6: Check to see if the data shows a bias against "foreign workers" (attribute 20), or "personal-status"(attribute 9). One way to do this (perhaps rather simple minded) is to remove these attributes from the dataset and see if the decision tree created in those cases is significantly different from the full dataset case which you have already done. To remove an attribute you can use the reprocess tab in Weka's GUI Explorer. Did removing these attributes have any significant effect? Discuss.

Experiment 7: Another question might be, do you really need to input so many attributes to get good results? Maybe only a few would do. For example, you could try just having attributes 2, 3, 5, 7, 10, 17 (and 21, the class attribute (naturally)). Try out some combinations. (You had removed two attributes in problem 7. Remember to reload the arff data file to get all the attributes initially before you start selecting the ones you want.)

Experiment 8: Sometimes, the cost of rejecting an applicant who actually has a good credit (case 1) might be higher than accepting an applicant who has bad credit (case 2). Instead of counting the misclassifications equally in both cases, give a higher cost to the first case (say cost 5) and lower cost to the second case. You can do this by using a cost matrix in Weka. Train your Decision Tree again and report the Decision Tree and cross-validation results. Are they significantly different from results obtained in problem 6 (using equal cost)?

Text/Reference Books:

1. Andrew Moore's Data Mining Tutorial (On decision trees and cross validation).
2. Decision trees (source: TAN, MSU)
3. TOM Mitchell's book slides (on Conceptual learning and decision trees)



WEKA resources Introduction to WEKA• Download WEKA• WEKA tutorial• ARFF format•
Using WEKA from command line•

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3



**M. Tech. in Computer Science and
Engineering**

**(Artificial Intelligence and Machine
Learning)**

2nd Year 3rd Semester Curriculum

Course Code	PAM3001			
Course Title	Neuro Fuzzy and Soft Computing			
Category	CS			
LTP& Credits	L	T	P	Credits
	3	1	0	3
Total Contact Hours	48			
Pre-requisites				

Learning Objective:

Aims to provide comprehensive understanding of soft computing approaches for AI problemsolving. Develops in depth knowledge on concepts related to different types of neural networks.Provides in depth knowledge on concepts related to Fuzzy logic, membership value assignment and reasoning with fuzzy quantities.Helps to understand the development of Fuzzy Inference systems and Fuzzy expert systems.Introduces the concepts related to Genetic algorithms for learning from examples.

Course Outcomes:

- CO1:** Build neural networks to extract patterns from data.
- CO2:** Build fuzzy inference systems and develop fuzzy expert systems.
- CO3:** Write genetic algorithms for learning the hyper parameters for data classification.
- CO4:** Implement hybrid models combining neural networks and fuzzy logic for advanced AI problem solving.
- CO5:** Evaluate the performance and suitability of soft computing approaches in real-world applications through case studies and projects.

Course Content:

Module 1:



Introduction to Soft computing, Artificial Neural Network: An Introduction, Evolution of Neural Networks, Basic Models of Artificial Neural Network, Important Terminologies of ANNs, McCulloch–Pitts Neuron, Linear Separability, Hebb Network

Module 2:

Supervised Learning Network, Perceptron Networks, Adaptive Linear Neuron (Adaline), Multiple Adaptive Linear Neurons, Back-Propagation Network, Radial Basis Function Network, Time Delay Neural Network, Associative Memory Networks, Hopfield Networks

Module 3:

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets, Classical Relations and Fuzzy Relations, Tolerance and Equivalence Relations, Noninteractive Fuzzy Sets, Membership Function, Features of the Membership Functions, Fuzzification, Methods of Membership Value Assignments, Methods of Membership Value Assignments, Defuzzification

Module 4:

Fuzzy Arithmetic and Fuzzy Measures, Measures of Fuzziness, Fuzzy Rule Base and Approximate Reasoning, Fuzzy Propositions, Formation of Rules, Decomposition of Rules (Compound Rules), Aggregation of Fuzzy Rules, Fuzzy Reasoning (Approximate Reasoning), Fuzzy Inference Systems (FIS), Overview of Fuzzy Expert System

Module 5:

Genetic Algorithm, Introduction, Biological Background, Genetic Algorithm and Search Space, Basic Terminologies in Genetic Algorithm, General Genetic Algorithm, Operators, Stopping Condition for Genetic Algorithm Flow, Constraints, Problem Solving Using Genetic Algorithm, The Schema Theorem, Classification of Genetic Algorithm, Advantages and Limitations of Genetic Algorithm, Applications of Genetic Algorithm

Text/Reference Books:

1. S.N. Sivanandam, S.N. Deepa, Principles of Soft Computing, 3ed, Wiley India.
2. Fakhreddine O. Karray, Clarence W. De Silva, Soft Computing and Intelligent Systems Design: Theory, Tools and Applications, 1e, Pearson.
3. Fundamentals of Neural Networks – Laurene Fauseett, Prentice Hall India, New Delhi, 1994.
4. Timothy J. Ross, Fuzzy Logic with Engineering Applications, 3 ed, Wiley India
5. E – Neuro Fuzzy and Soft computing – Jang J.S.R., Sun C.T and Mizutami, Prentice hall New Jersey, 1998

CO-PO Mapping

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	PAM302A			
Course Title	Pattern Recognition			
Category	CS			
LTP& Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	48			
Pre-requisites				

Learning Objectives:

From the course the student will learn Concepts of Algorithms, Searching and Sorting techniques, Trees, Binary trees, representation, traversal. Dictionaries, ADT for List, Stack, Queue, Hash table representation, Hash functions, Priority queues, Priority queues using heaps, Search trees. AVL trees, operations of AVL trees, Red- Black trees, Splay trees, comparison of search trees.

Course Outcomes:

- CO1:** Ability to write and analyze algorithms for algorithm correctness and efficiency
- CO2:** Master a variety of advanced Abstract Data Type (ADT) and data structures and their Implementation
- CO3:** Demonstrate various searching, sorting and hash techniques and be able to apply and solve problems of real life
- CO4:** Design and implement variety of data structures including linked lists, binary trees, heaps, graphs and search trees
- CO5:** Ability to compare various search trees and find solutions for IT related problems

Module 1:

Introduction: Overview of Pattern Recognition- Relations of PR with other Systems, PR Applications,



Different Approaches to Pattern Recognition- Statistical Approach to PR, Syntactic Approach to PR, Neural Approach to PR, Examples of PR Approaches. Other Approaches to PR.

Module 2:

Structure of PR System: Abstract Representation of PR Mappings, Structure of PR System, Patterns and Features, Feature Extraction Examples, Object Description and Classification, Figure Recognition, Numerical Results and Analysis. Feature Vector and Feature Space, training and Learning in PR System.

Module 3:

Statistical Pattern Recognition: Introduction, Gaussian Case and Class Dependency, Discriminate Function, Examples, Classifier Performance

Module 4:

Training: Parametric Estimation and Supervised Learning, Maximum Likelihood Estimation, Bayesian Parameter Estimation Approach, Parzen Windows, Direct Classification Using Training set., Unsupervised Learning and Clustering, Clustering for Unsupervised Learning and Classification

Module 5:

Syntactic Pattern Recognition: Overview of Syntactic Pattern Recognition, Grammar Based Approaches and Applications, Examples of String Generation as Pattern Description, 2-D line Drawing Description Grammar, Character Description using PDL, Object Description using Projected Cylinder Models, Block World Description Models, Heuristic Generation of Grammars

Module 6:

Recognition of Syntactic Description: Recognition by Matching, Recognition by Parsing, CYK Parsing Algorithm, Augmented Transition Nets in Parsing, Graph Based structure representation, Structured Strategy to Compare Attributed Graphs.

Module 7:

Neural Pattern Recognition: Introduction to Neural Networks,, Neural Network Structure for PR Applications, Physical Neural Networks, ANN Model, NN Based PR Association, Matrix Approaches and Examples

Module 8:

Feed Forward Neural Networks: Training by Back Propagation, Hopfield Approach to Neural Computing, Other related Neural Approaches and Extensions

Text/ Reference Books:

1. Pattern Recognition- Statistical, Structural and Neural Approaches, Rober.J. Shelkoff, JohnWiley & Sons, NY1992,ISBN0-471-52974-5
2. Neural Networks for pattern recognition, Christopher M.Bishop Oxford UniversityPress.



3. Pattern Classification, Richard O.Duda ,Wiley IndiaEdition

CO-PO Mapping:

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

Course Code	PAM302B				
Course Title	Speech Processing				
Category	PECS				
LTP& Credits	L	T	P	Credits	
	3	0	0	3	
Total Contact Hours	48				
Pre-requisites					

Learning Objective:

Aims to provide comprehensive understanding of soft computing approaches for AI problemsolving. Develops in depth knowledge on concepts related to different types of neural networks.Provides in depth knowledge on concepts related to Fuzzy logic, membership value assignment and reasoning with fuzzy quantities.Helps to understand the development of Fuzzy Inference systems and Fuzzy expert systems.Introduces the concepts related to Genetic algorithms for learning from examples.

Course Outcome:



- CO1:** To analyze a speech signal in terms of its frequency content.
- CO2:** To understand the basics of human speech production mechanism.
- CO3:** To understand which speech coding methods are used for what reasons.
- CO4:** To implement LPC Analysis.
- CO5:** To apply various techniques for speech enhancement, including spectral subtraction and enhancement by re-synthesis, to improve the quality and intelligibility of speech signals in noisy environments.

Module 1:

FUNDAMENTALS OF DIGITAL SPEECH PROCESSING: Anatomy & physiology of speech organs, The process of speech production, The acoustic theory of speech production, Digital models for speech signals.

Module 2:

TIME DOMAIN MODELS FOR SPEECH PROCESSING:

Introduction-Window considerations, Short time energy and average magnitude short time average zero crossing rate, Speech Vs Silence discrimination using Average energy and zero crossing, Pitch period estimation using parallel processing approach, The short time autocorrelation function, The short time average magnitude difference function, Pitch period estimation using the autocorrelation function.

Module 3:

LINEAR PREDICTIVE CODING (LPC) ANALYSIS: Basic principles of linear predictive analysis: The Autocorrelation method, The covariance method, solution of LPC equations: Cholesky Decomposition, solution for covariance method, Durbin's recursive solution for the Autocorrelation equations, Comparison between the methods of solution of the LPC parameters, Formant analysis using LPC parameters.

HOMOMORPHIC SPEECH PROCESSING: Introduction, Homomorphic systems for convolution: Properties of the complex cepstrum, computational considerations, The complex cepstrum of speech, pitch detection, Formant estimation, The homomorphic vocoder.

SPEECH SYNTHESIS

FormantSpeechSynthesis–ConcatenativeSpeechSynthesis–ProsodicModificationofSpeech– Source Filter Models For Prosody Modification

Module 4:

AUTOMATIC SPEECH RECOGNITION: Basic pattern recognition approaches, parametric representation of speech, evaluating the similarity of speech patterns, isolated digit recognition system, continuous digit recognition system.

HIDDEN MARKOV MODEL (HMM) FOR SPEECH: Hidden markov model (HMM) for speech recognition, Viterbi algorithm, Training and testing using HMMS, Adapting to variability in speech, Language models.



Module 5:

SPEAKER RECOGNITION: Recognition techniques, Features that distinguish speakers, speaker recognition systems: speaker verification system, Speaker identification system.

SPEECH ENHANCEMENT: Nature of interfering sounds, speech enhancement techniques, spectral subtraction, Enhancement by re-synthesis.

Text / References Books:

1. L.R. Rabiner and S.W. Schafer. Digital processing of speech signals, Pearson.
2. Douglas O. Shaughnessy, speech communication, second edition Oxford university press, 2000.
3. Fundamentals of speech recognition - L.R. Rabiner and B.H. Juang
4. Discrete Time Speech Signal Processing - Thomas F. Quateri 1/e, Pearson.
5. Speech & Audio signal processing - Ben Gold & Nelson Morgan, 1/e, Wiley.
 - a. Jang J.S.R., Sun C.T and Mizutami, Prentice hall New Jersey, 1998

CO-PO Mapping

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3



Course Code	PAM302C			
Course Title	Cyber Security and Cyber law			
Category	PECS			
LTP& Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	48			
Pre-requisites				

Learning Objective:

Aims to provide comprehensive understanding of soft computing approaches for AI problemsolving. Develops in depth knowledge on concepts related to different types of neural networks. Provides in depth knowledge on concepts related to Fuzzy logic, membership value assignment and reasoning with fuzzy quantities. Helps to understand the development of Fuzzy Inference systems and Fuzzy expert systems. Introduces the concepts related to Genetic algorithms for learning from examples.

Course Outcomes:

CO1: Build neural networks to extract patterns from data.

CO2: Build fuzzy inference systems and develop fuzzy expert systems.

CO3: Write genetic algorithms for learning the hyper parameters for data classification.

CO4: Analyze cyber security incidents and propose mitigation strategies.

CO5: Evaluate cyber security policies and regulations in the context of emerging technologies and cyber threats.

Course Content:

Module 1:

Introduction to Cyber Security Introduction, Computer Security, Threats, Harm, Vulnerabilities, Controls, Authentication, Access Control and Cryptography. Web attack: Browser Attacks, Web Attacks Targeting Users, Obtaining User or Website Data, Email Attacks. Network Vulnerabilities: Overview of vulnerability scanning, Open Port / Service Identification, Banner /Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples, OpenVAS, Metasploit. Networks Vulnerability Scanning (Netcat, Socat), Network Sniffers and Injection tools



Module 2:

Network Defense tools

Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs Firewall, How a Firewall Protects a Network, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding. VPN: the basic of Virtual Private Networks. Firewall: Introduction, Linux Firewall, Windows Firewall. Snort: Introduction Detection System.

Module 3:

Web Application Tools

Scanning for web vulnerabilities tools: Nikto, W3af, HTTP utilities - Curl, OpenSSL and Stunnel. Application Inspection tools – Zed Attack Proxy, Sqlmap, DVWA, Webgoat. Password Cracking and Brute-Force Tools: John the Ripper, L0htcrack, Pwdump, HTC-Hydra.

Module 4:

Introduction to Cyber Crime, law and Investigation

Cyber Crimes, Types of Cybercrime, Hacking, Attack vectors, Cyberspace and Criminal Behavior, Clarification of Terms, Traditional Problems Associated with Computer Crime, Introduction to Incident Response, Digital Forensics, Computer Language, Network Language, Realms of the Cyber world. Internet crime and Act: A Brief History of the Internet, Recognizing and Defining Computer Crime, Contemporary Crimes, Computers as Targets, Contaminants and Destruction of Data, Indian IT ACT 2000. Firewalls and Packet Filters, password Cracking, Keyloggers and Spyware, Virus and Worms, Trojan and backdoors, Steganography, DOS and DDOS attack, SQL injection, Buffer Overflow, Attack on wireless Networks.

Module 5:

Computer forensics fundamentals and collection of digital evidence Cyber security initiatives in India Cyber security strategies and policies Cybercrime and different modes of attacks Intrusion detection system.

Text/Reference Books:



1. Cyber Security, Cyber Crime and Cyber Forensics: Applications and Perspectives, RaghuSantanam, M. Sethumadhavan, Information Science Reference
2. Pfleeger, Charles P. and Shari L. Pfleeger. Security in Computing, 4th Edition. Upper SaddleRiver, NJ: Prentice Hall.
3. Cybercrime: Security and Surveillance in the Information Age, Douglas Thomas; Brian Loader
4. Computer Crime: A Crime-Fighters Handbook by David Ilove
5. Crime in the Digital Age: Controlling Telecommunications and Cyberspace Illegalities, Peter N. Grabosky
6. Cyberlaw – The Indian Perspective By Pavan Duggal, Saakshar Law Publications.
7. Jonathan Rosenoer, “Cyber Law: The law of the Internet”, Springer-Verlag, 1997
8. Mark F Grady, Francesco Parisi, “The Law and Economics of Cyber Security”, Cambridge University Press,

CO-PO Mapping

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	PAM303A			
Course Title	Natural Language Processing			
Category	PECS			
LTP& Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	48			
Pre-requisites				

Learning Objective:

This course introduces the fundamental concepts and techniques of natural language processing



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

Course Outcomes:

- CO1:** Demonstrate a given text with basic Language features.
- CO2:** To design an innovative application using NLP components
- CO3:** Explain a rule-based system to tackle morphology/syntax of a language
- CO4:** To design a tag set to be used for statistical processing for real-time applications.
- CO5:** To compare and contrast the use of different statistical approaches for different types of NLP applications.

Course Content:

Module 1:

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

Module 2:

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

Module 3:

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

Module 4:

SEMANTICS AND PRAGMATICS: Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using



Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.

Module 5:

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

Text/Reference Books:

1. Speech and Language Processing: An Introduction to Natural Language Processing,
2. Computational Linguistics and Speech, 2 Edition, Daniel Jurafsky, James H. Martin -Pearson Publication,2014.
3. Natural Language Processing with Python, First Edition, Steven Bird, Ewan Klein and Edward Loper, OReilly Media,2009.
4. Language Processing with Java and LingPipe Cookbook, 1Publisher,2015.
5. Handbook of Natural Language Processing, Second, Nitin Indurkha and Fred J. Damerau, Chapman and Hall/CRC Press, 2010.Edition
6. Natural Language Processing and Information Retrieval, 3 Edition, Tanveer Siddiqui, U.S.Tiwary, Oxford University Press,2008

CO-PO Mapping

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3



Course Code	PAM303B			
Course Title	Computer Vision			
Category	CS			
LTP& Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	48			
Pre-requisites				

Learning Objective:

To Recognize and describe both the theoretical and practical aspects of computing with images and to Connect issues from Computer Vision to Human Vision

Course Outcomes:

CO1: Provide an introduction to computer vision including fundamentals of image formation

CO2: Enumerate the concepts of Feature detection and Matching

CO3: Discuss about Image Segmentation Techniques

CO4: Discuss applications of Feature based alignment like pose estimation

CO5: Discuss different recognition techniques

Course Content:

Module 1:

Introduction: What is computer vision, A brief history, Image Formation, Geometric primitives and transformations, Photometric image formation, The digital camera.

Module 2:

Feature detection and matching: Points and patches, Feature detectors, Feature descriptors, Feature matching, Feature tracking, Application: Performance-driven animation, Edges, Application: Edge editing and enhancement, Lines, Application: Rectangle detection.

Module 3:

Segmentation: Active contours, Split and merge, Mean shift and mode finding, Normalized cuts, Graph cuts and energy-based methods, Application: Medical image segmentation.

Module 4:

Feature-based alignment: 2D and 3D feature-based alignment, Pose estimation, Geometric intrinsic calibration,



Calibration patterns, Vanishing points, Application: Single view metrology, Rotational motion, Radial distortion

Module 5:

Recognition: Object detection, Face detection, Pedestrian detection, Face recognition, Eigenfaces, Active appearance and 3D shape models, Application: Personal photo collections, Instance recognition, Category recognition, Context and scene understanding.

Text/Reference Books:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2010.
2. Rafael C. Gonzalez "Digital Image Processing", Pearson Education; Fourth edition (2018)
3. Forsyth/Ponce, "Computer Vision: A Modern Approach", Pearson Education India; 2nd edition (2015)
4. S. Nagabhushana, "Computer Vision and Image Processing", New Age International Pvt Ltd; First edition (2005)

CO-PO Mapping

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	PAM303C			
Course Title	Agile Technologies			
Category	CS			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	48			
Pre-requisites				



Learning Objective:

Aims to provide comprehensive understanding of soft computing approaches for AI problemsolving. Develops in depth knowledge on concepts related to different types of neural networks. Provides in depth knowledge on concepts related to Fuzzy logic, membership value assignment and reasoning with fuzzy quantities. Helps to understand the development of Fuzzy Inference systems and Fuzzy expert systems. Introduces the concepts related to Genetic algorithms for learning from examples.

Course Outcomes:

CO1: Build neural networks to extract patterns from data.

CO2: Build fuzzy inference systems and develop fuzzy expert systems.

CO3: Write genetic algorithms for learning the hyper parameters for data classification.

CO4: Apply agile design principles and practices including Single Responsibility Principle, Open Closed Principle, Liskov Substitution Principle, Interface Segregation Principles, and Dependency Inversion Principle in software design.

CO5: Utilize continuous integration, automated build tools, and version control systems in agile software development processes.

Course Content:

Module 1:

Fundamentals of Agile

The Genesis of Agile, Introduction and background, Agile Manifesto and Principles, Overview of Scrum, Extreme Programming, Feature Driven development, Lean Software Development, Agile project management, Design and development practices in Agile projects, Test Driven Development, Continuous Integration, Refactoring, Pair Programming, Simple Design, User Stories, Agile Testing, Agile Tools

Module 2:

Agile Scrum Framework

Introduction to Scrum, Project phases, Agile Estimation, Planning game, Product backlog, Sprint backlog, Iteration planning, User story definition, Characteristics and content of user stories, Acceptance tests and Verifying stories, Project velocity, Burn down chart, Sprint planning and retrospective, Daily scrum, Scrum roles – Product Owner, Scrum Master, Scrum Team, Scrum case study, Tools for Agile project management.



Module 3:

Agile Testing

The Agile lifecycle and its impact on testing, Test-Driven Development (TDD), xUnit framework and tools for TDD, Testing user stories - acceptance tests and scenarios, Planning and managing testing cycle, Exploratory testing, Risk based testing, Regression tests, Test Automation, Tools to support the Agile tester.

Module 4:

Agile Software Design and Development

Agile design practices, Role of design Principles including Single Responsibility Principle, Open Closed Principle, Liskov Substitution Principle, Interface Segregation Principles, Dependency Inversion Principle in Agile Design, Need and significance of Refactoring, Refactoring Techniques, Continuous Integration, Automated build tools, Version contr

Text/Reference Books:

1. The Art of Agile Development James shore, Chromatic, O'Reilly 2007
2. Agile Software Development, Principles, Patterns, and Practices Robert C. Martin Prentice Hall 1st edition, 2002
3. Agile and Iterative Development A Manger’s Guide Craig Larman Pearson Education First Edition, India, 2004

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	PAM3101			
Course Title	Soft Computing Lab			
Category	CS			
LTP& Credits	L	T	P	Credits
	0	0	3	1.5



Total Contact Hours	48
Pre-requisites	

Learning Objective:

Aims to provide comprehensive understanding of soft computing approaches for AI problemsolving. Develops in depth knowledge on concepts related to different types of neural networks. Provides in depth knowledge on concepts related to Fuzzy logic, membership value assignment and reasoning with fuzzy quantities. Helps to understand the development of Fuzzy Inference systems and Fuzzy expert systems. Introduces the concepts related to Genetic algorithms for learning from examples.

Course Outcomes:

CO1: Implement neural networks to solve real world problems

CO2: Choose appropriate pre-trained model to solve real time problem

CO3: Parameter tuning using Genetic algorithms

CO4: Write genetic algorithms for learning the hyper parameters for data classification.

CO5: Implement Fuzzy Inference

Course Content:

Software Packages required:

Open source tools for building neural network models, fuzzy logic and genetic algorithms

List of Experiments:

1. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
2. Implement multilayer perceptron algorithm for MNIST Hand written Digit Classification.
3. Design a neural network for classifying movie reviews (Binary Classification) using IMDB dataset.
4. Design a neural Network for classifying news wires (Multi class classification) using Reuters dataset.
5. Design a neural network for predicting house prices using Boston Housing Price dataset.
6. Implement fuzzy inference for image segmentation.



7. Implement the house price prediction problem with fuzzy reasoning
8. Implement the Fuzzy C-Means algorithm for clustering
9. Implement the basic concepts of genetic algorithms for learning
10. Implement genetic algorithms for hyper parameter tuning in neural networks for classifying IMDB dataset.

Text/Reference Books:

1. Ivan Gridin, “Learning Gentic Algorithms with Python”, BPB publishers, 2021
2. Rajasekaran and Pai, “Neural Networks, Fuzzy Logic and Evolutionary Algorithms: Synthesis and Applications, PHI, 2017

CO-PO Mapping

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3



5	PROJ	PAM3201	Innovative Project I	0	0	15	7.5
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MANDATORY NON-CGPA COURSE

MC	PAM3501	Recommended ONLINE NPTEL courses	Classes and evaluation procedures are as per the policy of the online course providers
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**M. Tech. in Computer Science and
Engineering**

**(Artificial Intelligence and Machine
Learning)**

2nd Year 4th Semester Curriculum

SEMESTER-4							
Sl. No.	Type	Course No.	Course Name	L	T	P	Credits
SESSIONAL (ONLY INTERNAL EVALUATION)							
1	PROJ	PAM4201	Innovative Project II	0	0	15	7.5
2	SEMINER	PAM4202	SEMINER	0	0	0	4.5
TOTAL				0	0	15	12