

COURSE SCHEME
EXAMINATION SCHEME
&
SYLLABUS

of

First, Second, Third & Fourth Semester
Choice Base Credit System (CBCS)

of

Master of Technology (M.Tech)

In

Artificial Intelligence(AI)

of

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

**Rashtrasant Tukadoji Maharaj Nagpur University,
Nagpur Faculty of Engineering & Technology
Course and Examination Scheme of Master of Technology
Choice Base Credit System (CBCS)
Semester-I M. Tech. Artificial Intelligence**

Subject Code	Subject	Teaching Scheme			Examination Scheme								
					Theory					Practical			
		Hours per week		No. of Credits	Duration of Paper (Hrs.)	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks
						Univers ity Assessm ent	College Assessm ent			Universi ty Assessm ent	College Assessm ent		
PGAI101T	Artificial Intelligence	4	-	4	3	70	30	100	50	-	-	-	-
PGAI102T	Natural Language Processing	4	-	4	3	70	30	100	50	-	-	-	-
PGAI103T	Soft Computing	4	-	4	3	70	30	100	50	-	-	-	-
PGAI104T	Elective-I	4	-	4	3	70	30	100	50	-	-	-	-
PGAI105T	Elective-II	4	-	4	3	70	30	100	50	-	-	-	-
PGAI106P	Laboratory –I (NLP)	-	2	1	-	-	-	-	-	50	50	100	50
PGAI107P	Laboratory –II (AI)	-	2	1	-	-	-	-	-	50	50	100	50
Total		20	4		-	350	150	500	-	100	100	200	-
Semester Total		24		22	700 Marks								

Elective –I PG AI104/1T- Cloud Computing PG AI104/2T- Agent Based Intelligent Systems PGAI104/3T- Big Data Mining And Analytics

Elective –II PG AI105/1T Robotic Process Automation using Ui Path PG AI105/2T - Data Science PGAI105/3T Human Computer Interface



**Rashtrasant Tukadoji Maharaj Nagpur University,
Nagpur Faculty of Engineering & Technology
Course and Examination Scheme of Master of Technology
Choice Base Credit System (CBCS)
Semester-II M. Tech. AI**

Subject Code	Subject	Teaching Scheme			Examination Scheme								
					Theory					Practical			
		Hour s per week		No. of Credits	Duration of Paper (Hrs.)	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks
		L	P			Univers ity Assessm ent	College Assessm ent			Universi ty Assessm ent	College Assessm ent		
PGAI201T	Machine Learning	4	-	4	3	70	30	100	50	-	-	-	-
PGAI202T	Deep Learning	4	-	4	3	70	30	100	50	-	-	-	-
PGAI203T	Math for Data Science	4	-	4	3	70	30	100	50	-	-	-	-
PGAI204T	Elective –III	4	-	4	3	70	30	100	50	-	-	-	-
PGFD205T	Foundation Course-1	4	-	4	3	70	30	100	50	-	-	-	-
PGAI206P	Laboratory –III (DLT)	-	2	1	-	-	-	-	-	50	50	100	50
PGAI207P	Laboratory –IV (ML)	-	2	1	-	-	-	-	-	50	50	100	50
Total		20	4	-	-	350	150	500	-	100	100	200	-
Semester Total		24		22	700 Marks								

Elective –III PG AI 204/1T - Pattern Recognition PG AI 204/2T – Advanced Algorithms and Analysis PG AI 204/3T- Optimization Techniques

Foundation Course-1: - PGFD205T - Research Methodology



**Rashtrasant Tukadoji Maharaj Nagpur University,
Nagpur Faculty of Engineering & Technology
Course and Examination Scheme of Master of Technology
Choice Base Credit System (CBCS)
Semester-III M. Tech. AI**

Subject Code	Subject	Teaching Scheme		No. of Credits	Examination Scheme								
					Theory					Practical			
		Hours per week			Duration of Paper (Hrs.)	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks
		L	P			Univers ity Assessm ent	College Assessm ent			Universi ty Assessm ent	College Assessm ent		
PGAI301T	Elective–IV	4	-	4	3	70	30	100	50	-	-	-	-
PGFD302T	Foundation Course –II	4	-	4	3	70	30	100	50	-	-	-	-
PGAI303P	Dissertation Phase-I/ Industrial Project	-	-	08	-	-	-	-	-	-	200	200	100
Total		8	-	-		140	60	200	-	-	200	200	-
Semester Total		8		16	400 Marks								

**Elective -IV PG AI 301/1T Computer Vision PG AI 301/2T Data Visualization Techniques PGAI 301/3T Block chain Technology Foundation
Course -II PGFD302T - Project planning and Management**



Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Faculty of Engineering & Technology
Course and Examination Scheme of Master of Technology
Choice Base Credit System (CBCS)
Semester-IV M. Tech. AI

Subject Code	Subject	Teaching Scheme			Examination Scheme								
					Theory					Practical			
		Hours per week		No. of Credits	Duration of Paper (Hrs.)	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks
		L	P			Univers ity Assessm ent	College Assessm ent			Universi ty Assessm ent	College Assessm ent		
PGAI401P	Dissertation Phase-II	-	-	16	-	-	-	-	-	400	-	400	200
Total		-	-	-	-	-	-	-	-	400	-	400	-
Semester Total		-		16		400 Marks							




PGAI101T – Artificial Intelligence

Teaching Scheme
Lectures: 3 Hrs/Week
No.of Credits: 04

Examination Scheme
Total Marks (IA+TH) : 100
Internal Assessment (IA) : 30
Theory (TH) : 70

Course Outcomes

CO1	To apply the various searching techniques, constraint satisfaction problem and example problems-game playing techniques.
CO2	To classify knowledge based system by problem solving technique.
CO3	To be able to design a knowledge based system
CO4	To analyze important historical and current trends addressing artificial intelligence.
CO5	To be familiar with terminology used in knowledge based system and expert system.

Unit-I Introduction of AI: AI History and applications, Overview of AI application areas, game playing, automated reasoning and theorem proving, expert systems, natural language understanding, planning and robotics, machine learning and Alan Turing Test, Intelligent Agents.

Unit-II Problem Solving and Knowledge representation: Solving problem by searching, Beyond classical search, Adversarial search, Constraint satisfaction problem, Knowledge, reasoning and planning, Logical Agents, First order logic, Inference in First order logic. Classical Planning, planning and acting in the real world, Logic Programming, Weak Slot-and-Filler Structures, Semantic Nets and Frames, Scripts for representing prototypical combination of events and actions, Ontology.

Unit-III Uncertain Knowledge and reasoning: Quantifying uncertainty ,rational decisions, axioms of probability, Baye"s Rule and conditional independence , Bayesian networks , Exact and Approximate inference in Bayesian Networks, Probabilistic reasoning, Hidden Markov Models, Dynamic Bayesian Networks,

Unit-IV AI Learning Models: Concept of learning, learning automation, Knowledge-Based Classification Inductive Learning, Deductive Learning: Feedback Based Classification Unsupervised Learning, Supervised Learning, Semi-supervised learning and Reinforcement Learning

Unit-V Expert Systems: Building an expert system, application areas of expert system Knowledge Engineering, Knowledge Acquisition, Knowledge Based Systems, Automated Reasoning, Rule-Based Expert Systems Case studies: MYCIN, RI, CaDeT, and DENDRAL.

Text Books:

1. E. Rich and K. Knight, "Artificial intelligence", TMH, 2nd ed., 1992.
2. N.J. Nilsson, "Principles of AI", Narosa Publ. House, 1990.
3. D.W. Patterson, "Introduction to AI and Expert Systems", PHI, 1992.

Reference Books:

- 1.R.J. Schalkoff, "Artificial Intelligence -an Engineering Approach", McGraw Hill Int. Ed., Singapore, 1992.
- 2.Peter Jackson, "Introduction to Expert Systems", AWP, M.A., 1992.
3. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, Prentice Hall, 3rd, 2009



PGAI102T: Natural Language Processing

Teaching Scheme
Lectures: 4 Hrs/Week
No.of Credits: 04

Examination Scheme
Total Marks (IA+TH) : 100
Internal Assessments (IA): 30
Theory (TH) : 70

Course Outcomes

CO1	To categorized various approaches to syntax and semantics in NLP.
CO2	To differentiate the approaches to discourse, generation, dialogue and summarization within NLP.
CO3	Model current methods for statistical approaches to machine translation
CO4	To examine machine learning techniques used in NLP, including hidden Markov models and clustering and unsupervised methods.
CO5	Able to apply the methods to new NLP problems and will be able to apply the methods to problems outside NLP.

Unit-I Introduction: Machine Learning and NLP, ArgMax Computation, word spellcheck, morphology using FSTs, Basic ideas in Lexical Semantics, Word Sense Disambiguation, WordNet, Application in Query Expansion, Measures of Word Net Similarity, Concept Mining using Latent Semantic Analysis, Word Sense Disambiguation.

Unit-II Sentences: Basic ideas in compositional semantics, Classical Parsing (Bottom up, top down, Dynamic Programming, CYK parser), Parsing using Probabilistic Context Free Grammars and EM based approaches for learning PCFG parameters, Language Modelling.

Unit-III Speech : Phonetics, Hidden Markov Model, Morphology, Graphical Models for Sequence Labelling in NLP, Consonants (place and manner of articulation) and Vowels. Forward Backward probability; Viterbi Algorithm, Phonology, Sentiment Analysis and Opinions on the Web, Machine Translation and MT Tools -GIZA++ and Moses, Text Alignment, POS Tagging.

Unit-IV Machine Translation: Need of MT, Problems of Machine Translation, MT Approaches, Direct Machine Translations, Rule-Based Machine Translation, Knowledge Based MT System, Statistical Machine Translation, UNL Based Machine Translation, Translation involving Indian Languages.

Unit-V Information Extraction: Introduction to Named Entity Recognition and Relation Extraction
Natural Language Generation, the potential of using ML for NLG

Text Books:

- 1.Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming, 1995.
- 2.Charniack, Eugene, Statistical Language Learning, MIT Press, 1993.
- 3.Jurafsky, Dan and Martin, James, Speech and Language Processing, Second Edition, Prentice Hall, 2008.
- 4.Manning, Christopher and Heinrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.

Reference Books:

1. Jensen K., Heidorn G.E., Richardson S.D., Natural Language Processing: The PLNLP Approach, Springer ,2013.
2. Siddiqui and Tiwary U.S., Natural Language Processing and Information Retrieval, Oxford University Press, 2008.
3. Radford, Andrew et. al.,Linguistics, An Introduction, Cambridge University Press, 1999.

PG AI 103T- Soft Computing

Teaching Scheme

Lectures: 3 Hrs/Week

No.of Credits: 04

Examination Scheme

Total Marks (IA+TH) : 100

Internal Assessments (IA) : 30

Theory (TH) : 70

Course Outcomes

CO1	Identify and describe soft computing techniques and their roles in building intelligent machines
CO2	Recognize the feasibility of applying a soft computing methodology for a particular problem
CO3	Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems
CO4	Apply genetic algorithms to combinatorial optimization problems
CO5	To construct appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications

Unit-I Introduction to Soft computing: Introduction, requirement, different tools and techniques, use fullness and applications. Artificial Intelligence-Artificial Neural Networks-Fuzzy Systems-Genetic Algorithm and Evolutionary Programming-Swarm Intelligent Systems-Classification of ANNs-McCulloch and Pitts Neuron Model-Learning Rules, Different learning methods: Supervised, Unsupervised & reinforced, Common activation functions

Unit-II Artificial Neural Networks: Introduction, basic models, Hebb's learning, Perceptron, Multilayer feed forward network, Different issues regarding convergence of Multilayer Perceptron, Competitive learning, Back propagation Neural Networks, Kohonen Neural Network, Learning Vector Quantization, Hamming Neural Network, Hopfield Neural Network, Bi-directional Associative Memory, Adaptive Resonance Theory Neural Networks, Support Vector Machines, Spike Neuron Models.

Unit-III Fuzzy Systems Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets ,Classical Relations and Fuzzy Relations ,Membership Functions, Defuzzification, Fuzzy Arithmetic and Fuzzy Measures , Fuzzy Rule Base and Approximate Reasoning ,Introduction to Fuzzy Decision Making. Linguistic variables, Linguistic hedges, Applications, fuzzy controllers, fuzzy pattern recognition, fuzzy image processing, fuzzy database.

Unit-IV Genetic Algorithms: Basic Concepts, role of genetic algorithms in optimization, Working Principles ,Encoding, Fitness Function, Reproduction ,Inheritance Operators , Cross Over , Inversion and Deletion ,Mutation Operator ,Bit-wise Operators ,Convergence of Genetic Algorithm. Multi objective & Multi modal optimization in genetic algorithms, Application- Travelling Salesman Problem, Graph Coloring problem

Unit-V Hybrid Systems: Hybrid Systems -Neural Networks, Fuzzy Logic and Genetic , GA Based Weight Determination , LR-Type Fuzzy Numbers , Fuzzy Neuron, Fuzzy BP Architecture ,Learning in Fuzzy BP, Inference by Fuzzy BP ,Fuzzy ArtMap: A Brief Introduction , Soft Computing Tools ,GA in Fuzzy Logic Controller Design ,Fuzzy Logic Controller.

Text Books:

1. N.P.Padhy, S.P.Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015.
2. S.N.Sivanandam , S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt. Ltd., 2nd Edition, 2011.
3. S.Rajasekaran, G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt. Ltd., 2017.

Reference books :

- 1.J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI, 2004, Pearson Education.
2. N.P.Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press, 2006
- 3.SamirRoy"Introduction to Soft computing "NeuroFuzzy and Genetic Algorithms", First edition, Pearson Publishers, 2015.

4. J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", Pearson, 2004.
5. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill, 1997.
6. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, 2009.

Four handwritten signatures in blue ink are arranged horizontally. From left to right: the first is a simple 'K' with a horizontal line; the second is a stylized, cursive signature; the third is a signature starting with a large 'E' or 'G'; the fourth is a signature starting with a large 'J' or 'D'.

Elective –I

PG AI104/IT- Cloud Computing

Teaching Scheme

Lectures: 3 Hrs/Week

No.of Credits: 04

Examination Scheme

Total Marks (IA+TH) 100

Internal Assessments (IA) : 30

Theory (TH) 70

Course Outcomes

CO1	To construct the concepts, characteristics, delivery models and benefits of cloud computing
CO2	Discuss system, network and storage virtualization and outline their role in enabling the cloud computing system model.
CO3	Apply fundamental concepts in cloud infrastructures to understand the tradeoffs in power, efficiency and cost, and then study how to leverage and manage single and multiple datacenters to build and deploy cloud applications
CO4	To determine the key security and compliance challenges of cloud computing
CO5	Analyze various cloud programming models and apply them to solve problems on the cloud.

Unit-I Introduction to Cloud Computing: Introduction to Cloud Computing, History of Cloud Computing, Cloud service providers. Properties, Characteristics & Disadvantages - Pros and Cons of Cloud Computing, Benefits of Cloud Computing, Cloud computing vs. Cluster computing vs Grid computing, Role of Open Standards.

Unit-II Cloud Architecture, Services And Storage: Cloud computing stack , Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used, Role of Web services. Service Models (XaaS) - Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service(SaaS). Deployment Models, Public cloud, Private cloud, Hybrid cloud, Community cloud.

Unit-III Cloud Virtualization: Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and paravirtualization, Hardware support for virtualization, Case Study: Xen a VMM based paravirtualization, Optimization of network virtualization, vBlades, Performance comparison of virtual machines, The dark side of virtualization, Exercises and problems

Unit-IV Security in Cloud: Cloud Security Challenges, Infrastructure Security, Network level security, Host level security, Application level security, data privacy, data security, application security, virtual machine security, Identity Access Management, Authentication in cloud computing, Client access in cloud, Cloud contracting Model, Commercial and business considerations

Unit-V Creating Cloud Application using Azure: Creating simple cloud application, configuring an application, creating virtual machine, deployment of application to Windows Azure Cloud, using Azure Storage Services, using Azure Table Service, deployment of application to the production environment.

Text Books:

1. Essentials of cloud Computing: K.Chandrasekhran, CRC press, 2014.
2. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumaraswamy, Shahed Latif, O'Reilly, SPD, rp2011.
3. Cloud Computing Theory and Practice, Dan C Marinescu, Elsevier (MK) 2013.

Reference Books:

1. Thomas Erl, Zaigham Mahood, Ricardo Puttini, "Cloud Computing, Concept, Technology & Architecture", Prentice Hall, 2013.

2. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, "Mastering Cloud Computing", Tata McGraw-Hill, 2013.
3. Toby Velte, Anthony Velte, Robert C. Elsenpeter, "Cloud Computing, A Practical Approach", Tata McGraw-Hill Edition, 2010.

PG AI104/2T- Agent Based Intelligent Systems

Teaching Scheme

Lectures: 3 Hrs/Week

No. of Credits: 04

Examination Scheme

Total Marks (IA+TH) 100

Internal Assessments (IA) : 30

Theory (TH) 70

Course Outcomes

CO1	To determine the factors of the basic artificial intelligence techniques.
CO2	To distinguish between intractability with procedural control of reasoning.
CO3	Able to deploy an agent within a simulated agent trading environment
CO4	To construct Intelligent Agent Systems by applying various principles.
CO5	Analyse and critique the performance of a deployed agent

Unit-I Introduction: Agents as a paradigm for software engineering, Agents as a tool for understanding human societies, Intelligent Agent: Agents and Objects, Agents and Expert Systems, Agents as Intentional Systems, Abstract Architectures for Intelligent Agents, How to Tell an Agent What to Do.

Unit-II Learning in agents: Proportional Case, Handling variables and qualifiers, Dealing with intractability, Reasoning with horn clauses, Procedural control of reasoning, Rules in production, Reasoning with Higher order Logics

Unit-III Communication and Cooperation in Agents: Software tools for ontology, Speech acts, Cooperative Distributed Problem Solving, Task Sharing and Result Sharing, Result Sharing, Combining Task and Result Sharing, Handling In consistency, Coordination, Multiagent Planning and Synchronization

Unit-IV Developing Intelligent Agent Systems: Situated Agents, Actions and Percepts, Proactive and Reactive Agents: Goals and Events, Challenging Agent Environments: Plans and Beliefs of Social Agents, Agent Execution Cycle, Deciding on the Agent Types, Grouping functionalities, Review Agent Coupling-Acquaintance Diagrams-Develop Agent Descriptors.

Unit-V Applications: Agent for workflow and business process management, Mobile agents, Agents for distributed systems, agents for information retrieval and management, agents for electronic commerce agent for human computer interface agents for virtual environments agents for social simulation.

Text Books:

1. Ronald Brachman, Hector Levesque—Knowledge Representation and Reasoning, The Morgan Kaufmann Series in Artificial Intelligence 2004.
2. Arthur B. Markman, —Knowledge Representation, Lawrence Erlbaum Associates, 1998.
3. Agent-Based Hybrid Intelligent Systems: An Agent-Based Framework for Complex Problem Solving by Zili Zhang, Chengqi Zhang, Springer; 2004.

Reference Books:

1. Michael Wooldridge, an Introduction to Multi Agent Systems, Second Edition, John Wiley and Sons, 2009.
2. Stuart Russell, Peter Norvig, —Artificial Intelligence: A Modern Approach||, Third Edition, Pearson Education, 2009.
3. Lin Padgham, Michael Winikoff, Developing Intelligent Agent Systems: A Practical Guide, Wiley publications, 2005.

PG AI104/3T- Big Data Mining and Analytics

Teaching Scheme

Lectures: 4 Hrs/Week

No.of Credits: 04

Examination Scheme

Total Marks (IA+TH) : 100

Internal Assessments (IA): 30

Theory (TH) : 70

Course Outcomes

CO1	To categorize the key issues in big data management and its associated applications in intelligent business and scientific computing
CO2	To acquire fundamental enabling techniques and scalable algorithms like Hadoop, Map Reduce and NO SQL in big data analytics.
CO3	Able to solve problems associated with batch learning and online learning, and the big data characteristics such as high dimensionality.
CO4	Ability to understand and apply scaling up machine learning techniques and associated computing techniques and technologies.
CO5	To determine the factors that scaling up machine learning techniques and associated computing techniques and technologies.

Unit-I Data Mining And Large Scale Files Introduction to Statistical modeling, Machine Learning , Computational approaches to modeling , Summarization, Feature Extraction , Statistical Limits on Data Mining , Distributed File Systems, Map-reduce , Algorithms using Map Reduce , Efficiency of Cluster Computing Techniques.

Unit-II: Link Analysis And Frequent Item sets Page Rank , Efficient Computation ,Topic Sensitive Page Rank , Link Spam , Market Basket Model , Apriori algorithm , Handling Larger Datasets in Main Memory , Limited Pass Algorithm , Counting Frequent Item sets.

Unit-III: Clustering Introduction to Clustering Techniques , Hierarchical Clustering , Algorithms, K-Means , CURE , Clustering in Non Euclidean Spaces , Streams and Parallelism , Case Study: Advertising on the Web –Recommendation Systems

Unit-IV: Finding Similar Items Nearest Neighbor Search, Shingling of Documents, Similarity preserving summaries, Locality sensitive hashing for documents, Distance Measures, Theory of Locality Sensitive Functions, LSH Families, Methods for High Degree of Similarities.

Unit-V: Mining Data Streams Stream Data Model , Sampling Data in the Stream , Filtering Streams, Counting Distance Elements in a Stream , Estimating Moments , Counting Ones in Window, Decaying Windows.

Text Books:

1. Data Mining Concepts and Techniques, Jiawei Han Micheline Kamber, Jian pei, Morgan Kaufmann.
2. Data Mining Techniques –Arun K pujari, Universities Press.
3. Data Mining Concepts and Techniques Third Edition Jiawei Han University of Illinois at Urbana-Champaign Micheline Kamber, Jian Pei Simon, Fraser University , Elsevier 2012.

Reference Books:

1. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, Second Edition, 2014.
2. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining Concepts and Techniques", Morgan Kaufman Publications, Third Edition, 2011.
3. Ian H. Witten, Eibe Frank "Data Mining –Practical Machine Learning Tools and Techniques", Morgan Kaufman Publications, Third Edition, 2011.
4. David Hand, Heikki Mannila and Padhraic Smyth, "Principles of Data Mining", MIT Press, 2001.

Elective –II

PG AI 105/1T: Robotic Process Automation using UiPath.

Teaching Scheme

Lectures: 3 Hrs/Week

No.of Credits: 04

Examination Scheme

Total Marks (IA+TH) 100

Internal Assessments (IA) : 30

Theory (TH) 70

Course Outcomes

CO1	To acquire insights into Robotic Process Automation Technology and Learn basic concepts of UI Automation using UiPath
CO2	To classify several types of data inside a workflow and Gain skills in building workflows in UiPath
CO3	Categorize knowledge in dissecting the myths from the facts and realize the true benefits of RPA
CO4	Able to implement REFramework by following a rules of developing.
CO5	To distinguish the strategic and tactical roll out of the RPA solution

Unit-I Introduction to Robotic Process Automation: Emergence of Robotic Process Automation (RPA), Evolution of RPA, Future of RPA, Differentiating RPA from Automation, Defining Robotic Process Automation & its benefits, What RPA is Not, Types of Bots, Application areas of RPA, How Robotic Process Automation works, RPA development methodology and key considerations, List of Robotic Process Automation Tools

Unit-II Overview of UiPath: Introduction to UiPath platform and its components, Installation details of UiPath's Community Edition, Types of Templates, User Interface, Domains in Activities, Workflow Files in UiPath Process Components and Activities: UI Automation Activities, System Activities, Variables, Arguments, Imports Panel and User Events.

Unit-III App Integration, Recording and Scraping: App Integration, Recording, Scraping, Selector, Workflow Activities Example of Automate login to your (web)Email account, Recording mouse and keyboard actions to perform an operation, Scraping data from website and writing to CSV.

Unit-IV Implementing REframe work: Introduction to REFramework, About REFramework Purpose of REFramework Using State Machine Layout, States of the State Machine, Workflows Involved, Workflows of the Framework, Exception Handling & Logging, Rules of Developing a Process using REFramework.

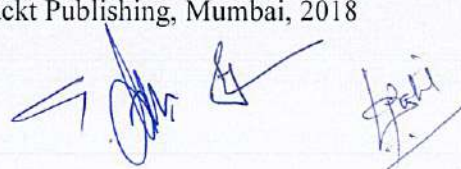
Unit-V Data Manipulation & PDF Automation: Data Manipulation, Automation of Virtual Machines, Introduction to Native Citrix Automation, Text and Image Automation, PDF Automation, Computer Vision

Text books:

1. RPA robotic process automation by Gerardus Blokdyk, 2018
2. Learning Robotic Process Automation by Alok Mani Tripathi, Packt Publishing, Mumbai, 2018
3. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath by Alok Mani Tripathi, Packt Publishing, Mumbai, 2018.

Reference Books:

1. The Simple Implementation Guide to Robotic Process Automation (Rpa): How to Best Implement Rpa in an Organization, Kelly wibbenmeyer, iUniverse publications.
2. Essentials of Robotics Process Automation by S. Muhkerjee, Khanna Publishing, 2019.
3. Robotic Process Automation with Blue Prism Quick Start Guide: Create software robots and automate business processes by Lim Mei Ying, Packt Publishing, Mumbai, 2018



PG AI 105/2T - Data Science

Teaching Scheme

Lectures: 3 Hrs/Week

No.of Credits: 04

Examination Scheme

Total Marks (IA+TH) : 100

Internal Assessments (IA) : 30

Theory (TH) : 70

Course Outcomes

CO1	Provide students with knowledge and skills in both computer science and statistical modeling for data-intensive problem solving and scientific discovery
CO2	Equip students with software engineering and machine learning skills to design and implement efficient, data-driven solutions to real world problems
CO3	Train students for careers and advanced studies in a wide range of applied computer science, engineering, business, and biotechnology disciplines
CO4	Develop articulate, conscientious leaders and problem solvers who are committed to contributing to their fields and society.
CO5	Provide students with a broad foundation of knowledge and skills and cultivate a commitment to life-long learning.

Unit-I Introduction : Data Science Articulated, History And Context, Ethical Issues, Technology Landscape Parallel Databases, Parallel Query Processing, Data Engineering, Mapreduce, Hadoop, Key-Value Stores And Nosql; Tradeoffs Of Sql And Nosql.

Unit-II Statistical Inference: Populations And Samples, Statistical Modeling, Probability Distributions, Fitting A Model, Intro To R machine Learning: Supervised Learning: Regression, Polynomial Regression, Local Regression, K-Nearest Neighbors, Unsupervised Learning: Kernel Density Estimation, K-Means, Naive Bayes, Data And Data Scraping, Classification, Ranking, Logistic Regression

Unit-III Introduction To Big Data Analytics: Big Data Platforms, Big Data Storage And Processing, Big Data Analytics Algorithms (Recommendation, Clustering, And Classification), Spark And Data Analytics, Linked Big Data --I (Graph Db & Graph Analytics, Big Data Applications (Tba))

Unit-IV 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) Social Network Analysis, Observational Causal Modeling, Sampling, Data Leakage, Data Incest.

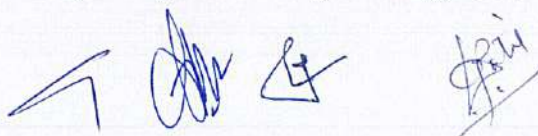
Unit-V Graph Analytics: Structure, Traversals, Analytics, Pagerank, Community Detection, Recursive Queries, Semantic Web Fundamentals Of Data Visualization, Basic Principles, Ideas And Tools For Data Visualization

Text Books:

1. "Doing Data Science, Straight Talk From The Frontline": Cathy O'neil And Rachel Schutt. .O'reilly. 2014.
2. "Mining Of Massive Datasets", Anand Rajaraman And Jeff Ullman.
3. R for Data Science by Garrett Grolemund, Hadley Wickham published by O'Reilly, 2017.

Reference Books:

1. "Data Mining And Analysis: Fundamental Concepts And Algorithms.": Mohammed J.Zaki Andwagner Miera Jr. Cambridge University Press. 2014.
2. "Data Mining: Concepts And Techniques": Jiawei Han, Micheline Kamber And Jian Pei. Third Edition. Isbn 0123814790. 2011.
3. Data Science From Scratch: First Principles of Python by Joel Grus by O'Reilly, 2019.



PG AI/ML 105/3T- Human Computer Interface

Teaching Scheme

Lectures: 3 Hrs/Week

No.of Credits: 04

Examination Scheme

Total Marks (IA+TH) : 100

Internal Assessments (IA) : 30

Theory (TH) : 70

Course Outcomes:

CO1	To demonstrate core theories, models and methodologies from the field of HCI
CO2	Describe what the user-centered design cycle is and explain how to practice this approach to design interactive software systems
CO3	Analyze one after another the main features of interactive systems, and explain how to gauge the usability of digital environments, tools and interfaces
CO4	To compute with various elements of Mobile design including games & widgets.
CO5	Implement graphical user interfaces with modern software tools

Unit-I Introduction: Foundation of Human Computer Interaction Paradigms ,What is HCI , Components ,Cognitive Framework ,Perception and Representation ,Attention and Memory Constraint, Knowledge and Mental Model ,Interface Metaphors ,Input, Output.

Unit-II Design process: Interaction Styles ,Interaction Design Basics, HCI in the Software Process, Design Rules , Designing Windowing Systems , User Support and On-Line Information, Designing For Collaborative Work and Virtual Environments, Principles and User-Centred Design -Methods for User-Centred Design.

Unit-III Models and Theories: Cognitive models, Socio-Organizational issues and stake holder requirements, Communication and collaboration models-Hypertext, Multimedia and WWW.

Unit-IV 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.

Unit-V Software tools and Web Interface Design: Specification methods, interface, Building Tools. Eight Interaction Devices, Keyboard and function keys, pointing devices, speech recognition digitization and generation, image and video displays, drivers. Designing Web Interfaces, Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Case Studies.

Reference Books

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale Human Computer Interaction, 3rd Edition Prentice Hall, 2004.
2. Jonathan Lazar Jinjuan Heidi Feng, Harry Hochheiser, Research Methods in HumanComputer Interaction, Wiley, 2010.
3. Ben Shneiderman and Catherine Plaisant Designing the User Interface: Strategies for Effective Human-Computer Interaction (5th Edition, pp. 672, ISBN 0-321-53735-1, March 2009).

Reference Books

1. Human-Computer Interaction, Alan Dix ,Janet E. Finlay, Gregory D. Abowd, Russell Beale Pearson Education.
2. Brian Fling, "Mobile Design and Development", First Edition , OReilly Media Inc., 2009
3. Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, OReilly, 2009.



Semester – II

PGAI201T- Machine Learning

Teaching Scheme

Lectures: 3 Hrs/Week

No.of Credits: 04

Examination Scheme

Total Marks (IA+TH) 100

Internal Assessments (IA) 30

Theory (TH) 70

Course Outcomes:

CO1	Analyze the basic concepts of Machine Learning
CO2	To dissect the problems using Supervised machine learning techniques
CO3	Solve the problems using Unsupervised machine learning techniques
CO4	Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.
CO5	Experiment the learning algorithm for hidden Markov model with latent variables and algorithms for learning Bayesian networks.

Unit-I Introduction: Types of Machine Learning , Machine Learning process, preliminaries, testing Machine Learning algorithms, turning data into probabilities, and Statistics for Machine Learning, Probability theory ,Probability Distributions ,Decision Theory.

Unit-II Supervised Learning: Linear Models for Regression , Classification, Discriminant Functions, Probabilistic Generative Models, Probabilistic Discriminative Models , Decision Tree Learning , Bayesian Learning, Naïve Bayes , Ensemble Methods, Bagging, Boosting, Neural Networks , Multi-layer Perception, Feed-forward Network, Error Back propagation ,Support Vector Machines.

Unit-III Unsupervised Learning: Clustering-K-means , EM Algorithm, Mixtures of Gaussians , Dimensionality Reduction, Linear Discriminant Analysis, Factor Analysis, Principal Components Analysis, Independent Components Analysis.

Unit-IV Discriminative Models: Least Square Regression, Gradient Descent Algorithm, Univariate and Multivariate Linear Regression, Prediction Model, probabilistic interpretation, Regularization, Logistic regression, multi class classification, Support Vector Machines- Large margin classifiers, Nonlinear SVM, kernel functions, SMO algorithm.

Unit-V Generative models: k-Nearest Neighbour Classification, Bayesian concept learning, Likelihood, Posterior predictive distribution, beta-binomial model, Naive Bayes classifiers, classifying documents using bag of words. Bayesian Statistics and Frequentist statistics. Directed graphical models (Bayes nets), Conditional independence, Inference.

Text books:

1. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2016.
2. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Third Edition, 2014.
3. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.

Reference Books:

1. Christopher Bishop, "Pattern Recognition and Machine Learning" Springer, 2007.
2. Stephen Marsland, "Machine Learning –An Algorithmic Perspective", Chapman and Hall, CRC Press, Second Edition, 2014.
3. Randal S, "Python Machine Learning, PACKT Publishing, 2016

PGAI202T: Deep Learning

Teaching Scheme

Lectures: 3 Hrs/Week

No.of Credits: 04

Examination Scheme

Total Marks (IA+TH) 100

Internal Assessments (IA) : 30

Theory (TH) 70

Course Outcomes

CO1	To determine the fundamentals of deep learning.
CO2	To classify the main techniques in deep learning and the main research in this field.
CO3	Able to solve Dimensionality Reduction in networks using architectures.
CO4	To understand Optimization & generalization in Deep Learning
CO5	To know the knowledge about Computational & Artificial Neuroscience

Unit-I Introduction: Introduction to machine learning- Linear models (SVMs and Perceptrons, logistic regression), Introduction to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates.

Unit-II Deep Networks History of Deep Learning: A Probabilistic Theory of Deep Learning, Back propagation and regularization, batch normalization, VC Dimension and Neural Nets, Deep Vs Shallow Networks Convolutional Networks, Generative Adversarial Networks (GAN), Semi-supervised Learning.

Unit-III Dimensionality Reduction: Linear (PCA, LDA) and manifolds, metric learning, Auto encoders and dimensionality reduction in networks, Introduction to Convnet Architectures, AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyper parameter optimization.

Unit-IV Optimization and Generalization: Optimization in deep learning- Non -convex optimization for deep networks- Stochastic Optimization Generalization in neural networks- Spatial Transformer Networks- Case Study of Imagenet, Detection-Audio Wave Net.

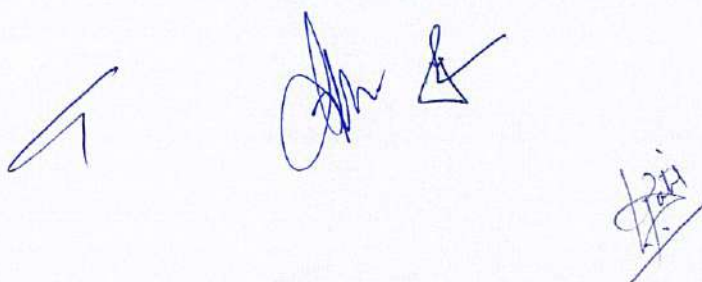
Unit-V Recurrent Neural Network: Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning, Computational & Artificial Neuroscience Case study on Natural Language Processing Word2Vec, Joint Detection Bioinformatics, Face Recognition.

Text Books:-

1. Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press, 2016.
2. Deng & Yu, "Deep Learning: Methods and Applications", Now Publishers, 2013.
3. Michael Nielsen, "Neural Networks and Deep Learning", Determination Press, 2015.

Reference Books:-

1. Neural Networks: A Systematic Introduction, Raúl Rojas, 1996
2. Pattern Recognition and Machine Learning, Christopher Bishop, 2007
3. Cosma Rohilla Shalizi, "Advanced Data Analysis from an Elementary Point of View", 2015



PG AI 203T – Math for Data Science

Teaching Scheme

Lectures: 3 Hrs/Week

No.of Credits: 04

Examination Scheme

Total Marks (IA+TH) 100

Internal Assessments (IA) : 30

Theory (TH) 70

Course Outcomes

CO1	Demonstrate understanding of basic mathematical concepts in data science, relating to linear algebra, probability, and calculus.
CO2	Employ methods related to these concepts in a variety of data science applications.
CO3	Apply logical thinking to problem-solving in context.
CO4	Use appropriate technology to aid problem-solving and data analysis.
CO5	Demonstrate skills in unconstrained optimization.

Unit-I Basics of Data Science: Introduction; Typology of problems; Importance of linear algebra, statistics and optimization from a data science perspective, structured thinking for solving data science problems.

Unit-II Calculus of Several Variables: Functions of Several Variables, Limits and continuity in Higher Dimensions, Partial Derivatives, The Chain Rule - Directional Derivative and Gradient vectors, Tangent Planes and Differentials, Extreme Values and Saddle Points, Lagrange Multipliers.

Unit-III Linear Algebra: Matrices and their properties (determinants, traces, rank, nullity) Eigenvalues and eigenvectors, Matrix factorizations, Inner products, Distance measures, Projections, Notion of hyper planes, half-planes.

Unit-IV Probability, Statistics and Random Processes: Probability theory and axioms, Random variables, Probability distributions and density functions (univariate and multivariate) Expectations and moments, Covariance and correlation, Statistics and sampling distributions, Hypothesis testing of means, proportions, variances and correlations, Confidence (statistical) intervals, Correlation functions, White-noise process.

Unit-V Optimization: Unconstrained optimization, Necessary and sufficiency conditions for optima, Gradient descent methods, Constrained optimization, KKT conditions, Introduction to non-gradient techniques, Introduction to least squares optimization, Optimization view of machine learning. Data Science Methods: Linear regression as an exemplar function approximation problem, linear classification problems.

Text Books:

1. G. Strang Introduction to Linear Algebra, Wellesley-Cambridge Press, Fifth edition, USA 2016.
2. Bendat, J. S. and A. G. Piersol Random Data: Analysis and Measurement Procedures. 4th Edition. John Wiley & Sons, Inc., NY, USA 2010.
3. Montgomery, D. C. and G. C. Runger Applied Statistics and Probability for Engineers. 5th Edition. John Wiley & Sons, Inc., NY, USA, 2011.

Reference Books:

1. Cathy O'Neil and Rachel Schutt, Doing Data Science, O'Reilly Media 2013.
2. S. P. Boyd and L. Vandenberghe, Convex optimization. Cambridge Univ. Pr., 2011.
3. M. D. Weir, J. Hass, and G. B. Thomas, Thomas' calculus. Pearson, 2016.



Elective –III

PGAI204/1T- Pattern Recognition

Teaching Scheme

Lectures: 3 Hrs/Week

No.of Credits: 04

Examination Scheme

Total Marks (IA+TH) 100

Internal Assessments (IA) 30

Theory (TH) 70

Course Outcomes:

CO1	Differentiate a variety of pattern classification, structural pattern recognition, and pattern classifier combination techniques.
CO2	Summarize, analyze, and relate research in the pattern recognition area verbally and in writing.
CO3	Apply performance evaluation methods for pattern recognition, and critique comparisons of techniques made in the research literature.
CO4	Apply pattern recognition techniques to real-world problems such as document analysis and recognition.
CO5	To implement simple pattern classifiers, classifier combinations, and structural pattern recognizers.

Unit-I Introduction: Definition ,Applications, Datasets , Different paradigms , Data structures for Pattern Recognition, Introduction to probability, events, random variables, Joint distributions and densities, moments. Estimation minimum risk estimators, problems, Representation of clusters, proximity measures, size of patterns, Abstraction of Data set, Feature extraction, Feature selection, Evaluation

Unit-II Statistical Pattern Recognition: Review of probability theory, Gaussian distribution, Bayes decision theory and Classifiers, Optimal solutions for minimum error and minimum risk criteria, Normal density and discriminant functions, Decision surfaces.

Unit-III Parameter Estimation Methods: Maximum-Likelihood Estimation: Gaussian case. Maximum Posteriori estimation, Bayesian estimation, Gaussian case. Unsupervised learning and clustering - Criterion functions for clustering, Algorithms for clustering, K-Means, Hierarchical and other methods. Cluster validation. Gaussian mixture models, Expectation-Maximization method for parameter estimation. Maximum entropy estimation, Sequential Pattern Recognition. Hidden Markov Models, Nonparametric techniques for density estimation.

Unit-IV Non-Parameter methods: Non-parametric techniques for density estimation, Parzen-window method, K-Nearest Neighbour method, Non-metric methods for pattern classification, Non-numeric data or nominal data Decision trees, Concept of construction, splitting of nodes, choosing of attributes, overfitting, pruning.

Unit-V Dimensionality reduction: Fisher discriminant analysis, Principal component analysis, Factor Analysis, Linear discriminant functions, Gradient descent procedures, Perceptron, Support vector machines, Non-metric methods for pattern classification, Non-numeric data or nominal data, Decisiontrees:CART

Text Books:

1. R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001
2. S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009
3. C.M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006

Reference Books:

1. Duda R O, Hart P E, and Stork D G, Pattern classification, John Wiley and Sons, 2001.
2. Robert J. Schalkoff, Pattern Recognition : Statistical, Structural and Neural Approaches, John Wiley & Sons Inc., New York, 2007.
3. Ethem Alpaydin, "Machine Learning: The New AI", MIT Press, 2016.



PGAI204/2T: Advanced Algorithms and Analysis

Teaching Scheme

Lectures: 3 Hrs/Week

No. of Credits: 04

Examination Scheme

Total Marks (IA+TH) : 100

Internal Assessments (IA) : 30

Theory (TH) : 70

Course Outcomes:

CO1	Analyse a variety of algorithms with practical applications and the resource requirements of each.
CO2	Determine the most suitable algorithm for any given task and then apply it to the problem
CO3	Demonstrate adequate comprehension of the theory of intractability and prove when certain kinds of problems are intractable.
CO4	To formulate the various algorithms for applications involving probability and statistics in computing
CO5	Design and build solutions for a real world problem by applying relevant distributions

Unit-I Algorithm Analysis: Asymptotic Notation, Standard, Recurrences, Solution to Recurrences Divide and Conquer, Sorting, Matrix Multiplication and Binary Search. Dynamic Programming, Longest Common Substring or Subsequence Matrix Chain Multiplication, Knapsack Problem, Coin Change Problem.

Unit-II Greedy Algorithms: Fractional Knapsack, Job Scheduling, Matroids. Graph Algorithms, Graph Traversal, Single- Source Shortest Paths, All Pairs Shortest Paths, Depth First Search, Breadth First Search and Their Applications, Minimum Spanning Trees.

Unit-III Network Flow And Matching: Flow Algorithms, Maximum Flow, Cuts - Maximum Bipartite Matching, Graph Partitioning Via Multi-Commodity Flow, Karger's Min Cut Algorithm. Amortized Analysis, Aggregate Method, Accounting Method - Potential Method.

Unit-IV String Matching Algorithms: Kmp, Aho- Korasik Algorithm, Z-Algorithm. Np Completeness: Overview, Class P, Class Np, Np Hardness, Np Completeness, Cook Levine Theorem, Important Np Complete Problems, Reduction Of Standard Np Complete Problems (Sat, 3sat, Clique, Vertex Cover, Set Cover, Hamiltonian Cycle).

Unit-V Approximation Algorithms: Approximation Algorithms For Known Np Hard Problems, In Approximability, Analysis Of Approximation Algorithms.

Text Books:

1. Sanjoy Dasgupta, Christos Papadimitriou and Umesh Vazirani, "Algorithms", Tata McGraw-Hill, 2009.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, The MIT Press, 2009.
3. Aho, A V Hopcraft Ullman JD, "The Design and analysis of computer Algorithms", Pearson Education, 2007.

Reference Books:

1. Michael T Goodric and Roberto Tamassia, "Algorithm Design: Foundations, Analysis and Internet Examples", John Wiley and Sons, 2002.
2. RK Ahuja, TL Magnanti and JB Orlin, "Network flows: Theory, Algorithms, and Applications", Prentice Hall Englewood Cliffs, NJ 1993.
3. Rajeev Motwani and Prabhakar Raghavan, "Randomized Algorithms", Cambridge University Press, 1995.



PG AI 204/3T – Optimization Techniques

Teaching Scheme
Lectures: 3 Hrs/Week
No.of Credits: 04

Examination Scheme
Total Marks (IA+TH) : 100
Internal Assessments (IA) : 30
Theory (TH) : 70

Course Outcomes

CO1	To illustrate the importance of optimization of industrial process management
CO2	To implement basic concepts of mathematics to formulate an optimization problem
CO3	Analyse and appreciate variety of performance measures for various optimization problems
CO4	To design the model engineering minima/maxima problems as optimization problems
CO5	To apply Dynamic programming technique.

Unit-I Linear Programming: Introduction and need for optimization in engineering design, formulating linear programs, graphical solution of linear programs, special cases of linear programming.

Unit-II The Simplex Method: Converting a problem to standard form, the theory of the simplex method, the simplex algorithm, special situations in the simplex algorithm, obtaining initial feasible solution.

Unit-III Duality and Sensitivity Analysis: Sensitivity analysis, shadow prices, dual of a normal linear program, duality theorems, dual simplex method. Integer Programming: Formulating integer programming problems, the branch-and-bound algorithm for pure integer programs, the branch and bound algorithm for mixed integer programs.

Unit-IV Non-linear Programming: Introduction to non-linear programming (NLP), Convex and concave functions, NLP with one variable, Line search algorithms, Multivariable unconstrained problems, constrained problems, Lagrange Multiplier, The Karush-Kuhn-Tucker (KKT) conditions, the method of steepest ascent, convex combination method, penalty function, Quadratic programming.

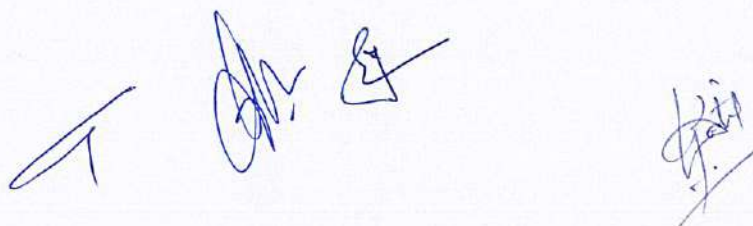
Unit-V Dynamic programming: Evolutionary algorithms: Genetic Algorithm, concepts of multi objective optimization, Markov Process, Queuing Models.

Text Books:

1. S.S. Rao, Engineering Optimization: Theory and Practice, Wiley & Sons, New Jersey, 2009.
2. F.H. Hiller and G.J. Liberman, Introduction to Operations Research, Tata-McGraw-Hill, 2010.
3. K. Deb, Multi-Objective Optimization using evolutionary algorithms, John Wiley and Sons, 2009.

Reference Books:

1. W.L. Winston, Operations Research: Applications and Algorithm, 4th Edition, Cengage Learning, 1994.
2. K. Deb, Optimization for Engineering Design, Prentice Hall, 2013.
3. M.C. Joshi and K.M. Moudgalay, Optimization: Theory and Practice, Narosa, 2004.



Semester – III
Elective –IV

PG AI 301/IT Computer Vision

Teaching Scheme

Lectures: 3 Hrs/Week

No.of Credits: 04

Examination Scheme

Total Marks (IA+TH) 100

Internal Assessments (IA) : 30

Theory (TH) 70

Course Outcomes

CO1	To identify basic concepts, terminology, theories, models and methods in the field of computer vision.
CO2	To describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition.
CO3	To analyze and demonstrate various image segmentation techniques.
CO4	To distinguish the methods to use for solving a given problem, and analyse the accuracy
CO5	Utilize the techniques, skills and modern computer Engineering tools, Software and techniques necessary for Engineering practice.

Unit-I Introduction: Purpose of computer vision, State-of-the-art, history of computer vision, some typical applications of computer vision in surveillance, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis.

Unit-II Image Formation Models: Monocular imaging system, orthographic & perspective projection, camera model and camera calibration, binocular imaging systems, Image Processing and Feature Extraction, Image representations colour representations, edge detection, some important texture representation, Motion Estimation, Regularization theory, optical flow computation, stereo vision, motion estimation, structure from motion.

Unit-II Image Segmentation: Model based segmentation, pixel grouping, context guided segmentation, errors in segmentation, Active contours, Split and Merge, Mean shift and Mode finding, Normalized cuts, Graph cuts and Energy based methods, Morphological filtering.

Unit-III Object Recognition and Tracking: Shape representation, shape descriptors, object localization, object representation using low level and high level features; Object Tracking: Basics of object tracking, single object tracking, multiple object tracking, slow moving and fast moving objects and related algorithms, object trajectory analysis

Unit-IV Visual Surveillance: Basics of surveillance, single camera based surveillance, multiple camera guided surveillance, surveillance using moving camera, public place surveillance, healthcare surveillance.

Unit-V 3D Vision: Projective geometry, single perspective camera, stereopsis, the fundamental matrix –its estimation from image point correspondences, applications of epipolar geometry in vision, correlation based and feature based stereo correspondence, shape from motion, optical flow.

Text Books:

1. Computer Vision -A Modern Approach by D. A. Forsyth and J. Ponce, Pearson, 2nd edition, 2012
2. Schalkoff, John Wiley and Sons, "Digital Image Processing & Computer Vision", 1989, John Wiley and Sons.
3. Introductory Techniques for 3D Computer Vision-, by E. Trucco and A. Verri, Publisher: Prentice Hall.

Reference Books:

1. Gonzalez and Woods, "Digital Image Processing" 2002, Pearson education, Asia.
2. Sonka, Hlavac and Boyle Brooks/Cole, "Image Processing, Analysis, and Machine Vision", 1999, Thomson Asia Pte Ltd Singapore.
3. Jain and Rangachar, "Machine Vision", 1999, McGraw Hill International Edition.

PG AI 301/2T Data Visualization Techniques

Teaching Scheme

Lectures: 3 Hrs/Week

No. of Credits: 04

Examination Scheme

Total Marks (IA+TH) : 100

Internal Assessments (IA) : 30

Theory (TH) : 70

Course Outcomes

CO1	Design and create data visualizations and Conduct exploratory data analysis using visualization.
CO2	Critique existing visualizations based on data visualization theory and principles.
CO3	To use knowledge of perception and cognition to evaluate visualization design alternatives.
CO4	Identify opportunities for application of data visualization in various domains.
CO5	To apply the appropriate data visualization technique.

Unit-I Introduction –Data-Visualization-Design, Data & Tasks-Data Types, Dataset Types, Spatial Data, Scivis and Infovis, Graphic Design, Graphical Integrity, Data-Ink Ratio, Aspect Ratios & Scales.

Unit-II Data-Driven documents (D3) Introduction to D3-Relative vs. Absolute Judgments-Luminance Perception-D3 Key Features-Concepts Visualization Process. Design Iterations. Sketching, Data Types. Statistical Graphs. Interaction Design. Overview & Detail, Dynamic Queries. Brushing & Linking, Animation, Trees & Networks, Radial Layouts. Tree maps, Linear Layouts, Maps, Choropleth Maps, Cartograms, Symbol Maps, Flow Maps, Real-Time Maps.

Unit-III Design Studio & Text visualization Design Studio High-Dimensional Data Filtering. Parallel Coordinates, Glyphs, Aggregation, Text Visualization, Document Visualization, Images & Video, Maps. Choropleth Maps, Cartogram, Symbol Maps, Flow Maps. Real-Time Maps, Perception, Visual Channels. Weber's Law, Pre-attentive Processing, Visual Channel Rankings.

Unit-IV Color processing Color Spaces. Color Aesthetics. Colors for Visualization Cognition. Looking vs Seeing, Image Gist, Gestalt Principles, Visual Attention, Visual Working & Long-Term Memory.

Unit-V Data visualisation system Visual Story Telling, Messaging. Effective Presentations. Design for Information Visualization and Arts, Visualization Systems, Database Visualization, Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GIS systems, collaborative visualizations, evaluating visualizations.

Text Books:

1. Ben Fry "Visualizing Data: Exploring and Explaining Data with the Processing Environment" O'Reilly Media, 2007.
2. Ward, Grinstein Keim, Interactive Data Visualization: Foundations, Techniques, and Applications. Natick: A K Peters, Ltd
3. Scott Murray "Interactive Data Visualization for the Web" O'Reilly Media, 2013.

Reference Books

1. Edward Tufte "The Visual Display of Quantitative Information" 2001.
2. Colin Ware, "Visual Thinking for Design", Morgan Kaufman Series, 2008.
3. Alberto Cairo, "The Functional Art: An introduction to information graphics and visualization", New Riders, 2012.



PGAI 301/3T Block chain Technology

Teaching Scheme

Lectures: 3 Hrs/Week

No.of Credits: 04

Examination Scheme

Total Marks (IA+TH) : 100

Internal Assessments (IA) : 30

Theory (TH) : 70

Course Outcomes

CO1	Analyze the clustering applications like Market segmentation and Social network analysis
CO2	Discriminate between clustering and classification problems.
CO3	Apply data reduction and data pre-processing techniques for clustering
CO4	Appraise feature extraction methods and identify the suitable method for a given problem

Unit-I Introduction: Basic Cryptographic primitives used in Block chain –Secure, Collision-resistant hash functions, digital signature, public key cryptosystems, zero-knowledge proof systems. Need for Distributed Record Keeping, Modelling faults and adversaries, Byzantine Generals problem, Consensus algorithms and their scalability problems, Why Nakamoto Came up with Block chain based crypto currency?

Unit-II Technologies Borrowed in Block chain: hash pointers, Consensus, Byzantine Models of fault tolerance, digital cash etc.Bitcoin block chain - Wallet - Blocks - Merkley Tree - hardness of mining ,transaction verifiability , anonymity ,forks , double spending ,mathematical analysis of properties of Bitcoin. Bitcoin, the challenges, and solutions.

Unit-III Abstract Models For Block chain: GARAY model, RLA Model, Proof of Work (PoW) as random oracle, formal treatment of consistency, liveness and fairness - Proof of Stake (PoS) based Chains, Hybrid models (PoW + PoS), Bitcoin scripting language and their use.

Unit-IV Ethereum: Ethereum Virtual Machine, Wallets for Ethereum, Solidity -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. Some attacks on smart contracts.

Unit-V Block chain application development: Hyper ledger Fabric-Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, Writing smart contract using Hyper ledger Fabric, Writing smart contract using Ethereum, Overview of Ripple and Corda.

Text Books :

1. Blockchain: Blueprint for a New Economyby Melanie Swan, O'Reilly, 2015
2. Blockchain Technology: Cryptocurrency and Applications, S. Shukla, M.Dhawan, S. Sharma, S. Venkatesan, OxfordUniversity Press, 2019.
3. Blockchain Basicsby Daniel Drescher, Apress; 1stedition, 2017

Reference Books

1. Research perspectives and challenges for Bitcoin and cryptocurrencyJoseph Bonneauet al, SoKIEEE Symposium on security and Privacy2015
2. The bitcoin backbone protocol -analysis and applicationsJ.A.Garay et al, EUROCRYPT LNCS VOI 9057, (VOLII), pp 281-3102015
3. Analysis of Blockchain protocol in Asynchronous networksR.Passet al, EUROCRYPT 2017
4. Fruitchain, a fair blockchainR.Pass et al, PODC 2017
5. Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming"Josh ThompsonCreate Space Independent Publishing Platform2017