SCHEME
&
SYLLABUS

Of

First, Second, Third & Fourth Semester
Choice Base Credit System (CBCS)
Of
Master of Technology (M.Tech)

In
Artificial Intelligence and Data Science
Of
RASHTRASANT TUKDOJI MAHARAJ
NAGPUR UNIVERSITY, NAGPUR

Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur
Faculty of Engineering & Technology
Course and Examination Scheme of Master of Technology
Choice Base Credit System(CBCS)

I Semester M. Tech. (AIDS)

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			University Assessment	College Assessment			University Assessment	College Assessment		
PGAIDS101T	Data Science Using Python	4	-	4	3	70	30	100	50	-	-	-	-
PGAIDS102T	Artificial Intelligence	4	-	4	3	70	30	100	50	-	-	-	-
PGAIDS103T	Research Methodology and IPR	4	-	4	3	70	30	100	50	-	-	-	-
PGAIDS104T	Elective-1(Discipline Specific)	4	-	4	3	70	30	100	50	-	-	-	-
PGAIDS105T	Elective-2 (Open)	4	-	4	3	70	30	100	50				
PGAC106T	Audit Course-1	2	-		2	0	-	0	0	-	-	-	-
PGAIDS107P	Data Science Using Python Lab 1	-	2	1	-	-	-	-	-	50	50	100	50
PGAIDS108P	Artificial Intelligence Lab 2	-	2	1	-	-	-	-	-	50	50	100	50
Total		22	4		-	350	150	500	-	100	100	200	-
Semester Total		26		22	700 Marks								

L: Lecture P: Practical

Elective –1 (Discipline Specific) PGAIDS104T/1- Soft Computing**,** PGAIDS104T/2- Cloud Computing, PGAIDS104T/3- Data Analytics
Elective –2 (Open) PGAIDS105T/1- Business Analytics**,** PGAIDS105T/2- Optimization Techniques, PGAIDS105T/3- Big Data Analytics

Audit Course-1- PGAC105T- Value Education

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II Semester M. Tech. (AIDS)

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			University Assessment	College Assessment			University Assessment	College Assessment		
PGAIDS201T	Natural Language Processing	4	-	4	3	70	30	100	50	-	-	-	-
PGAIDS202T	Machine Learning	4	-	4	3	70	30	100	50	-	-	-	-
PGAIDS203T	Neural Networks	4		4									
PGAIDS204T	Elective-3(Discipline Specific)	4	-	4	3	70	30	100	50	-	-	-	-
PGAIDS205T	Elective-4 (Open)	4	-	4	3	70	30	100	50	-	-	-	-
PGAC206T	Audit Course -2	2	-	0	3	0	-	0		-	-	-	-
PGAIDS207P	Natural Language Processing Lab 3	-	2	1	-	-	-	-	-	50	50	100	50
PGAIDS208P	Machine Learning Lab 4	-	2	1	-	-	-	-	-	50	50	100	50
Total		22	4		-	350	150	500	-	100	100	200	-
Semester Total		26		22	600 Marks								

Elective –3 (Discipline Specific) PGAIDS204T /1- Information Retrieval Systems**,** PGAIDS204T /2- Block Chain Technology **,** PGAIDS204T /3- Computer Vision
Elective –4 (Open) PGAIDS205T/1- Digital Image Processing and Analysis , PGAIDS205T/2 - Cyber Security, PGAIDS205T/2- Internet of Things.
Audit Course-II- PGAC205T- Indian Constitution and Fundamental Rights.

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III Semester M. Tech. (AIDS)

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			University Assessment	College Assessment			University Assessment	College Assessment		
PGAIDS301T	Deep Learning	4	-	4	3	70	30	100	50	-	-	-	-
PGAIDS302T	Elective–5 (Open)	4	-	4	3	70	30	100	50	-	-	-	-
PGAIDS303T	Audit Course - 3	2											
PGAIDS304P	Dissertation/Phase-1	-	16	8	-	-	-	-	-	-	200	200	100
Total		10	-	-		140	60	200	-	-	200	200	-
Semester Total		26		16	400 Marks								

Elective –5 (Open) PGAIDS302T/1 -Predictive Analytics with R, PGAIDS302T/2 - GPU Computing , PGAIDS302T/3- Robotic Process Automation

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IV Semester M. Tech. (AIDS)

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			University Assessment	College Assessment			University Assessment	College Assessment		
PGAIDS401P	Dissertation/Phase-2	-	32	16	-	-	-	-	-	400	-	400	200
Total		-	-		-	-	-	-	-	400	-	400	-
Semester Total		32		16	400 Marks								

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Nagpur Faculty of Engineering & Technology
Course and Examination Scheme of Master of Technology
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M. Tech. (AIDS) - I Semester

Course Code	Course	Teaching Scheme		
		Hours Per Week		Credits
		L	P	
PGAIDS101T	Data Science Using Python	4	-	4

Course Objectives:

1. Creating expertise in Python Programming to develop data science applications.
2. Students should be able to write short scripts to import, prepare and analyze data.
3. Develops skills of writing and running a code using Python
4. Develops Knowledge on Data Analysis and Analytics.
5. Develop Knowledge about probability

Course Outcomes:

1. Know basic fundamentals in Python.
2. Know Packages modules in python datasets.
3. Demonstrate proficiency with statistical analysis of data.
4. Student will know about Probability Theorem
5. Students will execute statistical analyses with professional statistical **software.**

UNIT-I

Fundamental Concepts of Python: Python Strings, Python Tuples, Python Dictionary, Loop Control Statements, Function Arguments, Required arguments, Keyword arguments, Default arguments, Creating class in Python, Documented String, Private Identifier

UNIT-II

Python Modules and Packages: Framework vs Packages, Folium, Introduction Creating modules Decorator, Iterator and Generator, Anonymous Function , Lambda , Map ,Filter , Reduce.

UNIT-III

Data Science Overview: Analysis and Analytics, Business Analytics, Data Analytics, and Data Science, Data Science Diagram, BI, ML and AI, Measuring Data, Measurement of Central Tendency, Measurements Dispersion ,Measurement Quartile , Bi-variate Data and Co-variance ,Pearson Correlation Coefficient

UNIT-IV

Probability: Permutations , Combinations, Intersections Unions and Complements, Independent and Dependent Events, Conditional Probability, Bayes Theorem

UNIT-V

Statistics: Sampling, Central Limit Theorem, Standard Error, Hypothesis Testing
Anova Introduction to ANOVA, Two Way ANOVA Overview,F- Distribution, Chi-Square Analysis

Text Book:

1. **Handbook of computer programming with Python** by Christos Manolas, Dimitrios Xanthidis
2. Data Science Using Python by Wade Briggs, Notion Press Publisher

Suggested Reading:

1. Daniel Jurafsky and James H Martin. Speech and Language Processing, 2nd Edition, PearsonEducation, 2009.
2. Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, 2ndEdition,Chapman and Hall/CRC Press, 2010.
3. Tanveer Siddiqui, U.S. Tiwary, ―Natural Language Processing and Information Retrieval, Oxford University Press, 2008.
4. Nitin Hardaniya, Jacob Perkins, -Natural Language Processing: Python and NLTKl, Packt Publishers, 2016.

Web Resources:

1. https://pll.harvard.edu/course/introduction-data-science-python
2. https://www.msmetcblr.org/download/DATASCIENCE__ONLINE.pdf

Course Code	Course	Teaching Scheme		
		Hours Per Week		Credits
		L	P	
PGAIDS102T	Artificial Intelligence	4	-	4

Course Objectives:

1. To learn basics of AI and concept of Intelligent Agent.
2. To learn the various Searching techniques
3. To learn first order and second order predicate Logic to infer knowledge
4. To learn classical and real world planning approaches
5. To learn uncertainty and probabilistic reasoning models

Course Outcomes:

Upon completing this course, students will be able to:

1. Understand the basics of AI and concept of Intelligent Agent.
2. Compare the Searching techniques
3. Understand and apply the first order and second order predicate Logic to infer the knowledge
4. Analyze classical and real-world planning approaches
5. Understand the uncertainty and apply the probabilistic reasoning models

Unit – I

Introduction: AI Definition, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art ; **Intelligent Agents :** Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, The Structure of Agents; **Solving Problems by Searching:** Problem- Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions

Unit - II

Beyond Classical Search: Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces, Searching with Nondeterministic Actions, Searching with Partial Observations, Online Search Agents and Unknown Environments, **Adversarial Search:** Games, Optimal Decisions in Games, Alpha–Beta Pruning, Imperfect Real-Time Decisions, Stochastic Games, Partially Observable Games, State-of-the-Art Game Programs; Alternative Approaches; **Constraint Satisfaction Problems:** Defining Constraint Satisfaction Problems, Constraint Propagation: Inference in CSPs , Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems.

Unit - III

Logical Agents : Knowledge-Based Agents, the Wumpus World, Logic, Propositional Logic: A Very Simple Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic; **First-Order Logic:** Representation Revisited, Syntax and Semantics of First-Order Logic, Using First- Order Logic, Knowledge Engineering in First-Order Logic; **Inference in First-Order Logic:** Propositional Vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution.

Unit - IV

Classical Planning: Definition of Classical Planning, Algorithms for Planning as State-Space Search, Planning Graphs, Other Classical Planning Approaches, Analysis of Planning Approaches; **Planning and Acting in the Real World:** Time, Schedules, and Resources, Hierarchical Planning, Planning and Acting in Nondeterministic Domains, Multiagent Planning; **Knowledge Representations:** Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information, The Internet Shopping World.

Unit - V

Quantifying Uncertainty: Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Independence, Bayes' Rule and Its Use, The Wumpus World Revisited; **Probabilistic Reasoning:** Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Exact Inference in Bayesian Networks, **Probabilistic Reasoning over Time:** Time and Uncertainty, Inference in Temporal Models, Hidden Markov Models

Text Books:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson Edition, 4thEdition.

Suggested Reading:

1. Rich, Knight, Nair: –Artificial intelligence‖, Tata McGraw Hill, Third Edition, 2009.
2. Nilsson, N., ―Artificial Intelligence: A New Synthesis‖, San Francisco, Morgan Kaufmann, 1998.
3. Kulkarni, Parag, Joshi, Prachi , ―Artificial Intelligence : Building Intelligent Systems‖, PHI, 2015.
4. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, 2011.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc19_cs19/
2. https://www.coursera.org/learn/ai-for-everyone

Course Code	Course	Teaching Scheme		
		Hours Per Week		Credits
		L	P	
PGAIDS103T	Research Methodology and IPR	4	-	4

Course Objectives:

To make the students to

1. Motivate to choose research as career
2. Formulate the research problem, prepare the research design
3. Identify various sources for literature review and data collection report writing
4. Equip with good methods to analyze the collected data
5. Know about IPR copyrights

Course Outcomes:

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

1. Define research problem, review and asses the quality of literature from various sources
2. Improve the style and format of writing a report for technical paper/ Journal report, understand and develop various research designs
3. Collect the data by various methods: observation, interview, questionnaires
4. Analyze problem by statistical techniques: ANOVA, F-test, Chi-square
5. Understand apply for patent and copyrights

UNIT - I

Research Methodology: Research Methodology: Objectives and Motivation of Research, Types of Research, research approaches, Significance of Research, Research Methods verses Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general. Defining the Research Problem: Selection of Research Problem, Necessity of Defining the Problem

UNIT - II

Literature Survey Report writing: Literature Survey: Importance and purpose of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet. Report writing: Meaning of interpretation, layout of research report, Types of reports, Mechanics of writing a report. Research Proposal Preparation: Writing a Research Proposal and Research Report, Writing Research Grant Proposal

UNIT - III

Research Design: Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design, Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Steps in sample design, types of sample designs.

UNIT - IV

Data Collection and Analysis: Data Collection: Methods of data collection, importance of Parametric, non parametric test, testing of variance of two normal population, use of Chi-square, ANOVA, Ftest, z-test

UNIT - V

Patents and Copyright: Patent: Macro economic impact of the patent system, Patent document, How to protect your inventions. Granting of patent, Rights of a patent, how extensive is patent protection. Copyright: What is copyright. What is covered by copyright. How long does copyright last? Why protect copyright? Related Rights: what are related rights? Enforcement of Intellectual Property Rights: Infringement of intellectual property rights, Case studies of patents and IP Protection

Text Books:

1. C.R Kothari, ―Research Methodology, Methods & Technique‖; New Age International Publishers,2004
2. R. Ganesan, –Research Methodology for Engineers‖, MJP Publishers, 2011
3. Y.P. Agarwal, –Statistical Methods: Concepts, Application and Computation‖, Sterling Publs., Pvt., Ltd., New Delhi, 2004

Suggested Reading:

1. Ajit Parulekar and Sarita D‘ Souza, –Indian Patents Law – Legal & Business Implications‖; Macmillan India ltd , 2006
2. B. L.Wadehra; –Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications‖; Universal law Publishing Pvt. Ltd., India 2000.
3. P. Narayanan; ―Law of Copyright and Industrial Designs‖; Eastern law House, Delhi 2010

Course Code	Course	Teaching Scheme		
Elective 1(Discipline Specific) PGAIDS104T/1	Soft Computing	**Hours Per Week**		**Credits**
		L	**P**	
		4	-	4

Course Objectives:

1. Learn about soft computing techniques, their applications and Be familiar with the design of neural networks and related algorithms.
2. Understand Fuzzy Logic, Various fuzzy systems and their functions.
3. Learn mathematical background for optimized genetic programming
4. Understand advanced soft computing techniques.
5. Introduce real time applications of soft computing techniques.

Course Outcomes:

After successful completion of the course, student will be able to:

1. Understand soft computing techniques and their role in building intelligent machines.
2. Demonstrate fuzzy logic and reasoning to handle uncertainty and solve engineering problems.
3. Apply genetic algorithms to provide optimized solutions.
4. Explain rough set theory and swarm intelligence techniques to solve problems.
5. Build real time applications using soft computing techniques

UNIT-I

Introduction to soft computing: Concept of computing systems, classification of soft computing techniques, "Soft" computing versus "Hard" computing Characteristics of Soft computing, Applications of Soft computing techniques, Structure & functioning of biological brain & Neuron, and concept of learning/training. Model of an Artificial Neuron, transfer/activation functions, perceptron learning model, binary & continuous inputs, linear separability. **Multilayer Neural Networks:** Feed Forward network - significance, training, loss function, Back- Propagation algorithm, convergence & generalization, momentum, applications. Feedback network -Hopfield Nets: architecture, energy functions, training algorithms & examples, competitive learning, self-organizing maps.

UNIT-II

Fuzzy Logic: Membership functions: features, fuzzification, methods of membership value assignments- Defuzzification: lambda cuts – methods – fuzzy arithmetic and fuzzy measures: fuzzy arithmetic -extension principle – fuzzy measures – measures of fuzziness -fuzzy integrals – fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules-decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems-overview of fuzzy expert system-fuzzy decision making..

UNIT-III

Genetic algorithm: concepts, creation of offspring, working principle, encoding, fitness functions, reproduction, genetic modeling. Generation cycle & convergence of GA, application areas of GA. **Hybrid Soft Computing Techniques and Applications**: Neuro-fuzzy hybrid systems – genetic neuro hybrid systems – genetic fuzzy hybrid and fuzzy genetic hybrid systems – simplified fuzzy ARTMAP – Applications: A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing based hybrid fuzzy controllers.

UNIT- IV

Advanced soft computing techniques: Rough Set Theory - Introduction, Set approximation, Rough membership, Attributes, optimization. SVM - Introduction, obtaining the optimal hyper plane, linear and nonlinear SVM classifiers. **Introduction to Swarm Intelligence**: What is swarm intelligence? Various animal behavior which have been used as examples, ant colony optimization,

swarm intelligence in bees, flocks of birds, shoals of fish, ant-based routing, particle swarm optimization.

UNIT V

Applications of Soft Computing: Image registration – Object recognition – Automated feature extraction –navigation – Integration of soft computing and GIS for flood forecasting and monitoring, Landslide susceptibility, Highway alignment, smart city planning, agriculture, solid waste disposal

Text Books:

1. S. N.Sivanandam and S.N.Deepa, –Principles of Soft Computingl, Wiley India Pvt Ltd, 2011.
2. S, Rajasekaran & G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic & Genetic Algorithms,Synthesis & applications, PHI Publication

Suggested Reading:

1. George J. Klir, Ute St. Clair, Bo Yuan, Fuzzy Set Theory: Foundations and Applications Prentice Hall, 1997.
2. David E. Goldberg, Genetic Algorithm in Search Optimization and Machine Learning Pearson Education India, 2013.

Web Resource:

1. https://nptel.ac.in/courses/106/105/106105173/
2. https://www.javatpoint.com/artificial-neural-network
3. https://www.javatpoint.com/fuzzy-logic

Course Code	Course	Teaching Scheme		
		Hours Per Week		Credits
		L	P	
Elective –1 (Discipline Specific) PGAIDS104T/2	Cloud Computing	4	-	4

Course Objectives:

1. To familiarize basic concepts of cloud computing and enabling technologies.
2. To introduce Auto-Scaling, capacity planning and load balancing in cloud.
3. To impart knowledge on issues related to security, privacy and compliance.
4. To introduce cloud management standards and programming models.
5. To deal with the concepts of Service oriented architecture and cloud database technology.

Course Outcomes:

Upon completing this course, students will be able to:

1. Understand different types of cloud computing concepts and the techniques.
2. Determine the issues related to scaling, capacity planning and load balancing.
3. Assess the cloud infrastructure, information security and compliance issues.
4. Analyse the Portability and Interoperability issues of cloud virtualization.
5. Evaluate the importance of SOA and cloud database technology.

UNIT-I

Introduction-Limitations of the Traditional Computing Approaches, Three Layers of Computing, Three Layers in Traditional Computing, The End of Traditional Computing, Influences behind Cloud Service Adoption. Benefits and challenges: Origin of the Term _Cloud Computing', Early Initiatives, Utility Computing, Metering and Billing in Cloud, Separation of Data Center Operation, Benefits of Cloud Computing, Challenges of Cloud Computing, How Cloud Computing Addresses Business Challenges, Ethical Issues in Cloud Computing, Cloud Computing: Network as Computer, Role of Web Service, Role of API, Ubiquitous Cloud, Confusion Between Cloud and Internet. Cloud computing services, Resource Virtualization, Resource pooling, sharing and provisioning.

UNIT-II

Scaling in cloud- Introduction to Scaling, Scaling in Traditional Computing, Scaling in Cloud Computing, Foundation of Cloud Scaling, Scalable Application , Scaling Strategies in Cloud, Auto-Scaling in Cloud, Types of Scaling , Performance and Scalability , the Resource Contention Problem , Cloud Bursting: A Scenario of Flexible Scaling, Scalability is a Business Concern

Capacity Planning- Capacity Planning, Capacity Planning in Computing, Capacity Planning in Cloud Computing, Approaches for Maintaining Sufficient Capacity, Steps for Capacity Planning

Load Balancing- Load Balancing , Importance of Load Balancing in Cloud Computing, Load Balancing in Cloud, Goals of Load Balancing, Categories of Load Balancing, Load Balancing Algorithms, Case study on Google cloud and Amazon Elastic Compute Cloud (EC2), File System and Storage.

UNIT-III

Content Delivery Network: CDN Service Operations, Evolution of CDN, Advantages of CDN, Disadvantages of CDN, CDN Service Provider, Security Reference Model

Security Issues- Cloud security, threats to Cloud Security, Infrastructure Security, Information Security, Identity Management and Access Control, Cloud Security Design Principles, Cloud Security Management Frameworks, Security-as-a-Service, Privacy and Compliance Issues.

UNIT-IV

Portability and Interoperability Issues- Challenges in the Cloud, The Issues in Traditional Computing, Addressing Portability and Interoperability in Cloud, Portability and Interoperability

Scenarios, Machine Imaging or Virtual Machine Image, Virtual Appliance, Difference between Virtual Machine Image and Virtual Appliance, Open Virtualization Format (OVF), Cloud Management and a Programming Model Case Study, Popular Cloud Services.

UNIT-V

Service-Oriented Architecture: The Pre-SOA Era, Role of SOA in Cloud Computing, Service-Oriented Architecture, Goal of System Designing, Service Represents Business Functionality, Open Standard Implementation, Benefits of SOA, SOA and Cloud Computing.

Database Technology: Database in Cloud, Data Models, Database-as-a-Service, Relational DBMS in Cloud, Non-relational DBMS in Cloud.

Text Book:

1. Sandeep Bhowmik, –Cloud Computing‖, Cambridge University Press, 2017.

Suggested Reading:

1. Kai Hwang, Geoffrey C.Fox, Jack J.Dongarra, –Distributed and Cloud Computing from Parallel Processing to the Internet of Things‖, Elsevier, 2012.
2. Barrie Sosinsky‖ Cloud Computing Bible‖, Wiley-India, 2010
3. Ronald L. Krutz, Russell Dean Vines —Cloud Security: A Comprehensive Guide to Secure CloudComputing‖, Wiley- India,2010
4. John W. Rittenhouse, James F. Ransome, "Cloud Computing: Implementation, Management, and Security",CRC Press, 2009.

Web Resources:

1. https://nptel.ac.in/courses/106105167/1

Course Code	Course	Teaching Scheme		
		Hours Per Week		Credits
		L	P	
Elective –1 (Discipline Specific) PGAIDS104T/3	Data Analytics	4	-	4

COURSE OBJECTIVES:

1. To understand the fundamentals of Exploratory Data Analysis
2. To know the Data Transformation techniques
3. To provide the knowledge on Descriptive Statistics
4. To learn the correlation analysis and Time series analysis
5. To understand the model development and evaluation

COURSE OUTCOMES:

1. Examine the fundamentals of Exploratory Data Analysis
2. Comprehend the Data Transformation techniques
3. Apply Descriptive Statistics
4. Apply correlation analysis and Time series analysis
5. Develop the Model and evaluate it

Unit I

EXPLORATORY DATA ANALYSIS FUNDAMENTALS

Understanding data science- The significance of EDA- Making sense of data - Comparing EDA with classical and Bayesian analysis - Software tools available for EDA - Getting started with EDA - Visual Aids for EDA - Line chart -Bar charts - Scatter plot - Area plot and stacked plot - Pie chart - Table chart - Polar chart – Histogram - Lollipop chart - Choosing the best chart - Other libraries to explore.

Unit II

DATA TRANSFORMATION

Technical requirements – Background - Merging database-style data frames - Transformation techniques - Renaming axis indexes - Discretization and binning - Outlier detection and filtering - Permutation and random sampling - Computing indicators/dummy variables - Benefits of data transformation.

Unit III

DESCRIPTIVE STATISTICS & GROUPING DATASETS

Descriptive Statistics - Understanding statistics - Measures of central tendency - Measures of dispersion - Grouping Datasets - Understanding group by() – Group by mechanics - Data aggregation - Pivot tables and cross-tabulations.

Unit IV

CORRELATION& TIME SERIES ANALYSIS

Introducing correlation - Types of analysis - Discussing multivariate analysis using the Titanic dataset - Outlining Simpson's paradox - Correlation does not imply causation - Understanding the time series dataset - TSA with Open Power System Data.

Unit V

MODEL DEVELOPMENT AND EVALUATION

Understanding regression - Model development and evaluation – Model Hypothesis Testing and Regression - Hypothesis testing - phacking - Development and Evaluation - Types of machine learning - Understanding supervised learning - Understanding unsupervised learning - Understanding reinforcement learning - Unified machine learning workflow - EDA on Wine Quality Data Analysis - Disclosing the wine quality dataset - Analyzing red wine - Analyzing white wine - Model development and evaluation .

TEXT BOOKS:

1. Suresh Kumar Mukhiya, Usman Ahmed, “Hands-On Exploratory Data Analysis with Python Perform EDA Techniques to Understand, Summarize, and Investigate Your Data”, Packt Publishing – 2020, ISBN:9781789535624, 178953562X

REFERENCES:

1. Peter Bruce, Andrew Bruce, “Practical Statistics for Data Scientists”,O'Reilly Media – 2017, ISBN:9781491952917, 1491952911

Web Resources:

1. http://www.planetcassandra.org/what-is-nosql
2. https://stanford.edu/~rezab/sparkworkshop/slides/xiangrui.pdf
3. https://class.coursera.org/datasci-001/lecture

Course Code	Course	Teaching Scheme		
Elective –2 (Open) PGAIDS105T/1	Business Analytics	**Hours Per Week**		**Credits**
		L	**P**	
		4	-	4

Course Objectives:

1. Understanding the basic concepts of business analytics and applications
2. Study various business analytics methods including predictive, prescriptive and prescriptive analytics
3. Prepare the students to model business data using various data mining, decision making methods

Course Outcomes:

Upon completing this course, students will be able to:

1. To understand the basic concepts of business analytics
2. Identify the application of business analytics and use tools to analyze business data
3. Become familiar with various metrics, measures used in business analytics
4. Illustrate various descriptive, predictive and prescriptive methods and techniques
5. Model the business data using various business analytical methods and techniques

UNIT-I

Introduction to Business Analytics: Introduction to Business Analytics, need and science of data driven (DD) decision making, Descriptive, predictive, prescriptive analytics and techniques, Big data analytics, Web and Social media analytics, Machine Learning algorithms, framework for decision making, challenges in DD decision making and future.

UNIT-II

Descriptive Analytics: Introduction, data types and scales, types of measurement scales, population and samples, measures of central tendency, percentile, decile and quadrille, measures of variation, measures of shape-skewness, data visualization

UNIT-III

Forecasting Techniques: Introduction, time-series data and components, forecasting accuracy, moving average method, single exponential smoothing, Holt‘s method, Holt-Winter model, Croston‘s forecasting method, regression model for forecasting, Auto regression models, auto-regressive moving process, ARIMA, Theil‘s coefficient

UNIT-IV

Decision Trees: CHAID, Classification and Regression tree, splitting criteria, Ensemble and method and random forest. **Clustering**: Distance and similarity measures used in clustering, Clustering algorithms, K-Means and Hierarchical algorithms, **Prescriptive Analytics**- Linear Programming(LP) and LP model building,

UNIT-V

Six Sigma: Introduction, introduction, origin, 3-Sigma Vs Six-Sigma process, cost of poor quality, sigma score, industry applications, six sigma measures, DPMO, yield, sigma score, DMAIC methodology, Six Sigma toolbox

Text Books:

1. U Dinesh Kumar, –Data Analytics‖, Wiley Publications, 1st Edition, 2017
2. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, –Business analytics Principles, Concepts, and Applications with SAS‖, Associate Publishers, 2015

Suggested Reading:

1. S. Christian Albright, Wayne L. Winston, –Business Analytics - Data Analysis and Decision Making‖, 5th Edition, Cengage, 2015

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc18-mg11/preview
2. https://nptel.ac.in/courses/110105089/

Course Code	Course	Teaching Scheme		
		Hours Per Week		Credits
		L	P	
Elective2 (Open) PGAIDS105T/2	Optimization Technique	4	-	4

Course Objectives:

The students will

1. Come to know the formulation of LPP models
2. Understand the Transportation and Assignment techniques
3. Come to know the procedure of Project Management along with CPM and PERT techniques
4. Understand the concepts of queuing theory and inventory models
5. Understand sequencing techniques

Course Outcomes:

Upon completing this course, students will be able to:

1. Formulate a linear programming problems (LPP)
2. Build and solve Transportation Models and Assignment Models.
3. Apply project management techniques like CPM and PERT to plan and execute project successfully
4. Apply queuing and inventory concepts in industrial applications
5. Apply sequencing models in industries

UNIT – I

Operations Research: Definition, scope, Models, Linear programming problems (LPP), Formulation, GraphicalMethod, and Simplex Method

UNIT – II

Transportation Models: Finding an initial feasible solution - North West Corner Method, Least Cost Method, Vogel‘s Approximation Method, Finding the optimal solution, Special cases in Transportation problems - Unbalanced Transportation problem, Degeneracy in Transportation, Profit Maximization in Transportation.

UNIT – III

Project Management: Definition, Procedure and Objectives of Project Management, Differences between PERT and CPM, Rules for drawing Network diagram, Scheduling the activities, Fulkerson‘s rule, Earliest and Latest times, Determination of ES and EF times in forward path, LS & LF times in backward path, Determination of critical path, duration of the project, Free float, Independent float and Total float

UNIT – IV

Queuing Theory and Inventory:: Kendols Notation, single server models, Inventory control - deterministic inventory models - Probabilistic inventory control models.

UNIT – V

Sequencing Models: Introduction, Objectives, General assumptions, processing _n‘ jobs through two Machines, processing _n‘ jobs through three machines

Text Books:

1. H.A. Taha, –Operations Research, An Introduction‖, PHI, 2008
2. H.M. Wagner, –Principles of Operations Research‖, PHI, Delhi, 1982
3. J.C. Pant, –Introduction to Optimisation: Operations Research‖, Jain Brothers, Delhi, 2008

Suggested Reading:

1. Hitler Libermann, –Operations Research‖, McGraw Hill Pub. 2009

2. Pannerselvam, –Operations Research‖, Prentice Hall of India 2010
3. Harvey M Wagner, –Principles of Operations Research‖, Prentice Hall of India 2010

Course Code	Course	Teaching Scheme		
		Hours Per Week		Credits
		L	P	
Elective –2 (Open) PGAIDS105T/3	Big Data Analytics	4	-	4

Course Objectives:

1. To introduce big data and HDFS.
2. To impart knowledge on Mapper and Reducer.
3. To provide the concepts of NoSQL and MongoDB.
4. To introduce programming tools PIG and HIVE in Hadoop echo system.
5. To facilitate learning of Spark with machine learning applications.

Course Outcomes:

Upon completing this course, students will be able to:

1. Perform data analysis in Hadoop framework.
2. Build applications using MapReduce.
3. Model the data using NoSQL and MongoDB.
4. Perform analysis on large datasets using Pig and Hive.
5. Develop machine learning solutions in Spark.

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UNIT-I

Introduction to Big Data: Big Data Important, Big Data Solution, Big Data Use Cases: IT for IT Log Analytics, the Fraud Detection Pattern, Social Media Pattern.

The Hadoop Distributed Files system: The Design of HDFS, HDFS Concepts, Blocks, Name nodes and Data nodes, Block Caching, HDFS Federation, HDFS High Availability, The Command-Line Interface, Basic File system Operations, Hadoop File systems, Interfaces, The Java Interface, Reading Data from a Hadoop URL, Reading Data Using the File System API, Writing Data, Directories, Querying the File system, Deleting Data, Data Flow, Anatomy of a File Read, Anatomy of a File Write.

UNIT-II

MapReduce: Introduction, Architecture of map reduce, Anatomy of a MapReduce Job Run, Job Submission, Job Initialization, Task Assignment, Task Execution, Progress and Status Updates, Job Completion, Failures, Task Failure, Application Master Failure, Node Manager Failure, Resource Manager Failure, Shuffle and Sort, The Map Side, The Reduce Side, **MapReduce Types and Formats:** MapReduce Types, The Default MapReduce Job, Input Formats, Input Splits and Records, Text Input, Output Formats, Text Output, Developinga MapReduce Application.

Hadoop Ecosystem and YARN: Hadoop ecosystem components - Schedulers - Fair and Capacity, Hadoop 2.0 New Features NameNode High Availability, HDFS Federation, MRv2, YARN, Running MRv1 in YARN.

UNIT-III

No SQL Databases: Review of traditional Databases, Need for NoSQL Databases, Columnar Databases, Failover and reliability principles, CAP Theorem, Differences between SQL and NoSQL databases, **Working Mechanisms of Mongo DB**: Overview, Advantages, Environment, Data Modelling, Create Database, Drop Database, Create collection, Drop collection, Data types, Insert, Query, Update and Delete operations, Limiting and Sorting records, Indexing, Aggregation

UNIT-IV

Pig: Generating Examples, Comparison with Databases, Pig Latin, User-Defined Functions, Data Processing Operators, Pig in Practice.

Hive: Comparison with Traditional Databases, HiveQL, Tables, Querying Data, User-Defined Functions, Writing a User Defined Functions, Writing a User Defined Aggregate Function.

UNIT-V

Spark: Spark and its Purpose, Components of the Spark Unified Stack, Batch and Real-Time Analytics with Apache Spark, Resilient Distributed Dataset, **Scala** (Object Oriented and Functional Programming)

Machine Learning with Spark: Designing a Machine Learning System, Obtaining, Processing and Preparing Data with Spark, Building a Recommendation Engine with Spark, Building a Classification Model with Spark, Building a Regression Model with Spark and Building a Clustering Model with Spark.

Text Books:

3. Tom White, "Hadoop: The Definitive Guide", Fourth Edition, O'Reilly Media Inc, 2015.
4. Nick Pentreath, –Machine Learning with Spark|, First Edition, Packt Publishing, 2015.

Suggested Reading:

6. Thilina gunarathne, –Hadoop MapReduce v2 Cookbook|, Second Edition, Packet Publishing, 2015.
7. Chuck Lam, Mark Davis, Ajit Gaddam, –Hadoop in Action|, Manning Publications Company, 2016.
8. Alex Holmes, –Hadoop in Practice|, Manning Publications Company, 2012.
9. Alan Gates, "Programming Pig", O'Reilly Media Inc, 2011.
10. Edward Capriolo, Dean Wampler, Jason Rutherglen, "Programming Hive", O'Reilly Media Inc, 2012.

Web Resources:

4. http://www.planetcassandra.org/what-is-nosql
5. https://stanford.edu/~rezab/sparkworkshop/slides/xiangrui.pdf
6. https://class.coursera.org/datasci-001/lecture

Course Code	Course	Teaching Scheme		
		Hours Per Week		Credits
		L	P	
PGAC105T	Value Education	2	-	-

Course Objectives:

1. Understand the need and importance of Values for self-development and for National development.
2. Imbibe good human values and Morals
3. Cultivate individual and National character.

Course outcomes:

Upon completing this course, students will be able to:

1. Gain necessary Knowledge for self-development
2. Learn the importance of Human values and their application in day to day professional life.
3. Appreciate the need and importance of interpersonal skills for successful career and social life
4. Emphasize the role of personal and social responsibility of an individual for all-round growth.
5. Develop a perspective based on spiritual outlook and respect women, other religious practices, equality,non- violence and universal brotherhood.

UNIT I

Human Values, Ethics and Morals: Concept of Values, Indian concept of humanism, human values; Values for self-development, Social values, individual attitudes; Work ethics, moral and non- moral behaviour, standards and principles based on religion, culture and tradition.

UNIT II

Value Cultivation, and Self-management: Need and Importance of cultivation of values such as Sense-of Duty, Devotion to work, Self-reliance, Confidence, Concentration, Integrity & discipline, and Truthfulness.

UNIT III

Spiritual outlook and social values: Personality and Behavior, Scientific attitude and Spiritual (soul) outlook; Cultivation of Social Values Such as Positive Thinking, Punctuality, Love & Kindness, Avoiding fault finding in others, Reduction of anger, forgiveness, Dignity of labour, True friendship, Universal brotherhood and religious tolerance.

UNIT IV

Values in Holy Books : Self-management and Good health; **and internal & external Cleanliness,** Holy books versus Blind faith, Character and Competence, Equality, Nonviolence, Humility, Role of Women.

UNIT V

Dharma, Karma and Guna: Concept of soul; Science of Reincarnation, Character and Conduct, Concept of Dharma; Cause and Effect based Karma Theory; The qualities of Devine and Devilish; Satwic, Rajasic and Tamasicgunas.

Suggested Reading:

1. Chakroborty, S.K. –Values & Ethics for organizations Theory and practice|, Oxford University Press, New Delhi, 1998.
2. Jaya Dayal Goyandaka, –Srimad Bhagavad Gita|, with Sanskrit Text, Word meaning and Prose meaning, Gita Press, Gorakhpur, 2017.

Course Code	Course	Teaching Scheme		
		Hours Per Week		Credits
		L	P	
PGAIDS107P	Data Science Using Python Lab 1	-	2	1

Course Objectives:

1. To provide practical knowledge of language processing that involves various operations that can be performed on text data.
2. To familiarize with fundamental topics in language processing that include tokenization, stemming, tagging, classification, and information extraction using Python programs.
3. To facilitate understanding of regular expressions, formal grammar that describe the structure of an unlimited set of sentences.
4. To create classifiers and choose the best classifier.
5. To perform NLP operations on existing corpora and build simple AI Applications

Course Outcomes:

Upon completing this course, students will be able to:

1. Apply the concept of python working directory.
2. Build text corpora with tokenization, Stemming, Lemmatization and apply visualization techniques.
3. Evaluate the classifiers and choose the best classifier.
4. Access WordNet and Treebank and apply regular expression pattern recognition methods.
5. Create Artificial Intelligence applications for text data.

List of Programs

1.Python program to display details about the operating system, working directory, files and directories in the current directory, lists the files and all directories, scan and classify them as directories and files.
2. Python program to convert an array to an array of machine values and vice versa.
3. Python program to get information about the file pertaining to the file mode and to get time values with components using local time and gm time.
4. Python program to connect to Google using socket programming.
5. Python program to perform Array operations using Numpy package.
6. Python program to perform Data Manipulation operations using Pandas package.
7. Python program to display multiple types of charts using Matplotlib package.
8. Python program to perform File Operation on Excel Data Set.
9. Python program to implement with Python Sci Kit-Learn & NLTK.
10. Python program to implement with Python NLTK/Spicy/Py NLPI.

Suggested Reading:

1. Daniel Jurafsky and James H Martin. Speech and Language Processing, 2nd Edition, Pearson Education, 2009.
2. Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, 2nd Edition,Chapman and Hall/CRC Press, 2010.
3. Tanveer Siddiqui, U.S. Tiwary, ―Natural Language Processing and Information Retrieval, OxfordUniversity Press, 2008.
4. Nitin Hardaniya, Jacob Perkins, ‖Natural Language Processing: Python and NLTK‖, Packt Publishers, 2016.

Datasets:

1. https://www.kaggle.com/datasets
2. https://www.csie.ntu.edu.tw/~cjlin/libsvmtools/datasets/multilabel.html#siam-competition2007
3. https://archive.ics.uci.edu/ml/index.php

Web Resources:

1. https://pythonprogramming.net/tokenizing-words-sentences-nltk-tutorial/
2. http://www.nptelvideos.in/2012/11/natural-language-processing.html
10. https://github.com/keon/awesome-nlp

Course Code	Course	Teaching Scheme		
		Hours Per Week		Credits
		L	P	
PGAIDS108P	Artificial Intelligence Lab 2	-	2	1

Course Objectives:

1. To familiarize with search and game playing strategies.
2. To introduce logic programming concepts through Prolog.
3. To learn probabilistic reasoning on uncertain data.
4. To learn knowledge representation and inference
5. To learn building AI Systems

Course Outcomes:

Upon completion of this course, students will be able to:

1. Solve AI problems through Python Programming
2. Demonstrate an intelligent agent
3. Evaluate Search algorithms
4. Build knowledge representation system and infer knowledge from it.
5. Apply probabilistic reasoning on data.

List of Programs

1. Implementation of uninformed search techniques.
2. Implementation of informed search techniques.
3. Implementation of game search.
4. Implementation of a program to represent knowledge
5. Implementation of a program to construct a Bayesian network from given data.
6. Implementation of a program to infer from the Bayesian network.
7. Installation of Prolog and demonstration of basic operations.
8. Mini Project work

Text Books:

1. Russell, Norvig, ―Artificial Intelligence: A Modern Approach‖, Pearson Education, Third Edition, 2015
2. Allen B. Downey, –Think Python How to Think Like a Computer Scientist‖, Second Edition, O'Reilly, 2016.

Suggested Reading:

1. Saroj Kaushik, ―Artificial Intelligence‖, Cengage Learning India, 2011.
2. Rich, Knight, Nair: –Artificial intelligence‖, Tata McGraw Hill, Third Edition, 2009.
3. Nicole Bauerle, Ulrich Rieder, –Markov Decision Process with Applications to Finance‖, Springer, 2011.
4. Nilsson. N., ―Artificial Intelligence: A New Synthesis‖, First Edition, Morgan Kaufmann, 1998.
5. Trivedi, M.C., –A Classical Approach to Artificial Intelligence‖, Khanna Publishing House, Delhi.

Web Resources:

1. https://ai.berkeley.edu/project_overview.html
2. http://aima.cs.berkeley.edu/

Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur
Faculty of Engineering & Technology
Course and Examination Scheme of Master of Technology
Choice Base Credit System(CBCS)

M. Tech. (AIDS) II Semester

Course Code	Course	Teaching Scheme		
		Hours Per Week		Credits
		L	P	
PGAIDS201T	Natural Language Processing	4	-	4

Course Objectives:

1. To acquire basic understanding of linguistic concepts and natural language complexity, variability.
2. To acquire basic understanding of machine learning techniques as applied to language.
3. To implement N-grams Models.

Course Outcomes:

After completion of the course student will be able to:

1. Able to understand Natural Language Processing.
2. Able to Understand basics of Parsing
3. Applying Hidden Markov model and Speech Recognition.
4. Able to implement probabilistic and language parsing.
5. Able to understand semantic representation.

Unit-I: Introduction- Human languages, models, ambiguity, processing paradigms; Phases in natural language processing, applications. Text representation in computers, encoding schemes.

Unit-II : Context Free Grammars Constituency, CFG definition, use and limitations. Chomsky Normal Form, Top-down parsing, bottom-up parsing, Non- probabilistic Parsing Efficient CFG parsing with CYK, another dynamic programming algorithms. Early parser. Designing a little grammar, and parsing with it on some test data. Probability Introduction to probability theory Joint and conditional probability, marginals, independence, Bayes rule, combining evidence.

Unit-III: Language modelling and Naive Bayes Probabilistic language modeling and its applications. Markov models. N-grams. Estimating the probability of a word, and smoothing. Generative models of language. Part of Speech Tagging and Hidden Markov Models, Viterbi Algorithm for Finding Most Likely HMM Path Dynamic programming with Hidden Markov Models, and its use for part-of-speech tagging, Chinese word segmentation, prosody, information extraction, etc.

Unit-IV Probabilistic Context Free Grammars, Weighted context free grammars, Weighted CYK. Pruning and beam search, Parsing with PCFGs, A tree bank, the probabilistic version of CYK, how do humans parse, Experiments with eye-tracking, Modern parsers, Maximum Entropy Classifiers, The maximum entropy principle and its relation to maximum likelihood, Maximum entropy classifiers and their application to document classification, sentence segmentation, and other language tasks

Unit-V Semantics- Meaning representation, semantic analysis, lexical semantics, Word Net Word Sense Disambiguation- Selection restriction, machine learning approaches, dictionary-based approaches. Discourse-Reference resolution, constraints on co reference, algorithm for pronoun resolution, text coherence, discourse structure.

References:

1. Jurafsky and Martin, “Speech and Language Processing”, 2nd Edition, Prentice Hall, 2008.
2. Manning and Schutze, “Statistical Natural Language Processing”, MIT Press, 2001.

3. James Allen, “Natural Language Understanding”, The Benajmins /Cummings Publishing Company,1998. Cover, T. M. and J. A. Thomas, “Elements of Information Theory”, 2nd Edition, Wiley, 2006.
4. Charniak, E., “Statistical Language Learning”, The MIT Press,1994. Jelinek, F, “Statistical Methods for Speech Recognition”, 4th Edition, The MIT Press,1998.

Course Code	Course	Teaching Scheme		
PGAIDS202T	**Machine Learning**	**Hours Per Week**		**Credits**
		L	**P**	
		4	-	4

Course Objectives:

1. To impart knowledge on the basic concepts underlying machine learning.
2. To acquaint with the process of selecting features for model construction.
3. To familiarize different types of machine learning techniques.
4. To facilitate understanding of neural networks, artificial neural networks and genetic algorithms
5. To provide basic knowledge analytical learning and reinforcement learning.

Course Outcomes: After successful completion of the course, student will be able to:

1. Understand the concepts of Machine learning and Concept learning
2. Build classification algorithms and artificial neural networks and evaluate the accuracy.
3. Examine the Bayesian classifier and its variants for predicting the probabilities.
4. Design solutions based on optimization using genetic algorithms.
5. Develop search control knowledge by inductive and analytical learning
6. Understand reinforcement learning and choose the best learning mechanism to the problem.

UNIT-I Introduction: Well-posed learning problems, Designing a learning system, Perspectives and issues in machine learning, types of Machine Learning. Concept learning and the general to specific ordering: Introduction, A concept learning task, Concept learning as search, Find-S: finding a maximally specific hypothesis, Version spaces and the candidate elimination algorithm, Remarks on version spaces and candidate elimination, Inductive bias. Decision Tree learning: Introduction, Decision tree representation, Appropriate problems for decision tree learning, The basic decision tree learning algorithm, Hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning.

UNIT-II Artificial Neural Networks: Introduction, Neural network representation, Appropriate problems for neural network learning, Perceptrons, Multilayer networks and the back propagation algorithm, Remarks on the back propagation algorithm, An illustrative example face recognition, Advanced topics in artificial neural networks. Evaluating Hypotheses: Motivation, Estimation hypothesis accuracy, Basics of sampling theory, A general approach for deriving confidence intervals, Difference in error of two hypotheses, Comparing learning algorithms.

UNIT-III Bayesian learning: Introduction, Bayes theorem, Bayes theorem and concept learning, Maximum likelihood and least squared error hypotheses, Maximum likelihood hypotheses for predicting probabilities, Minimum description length principle, Bayes optimal classifier, Gibbs algorithm, Naïve Bayes classifier, An example learning to classify text, Bayesian belief networks The EM algorithm. Instance-Based Learning: Introduction, k -Nearest Neighbour Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning, Remarks on Lazy and Eager Learning.

UNIT-IV Genetic Algorithms: Motivation, Genetic Algorithms, An illustrative Example, Hypothesis Space Search, Genetic Programming, Models of Evolution and Learning, Parallelizing Genetic Algorithms Analytical Learning: Introduction, Learning with Perfect Domain Theories: Prolog-EBG Remarks on Explanation-Based Learning, Explanation-Based Learning of Search Control Knowledge.

UNIT- V Combining Inductive and Analytical Learning: Motivation, Inductive-Analytical Approaches to Learning, Using Prior Knowledge to Initialize the Hypothesis, Using Prior Knowledge to Alter the Search Objective, Using Prior Knowledge to Augment Search Operators Reinforcement Learning: Introduction, The Learning Task, Q Learning, Non-Deterministic, Rewards and Actions, Temporal Difference Learning, Generalizing from Examples, Relationship to Dynamic Programming

Text Books:

1. Tom Mitchel ―Machine Learning‖, Tata McGraW Hill, 2017.
2. Giuseppe Bonaccorso, ―Machine Learning Algorithms‖, 2nd Edition, Packt, 2018

Suggested Reading:

1. Ethem Alpaydin, ―Introduction to Machine Learning‖, PHI, 2004
2. StephenMarshland, ―Machine Learning: An Algorithmic Perspective‖,CRC PressTaylor & Francis, 2nd Edition, 2015
3. Abhishek Vijavargia ―Machine Learning using Python‖, BPB Publications, 1 st Edition, 2018
4. ReemaThareja ―Python Programming‖, Oxford Press, 2017 5. YuxiLiu, ―Python Machine Learning by Example‖, 2 nd Edition, PACT, 2017

Web Resource:

1. https://nptel.ac.in/courses/106/106/106106139/
2. https://www.geeksforgeeks.org/machine-learning/
3. https://www.guru99.com/machine-learning-tutorial.htm
4. https://www.tutorialspoint.com/machine_learning_with_python/index.htm

Course Code	Course	Teaching Scheme		
PGAIDS203T	Neural Networks	Hours Per Week		Credits
		L	P	
		4	-	4

Course objectives:
In this course, we will study the following topics:

1. Basic neuron models: McCulloch-Pitts model and the generalized one, distance or similarity based neuron model, radial basis function model, etc.
2. Basic neural network models: multilayer perceptron, distance or similarity based neural networks, associative memory and self-organizing feature map, radial basis function based multilayer perceptron, neural network decision trees, etc.
3. Basic learning algorithms: the delta learning rule, the back propagation algorithm, self-organization learning, the r4-rule, etc.
4. Applications: pattern recognition, function approximation, information visualization, etc.

Course Outcomes:

1. Be able to analyze a problem for NN solution in terms of these methods.
2. Have an awareness of the computational theory underlying NN.
3. Have a working knowledge of a typical neural network simulation
4. Experience in programming NN applications from scratch.
5. Have knowledge of sufficient theoretical background to be able to reason about the behavior of neural networks.

UNIT-I What is a Neural Network?, Human Brain, Models of Neuron, Neural Networks viewed as directed graphs, Feedback, Network Architectures, Knowledge representation, Artificial Intelligence and Neural Networks.
Error-correction learning, Memory-based learning, Hebbian learning, Competitive learning,Boltzamann learning, Credit Assignment problem, Learning with a Teacher, Learning without a Teacher, Learning tasks, Memory, Adaptation.

UNIT-II Learning Processes – 2, Single Layer Perceptrons: Statistical nature of the learning process, Statistical learning theory, Approximately correct model of learning. Single Layer Perceptrons: Introduction, Adaptive filtering problem, Unconstrained optimization techniques, Linear least-squares filters, Least-mean square algorithm, Learning curves, Learning rate annealing techniques, Perceptron, Perceptron convergence theorem, Relation between the Perceptron and Bayes classifier for a Gaussian environment.

UNIT-III Multilayer Perceptrons – 1: Introduction, Some preliminaries, Back-propagation Algorithm, Summary of back-propagation algorithm, XOR problem, Heuristics for making the back-propagation algorithm perform better, Output representation and decision rule, Computer experiment, Feature detection, Back-propagation and differentiation.

UNIT-IV Radial-Basic Function Networks – 1: Introduction, Cover's theorem on the separability of patterns, Interpolation problem, Supervised learning as an ill-posed Hypersurface reconstruction problem, Regularization theory, Regularization networks, Generalized radial-basis function networks, XOR problem, Estimation of the regularization parameter.

UNIT-V Radial-Basic Function Networks – 2, Optimization – 1: Approximation properties of RBF networks, Comparison of RBF networks and multilayer Perceptrons, Kernel regression and it's relation to RBF networks, Learning strategies, Computer experiment. Optimization using Hopfield networks: Traveling salesperson problem, Solving simultaneous linear equations, Allocating documents to

multiprocessors.

Text Book:

1. Neural Networks and Deep Learning (Second Edition), Springer, July 2023 Charu C. Aggarwal.
2. Deep Learning: A Practitioner's Approach by Josh Patterson.
3. Hands-On Deep Learning Algorithms with Python by Sudharsan Ravichandiran

Reference Book:

1. Neural Smithing – Supervised Learning in Feedforward Artificial Neural Networks by Russell Reed

Course Code	Course	Teaching Scheme		
		Hours Per Week		Credits
		L	P	
PGAIDS204T/1	Elective-3(Discipline) **Information Retrieval Systems**	4	-	4

Course Objectives:

1. To familiarize with different Information Retrieval models.
2. To learn query languages for data retrieval.
3. To introduce various methods for efficient retrieval of information.
4. To impart knowledge on text operations.
5. To introduce Parallel and Distributed IR models.

Course Outcomes: After successful completion of the course, student will be able to:

1. Understand different Information Retrieval models.
2. Evaluate the performance of queries for retrieval of data.
3. Analyze the methods for efficient information retrieval.
4. Perform text operations and build indices.
5. Analyze searching techniques and understand Parallel and Distributed IR models.

UNIT-I Introduction: Basic concepts, Past, Present and Future of IR, The Retrieval Process. Modeling: Introduction, A Taxonomy of IR Models, Retrieval: Adhoc and Filtering, A formal characterization of IR Models, Classic Information Retrieval, Alternative Set Theoretic Models, Alternative Algebraic Models, Alternative Probabilistic Models.

UNIT-II Structured Text Retrieval Models, Models for Browsing Retrieval Evaluation: Introduction, Retrieval Performance Evaluation, Reference Collections Query languages: Introduction, Keyword-based querying, pattern Matching, Structural Queries, Query Protocols

UNIT-III Query operations: Introduction, User Relevance Feedback, Automatic Local Analysis, Automatic Global Analysis Text and Multimedia Languages and Properties: Introduction, Metadata, Text, Markup Languages, Multimedia

UNIT-IV Text Operations: Introduction, Document Preprocessing, Document Clustering, Text Compression, Comparing Text Compression Techniques Indexing: Introduction, Inverted Files, Other Indices for Text, Boolean Queries

UNIT- V Searching: Sequential Searching, Pattern Matching, Structural Queries, Compression
Parallel and Distributed IR: Introduction, Parallel IR, Distributed IR.

Text Book:

1. Ricardo, Baeza-yates, Berthier Ribeiro-Neto, ―Modern Information Retrieval‖, Pearson Education, 2008.

Suggested Reading:

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze, ―Introduction to Information Retrieval‖, Cambridge University Press, 2009.
2. David A. Grossman, Ophir Frieder, "Information Retrieval - Algorithms and Heuristics", Springer, 2nd Edition, 2004.
3. Gerald Kowalski, ―Information Retrieval Systems: Theory and Implementation‖, Springer

Course Code	Course	Teaching Scheme		
PGAIDS204T/2	Elective –III (Discipline)	Hours Per Week		Credits
		L	P	
	Block Chain Technology	4	-	4

Course Objectives:

1.Understand the fundamentals of blockchain technology and its components.
2.Explore different Blockchain subjects, platforms, and their unique features.
3.Learn how to develop and deploy smart contracts.
4.Analyse the impact of blockchain on various industries.

Course Outcomes:

Upon completing this course, students will be able to:

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

UNIT-I

Introduction: Overview of Block chain, Public Ledgers, Bit coin, Smart Contracts, Block in a Block chain, Transactions, Distributed Consensus, Public vs Private Block chain, Understanding Crypto currency to Block chain, Permission Model of Block chain, Overview of Security aspects of Block chain Basic Crypto Primitives: Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography, A basic crypto currency.

UNIT-II

Bit coin and Block chain: Creation of coins, Payments and double spending, Bit coin Scripts, Bit coin P2PNetwork, Transaction in Bit coin Network, Block Mining, Block propagation and block relay. Working with Consensus in Bit coin: Distributed consensus in open environments, Consensus in a Bit coin network, Proof of Work (PoW): basic introduction, Hash cash PoW, Bit coin PoW, Attacks on PoW and the mono polythemonopoly problem, Proof of Stake, Proof of Burn and Proof of Elapsed Time, The life of a Bit coin Miner, Mining Difficulty, Mining Pool.

UNIT-III

Permissioned Block chain: Permissioned model and use cases, Design issues for Permissionedblock chains, Execute contracts, State machine replication, Overview of Consensus models for permissioned block chain- Distributed consensus in closed environment, Paxos, RAFT Consensus, Byzantine general problem, Byzantine fault tolerant system, Lamport- Shostak-Pease BFT Algorithm, BFT over Asynchronous systems.

UNIT-IV

Enterprise Application of Block chain: Cross border payments, Know Your Customer (KYC), Food Security, Mortgage over Block chain, Block chain enabled Trade, We Trade — Trade Finance Network,Supply Chain Financing, Identity on Block chain

UNIT-V

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. Melanie Swan, ―Blockchain: Blueprint for a New Economy‖, O'Reilly, 2015.
2. Andreas Antonopoulos, ―Mastering Bitcoin: Unlocking Digital Cryptocurrencies‖, O'Reilly, 2014.

Suggested Reading:

1. Iran Bashir ―Mastering Blockchain‖, Second Edition Paperback, 2018.
2. Daniel Drescher, ―Blockchain Basics‖, First Edition, Apress, 2017.
3. Ritesh Modi, ―Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain‖, Packt Publishing..

Web Resources:

1. https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/ crse0401.html
2. https://www.hyperledger.org/projects/fabric
3. https://www.packtpub.com/big-data-and-business-intelligence/ hands-blockchain-hyperledger

Web Resource:

1. www.blockchain.com
2. https://www.blockchain.com/btc/blocks?page=1
3. https://andersbrownworth.com/blockchain/hash

Course Code	Course	Teaching Scheme		
		Hours Per Week		Credits
		L	P	
PGAIDS204T/3	Elective –III (Discipline) **Computer Vision**	4	-	4

Course Objective:

1. Understand and master basic knowledge, theories and methods in image procesing and computer vision.
2. Identify, formulate and solve problems in image procecssing and computer vision.
3. Analyse, evaluate and examine existing practical computer vision systems.
4. Communicate effectively and work in teams to develop a working computer vision system.
5. Critically review and assess scientific literature in the field and apply theoretical knowledge to identify the novelty and practicality of proposed methods.

Course Outcomes:

After learning the course the students should be able to:

1. To implement fundamental image processing techniques required for computer vision
2. Understand Image formation process
3. To perform shape analysis
4. Extract features form Images and do analysis of Images
5. Generate 3D model from images

Unit I :

Introduction : Image Processing, Computer Vision and Computer Graphics , What is Computer Vision - Low-level, Mid-level, High-level , Overview of Diverse Computer Vision Applications: Document Image Analysis, Biometrics, Object Recognition, Tracking, Medical Image Analysis, Content-Based Image Retrieval, Video Data Processing, Multimedia, Virtual Reality and Augmented Reality

Unit II :

Image Formation Models : Monocular imaging system , Radiosity: The 'Physics' of Image Formation, Radiance, Irradiance, BRDF, color etc, Orthographic & Perspective Projection,• Camera model and Camera calibration, Binocular imaging systems, Multiple views geometry, Structure determination, shape from shading , Photometric Stereo, Depth from Defocus , Construction of 3D model from images

Unit-III

Image Processing and Feature Extraction: Image preprocessing, Image representations (continuous and discrete) , Edge detection

Motion Estimation : Regularization theory , Optical computation , Stereo Vision , Motion estimation , Structure from motion

Unit-IV

Shape Representation and Segmentation : Contour based representation, Region based representation, Deformable curves and surfaces , Snakes and active contours, Level set representations , Fourier and wavelet descriptors , Medial representations , Multiresolution analysis

Unit-V

Object recognition : Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal component analysis , Shape priors for recognition

Image Understanding : Pattern recognition methods, HMM, GMM and EM

Reference Books:

1. Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill.

2. Introductory Techniques for 3D Computer Vision, by E. Trucco and A. Verri, Publisher: Prentice Hall.

3. R. C. Gonzalez, R. E. Woods. Digital Image Processing. Addison Wesley Longman, Inc., 1992.

4. D. H. Ballard, C. M. Brown. Computer Vision. Prentice-Hall, Englewood Cliffs, 1982.

5. Richard Szeliski, Computer Vision: Algorithms and Applications (CVAA). Springer, 2010

Course Code	Course	Teaching Scheme		
PGAIDS205T/1	Elective –IV (open) **Digital Image Processing and Analysis**	Hours Per Week		Credits
		L	P	
		4	-	4

Course Objectives:

1. To learn the fundamental concepts and applications of digital image processing and analysis, imagefundamentals, intensity transformations and spatial filtering
2. To learn basics of frequency domains filtering, image restoration and reconstruction concepts
3. To learn about wavelets and other transformations, basics of colour image processing and various image compression methods
4. To learn morphological image processing concepts and various image segmentation techniques
5. To learn various feature extraction methods and image pattern classification approaches

Course Outcomes:

Upon successful compilation of the course, student will be able to

1. Explain the fundamentals of digital image processing, colour models and intensity transformations
2. Demonstrate smoothing and sharpening in both spatial and frequency domains, image restoration and reconstruction
3. Demonstrate the usage of wavelets and other image transforms
4. Compare image compression methods Huffman Coding, Arithmetic Coding, LZW Coding, Block Transform Coding
5. Recommend proper use of morphological and segmentation algorithms
6. Build an image pattern classification system using feature extraction and image pattern classification techniques

UNIT - I

Introduction and applications; **Digital Image Fundamentals**, Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sampling and Quantization, Basic Concepts in Sampling and Quantization, Some Basic Relationships Between Pixels; **Intensity Transformations and Spatial Filtering**, Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, The Mechanics of Linear Spatial Filtering, Smoothing (Low pass) Spatial Filters, Sharpening (High pass) Spatial Filters;

UNIT - II

Filtering in the Frequency Domain, Preliminary Concepts, Sampling and the Fourier Transform of Sampled Functions, The Discrete Fourier Transform of Two Variables, Some Properties of the 2-D DFT and IDFT, The Basics of Filtering in the Frequency Domain, Image Smoothing Using Low pass Frequency Domain Filters, Image Sharpening Using High pass Filters; I**mage Restoration and Reconstruction,** A Model of the Image Degradation/Restoration Process, Noise Models, Restoration in the Presence of Noise Only—Spatial Filtering, Periodic Noise Reduction Using Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering

UNIT - III

Wavelet and other Image Transforms, Matrix-based Transforms, Correlation, Basis Functions in the Time- Frequency Plane, Basis Images, Fourier-Related Transforms, Walsh-Hadamard Transforms, Slant Transform, Haar Transform, Wavelet Transforms; **Color Image** Fundamentals, Huffman Coding, Arithmetic Coding, LZW Coding, Bit-plane Coding, Block Transform Coding

UNIT - IV

Morphological Image Processing, Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transform, Some Basic Morphological Algorithms, **Image Segmentation,** Fundamentals, Point, Line, and Edge Detection, Thresholding, Segmentation by Region Growing and by Region Splitting and Merging, Region Segmentation Using Clustering and Super pixels, Region Segmentation Using Graph Cuts, Segmentation Using Morphological Watersheds, The Use of Motion in Segmentation

UNIT - V

Feature Extraction, Background, Boundary Preprocessing, Boundary Feature Descriptors, Region Feature Descriptors, Some Basic Descriptors, Principal Components as Feature Descriptors, Whole-Image Features, Scale-Invariant Feature Transform (SIFT); **Image Pattern Classification,** Background, Patterns and Pattern Classes, Pattern Classification by Prototype Matching, Optimum (Bayes) Statistical Classifiers

Text Book:

1. Rafael C. Gonzalez and Richard E. Woods, –Digital Image Processing‖, Pearson Education, Fourth Edition, 2019.

Suggested Reading:

1. Vipula Singh, –Digital Image Processing with MatLab and lab View‖, Elsevier.
2. Thomas B. Moeslund, –Introduction to Video and Image Processing: Building Real Systems and Applications‖, Springer, 2012.
3. Milan Sonka, Vaclav Halvac and Roger Boyle, –Image Processing, Analysis, and Machine Vision‖, Second Edition, Thomson Learning Publishers.
4. Kenneth R.Castleman, –Digital Image Processing‖, Pearson Education, 2006.

Course Code	Course	Teaching Scheme		
PGAIDS205T/2	Elective –IV (open) **Cyber Security**	Hours Per Week		Credits
		L	P	
		4	-	4

Course Objectives:

1. To present basic concepts of Cybercrime and Cyber attacks.
2. To impart knowledge on Tools and Methods used in Cybercrime
3. To introduce Systems Vulnerability Scanning and tools
4. To familiarize about Network Defense tools.
5. To have knowledge about various Web Application Tools.

Course Outcomes:

After successful completion of the course, student will be able to:

1. Describe legal and global perspectives of Cybercrimes and inspect how criminals plan the attacks.
2. Examine phishing techniques ,keyloggers, spywares, password cracking methods and types of thefts used in cybercrimes.
3. Determine the challenges of various vulnerability mechanisms and Injection Tools.
4. Demonstrate how Network Defense tools is used in investigations.
5. Experiment with security tool that will test a web site for thousands of possible security issues like dangerous files, mis-configured services, vulnerable scripts and other issues.

UNIT-I

Introduction to Cybercrime: Definition and origins of the word, Cyber crime and Information security ,who are cybercriminals, Classification of Cybercrimes ,Legal Perspectives, Indian Perspective, Cybercrime and the Indian ITA 2000,A Global Perspective on Cybercrimes, Cybercrime Era.

Cyber offenses: Introduction, How Criminals plan the attacks, Social Engineering, CyberStalking, Cybercafe and Cybercrimes, Botnets, Attack vector, Cloud computing.

UNIT-II

Tools and Methods Used in Cybercrime: Introduction, Proxy servers and Anonymizers, Phishing ,Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDos Attacks, SQL Injection, Buffer Overflow, Attacks on wireless Networks.

Phishing and Identity Theft: Introduction, Phishing, Identity Theft.

UNIT-III

Systems Vulnerability Scanning Overview of vulnerability scanning, Open Port / Service Identification, Banner /Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples, Open VAS, Metasploit, Networks-Netcat, Socat, understanding Port and Services tools - Datapipe, Fpipe, WinRelay, Network Reconnaissance – Nmap, THC-Amap and System tools, Network Sniffers and Injection tools – Tcpdump and Windump, Wireshark, Ettercap, Hping, Kismet

UNIT-IV

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, the basic of Virtual Private Networks, Linux Firewall, Windows Firewall, Snort: Intrusion Detection System.

UNIT- V

Web Application Tools Scanning for web vulnerabilities tools: Nikto, HTTP utilities - Curl, Open SSL and Stunnel, Application Inspection tools – Zed Attack Proxy, Sqlmap, Password Cracking and Brute-Force Tools – John the Ripper,L0phtcrack, Pwdump, THC-Hydra

Text Books:

1. Nina Godbole, Sunit Belapure, ‖Cyber Security understanding Cyber Crimes, Computer forensics and Legal Perspectives‖, Wiley India Pvt.Ltd., 2013
2. Anti-Hacker Tool Kit (Indian Edition) by Mike Shema, Fourth Edition, Publication McGraw Hill,2014.

Suggested Reading:

1. William Stallings ―Cryptography and Network Security Principles and Practice, 6th Edition, Pearson2014.
2. Dr.V.K.Jain, ‖Cryptography and Network Security‖, First Edition ,Khanna Book publishing New Delhi2013.
3. Nina Godbole,‖ Information Systems Security Security Management, Metrics, Frameworks and Best Practices‖, Wiley ,2nd Edition,2012

Web Resource:

1. https://www.udemy.com/the-complete-cyber-security-course-end-point-protection/

Course Code	Course	Teaching Scheme		
PGAIDS205T/3	Elective –IV (open) **Internet of Things**	Hours Per Week		Credits
		L	P	
		4	-	4

Course Objectives:

1. To provide an overview of Internet of Things, building blocks of IoT.
2. To explore various IoT enabling technologies, Levels and Applications.
3. To facilitate with steps in IoT design Methodology.
4. To identify the Raspberry pi and other devices and end points.
5. To introduce about the Raspberry Pi device, its interfaces and Django Framework.

Course Outcomes:

After successful completion of the course, student will be able to:

1. Describe the terminology, protocols, Communication models and APIs of IoT.
2. Analyze the various IoT enabling technologies, Levels,M2M and Domain specific Applications.
3. Design IoT platform and interpret the Case Studies.
4. Develop IoT applications using Raspberry Pi3.
5. Create web applications using Django frame work.

UNIT-I

Introduction: Internet of Things- Definitions & Characteristics of IoT, Physical Design of IoT-Physical Layer, Network Layer, Transport Layer, Application Layer, Things in IoT, IoT Protocols, Logical Design of IoT-IoT Functional Blocks, IoT Communication Models-Request-response, Publisher-Subscriber, Push-Pull, Exclusive Pair, IoT Communication APIs-REST API, Web socket API.

UNIT-II

IOT Enabling Technologies: Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems, IoT Levels and Deployment Templates. M2M, Differences and similarities between IoT and M2M, SDN and NFV for IoT. Domain Specific IoT – IoT applications for Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle.

UNIT-III

IoT Platforms Design Methodology: Introduction, IoT Design Methodology Steps-Purpose and Requirements Specification, Process Specification, Domain Model Specification, Information Model Specification, Service Specifications, IoT Level Specification, Functional View Specification, Operational View Specification, Device and Component Integration, Application Development, Case Study on IoT System for Weather Monitoring.

UNIT-IV

IoT Physical Devices and End Points: Basic building blocks of an IoT device, Raspberry Pi . About the Raspberry Pi board, Raspberry Pi interfaces-Serial, SPI, I2C, Other IoT Devices pcDuino, Beagle Bone Black, Cubie board.

UNIT- V

IoT Physical Servers and cloud offerings: Introduction to cloud storage models and communication APIs, WAMP, Xively cloud for IoT, Python Web Application Framework:

Django Framework Django Architecture, Designing a RESTful Web API, Amazon web services for IoT. SkyNetIoT messaging platform.

Text Books:

1. ArshdeepBahga, Vijay Madisetti, –Internet of Things - A Hands-on Approach, Universities Press, 2015.
2. Matt Richardson, Shawn Wallace, –Getting Started with Raspberry Pi‖, O'Reilly (SPD), 2014.

Suggested Reading:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Aves and, Stamatis Karnouskos, David Boyle,
   –From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence‖, 1st Edition, Academic Press, 2014.
2. Francis da Costa, –Rethinking the Internet of Things: A Scalable Approach to Connecting Everything‖, 1st Edition, Apress Publications, 2013.
3. Daniel Minoli, –Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications‖, ISBN: 978-1-118-47347- 4, Willy Publications.

Web Resource:

1. The Internet of Things - Article https://dl.acm.org/citation.cfm?id=1862541 2. Internet of Things -Tutorial.
2. http://archive.eurescom.eu/~pub/about-eurescom/message_2009_02/Eurescom_message_02_2009.pdf
3. Publications on the Internet of Things.
   http://www.itu.int/osg/spu/publications/internetofthings/InternetofThings_summary.pdf

Course Code	Course	Teaching Scheme		
		Hours Per Week		Credits
		L	P	
PGAC205T	Indian Constitution and Fundamental Rights	2	-	-

Course Objectives:

1. The history of Indian Constitution and its role in the Indian democracy.
2. Address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. Have knowledge of the various Organs of Governance and Local Administration.

Course Outcomes:

Upon completing this course, students will be able to:

1. Understand the making of the Indian Constitution and its features.
2. Understand the Rights of equality, the Right of freedom and the Right to constitutional remedies.
3. Have an insight into various Organs of Governance - composition and functions.
4. Understand powers and functions of Municipalities, Panchayats and Co-operative Societies.
5. Understand Electoral Process, special provisions.

UNIT-I

History of making of the Indian constitutions: History, Drafting Committee (Composition & Working).
Philosophy of the Indian Constitution: Preamble, Salient Features.

UNIT-II

Contours of Constitutional Rights and Duties Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT-III

Organs of Governance": Parliament: Composition, Qualifications, Powers and Functions, Union executives : President, Governor, Council of Ministers, Judiciary, appointment and transfer of judges, qualifications, powers and functions

UNIT-IV

Local Administration - District's Administration head: Role and importance. Municipalities: Introduction, ayor and role of Elected Representative, CEO of Municipal Corporation. Panchayati Raj: Introduction, PRI: Zilla Panchayat, Elected Officials and their roles, CEO Zilla Panchayat: positions and role.
Block level: Organizational Hierarchy (Different departments) Village level: role of elected and appointed officials. Importance of grass root democracy.

UNIT-V

Election commission: Election Commission: Role and functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and functioning. Institute and Bodies for the welfare of SC/ST/OBC and women**.**

Suggested Reading:

1. –The Constitution of India‖, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, –Framing of Indian Constitution‖, 1st Edition, 2015.
3. M. P. Jain, –Indian Constitution Law‖, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, –Introduction to the Constitution of India‖, Lexis Nexis, 2015

Course Code	Course	Teaching Scheme		
		Hours Per Week		Credits
		L	P	
PGAIDS207P	Natural Language Processing Lab	-	2	1

Course Objectives:

1. To provide practical knowledge of language processing that involves various operations that can be performed on text data.
2. To familiarize with fundamental topics in language processing that include tokenization, stemming, tagging, classification, and information extraction using Python programs.
3. To facilitate understanding of regular expressions, formal grammar that describe the structure of an unlimited set of sentences.
4. To create classifiers and choose the best classifier.
5. To perform NLP operations on existing corpora and build simple AI Applications

Course Outcomes:

Upon completing this course, students will be able to:

1 Apply the concept of natural language processing (NLP) using Natural Language Toolkit (NLTK).
2 Build text corpora with tokenization, Stemming, Lemmatization and apply visualization techniques.
3 Evaluate the classifiers and choose the best classifier.
4 Access WordNet and Treebank and apply regular expression pattern recognition methods.
5 Create Artificial Intelligence applications for text data.

List of Programs

1 i) Write a program to find the 50 most frequent words of a dataset.
ii) Demonstrate the functions: bigram( ), upper( ), lower( ), isupper( ), islower( ), split( ), append( )
iii) Visualize and infer the insights from datasets.
iv) Find all the four-letter words in the Chat Corpus. With the help of a frequency distribution, show these words in decreasing order of frequency.

2 i) Write a program that performs processing of raw text. ii)Explore CMU Pronouncing Dictionary and Wordnet.

3 Perform Tokenization, Stemming, and Lemmatization to carry out the analysis with text corpora.

4 Describe the class of strings matched by the following regular expressions:
a. [a-zA-Z]+
b. [A-Z][a-z]*
c. p[aeiou]{,2}t
d. \d+(\.\d+)?
e. ([^aeiou][aeiou][^aeiou])*
f. \w+|[^\w\s]+
g. Write a regular expression which collects organization name from the organization mail-id.(Ex: _cbit.ac.in‘ from — From: xyz_it@cbit.ac.in‖)

5 i) Write code to access web page and forecast top temperature for today.
a. Explore _punkt‘ package in NLTK
b. Develop a simple extractive summarization tool and rank the sentences according to their

score.

6 i) Perform Automatic, N-gram and Transformation based Tagging for text data.

a. Write a program to demonstrate Mapping Words to Properties Using Python Dictionaries

7 Using any of the three classifiers, build the best name gender classifier. Begin by splitting the Names Corpus into three subsets: 500 words for the test set, 500 words for the dev-test set, and the remaining 6,900 words for the training set. Then, starting with the example name gender classifier, make

incremental improvements. Use the devtest set to check the progress. Check its final performance onthe test set. Analyze the performance on the test set compare to the performance on the dev-test set.

8 Write a recursive function to traverse a tree and return the depth of thetree.

9 Perform operations on Treebank dataset

10 Build a simple Chatbot and analyze.

Text Book:

1. Steven Bird, Evan Klein and Edward Loper, –Natural Language Processing with Python‖, O'Reilly Media, Inc., 2009.

Suggested Reading:

1. Daniel Jurafsky and James H Martin. Speech and Language Processing, 2nd Edition, Pearson Education, 2009.
2 Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, 2ndEdition,Chapman and Hall/CRC Press, 2010.
3 Tanveer Siddiqui, U.S. Tiwary, ―Natural Language Processing and Information Retrieval, Oxford University Press, 2008.
4 Nitin Hardaniya, Jacob Perkins, –Natural Language Processing: Python and NLTK‖, Packt Publishers, 2016.

Datasets:

1 https://www.kaggle.com/datasets
2 https://www.csie.ntu.edu.tw/~cjlin/libsvmtools/datasets/multilabel.html#siam-competition2007
3 https://archive.ics.uci.edu/ml/index.php

Web Resources:

1 https://pythonprogramming.net/tokenizing-words-sentences-nltk-tutorial/
2 http://www.nptelvideos.in/2012/11/natural-language-processing.html
3 https://github.com/keon/awesome-nlp

Course Code	Course	Teaching Scheme		
PGAIDS208P	Machine Learning Lab 4	Hours Per Week		Credits
		L	P	
			2	1

Course Objectives:

1. To impart knowledge on the basic concepts underlying machine learning.
2. To acquaint with the process of selecting features for model construction.
3. To familiarize different types of machine learning techniques.
4. To facilitate understanding of neural networks, artificial neural networks and genetic algorithms
5. To provide basic knowledge analytical learning and reinforcement learning.

Course Outcomes: After successful completion of the course, student will be able to:

1. Build classification algorithms and artificial neural networks and evaluate the accuracy.
2. Examine the Bayesian classifier and its variants for predicting the probabilities.
3. Design solutions based on optimization using genetic algorithms.
4. Implement k-means, k-nearest and SVM algorithms
5. Understand reinforcement learning and choose the best learning mechanism to the problem.

List of Programs

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples of .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. Design genetic algorithm which reflects the process of natural selection where the fittest individuals are selected for reproduction in order to produce offspring of the next generation.
7. Demonstrate SVM algorithm used for character recognition task.
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.
9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions.
10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for the experiment and draw graphs.

Text Books:

1. Tom Mitchel ―Machine Learning‖, Tata McGraW Hill, 2017.

2. Giuseppe Bonaccorso, ―Machine Learning Algorithms‖, 2nd Edition, Packt, 2018,

Suggested Reading:

1. Ethem Alpaydin, ―Introduction to Machine Learning‖, PHI, 2004

2. StephenMarshland, ―Machine Learning: An Algorithmic Perspective‖,CRC PressTaylor & Francis, 2nd Edition, 2015

3. Abhishek Vijavargia ―Machine Learning using Python‖, BPB Publications, 1 st Edition, 2018

4. ReemaThareja ―Python Programming‖, Oxford Press, 2017 5. YuxiLiu, ―Python Machine Learning by Example‖, 2 nd Edition, PACT, 2017

Datasets:

1. https://www.kaggle.com/datasets
2. https://www.csie.ntu.edu.tw/~cjlin/libsvmtools/datasets/multilabel.html#siam-competition2007
3. https://archive.ics.uci.edu/ml/index.php

Web Resource:

1. https://nptel.ac.in/courses/106/106/106106139/
2. https://towardsdatascience.com/introduction-to-genetic-algorithms-including-example-codee396e98d8bf3
3. https://www.geeksforgeeks.org/machine-learning/
4. https://www.guru99.com/machine-learning-tutorial.htm
5. **https://www.tutorialspoint.com/machine_learning_with_python/index.htm**

Rashtrasant Tukdoji Maharaj Nagpur University,
Nagpur Faculty of Engineering & Technology
Course and Examination Scheme of Master of TechnologyChoice Base Credit System(CBCS)

M. Tech. (AIDS) III Semester

Course Code	Course	Teaching Scheme		
		Hours Per Week		Credits
		L	P	
PGAIDS301T	Deep Learning	4	-	4

Course Objectives:

1. To introduce the concepts, architecture and limitations of neural networks
2. To provide foundational concepts of deep learning.
3. To learn the concepts convolution neural networks.
4. To familiarize with architectures of recurrent neural networks.
5. To impart the knowledge of advanced applications of deep neural networks.

Course Outcomes:

After successful completion of the course, student will be able to:

1. Illustrate the working principle of neural networks, deep learning and their challenges.
2. Understand training of deep feed forward network and Partially Observable Markov Decision Process.
3. Identify the challenges in Neural Network optimization and apply Convolution Neural Network.
4. Analyze the usage of Recurrent Neural Networks for sequential analysis.
5. Implement deep learning algorithms for real-world problems and evaluate their performance.

UNIT-I

The Neural Network (Deep Learning): Neurons, Linear Perceptron as Neuron, Neural Nets Architecture/ Design, Working of Neural Nets, Layers of Neural Networks and Deep learning, Activation Functions, Feed Forward Neural Networks, Limitations of Neurons, Deep Belief Networks (DBNs), Large Scale DBNs, Large Scale Convolution Neural Networks, Deep Learning for Big Data, Deep Learning from High Volumes of Data, Deep Learning from High Variety of Data, Deep Learning for High Velocity of Data, Local Minima in Deep Networks, Rearranging Neurons in a layer of a Neural Network, Spurious Local Minima in Deep Networks.

UNIT-II

Deep Feed forward Networks: Training Neurons, Common terminologies, Flowchart for Training a Deep Learning Model, Avoiding Over fitting in Deep Neural Networks, Deep Reinforcement Learning, Explore versus Exploit, Policy versus Value Learning, Q-Learning and Deep Q-Networks, POMDPS(Partially Observable Markov Decision Process), Applications of POMDPS.

UNIT-III

Deep Learning Optimization: Learning versus Pure Optimization, Challenges in Neural Network Optimization, Basic Optimization Algorithms, Parameter Initializations, Meta-algorithms, **Convolution Neural Networks:** Convolution, The Convolution Layer, The Convolution Operation, Max Pooling, Various Convolution Network Architectures.

UNIT-IV

Sequence Analysis: Variable –sized Inputs Analysis, Beam Search, Stateful Deep Learning Models, Recurrent Neural Networks (RNN), Bidirectional RNNs, Deep Recurrent Networks, Augmenting Recurrent Networks, Neural Turing Machines, Applications of Deep Learning.

UNIT- V

Deep Learning Survey: Representation Learning, Transfer Learning, Exponential Gains from Depth, Challenges of Unstructured Modeling, Using Graphs to explain Model Structure, Sampling, Advantages of Structured Modeling, Deep Learning Approach to Structured Probabilistic Models, Deep Boltzmann Machines, Directed Generative Nets, Generative Stochastic Networks.

Text Books:

1. Rajiv Chopra, –Deep Learning A Practical Approach (using python)‖, 2nd edition, Khanna Book Publishing Co., New Delhi, 2020.

Suggested Reading:

1. Anurag Bhardwaj, Wei Di, Jianing Wei,–Deep Learning Essentials‖, Packt Publishing, 2018.
2. Goodfellow, I., Bengio,Y., and Courville, A., –Deep Learning‖, MIT Press, 2016.
3. Raúl Rojas , –Neural Networks: Asystematic Introduction‖, 1996.
4. Chirstopher Bishop, –Pattern Recognition and machine Learning‖, Springer, 2007.

Web Resources:

1. NPTEL Deep Learning Part-1, https://nptel.ac.in/courses/106/106/106106184/#
2. Coursera Deep Learning Specialization course, https://www.coursera.org/specializations/deep-learning

Course Code	Course	Teaching Scheme		
PGAIDS302T/1	Elective –IV (open) **Predictive Analytics with R**	Hours Per Week		Credits
		L	P	
		4	-	4

Course Objectives:

1. To introduce Predictive Modeling.
2. To familiarize Regression and ClassificationTechniques.
3. To impart knowledge on the concepts of Support vector machines and Neural Networks.
4. To explore tree based classifiers and ensemble methods
5. To introduce Topic modeling.

Course Outcomes:

Upon completing this course, students will be able to:

1. Comprehend predictive modeling and assess the performance
2. Apply regression techniques and analyse the performance
3. Demonstrate Support Vector Machines and build an efficient networking model
4. Analyze ensemble methods by choosing Tree based classifiers
5. Select appropriate probabilistic Graphic models and identify topics through topic modeling

UNIT-I

Gearing Up for Predictive Modeling: Models**, Types of models :** Supervised, unsupervised, semi-supervised, and reinforcement learning models, Parametric and nonparametric models, Regression and classification models, Real-time and batch machine learning models, **The process of Predictive Modeling:** Defining the model's objective, Collecting the data, Picking a model, Preprocessing the data, Exploratory data analysis, Feature transformations, Encoding categorical features, Missing data, Outliers, Removing problematic features, Feature engineering and dimensionality reduction, Training and assessing the model, Repeating with different models and final model selection, Deploying the model, **Performance metrics:** Assessing regression models, Assessing classification models, Assessing binary classification models.

UNIT-II

Linear Regression: Introduction to linear regression, Simple linear regression, Multiple linear regression, Assessing linear regression models, Problems with linear regression, Feature selection, Regularization, Ridge regression**.**

Logistic Regression: Classifying with linear regression, Assessing logistic regression models, Regularization with the lasso, Classification metrics, Extensions of the binary and Multinomial logistic classifier

UNIT-III

Support Vector Machines: Maximal margin classification, Support vector classification, Inner products**,** Kernels and support vector machines, Cross-validation.

Neural Networks: Stochastic gradient descent**:** Gradient descent and local minima, The perceptron algorithm, Linear separation, The logistic neuron, **Multilayer perceptron networks:** Training multilayer perceptron networks.

UNIT-IV

Tree-based Methods: The intuition for tree models, Algorithms for training decision trees-
Classification and regression trees, CART regression trees, Tree pruning, Missing data, Regression model trees CART classification trees, C5.0, Predicting complex skill learning,

Variable importance in tree models, **Ensemble Methods: Bagging -** Margins and out-of-bag observations, Predicting heart disease with bagging,Limitations of bagging, **Boosting –** AdaBoost, Limitations of boosting, **Random forests-** The importance ofvariables in random forests

UNIT-V

Probabilistic Graphical Models: A little graph theory, Bayes' Theorem, Conditional independence, Bayesian networks, The Naïve Bayes classifier. Hidden Markov models-Predicting letter patterns in English words.

Topic Modeling: An overview of topic modeling, Latent Dirichlet Allocation, The Dirichlet distribution, The generative process, Fitting an LDA model, Modeling the topics of online news stories, Model stability, Finding the number of topics, Topic distributions, Word distributions, LDA extensions.

Text Books:

1. Rui Miguel Forte, ―Mastering Predictive Analytics with R‖, Packt Publishing Ltd, 2015.
2. Roger D. Peng,–R Programming for Data Science‖, Lean Publishing, 2015.

Suggested Reading:

1. Lantz Brett, –Machine Learning with R‖, 2nd Edition, Packt Publishing Limited.
2. SunilaGollapudi, –Practical Machine Learning‖, Packt Publishing Ltd.
3. EthemAlpaydin, –Introduction to Machine Learning‖, 2nd Edition, PHI, 2013.

Web Resources:

1. https://data-flair.training/blogs/r-predictive-and-descriptive-analytics/
2. https://www.littlemissdata.com/blog/predictive-analytics-tutorial-part-1

http://uc-r.github.io/mars

Course Code	Course	Teaching Scheme		
PGAIDS302T/2	Elective –IV (open)	Hours Per Week		Credits
		L	P	
	GPU Computing	4	-	4

Course Objectives:

1. To provide knowledge on basics of Multi-core architectures and parallel programming models
2. To design parallel algorithms, implement them on graphics processing units (GPUs) such as OpenMP,CUDA and improve their performance by utilizing the GPU architecture effectively.
3. Use OpenGL and CUDA to create real-time visualization coupled with simulations.
4. To apply program optimizations on parallel programs and evaluate the performance using profiling tools.
5. To learn how to design and implement accelerated programs exploiting the potential of GPUs forbusiness use cases.

Course Outcomes:

After successful completion of the course, student will be able to:

1. Outline the developments in the evolution of multi-core architectures and parallel programmingparadigms feature vectors for the Images.
2. Comprehend the various programming languages and libraries for parallel computing platforms.
3. Use of profiling tools to analyse the performance of applications by interpreting the given data.
4. Compare and contrast the features of parallel programming languages such as OpenMP and CUDA.
5. Write parallel programs using OpenMP and CUDA.
6. Evaluate efficiency trade-offs among alternative parallelcomputing architectures for an efficientparallel Application design.

UNIT-I

Introduction: History, Graphics Processors, Graphics Processing Units,GPGPUs. Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators,Parallel programming, CUDA OpenCL / OpenACC,Hello World Computation Kernels, Launch parameters, Thread hierarchy, Warps / Wavefronts, Thread blocks / Workgroups, Streaming multiprocessors, 1D / 2D / 3D thread mapping, Device properties, Simple Programs

UNIT-II

Memory: Memory hierarchy, DRAM / global, local / shared, private / local ,textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories

UNIT-III

Synchronization: Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU Functions: Device functions, Host functions, Kernels functions, Using libraries (such as Thrust), and developing libraries.

UNIT-IV

Support: Debugging GPU Programs. Profiling, Profile tools, Performance aspects

Streams: Asynchronous processing, tasks, Task-dependence, Overlapped data transfers, Default Stream, Synchronization with streams. Events, Event-based- Synchronization - Overlapping data transfer and kernel execution, pitfalls.

UNIT- V

Case Studies: Image Processing, Graph algorithms, Simulations, Deep Learning

Advanced topics: Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing

Text Books:

1. Programming Massively Parallel Processors: A Hands-on Approach; David Kirk, Wen-meiHwu; Morgan Kaufman; 2nd Edition, 2015
2. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook; Morgan Kaufman; 2012 (ISBN: 978-0124159334)

Suggested Reading:

1. Cheng J, Grossman M and McKercher T, Professional CUDA C Programming, Wrox Press Ltd.(2014).
2. Cook S, CUDA Programming: A Developer's Guide to Parallel Computing with GPUs, MorganKaufman (2012).

Web Resource:

1. https://docs.nvidia.com/cuda/cuda-c-programming-guide/index.html 2. https://nptel.ac.in/courses/106/105/106105220/
3. https://developer.nvidia.com/cuda-code-samples#multiGPU
4. http://www.gpucomputing.net/

Course Code	Course	Teaching Scheme		
		Hours Per Week		Credits
		L	P	
PGAIDS302T/3	Elective –IV (open) **Robotic Process Automation**	4	-	4

Course Objectives:

1. To give an overview of the Automation Anywhere Enterprise Platform, Architecture, and Components;and explain in detail various features and functionalities of the platform.
2. To facilitate learning on various components of client software, including Development and ControlRoom.
3. To make use of data manipulation concepts.
4. To create Bots using different types of Recorders.
5. To Provide an overview of MetaBots.

Course Outcomes:

After successful completion of the course, student will be able to:

1. Describe the Automation Anywhere Enterprise Platform, Architecture, Components and its features.
2. Demonstrate various Basic Commands to build Bots for automating simple processes.
3. Apply manipulation techniques for data extraction and integration.
4. Select the appropriate Recorders for web scrapping and capturing objects.
5. Analyze various aspects ofMeta Bots in Visual captures.

UNIT-I

Introduction to Robotic Process Automation (RPA): Scope and techniques of automation, What should be automated, What can be automated, Techniques of automation, What can RPA do, Benefits of RPA, Components of RPA, RPA platforms, The future of automation Introduction to Automation Anywhere, Automation Anywhere Architecture, Automation Anywhere Editors.

UNIT-II

Control Room View, Task Editor :Features of Task Editor, Different sections in Task Editor, Automation Anywhere Commands, Keystrokes / Mouse: Insert Keystrokes, Mouse Click, Insert Mouse Move, Mouse Scroll, Programs / Files / Windows :Open Files, Folders, Window Actions, Log To File, Manage Windows Controls, Object Cloning, Conditions / Loops :If/Loop ,Pause / Delays / Wait.

UNIT-III

Data Manipulation: Variables and scope, Variable Operation, String Operation, Comment, Interactive: Prompt Message Box, Clipboard management, File operation with step-by-step example: Read cell, Write cell, Read range, Write range, Append range, CSV/Excel to data table and vice versa: Reading an Excel file and creating a data table by using data from the Excel file, Creating a data table and then writing all its data to an Excel file.

UNIT -IV

Recorders: Basic recording, Desktop recording, Web recording, Error Handling, Image Recognition, Screen Capture, Integration: Email Automation, PDF Integration, Object Cloning Command , Web Control Room : Dashboard , Activity, Bots (View Bots Uploaded and Credentials) , Devices (View Development and Runtime Clients and Device Pools),Administration (Configure Settings, Users, Roles, License and Migration).

UNIT-V

Creating a MetaBot: Using MetaBot in a TaskBot and Uploading and Downloading MetaBots, Creating a newMetaBot using 'Record', Record Screen(s) and Record Screen(s) with Logic, Adding Screens to a MetaBot using'Add Screen', Updating MetaBots and Deleting MetaBots, Using the Logic Editor, Building Logic and Adding Commands, Using MetaBot DLLs in Task, MetaBot (Web Based), MetaBot (DLL Based), Bot Insight -Operational Analytics.

Text Books:

1. Alok Mani Tripathi ―Learning Robotic Process automation‖ Packet publishing Ltd–Mumbai, 2018.

Web Resources:

1. Learning Robotic Process Automation, https://www.packtpub.com/in/business/learning-robotic- process-automation
2. Automation Anywhere University, https://university.automationanywhere.com/
3. https://www.urbanpro.com/ghaziabad/rpa-robotics-process-automation-automation- anywhere/11461411