

Course Code	Course Name	Group	Teaching Scheme	Credits
			Lectures	
RJDSCDSAI351	Fuzzy Logic	DSC	3	3
Course Outcome: After completing this course, students will be able to: 1. Understand Fundamental Concepts 2. Apply Fuzzy Set Theory 3. Design Fuzzy Inference Systems (FIS) 4. Implement Fuzzy Systems in Computing 5. Analyze Fuzzy Control Systems. 6. Integrate Fuzzy Logic with Other Techniques Learning Outcomes (LOs) By the end of the course, students should be able to: 1. Differentiate between crisp and fuzzy logic systems. 2. Construct fuzzy membership functions and perform fuzzy set operations. 3. Formulate fuzzy rules and develop fuzzy reasoning models. 4. Implement fuzzy logic algorithms for decision-making applications. 5. Evaluate the effectiveness of fuzzy logic in solving real-world problems. 6. Use computational tools such as MATLAB, Python, or R for fuzzy logic modeling.				

UNIT	TOPICS
UNIT - I	Introduction: Background, Uncertainty and imprecision, Statistics and random processes, Uncertainty in information, Fuzzy sets and membership, Chance versus ambiguity, Classical sets - operations on classical sets to functions, Fuzzy sets-fuzzy set operations, Properties of fuzzy sets, sets as points in hypercube.
UNIT - II	Classical Relations And Fuzzy Relations: Cartesian product, Crisp relations-cardinality of crisp relations, Operations on crisp relations, Properties of crisp relations, Compositions, Fuzzy relationscardinality of fuzzy relations, Operations on fuzzy relations, Properties of fuzzy relations, Fuzzy Cartesian product and composition, Non interactive fuzzy sets, Tolerance and equivalence relations-crisp equivalence relation, Crisp tolerance relation, Fuzzy tolerance, Max-min Method, other similarity methods.

UNIT - III	Membership Functions: Features of the membership function, Standards forms and boundaries, fuzzification, Membership value assignments-intuition, Inference, Rank ordering, Angular fuzzy sets. Fuzzy Logic & Fuzzy Rule-Based Systems: Fuzzy logic, approximate reasoning, Fuzzy tautologies, Contradictions, Equivalence and logical proofs. Natural language, Linguistic hedges, Rule-based system canonical rule forms, Decomposition of compound rules, Likelihood and truth qualification, Aggregation of fuzzy rules.
UNIT - IV	Fuzzy Decision Making, Classification & Hybrid formation: Fuzzy synthetic evaluation, Fuzzy ordering, Preference and consensus, Multiobjective decision making under fuzzy states and fuzzy actions. Classification by equivalence relations-crisp relations, Fuzzy relations cluster analysis, neuro fuzzy and fuzzy genetic system, applications to engineering problems.
Reference Books:- 1. Neural Networks and Fuzzy Logic System by Bart Kosko, PHI Publications. 2. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekharan and Rai – PHI Publication. 3. Fuzzy Sets, Fuzzy Logic, and Fuzzy Systems by Lotfi A. Zadeh 4. Fuzzy logic with engineering application by Timothy J. Ross-wiley	

Course Code	Course Name	Group	Teaching Scheme	Credits
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RJDSCDSAI351P	Fuzzy Logic Practical	DSC	2	1

Practical List:

1. Define a fuzzy set for temperature (Cold, Warm, Hot) using numpy and matplotlib
2. Write a Python script to plot different membership functions using skfuzzy.membership
3. Given two fuzzy sets for age groups (Young, Old), apply AND, OR, and NOT operations
4. Design a fuzzy system for a washing machine that adjusts water level based on dirt level and load size
5. Compute defuzzified output for a fuzzy temperature control system using the Centroid method
6. Build a fuzzy traffic control system that adjusts traffic lights based on congestion levels
7. Cluster IMDB movie ratings into categories (e.g., Hit, Average, Flop) using FCM

Course Code	Course Name	Group	Teaching Scheme	Credits
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RJDSCDSAI352	Data Analysis and Visualization	DSC	3	3

Course Outcomes (COs)

After completing this course, students will be able to:

1. Understand Data Analysis Concepts
2. Handle and Process Data
3. Apply Statistical and Machine Learning Techniques
4. Develop Data Visualizations
5. Interpret and Communicate Findings
6. Implement Advanced Visualization Techniques Work with Large Datasets
7. Solve Real-World Problems

Learning Outcomes (LOs)

By the end of the course, students should be able to:

1. Collect, preprocess, and clean raw data from various sources.
2. Use Python (Pandas, NumPy) or R (tidyverse) for data manipulation and analysis.
3. Apply exploratory data analysis (EDA) techniques to uncover patterns and trends.
4. Choose appropriate visualization techniques for different types of data and insights.
5. Create dynamic and interactive visualizations for better user engagement.
6. Interpret statistical and machine learning models using visualization.
7. Communicate data-driven insights effectively through reports and dashboards.
8. Work with real-world datasets and present findings in a structured manner.

UNIT	TOPICS
UNIT - I	Introduction to Data Analysis: Data Analysis - Exploratory Data Analysis and Data Science Process - Responsibilities of a Data Analyst - Data Analytics vs. Data Analysis - Types of Data - Understanding Different Types of File Formats - Sources of Data - Languages for Data Professionals - Overview of Data Repositories - Data Marts, Data Lakes, ETL, and Data Pipelines - Foundations of Big Data - Identifying Data for Analysis
UNIT - II	Data Sources - How to gather and Import Data - Data Loading, Storage and File Formats - Reading and Writing Data in Text Format, Web Scraping, Binary Data Formats, interacting with Web APIs, Interacting with Databases – Data Wrangling - Hierarchical Indexing, Combining and

	Merging Data Sets Reshaping and Pivoting - Tools for Data Wrangling - Data Cleaning and Preparation - Handling Missing Data, Data Transformation, String Manipulation
UNIT - III	Intro to data visualization - Introduction to Visualization and Dashboarding Software - Visualization Tools - Getting started with Tableau Desktop – Connecting to the dataset - Creating charts – Creating common visualizations (bar charts, line charts etc.) - Filtering and sorting data - Adding Titles, Labels, and descriptions - Publish your work to Tableau Cloud - Interactivity with text and visual tooltips - Interactivity with actions (filter, highlight, URL) – Assembling dashboards from multiple charts
UNIT - IV	Introduction to Power BI - Understanding Desktop - Understanding Power BI Report Designer - Report Canvas, Report Pages: Creation, Renames - Report Visuals, Fields and UI Options - Experimenting Visual Interactions, Advantages - Reports with Multiple Pages and Advantages - Pages with Multiple Visualizations - PUBLISH Options and Report Verification in Cloud - Adding Report Titles. Report Format Options - Introduction to data storytelling - Creating a data story
References 1. Python for Data Analysis: Data Wrangling with Pandas, NumPy and IPython by McKinney, W., 2nd edition. O'Reilly Media, 2017 2. Doing Data Science: Straight Talk from the Frontline by O'Neil, C., & Schutt, R, O'Reilly Media, 2013 3. The Big Book of Dashboards by Steve Wexler, Jeffrey Shaffer, Andy Cotgreave, John Wiley & Sons, 2017 4. Practical Tableau by Ryan Sleeper, O'Reilly Media, 2018 5. Power BI. Book-1, Business Intelligence Clinic: Create and Learn by Roger F Silva, 2018 6. Introducing Microsoft Power BI by Alberto Ferrari and Marco Russo, Microsoft Press, Washington, 2016	

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RJDSCDSAI352P	Data Analysis and Visualization Practical	DSC	2	1

Practical List:

1. Show Basic Visualization in Python
2. Show Basic Visualization in R.
3. Connecting to Data and preparing data for visualization in Tableau
4. Use Data aggregation and statistical functions in Tableau.
5. Show Data Visualization using Tableau.
6. Use dashboards of Tableau.
7. Show Data Visualization using PowerBi.
8. Show Data Visualization using DataWrapper.
9. Show Data Visualization using Gantt Chart.
10. Show Data Visualization using Zoho.
11. Publish visualised data on Cloud in PowerBi

Course Code	Course Name	Group	Teaching Scheme	Credits
			Lectures	
RJDSCDSAI352	Project Documentation	DSC	2	2

Course Outcomes (COs):

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

1. Understand the Importance of Project Documentation
2. Structure and Organize a Project Report Effectively
3. Conduct a Literature Review and Problem Analysis
4. Design System Architecture and Data Flow Diagrams
5. Document Implementation Details and Methodology
6. Evaluate and Present Project Results
7. Identify Future Scope and Research Directions
8. Write Professional and Well-Formatted Reports

Learning Outcomes (LOs):

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

1. Define the Purpose and Scope of a Project Document.
2. Organize Information Logically in Sections Like Introduction, Literature Review, Methodology, and Conclusion.
3. Conduct Effective Research for Literature Review and Cite Sources Properly.
4. Develop System Design Diagrams, Including Architecture, DFD, and ER Models.
5. Describe Implementation Details with a Focus on AI/ML and Big Data Technologies.
6. Analyze and Present Results Using Tables, Graphs, and Performance Metrics.
7. Identify Project Challenges and Suggest Future Enhancements.
8. Apply Technical Writing Standards to Create a Professional and Readable Report.

UNIT	TOPICS
UNIT - I	Abstract (Max 250 words): Brief overview of the project, Problem statement and objective, Technologies used (AI/ML, Big Data, Databricks, PySpark, Kafka, etc.), Expected outcomes Introduction: Background of the problem, Importance and real-world applications, Scope of the project, Objectives of the project
UNIT - II	Literature Review: Summary of existing research/work in the domain Comparison with existing methods or technologies, Gaps in current research and how the project addresses them.

	System Analysis, Problem Statement – Define the issue the project solves, Existing System vs. Proposed System – Limitations of current approaches and improvements introduced, Feasibility Study – Technical, economic, and operational feasibility.
UNIT - III	System Design Architecture Diagram – High-level system architecture Modules Overview – Description of each module/component Data Flow Diagrams (DFD) – Process flow within the system Entity-Relationship (ER) Diagrams – Database design (if applicable) Technologies and Tools Used Programming Languages: (Python, Scala, SQL, etc.) Frameworks & Libraries: (PySpark, TensorFlow, Scikit-learn, etc.) Big Data Tools: (Databricks, Kafka, Dask, PostgreSQL, etc.) Cloud Services: (AWS, Azure, GCP, etc., if applicable)
UNIT - IV	Implementation & Methodology Dataset Used – Source, preprocessing, and transformation Algorithms & Models Used – AI/ML models, mathematical/statistical techniques Big Data Processing Workflow – Use of PySpark, Databricks, Kafka, etc. Training & Testing – Model evaluation, metrics (accuracy, precision, recall, F1-score) Challenges Faced & Solutions Implemented Results & Analysis Model Performance Evaluation – Accuracy, confusion matrix, RMSE, etc. Graphs, Tables, and Visualizations – Insights drawn from data Comparison with Existing Approaches

Course Code	Course Name	Group	Teaching Scheme	Credits
			Lectures	
RJDSCDSAI361	Machine Learning	DSC	4	4
<u>Course Outcome:</u> 1. To introduce various statistical and machine learning concepts and methods. 2. To introduce machine learning solutions to regression, classification and clustering problems. 3. To evaluate and interpret the results of algorithm. <u>Learning Outcome:</u> Upon completion of this course, the student should be able to 1. Perform end-to-end process of investigating data through a machine learning lens. 2. Extract and identify best features of data. 3. Evaluate the performance of machine learning algorithms.				

UNIT	TOPICS
UNIT - I	Introduction to Machine Learning : Types, Issues in Machine Learning, Application of Machine Learning, Steps of developing a Machine Learning Application. Supervised Learning: Introduction, Types, Applications, Linear Regression and Multiple linear regression, non-linear regression like polynomial regression, Performance measure of regression models: Means Square Error, Mean Absolute Error, Root Mean Square Error, R2 Score.
UNIT - II	Regularization : Overfitting and underfitting, ridge regression, lasso regression, elastic net regression. Classification: Types of classification, Logistic regression. Naive bayes classifier, Decision tree, Evaluating classification models.
UNIT - III	Unsupervised Learning : Introduction, applications, label and unlabeled datasets. Clustering : Partition based clustering, KMeans Clustering, Hierarchical Clustering, Agglomerative and Divisive approach, Density Based Clustering, DBSCAN Algorithm
UNIT - IV	Dimensionality reduction : curse of dimensionality, principal component analysis and t-distributed stochastic neighbor embedding. Reinforcement Learning : Introduction, : Value functions, Bellman's equation, value iteration, policy iteration, Markov Decision processes(MDPs) Q-Learning.

References

1. “An Introduction to Statistical Learning With Application in R”, By Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer Texts in Statistics.
2. “Machine Learning”, Mitchell Tom, McGraw Hill, 1997.
3. “Pattern classification”, 2nd edition, Richard O. Duda, Peter E. Hart, David G. Stork. Wiley, New York, 2001.
4. “Machine Learning: A Probabilistic Perspective”, Kevin P. Murphy, MIT Press, 2012
5. “Practical Data Science”, Andreas Francois Vermeulen, APress, 2018
6. “Principles of Data Science”, Sinan Ozdemir, Packt, 2016.

Course Code	Course Name	Group	Teaching Scheme	Credits
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RJDSCDSAI361P	Machine Learning	DSC	2	1

Practical List:

1. Implementation of simple and multiple linear regression.
2. Implementation of polynomial regression.
3. Perform regularization using ridge regression.
4. Perform binary classification using logistic regression model.
5. Implement decision tree model
6. Classification using naive bayes classifier.
7. Implement k means clustering
8. Implement DBSCAN algorithm on noisy dataset
9. Reduce dimensionality using PCA.
10. Implement Markov Decision Process.

Course Code	Course Name	Group	Teaching Scheme	Credits
			Lectures	
RJDSCDSAI362	Digital Image Processing	DSC	4	4

Course Outcomes (COs)

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

1. Understand the Fundamentals
2. Image Enhancement Techniques
3. Image Restoration
4. Image Segmentation & Feature Extraction
5. Compression Techniques
6. Morphological Processing
7. Machine Learning & Deep Learning in Image Processing
8. Applications of Digital Image Processing

Learning Outcomes (LOs)

After completing the course, students should be able to:

1. Describe the principles of digital image formation, acquisition, and representation.
2. Apply image enhancement and restoration techniques to improve image quality.
3. Analyze various edge detection and segmentation methods.
4. Develop algorithms for feature extraction and object recognition.
5. Implement image compression techniques for storage and transmission efficiency.
6. Evaluate the performance of image processing algorithms using standard metrics.
7. Integrate deep learning approaches for image classification and segmentation tasks.
8. Demonstrate problem-solving skills in various image processing applications.

UNIT	TOPICS
UNIT - I	Introduction to Digital Image Processing: What is Digital Image Processing?, Applications of Image Processing (Medical, Satellite, AI, Robotics), Image Formation & Representation (Pixels, Resolution, Bit Depth), Image File Formats (JPEG, PNG, TIFF, BMP) Image Enhancement & Restoration: Spatial and Frequency Domain Processing, Histogram Processing (Equalization, Stretching), Filtering Techniques (Mean, Gaussian, Median, Laplacian Filters), Noise Removal (Gaussian, Salt & Pepper, Wiener Filter)

UNIT - II	Image Transformation & Compression: Fourier Transform and Discrete Cosine Transform (DCT), Image Compression Techniques (Lossy vs. Lossless), JPEG & PNG Compression Methods, Wavelet Transform for Image Processing Morphological Image Processing: Dilation, Erosion, Opening, and Closing, Morphological Operations in Binary Images, Boundary Detection and Object Extraction
UNIT - III	Image Segmentation & Object Detection: Thresholding Techniques (Global, Adaptive, Otsu's), Edge Detection (Sobel, Prewitt, Canny), Contour Detection & Watershed Algorithm, Connected Component Labeling Color Image Processing: RGB, HSV, and YCbCr Color Models, Color Transformations and Normalization, Image Segmentation using Color Information
UNIT - IV	Feature Extraction & Pattern Recognition: Shape Descriptors (Hu Moments, Zernike Moments), Texture Analysis (Haralick Features, GLCM), Keypoint Detection (SIFT, SURF, ORB), Machine Learning for Image Classification (SVM, CNN) Deep Learning for Image Processing: Introduction to CNNs for Image Classification, Pretrained Models (VGG16, ResNet, MobileNet), Object Detection (YOLO, Faster R-CNN), Image Segmentation with U-Net Applications of Image Processing: Medical Imaging (X-Ray, MRI, CT Scan Analysis), Face Recognition & Biometric Systems, Satellite Image Processing & Remote Sensing, OCR (Optical Character Recognition)
References 1. "Digital Image Processing" – Rafael C. Gonzalez, Richard E. Woods 2. "Fundamentals of Digital Image Processing" – Anil K. Jain 3. "Image Processing, Analysis, and Machine Vision" – Milan Sonka, Vaclav Hlavac, Roger Boyle 4. "Computer Vision: Algorithms and Applications" – Richard Szeliski 5. "Programming Computer Vision with Python" – Jan Erik Solem 6. "Digital Image Processing and Analysis" – B. Chanda, D. Dutta Majumder 7. "Handbook of Image and Video Processing" – Al Bovik	

Course Code	Course Name	Group	Teaching Scheme	Credits
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RJDSCDSAI362P	Digital Image Processing	DSC	2	1

Practical List:

1. Load and display images using OpenCV or MATLAB
2. Apply histogram equalization on grayscale images
3. Implement smoothing and sharpening filters using OpenCV
4. Implement image compression using OpenCV and NumPy
5. Perform edge detection using Canny and Sobel operators
6. Segment objects in an image using Otsu's thresholding
7. Convert RGB images to HSV and extract specific color objects
8. Implement feature extraction using OpenCV
9. Train a CNN model for image classification using TensorFlow/Keras
10. Develop a complete image processing system (e.g., face recognition, medical image classification)