LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING

(AUTONOMOUS)

Accredited by NAAC with 'A' Grade, ISO 9001:2015 Certified Institution

Approved by AICTE, New Delhi and Affiliated to JNTUK, Kakinada

L.B. REDDY NAGAR, MYLAVARAM, NTR DIST., A.P.-521 230.

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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

COURSE HANDOUT

PART-A

Name of Course Instructor: **Dr Ch. Rajendra Babu**

Course Name & Code : **Data Warehousing and Data Mining (R23AD04)**

L-T-P Structure : **3-0-0** **Credits: 3**

Program/Sem/Sec : **B.Tech / V Sem / A** **A.Y.: 2025-26**

PREREQUISITE: DBMS, Probability, and Statistics

COURSE EDUCATIONAL OBJECTIVES (CEOs):

The Objective of the course is to introduce the concepts of data warehouse and data mining, which gives a complete description about the principles, used, architectures, applications, design and implementation of data mining and data ware housing concepts.

COURSE OUTCOMES (COs): At the end of the course, student will be able to

CO1	Design data warehouses to support effective data modeling, integration, and analytical processing. (Understand L2)
CO2	Understand data preprocessing techniques required to convert raw data into a suitable format for effective machine learning applications. (Understand L2)
CO3	Apply classification techniques using different algorithms to solve real-world problems and evaluate their performance. (Apply L3)
CO4	Apply Apriori and FP-Growth algorithms to analyze frequent patterns and uncover insights from large datasets. (Apply L3)
CO5	Understand clustering concepts and various cluster analysis methods to group similar data points effectively. (Understand L2)

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		2		3							2	2		3
CO2	3	2			3							2	2		3
CO3	3	3	3	2	3							2	3	2	2
CO4	2	2		2	3							2	3		2
CO5	2	2		2	3							2	3	1	2
1 - Low			**2 –**Medium						**3 -** High						

TEXTBOOKS:

1. Data Mining concepts and Techniques, 3rd edition, Jiawei Han, Michel Kamber, Elsevier, 2011.
2. Introduction to Data Mining: Pang-Ning Tan & Michael Steinbach, Vipin Kumar, Pearson, 2012.

REFERENCE BOOKS:

1. Data Mining: VikramPudi and P. Radha Krishna, Oxford Publisher.
2. Data Mining Techniques, Arun K Pujari, 3rd edition, Universities Press,2013.

3. (NPTEL course by Prof.PabitraMitra)
   http://onlinecourses.nptel.ac.in/noc17_mg24/preview
4. http://www.saedsayad.com/data_mining_map.htm

PART-B

COURSE DELIVERY PLAN (LESSON PLAN): Data Warehousing and Data Mining (R23AD04)

UNIT-I: Data Warehousing and Online Analytical Processing

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Discussion of CO'S and CEO'S	1	7/1/2025		TLM1 & 2	
2.	Basic concepts	1	7/3/2025		TLM1 & 2	
3.	Data Warehouse Modeling: Data Cube and OLAP	1	7/4/2025		TLM1 & 2	
4.	Data Warehouse Design and Usage	1	7/5/2025		TLM1 & 2	
5.	Data Warehouse Implementation	2	7/8/2025 7/10/2025		TLM1 & 2	
6.	Cloud Data Warehouse	1	7/11/2025		TLM1 & 2	
7.	Data Mining and Patten Mining	1	7/15/2025		TLM1 & 2	
8.	Technologies, Applications, Major issues	1	7/17/2025		TLM1 & 2	
9.	Data Objects & Attribute Types	1	7/18/2025		TLM1 & 2	
10.	Basic Statistical Descriptions of Data	1	7/19/2025		TLM1 & 2	
11.	Data Visualization	1	7/22/2025		TLM1 & 2	
12.	Measuring Data Similarity and Dissimilarity	1	7/24/2025		TLM1 & 2	
No. of classes required to complete UNIT-I: 12				**No. of classes taken:**		

UNIT-II: Data Pre-processing

S No	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
13.	An Overview, Data Cleaning	1	7/25/2025		TLM1 & 2	
14.	Data Integration	2	7/29/2025 7/31/2025		TLM1 & 2	
15.	Data Reduction	2	8/1/2025 8/2/2025		TLM1 & 2	
16.	Data Transformation	2	8/5/2025 8/7/2025		TLM1 & 2	
17.	Data Discretization	2	8/8/2025 8/12/2025		TLM1 & 2	
No. of classes required to complete UNIT-II : 09				**No. of classes taken:**		

UNIT-III: Classification

S No	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
18.	Basic Concepts, General Approach to solving a classification problem	1	8/14/2025		TLM1 & 2	
19.	Decision Tree Induction: Attribute Selection Measures	3	8/19/2025 8/21/2025 8/22/2025		TLM1 & 2	
20.	Tree Pruning	1	8/23/2025		TLM1 & 2	
21.	Scalability and Decision Tree Induction,	1	9/2/2025		TLM1 & 2	
22.	Visual Mining for Decision Tree Induction	1	9/4/2025		TLM1 & 2	
23.	Bayesian Classification Methods: Bayes	2	9/5/2025		TLM1 & 2	

	Theorem		9/6/2025			
24.	Naïve Bayes Classification	2	9/9/2025 9/11/2025		TLM1 & 2	
25.	Rule-Based Classification	2	9/12/2025 9/16/2025		TLM1 & 2	
26.	Model Evaluation and Selection	1	9/18/2025		TLM1 & 2	
No. of classes required to complete UNIT-III : 14				**No. of classes taken:**		

UNIT-IV: Association Analysis

S No	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
27.	Problem Definition	1	9/19/2025		TLM1 & 2	
28.	Frequent Item set Generation	1	9/20/2025		TLM1 & 2	
29.	Rule Generation: Confident Based Pruning	2	9/23/2025 9/25/2025		TLM1 & 2	
30.	Rule Generation in Apriori Algorithm	1	9/26/2025		TLM1 & 2	
31.	Compact Representation of frequent item sets	1	9/27/2025		TLM1 & 2	
32.	FP-Growth Algorithm	2	10/3/2025 10/4/2025		TLM1 & 2	
No. of classes required to complete UNIT-IV : 08				**No. of classes taken:**		

UNIT-V: Cluster Analysis

S No	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
33.	Overview, Basics and Importance of Cluster Analysis	1	10/7/2025		TLM1 & 2	
34.	Clustering techniques, Different Types of Clusters	1	10/9/2025		TLM1 & 2	
35.	K-means: The Basic K-means Algorithm	2	10/10/2025 10/14/2025		TLM1 & 2	
36.	K-means Additional Issues, Bi-secting K Means	2	10/16/2025 10/17/2025		TLM1 & 2	
37.	Agglomerative Hierarchical Clustering: Basic Agglomerative Hierarchical Clustering Algorithm	2	10/18/2025 10/23/2025		TLM1 & 2	
38.	DBSCAN: Traditional Density Center-Based Approach	2	10/24/2025 10/25/2025		TLM1 & 2	
39.	DBSCAN Algorithm	1	10/28/2025		TLM1 & 2	
40.	Strengths and Weaknesses	1	10/30/2025		TLM1 & 2	
41.	Assignment-5	1	10/31/2025		TLM1 & 2	
No. of classes required to complete UNIT-V : 11				**No. of classes taken:**		

Content beyond the Syllabus:

S No	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
50		1	11/1/2025		TLM5	

Teaching Learning Methods			
TLM1 & 2	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS (R23 Regulation):

Evaluation Task	Marks
Assignment-I (Units-I, II)	A1=5
I-Descriptive Examination (Units-I, II)	M1=15
I-Quiz Examination (Units-I, I))	Q1=10
Assignment-II (Unit-III , IV & V)	A2=5
II- Descriptive Examination (Unit-III , IV & V)	M2=15
II-Quiz Examination (Unit-III , IV & V)	Q2=10
Mid Marks =80% of Max ((M1+Q1+A1), (M2+Q2+A2)) + 20% of Min ((M1+Q1+A1), (M2+Q2+A2))	M=30
Cumulative Internal Examination (CIE): M	30
Semester End Examination (SEE)	70
Total Marks = CIE + SEE	100

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive

	clear instructions.
PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	To apply the fundamental engineering knowledge, computational principles, and methods for extracting knowledge from data to identify, formulate and solve real time problems.
PSO 2	To develop multidisciplinary projects with advanced technologies and tools to address social and environmental issues.
PSO 3	To provide a concrete foundation and enrich their abilities for Employment and Higher studies in Artificial Intelligence and Data science with ethical values.

Course Instructor	Course Coordinator	Module Coordinator	HOD
Dr. Ch Rajendra Babu	**Dr Ch. Rajendra Babu**	**Dr. V. Suryanarayana**	**Dr. P. Bhagath**

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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

COURSE HANDOUT

PART-A

Name of Course Instructor: Mr.K.VENKATESH
Course Name & Code : PRINCIPLES OF MACHINE LEARNING & 23AM03
L-T-P Structure : 3-0-0 **Credits:** 3
Program/Sem/Sec : B. Tech/V/A **A.Y.:** 2025-26

PREREQUISITES : Probability and Statistics, Data Warehousing and Data Mining

COURSE EDUCATIONAL OBJECTIVES (CEOs): The objectives of the course are to

- Define machine learning and its different types (supervised and unsupervised) and understand their applications.
- Apply supervised learning algorithms including decision trees and k-nearest neighbours (k-NN).
- Implement unsupervised learning techniques, such as K-means clustering

COURSE OUTCOMES (COs): At the end of the course, student will be able to

CO1	Understand development steps of model building and evaluation approaches. **(Understand-L2)**
CO2	Apply Nearest Neighbor-based models to solve real-time regression and classification problems **(Apply-L3)**
CO3	Make use of supervised learning algorithms to solve classification problems **(Apply-L3)**
CO4	Apply linear discriminants and perceptron classifiers to classify datasets **(Apply-L3)**
CO5	Learn advanced learning techniques to deal with complex data. **(Apply-L3)**

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	-	-	-	-	-	-	-	-	-	-	-	3
CO2	3	2	1	-	-	-	-	-	-	-	-	-	-	-	3
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-	3
CO4	2	2	-	-	-	-	-	-	-	-	-	-	-	-	3
CO5	2	3	1	-	-	-	-	-	-	-	-	-	-	-	3
1 - Low							**2** –Medium						**3** - High		

TEXTBOOKS:

T1: "Machine Learning Theory and Practice", M N Murthy, V S Ananthanarayana, Universities Press (India), 2024

T2: Subramanian Chandramouli, Saikat Dutt, Amit Kumar Das," Machine Learning", Pearson Education India ,1st edition,2015.

REFERENCE BOOKS:

R1 "Machine Learning", TomM. Mitchell, McGraw-Hill Publication, 2017

R2 "Machine Learning in Action", Peter Harrington, Dream Tech.

R3 "Introduction to Data Mining", Pang-Ning Tan, Michel Stenbach, Vipin Kumar, 7th Edition, 2019.

R4 "Understanding Machine Learning: From Theory to Algorithms" Shai Shalev-Shwartz, ShaiBen David, Cambridge.

Web Resources:

https://nptel.ac.in/courses/106106139

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: Introduction to Machine Learning

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Course and COs	1	30-06-2025		TLM1,2	
2.	Evolution of Machine Learning	1	02-07-2025		TLM1,2	
3.	Paradigms for ML	2	03-07-2025 04-07-2025		TLM1,2	
4.	Learning by Rote, Learning by Induction	1	07-07-2025		TLM1,2	
5.	Reinforcement Learning, Types of Data	3	09-07-2025 10-07-2025 11-07-2025		TLM1,2	
6.	Matching, Stages in Machine Learning,	2	14-07-2025 16-07-2025		TLM1,2	
7.	Data Acquisition, Feature Engineering,	2	17-07-2025 18-07-2025		TLM1,2	
8.	Data Representation, Model Selection	1	21-07-2025		TLM1,2	
9.	Model Learning, Model Evaluation	2	23-07-2025 24-07-2025		TLM1,2	
10.	Model Prediction, Search and Learning, Data Sets.	2	25-07-2025 28-07-2025		TLM1,2	
No. of classes required to complete UNIT-I: 17				**No. of classes taken:**		

UNIT-II: Nearest Neighbor-Based Models

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Proximity Measures	1	30-07-2025		TLM1,2	
2.	Distance Measures, Non-Metric Similarity Functions,	2	31-07-2025 01-08-2025		TLM1,2	
3.	Proximity Between Binary Patterns	1	04-08-2025		TLM1,2	
4.	Different Classification Algorithms Based on the Distance Measures	2	06-08-2025 07-08-2025		TLM1,2	
5.	K-Nearest Neighbor Classifier	2	08-08-2025 11-08-2025		TLM1,2	
6.	Radius Distance Nearest Neighbor Algorithm	1	13-08-2025		TLM1,2	
7.	KNN Regression, Performance of Classifiers	2	14-08-2025 18-08-2025		TLM1,2	
8.	Performance of Regression Algorithms	1	20-08-2025		TLM1,2	
9.	**Unit-1 and 2 Revision**	2	21-08-2025 22-08-2025		TLM1,2	
No. of classes required to complete UNIT-II: 14				**No. of classes taken:**		

UNIT-III: Models Based on Decision Trees

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Decision Trees for Classification	1	01-09-2025		TLM1,2	
2.	Impurity Measures ,Properties	1	03-09-2025		TLM1,2	
3.	Regression Based on Decision Trees, Bias–Variance Trade-off,	1	04-09-2025		TLM1,2	
4.	Random Forests for Classification and Regression	1	08-09-2025		TLM1,2	
5.	The Bayes Classifier: Introduction to the Bayes Classifier	1	10-09-2025		TLM1,2	
6.	Bayes' Rule and Inference,	1	11-09-2025		TLM1,2	
7.	The Bayes Classifier and its Optimality	1	12-09-2025		TLM1,2	
8.	Multi-Class Classification | Class Conditional Independence and Naive Bayes Classifier (NBC)	2	15-09-2025 17-09-2025		TLM1,2	
No. of classes required to complete UNIT-III: 09				**No. of classes taken:**		

UNIT-IV: Linear Discriminants for Machine Learning

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Linear Discriminants	1	18-09-2025		TLM1,2	
2.	Linear Discriminants for Classification	1	19-09-2025		TLM1,2	
3.	Perceptron Classifier, Perceptron Learning Algorithm	2	22-09-2025 24-09-2025		TLM1,2	
4.	Support Vector Machines, Linearly Non-Separable Case	2	25-09-2025 26-09-2025		TLM1,2	
5.	Non-linear SVM, Kernel Trick	1	06-10-2025		TLM1,2	
6.	Logistic Regression, Linear Regression	2	08-10-2025 09-10-2025		TLM1,2	
7.	Multi-Layer Perceptrons (MLPs)	1	10-10-2025		TLM1,2	
8.	Backpropagation for Training an MLP.	1	13-10-2025		TLM1,2	
No. of classes required to complete UNIT-IV: 11				**No. of classes taken:**		

UNIT-V: Other Types of Learning

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Ensemble Learning- Bagging, Boosting	2	15-10-2025 16-10-2025		TLM1,2	
2.	Stacking and its impact on bias and variance	1	17-10-2025		TLM1,2	
3.	AdaBoost	1	22-10-2025		TLM1,2	
4.	Gradient Boosting Machines,	1	23-10-2025		TLM1,2	
5.	XGBoost	1	24-10-2025		TLM1,2	
6.	Reinforcement Learning	1	27-10-2025		TLM1,2	
7.	Q Learning	1	29-10-2025		TLM1,2	
No. of classes required to complete UNIT-V: 08				**No. of classes taken:**		

CONTENT BEYOND THE SYLLABUS:

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Combining Inductive and Analytical Learning	1	30-10-2025		TLM1,2	
2.	Case Study of Analytics Learning	1	31-10-2025		TLM1,2	

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT(NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS (R23 Regulation):

Evaluation Task	**Marks**
Assignment-I (Units-I, II)	A1=5
I-Descriptive Examination (Units-I, II)	M1=15
I-Quiz Examination (Units-I, II)	Q1=10
Assignment-II (Unit-III, IV & V)	A2=5
II- Descriptive Examination (Unit-III, IV & V)	M2=15
II-Quiz Examination (Unit-III, IV & V)	Q2=10
Mid Marks =80% of Max ((M1+Q1+A1), (M2+Q2+A2)) + 20% of Min ((M1+Q1+A1), (M2+Q2+A2))	M=30
Cumulative Internal Examination (CIE): M	30
Semester End Examination (SEE)	70
Total Marks = CIE + SEE	100

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO 6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
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PO11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	To apply the fundamental engineering knowledge, computational principles, and methods for extracting knowledge from data to identify, formulate and solve real time problems.
PSO 2	To develop multidisciplinary projects with advanced technologies and tools to address social and environmental issues.
PSO 3	To provide a concrete foundation and enrich their abilities for Employment and Higher studies in Artificial Intelligence and Data science with ethical values.

Title	**Course Instructor**	**Course Coordinator**	**Module Coordinator**	**Head of the Department**
Name of the Faculty	**Mr.K.Venkatesh**	**Mr. K. Venkatesh**	**Dr.V.Surya Narayana**	**Dr. P.Bhagath**
Signature				

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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

COURSE HANDOUT

PART-A

Name of Course Instructor: Mr. S. V. V. D. JAGADEESH
Course Name & Code : DATA VISUALIZATION (23AD05)
L-T-P Structure : 3-0-0 **Credits:** 3
Program/Sem/Sec :III **B.Tech /V Sem /AI & DS - A** **A.Y.:** 2025-26

PREREQUISITE: Computer Graphics, Image Processing.

COURSE EDUCATIONAL OBJECTIVES (CEOs):
To familiarize students with the basic and advanced techniques of information visualization and scientific visualization, learn key techniques of the visualization process, a detailed view of visual perception, the visualized data and the actual visualization, interaction and distorting techniques.

COURSE OUTCOMES (CO's): After successful completion of the course the students are able to

CO1	Explain the basic principles of Data Visualization. **(Understand-L2)**
CO2	Apply visualization techniques to a problem and its associated dataset. **(Apply-L3)**
CO3	Apply structured approach to create effective visualization. **(Apply-L3)**
CO4	Explain about the valuable insights from the massive dataset using visualization. **(Understand-L2)**
CO5	Build visualization dashboard to support decision making. **(Apply-L3)**

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	1	-	-	-	-	-	-	-	-	2	-
CO2	2	2	3	-	2	-	-	-	-	-	-	-	2	2	-
CO3	2	2	3	-	1	-	-	-	-	-	-	-	2	2	-
CO4	2	2	-	-	1	-	-	-	-	-	-	-	-	2	-
CO5	2	2	3	-	1	-	-	-	-	-	-	-	2	2	-
1 - Low			**2 –**Medium								**3 –** High				

TEXTBOOKS:

T1 WARD, GRINSTEIN, KEIM.Interactive Data Visualization: Foundations, Techniques, and Applications. Natick : A K Peters, Ltd, 2nd Edition.

T2 E. Tufte, The Visual Display of Quantitative Information, Graphics Press.

REFERENCE BOOKS:

R1 Visualization Analytics & Design, Tamara Munzner, AK Peters Visualization Series, 1st Edition.
R2 Interactive Data Visualization for the Web, Scott Murray, 2nd Edition.

e-Resources:

1. https://kdd.cs.ksu.edu/Courses/CIS536/Lectures/Slides/Lecture-34-Main_6up.pdf
2. https://elearn.nptel.ac.in/shop/iit-workshops/completed/data-visualization-with r/?v=c86ee0d9d7ed
3. https://www.geeksforgeeks.org/data-visualzation-and-its-importance.

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: Introduction to Visualization

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	What Is Visualization? History of Visualization	1	30-06-2025		TLM 1,2	
2.	Relationship between Visualization and Other Fields	1	03-07-2025		TLM 1,2	
3.	The Visualization Process- Steps in visualization process	1	04-07-2025		TLM 1,2	
4.	The Visualization Process- Steps in visualization process	1	05-07-2025		TLM 1,2	
5.	Introduction of visual perception	1	07-07-2025		TLM 1,2	
6.	Data representations in visual perception	1	10-07-2025		TLM 1,2	
7.	visual representation of data	1	11-07-2025		TLM 1,2	
8.	Gestalt principles	1	12-07-2025		TLM 1,2	
9.	information overloads.	1	14-07-2025		TLM 1,2	
10.	Case Study: Understanding the Impact of COVID-19 Using Data Visualization Principles in R	1	17-07-2025		TLM 4	
11.	Case Study: Understanding the Impact of COVID-19 Using Data Visualization Principles in R	1	18-07-2025		TLM4	
12.	Case Study: Understanding the Impact of COVID-19 Using Data Visualization Principles in R	1	19-07-2025		TLM4	
No. of classes required to complete UNIT-I: 12				**No. of classes taken:**		

UNIT-II: Visual Represntations

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
13.	Creating Visual Representations	1	21-07-2025		TLM 1,2	
14.	Types of Visual Representations- Graphs, Plots, Charts, Maps	1	24-07-2025		TLM 1,2	
15.	visualization reference model	1	25-07-2025		TLM 1,2	
16.	Visual Mapping – Positional Mapping, Color Mapping	1	26-07-2025		TLM 1,2	
17.	Visual Mapping – Size Mapping, Opacity Mapping	1	28-07-2025		TLM 1,2	
18.	visual analytics- Static Visualization (ggplot2), Interactive Charts (plotly)	1	31-07-2025		TLM 1,2	
19.	visual analytics- Interactive Tables (DT)	1	01-08-2025		TLM 1,2	
20.	visual analytics- Geographic Visual Analytics (leaflet)	1	02-08-2025		TLM 1,2	
21.	Design of visualization applications	1	04-08-2025		TLM 1,2	
22.	Design of visualization applications	1	07-08-2025		TLM 1,2	
23.	Case Study: Visual Analytics of	1	08-08-2025		TLM 4	

	Global CO_2 Emissions					
24.	Case Study: Visual Analytics of Global CO_2 Emissions	1	11-08-2025		TLM 4	
No. of classes required to complete UNIT-II: 12				**No. of classes taken:**		

UNIT-III: Visualization Systems and Techniques

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
25.	Classification of visualization systems-By Data Type, By Task	1	14-08-2025		TLM 1,2	
26.	Classification of visualization systems-By Interactivity, By User Control	1	18-08-2025		TLM 1,2	
27.	Classification of visualization systems-By Visual Encoding, By Medium	1	21-08-2025		TLM 1,2	
28.	Interaction and visualization techniques misleading	1	22-08-2025		TLM 1,2	
29.	Visualization of one-dimensional data	1	23-08-2025		TLM 1,2	
30.	Visualization of one-dimensional text and text documents	1	01-09-2025		TLM 1,2	
31.	Visualization of two-dimensional data	1	04-09-2025		TLM 1,2	
32.	Visualization of two-dimensional text and text documents	1	06-09-2025		TLM 1,2	
33.	Visualization of two-dimensional data	1	08-09-2025		TLM 1,2	
34.	Visualization of two-dimensional text and text documents	1	11-09-2025		TLM 1,2	
35.	Case Study: Understanding Visualization Systems and Misleading Visuals Through Multi-dimensional and Text Data in R	1	12-09-2025		TLM 4	
36.	Case Study: Understanding Visualization Systems and Misleading Visuals Through Multi-dimensional and Text Data in R	1	13-09-2025		TLM 4	
No. of classes required to complete UNIT-III: 12				**No. of classes taken:**		

UNIT-IV: Visualization of Entities

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
37.	Visualization of groups	1	15-09-2025		TLM 1,2	
38.	Visualization of trees	1	18-09-2025		TLM 1,2	
39.	Visualization of graphs	1	19-09-2025		TLM 1,2	
40.	Visualization of clusters	1	20-09-2025		TLM 1,2	
41.	Visualization of networks	1	22-09-2025		TLM 1,2	
42.	Visualization of software	1	25-09-2025		TLM 1,2	
43.	Metaphorical visualization-ggraph/igraph, waffle	1	26-09-2025		TLM 1,2	

44.	Metaphorical visualization-treemap	1	27-09-2025		TLM 1,2	
45.	Metaphorical Visualization-grid/ggimage	1	06-10-2025		TLM 1,2	
46.	Case Study: Metaphorical Visualization of Population Data as a Tree and Icons	1	09-10-2025		TLM 4	
47.	Case Study: Metaphorical Visualization of Population Data as a Tree and Icons	1	10-10-2025		TLM 4	
No. of classes required to complete UNIT-IV: 11				**No. of classes taken:**		

UNIT-V: Visualization Trends-GIS Systems, Data Structures Used for Visualization

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
48.	Visualization of volumetric data, vector fields	1	11-10-2025		TLM 1,2	
49.	processes and simulations	1	13-10-2025		TLM 1,2	
50.	Visualization of maps	1	16-10-2025		TLM 1,2	
51.	Visualization of geographic information	1	17-10-2025		TLM 1,2	
52.	GIS systems	1	18-10-2025		TLM 1,2	
53.	collaborative visualizations	1	23-10-2025		TLM 1,2	
54.	Evaluating visualizations	1	24-10-2025		TLM 1,2	
55.	Recent trends in various perception techniques	1	25-10-2025		TLM 1,2	
56.	Recent trends in various visualization techniques	1	27-10-2025		TLM 1,2	
57.	Data structures used in data visualization.	1	30-10-2025		TLM 1,2	
No. of classes required to complete UNIT-V: 12				**No. of classes taken:**		

CONTENT BEYOND THE SYLLABUS:

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
58.	Understanding Data Structures in Data Visualization Using R: A Practical Approach	1	31-10-2025		TLM 4	
59.	Recent Trends in Data Visualization Techniques: An R-Based Exploration	1	01-11-2025		TLM 4	

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS (R23 Regulation):

Evaluation Task	**Marks**
Assignment-I (Units-I, II)	A1=5
I-Descriptive Examination (Units-I, II)	M1=15

I-Quiz Examination (Units-I, II)	Q1=10
Assignment-II (Unit-III, IV & V)	A2=5
II- Descriptive Examination (UNIT-III, IV & V)	M2=15
II-Quiz Examination (UNIT-III, IV & V)	Q2=10
Mid Marks =80% of Max ((M1+Q1+A1), (M2+Q2+A2)) + 20% of Min ((M1+Q1+A1), (M2+Q2+A2))	M=30
Cumulative Internal Examination (CIE): M	30
Semester End Examination (SEE)	70
Total Marks = CIE + SEE	100

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to
PO 11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	To apply the fundamental engineering knowledge, computational principles, and methods for extracting knowledge from data to identify, formulate and solve real time problems.
PSO 2	To develop multidisciplinary projects with advanced technologies and tools to address social and environmental issues.
PSO 3	To provide a concrete foundation and enrich their abilities for Employment and Higher studies in Artificial Intelligence and Data science with ethical values.

Title	**Course Instructor**	**Course Coordinator**	**Module Coordinator**	**Head of the Department**
Name of the Faculty	**Mr. S.V.V.D.Jagadeesh**	**Mrs. V. Sowjanya**	**Dr. V. Surya Narayana**	**Dr. P. Bhagath**
Signature				

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

COURSE HANDOUT
PART-A

Name of Course Instructor : KATTUPALLI SUDHAKAR
Course Name & Code : **EXPLORATORY DATA ANALYSIS (23AD07)**
L-T-P Structure : **3-0-0** **Credits:** 3
Program/Sem/Sec : B.Tech/VI/A-Sec **A.Y.:** 2025-26

PREREQUISITE: - Statistical methods for Data science, Data Science using Python

Course Objectives: The main objectives of the course are to

- Introducing the fundamentals of Exploratory Data Analysis.
- Cover essential exploration techniques for understanding multivariate data by summarizing it through statistical methods and graphical methods
- Evaluate the models and select the best model.

Course Educational Objectives (CEOs)

1. **To provide foundational knowledge** in data science concepts, including the role and importance of Exploratory Data Analysis (EDA) in the data science lifecycle.
2. **To equip students with practical skills** in data visualization and exploration techniques using modern tools and libraries.
3. **To develop the ability to preprocess and transform data** effectively for analysis and modelling, ensuring data quality and readiness.
4. **To enable students to apply statistical methods** for summarizing and interpreting data, fostering analytical thinking.
5. **To prepare students to build and evaluate predictive models**, enabling them to solve real-world problems using data-driven approaches.

COURSE OUTCOMES (COs): At the end of the course, the student will be able to

- CO1: Understand the Fundamentals of EDA and Data Science (Understand, L2)
- CO2: Apply Visualization Techniques for Data Exploration (Apply, L3)
- CO3: Perform Data Transformation and Preprocessing (Apply, L3)
- CO4: Analyze Data Using Descriptive Statistics (Analyze, L4)
- CO5: Develop and Evaluate Predictive Model (Apply, L3)

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	1	2	-	-	-	-	-	-	1	2	-	1
CO2	2	2	2	2	2	-	-	-	1	2	-	2	2	2	1
CO3	2	2	2	2	2	-	-	-	-	-	-	1	2	-	2
CO4	2	2	2	2	2	-	-	-	1	-	-	2	2	-	1
CO5	2	2	2	2	2	-	-	-	-	1	2	3	2	2	2
1 - Low							**2** –Medium						**3** - High		

Textbook:

1. Suresh Kumar Mukhiya, Usman Ahmed, Hands-On Exploratory Data Analysis with Python, Packt Publishing, 2020.

Reference Books:

1. Ronald K. Pearson, Exploratory Data Analysis Using R, CRC Press, 2020
2. Radhika Datar, Harish Garg, Hands-On Exploratory Data Analysis with R: Become an expert in exploration data analysis using R packages, 1st Edition, Packet Publishing, 2019

Web References:

1. https://github.com/PacktPublishing/Hands-on-Exploratory-Data-Analysis-with-Python
2. https://www.analyticsvidhya.com/blog/2022/07/step-by-step-exploratory-dataanalysis-eda-using-python/#h-conclusion
3. https://github.com/PacktPublishing/Exploratory-Data-Analysis-with-Python-Cookbook

PART-B

COURSE DELIVERY PLAN (LESSON PLAN)

S. No	Topic Name	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
	Unit I: Exploratory Data Analysis Fundamentals (9 Classes) **UNIT-I:** Exploratory Data Analysis Fundamentals: Understanding data science, the significance of EDA, Steps in EDA, making sense of data, Numerical data, Categorical data, Measurement scales, Comparing EDA with classical and Bayesian analysis, Software tools available for EDA, getting started with EDA.					
1	**Understanding Data Science & Significance of EDA**	**1**	**30-06-2025 (Mon)**		**TLM1, TLM2, TLM5**	
2	**Steps in EDA & Making Sense of Data**	**1**	**01-07-2025 (Tue)**		**TLM1, TLM2**	
3	**Numerical Data, Categorical Data, Measurement Scales**	**1**	**02-07-2025 (Wed)**		**TLM1, TLM2**	
4	**Comparing EDA with Classical and Bayesian Analysis**	**1**	**05-07-2025 (Sat)**		**TLM1, TLM2, TLM6**	

5	**Software Tools for EDA & Getting Started**	**1**	**07-07-2025 (Mon)**		**TLM2, TLM4**	
6	**Experiment 1a & 1b: Download Dataset & Install Libraries**	**1**	**08-07-2025 (Tue)**		**TLM4**	
7	**Experiment 2: NumPy Array Basic Operations & Built-in Functions**	**1**	**09-07-2025 (Wed)**		**TLM4, TLM3**	
8	**Experiment 3: Loading Dataset into Pandas DataFrame**	**1**	**14-07-2025 (Mon)**		**TLM4, TLM3**	
9	**Experiment 4: Selecting Rows and Columns in Data Frame**	**1**	**15-07-2025 (Tue)**		**TLM4, TLM3**	
	Total No of Classes:		**Actual No of Classes Taken:**			
	Unit II: Visual Aids for EDA (11 Classes) **Visual Aids for EDA:** Technical requirements, Line chart, Bar charts, Scatter plot using seaborn, Polar chart, Histogram, Choosing the best chart. Case Study: EDA with Personal Email, Technical requirements, Loading the dataset, Data transformation, Data cleansing, Applying descriptive statistics, Data refactoring, Data analysis.					
10	**Technical Requirements, Line Chart, Bar Charts**	**1**	**16-07-2025 (Wed)**		**TLM1, TLM2, TLM4**	
11	**Scatter Plot using Seaborn, Polar Chart, Histogram**	**1**	**19-07-2025 (Sat)**		**TLM1, TLM2, TLM4**	
12	**Choosing the Best Chart**	**1**	**21-07-2025 (Mon)**		**TLM1, TLM2, TLM6**	
13	**Experiment 1: Apply Different Visualization Techniques (Line, Bar, Scatter, Bubble)**	**1**	**22-07-2025 (Tue)**		**TLM4, TLM3**	
14	**Experiment 2: Generate Scatter Plot using Seaborn for Iris dataset**	**1**	**23-07-2025 (Wed)**		**TLM4, TLM3**	
15	**Experiment 3: Area Plot, Stacked Plot, Pie Chart, Table Chart**	**1**	**26-07-2025 (Sat)**		**TLM4, TLM3**	
16	**Experiment 4: Polar Chart, Histogram, Lollipop Chart**	**1**	**28-07-2025 (Mon)**		**TLM4, TLM3**	

17	**Case Study: EDA with Personal Email (Technical Req, Loading, Transformation)**	**1**	**29-07-2025 (Tue)**		**TLM2, TLM4, TLM6**	
18	**Case Study: EDA with Personal Email (Data Cleansing, Descriptive Stats)**	**1**	**30-07-2025 (Wed)**		**TLM2, TLM4, TLM6**	
19	**Case Study: EDA with Personal Email (Data Refactoring, Data Analysis)**	**1**	**02-08-2025 (Sat)**		**TLM2, TLM4, TLM6**	
20	**Experiment 5: Perform Exploratory Data Analysis with Personal Email Data**	**1**	**04-08-2025 (Mon)**		**TLM4, TLM3**	
	Total No of Classes:		**Actual No of Classes Taken:**			
	Unit III: Data Transformation (14 Classes) **Data Transformation:** Merging database-style data frames, concatenating along with an axis, merging on index, Reshaping and pivoting, Transformation techniques, handling missing data, Mathematical operations with NaN, Filling missing values, Discretization and binning, Outlier detection and filtering, Permutation and random sampling, Benefits of data transformation, Challenges.					
21	**Merging Database-Style Data Frames, Concatenating Along Axis**	**1**	**05-08-2025 (Tue)**		**TLM1, TLM2, TLM4**	
22	**Merging on Index, Reshaping and Pivoting**	**1**	**06-08-2025 (Wed)**		**TLM1, TLM2, TLM4**	
23	**Transformation Techniques, Handling Missing Data**	**1**	**11-08-2025 (Mon)**		**TLM1, TLM2, TLM4**	
24	**Mathematical Operations with NaN, Filling Missing Values**	**1**	**12-08-2025 (Tue)**		**TLM1, TLM2, TLM4**	
25	**Discretization and Binning**	**1**	**13-08-2025 (Wed)**		**TLM1, TLM2, TLM4**	
26	**Outlier Detection and Filtering**	**1**	**16-08-2025 (Sat)**		**TLM1, TLM2, TLM4**	
27	**Permutation and Random Sampling**	**1**	**18-08-2025 (Mon)**		**TLM1, TLM2, TLM4**	
28	**Benefits of Data Transformation, Challenges**	**1**	**19-08-2025 (Tue)**		**TLM1, TLM2, TLM6**	

29	**Experiment 1a,b: Merging Dataframes & Reshaping with Hierarchical Indexing**	**1**	**20-08-2025 (Wed)**		**TLM4, TLM3**	
30	**Experiment 1c,d: Data Deduplication & Replacing Values**	**1**	**23-08-2025 (Sat)**		**TLM4, TLM3**	
31	**Experiment 2a,b: NaN Values in Math Ops & Filling in Missing Data**	**1**	**01-09-2025 (Mon)**		**TLM4, TLM3**	
32	**Experiment 2c,d,e: Forward/Backward Filling, Index Values, Interpolation**	**1**	**02-09-2025 (Tue)**		**TLM4, TLM3**	
33	**Experiment 3a,b: Renaming Axis Indexes & Discretization and Binning**	**1**	**03-09-2025 (Wed)**		**TLM4, TLM3**	
34	**Experiment 3c,d: Permutation and Random Sampling & Dummy Variables**	**1**	**06-09-2025 (Sat)**		**TLM4, TLM3**	
	Total No of Classes:		**Actual No of Classes Taken:**			
	Unit IV: Descriptive Statistics (16 Classes) **Descriptive Statistics:** Distribution function, Measures of central tendency, Measures of dispersion, Types of kurtoses, calculating percentiles, Quartiles, Grouping Datasets, Correlation, Understanding univariate, bivariate, multivariate analysis, Time Series Analysis					
35	**Distribution Functions Overview**	**1**	**08-09-2025 (Mon)**		**TLM1, TLM2**	
36	**Experiment 1: Uniform, Normal, Gamma Distributions**	**1**	**09-09-2025 (Tue)**		**TLM4, TLM3**	
37	**Experiment 1: Exponential, Poisson, Binomial Distributions**	**1**	**10-09-2025 (Wed)**		**TLM4, TLM3**	
38	**Measures of Central Tendency (Mean, Median, Mode) & Experiment 3**	**1**	**15-09-2025 (Mon)**		**TLM1, TLM2, TLM4**	
39	**Measures of Dispersion (Variance, Standard Deviation)**	**1**	**16-09-2025 (Tue)**		**TLM1, TLM2**	
40	**Types of Kurtoses, Calculating Percentiles**	**1**	**17-09-2025 (Wed)**		**TLM1, TLM2**	

41	**Quartiles, Grouping Datasets, IQR & Box Plots**	**1**	**20-09-2025 (Sat)**		**TLM1, TLM2, TLM4**	
42	**Experiment 4: Explore Measures of Dispersion (Skewness, Kurtosis)**	**1**	**22-09-2025 (Mon)**		**TLM4, TLM3**	
43	**Experiment 5a,b: Calculating Percentiles & IQR/Box Plots**	**1**	**23-09-2025 (Tue)**		**TLM4, TLM3**	
44	**Correlation**	**1**	**24-09-2025 (Wed)**		**TLM1, TLM2, TLM4**	
45	**Understanding Univariate, Bivariate, Multivariate Analysis**	**1**	**27-09-2025 (Sat)**		**TLM1, TLM2, TLM6**	
46	**Experiment 6a: Bivariate Analysis on Automobile Dataset**	**1**	**29-09-2025 (Mon)**		**TLM4, TLM3**	
47	**Experiment 6b: Multivariate Analysis on Automobile Dataset**	**1**	**30-09-2025 (Tue)**		**TLM4, TLM3**	
48	**Time Series Analysis Fundamentals**	**1**	**01-10-2025 (Wed)**		**TLM1, TLM2**	
49	**Experiment 7: Time Series Analysis on Open Power Systems Dataset**	**1**	**04-10-2025 (Sat)**		**TLM4, TLM3**	
50	**Data Cleaning on a Sample Dataset (from Exp. 2 in syllabus)**	**1**	**06-10-2025 (Mon)**		**TLM4, TLM3**	
	Total No of Classes:		**Actual No of Classes Taken:**			
	Unit V: Model Development and Evaluation (11 Classes) **UNIT-V: Model Development and Evaluation:** Unified machine learning workflow, Data pre-processing, Data preparation, Training sets and corpus creation, Model creation and training, Model evaluation, best model selection and evaluation, Model deployment Case Study: EDA on Wine Quality Data Analysis					
51	**Unified Machine Learning Workflow, Data Pre-processing, Preparation**	**1**	**07-10-2025 (Tue)**		**TLM1, TLM2, TLM5**	

52	**Training Sets and Corpus Creation, Model Creation & Training**	**1**	**08-10-2025 (Wed)**		**TLM1, TLM2, TLM4**	
53	**Model Evaluation, Best Model Selection**	**1**	**13-10-2025 (Mon)**		**TLM1, TLM2, TLM6**	
54	**Model Deployment**	**1**	**14-10-2025 (Tue)**		**TLM1, TLM2**	
55	**Experiment 1: Hypothesis Testing (Z-Test, T-Test)**	**1**	**15-10-2025 (Wed)**		**TLM4, TLM3**	
56	**Experiment 2: Model Evaluation using Prediction Score, R2, MAE, MSE**	**1**	**18-10-2025 (Sat)**		**TLM4, TLM3**	
57	**Case Study: EDA on Wine Quality Data Analysis (Part 1)**	**1**	**21-10-2025 (Tue)**		**TLM2, TLM4, TLM6**	
58	**Case Study: EDA on Wine Quality Data Analysis (Part 2)**	**1**	**22-10-2025 (Wed)**		**TLM2, TLM4, TLM6**	
59	**Experiment 3: Perform EDA with Wine Quality Dataset**	**1**	**27-10-2025 (Mon)**		**TLM4, TLM3**	
60	**Overall Syllabus Review & Key Concepts Summary**	**1**	**28-10-2025 (Tue)**		**TLM1, TLM2, TLM6**	
61	**Practical Project Guidance & Final Q&A**	**1**	**29-10-2025 (Wed)**		**TLM1, TLM2, TLM6**	
	Total No of Classes:		**Actual No of Classes Taken:**			
	Content Beyond Syllabus (6 Classes)					
62	**Geospatial EDA (Geo-EDA): Introduction, Data Types & Basic Visualizations**	**1**	**01-11-2025 (Sat)**		**TLM2, TLM4, TLM5**	
63	**Geo-EDA: Spatial Queries, Aggregations & Advanced Mapping**	**1**	**03-11-2025 (Mon)**		**TLM2, TLM4, TLM3**	
64	**Interactive Dashboards: Introduction to Plotly & Simple Dash Layouts**	**1**	**04-11-2025 (Tue)**		**TLM2, TLM4, TLM5**	

65	**Interactive Dashboards: Callbacks, Interactivity & Deployment Basics**	**1**	**05-11-2025 (Wed)**		**TLM2, TLM4, TLM3**	
66	**Advanced Outlier Detection: Statistical & Proximity-Based Methods**	**1**	**10-11-2025 (Mon)**		**TLM2, TLM4, TLM5**	
67	**Advanced Outlier Detection: Model-Based Methods & Interpretation**	**1**	**11-11-2025 (Tue)**		**TLM2, TLM4, TLM3**	
	Total No of Classes:		**Actual No of Classes Taken:**			

Teaching Learning Methods			
TLM1	Chalk and talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

Evaluation Process (R23 Regulation):

Evaluation Task	**Marks**
Assignment-I (Units-I, II & UNIT-III (Half of the Syllabus))	A1=5
I-Descriptive Examination (Units-I, II & UNIT-III (Half of the Syllabus))	M1=15
I-Quiz Examination (Units-I, II & UNIT-III (Half of the Syllabus))	Q1=10
Assignment-II (Unit-III (Remaining Half of the Syllabus), IV & V)	A2=5
II- Descriptive Examination (UNIT-III (Remaining Half of the Syllabus), IV & V)	M2=15
II-Quiz Examination (UNIT-III (Remaining Half of the Syllabus), IV & V)	Q2=10
Mid Marks =80% of Max ((M1+Q1+A1), (M2+Q2+A2)) + 20% of Min ((M1+Q1+A1), (M2+Q2-	M=30
Cumulative Internal Examination (CIE): M	30
Semester End Examination (SEE)	70
Total Marks = CIE + SEE	100

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics,

	natural sciences, and engineering sciences.
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO 6	**The Engineer and Society**: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues, and the consequent responsibilities relevant to professional engineering practice.
PO 7	**Environment and sustainability**: Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PO 9	**Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and author effective reports and design documentation, make effective presentations, and give and receiving clear instructions.
PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	The ability to apply Software Engineering practices and strategies in software projects. development using open-source programming environment for the success of organization.
PSO 2	The ability to design and develop computer programs in networking, web applications and IoT as per the society needs
PSO 3	To inculcate an ability to analyze, design and implement database applications.

Title	**Course Instructor**	**Course Coordinator**	**Module Coordinator**	**Head of the Department**
Name of the Faculty	**K. Sudhakar**	**K. Sudhakar**	**Dr. V. Suryanarana**	**Dr. P. Bhagath**
Signature				

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Phone: 08659-222933, Fax: 08659-222931
DEPARTMENT OF MECHANICAL ENGINEERING

COURSE HANDOUT

PART-A

Name of Course Instructor: Mallikarjuna Rao Dandu, Sr. Assistant Professor

Course Name & Code	**:** Sustainable Energy Technologies- 23ME81	**Regulation**: R23
L-T-P Structure	**: 3-0-0**	**Credits:** 03
Program/Sem/Sec	**:** B.Tech- AI&DS V Sem A/S	**A.Y.:** 2025-26
PREREQUISITE	**: Nil**	

COURSE EDUCATIONAL OBJECTIVES (CEOs):

To provide the insights on different sustainable energy sources, potential, salient features and utilization of solar, wind, geothermal, ocean thermal energy, bio energy and fuel cell systems.

COURSE OUTCOMES (COs): At the end of the course, the student will be able to

CO 1	Demonstrate the importance, the impact of solar radiation. **(Understanding-L2)**
CO 2	Understand the principles of solar PV modules and storage in PV systems. **(Understanding-L2)**
CO 3	Discuss solar energy storage systems and their applications. **(Understanding-L2)**
CO 4	Describe power extraction from wind and bio-mass. **(Understanding-L2)**
CO5	Illustrate the working of geothermal, ocean energy and fuel cells. **(Understanding-L2)**

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	-	-	-	3	3	-	-	-	-	2	2	-	-
CO2	2	1	-	-	-	3	3	-	-	-	-	2	2	-	-
CO3	1	1	-	-	-	3	3	-	-	-	-	2	2	-	-
CO4	1	1	-	-	-	3	3	-	-	-	-	2	2	-	-
CO5	1	1	-	-	-	3	3	-	-	-	-	2	2	-	-

Note: Enter Correlation Levels **1** or **2** or **3.** If there is no correlation, **put '-'**
1- Slight (Low), **2 –** Moderate (Medium), **3 -** Substantial (High).

TEXT BOOKS:

T1 Renewable Energy Technologies -Ramesh & Kumar /Narosa

T2 Solar Energy – Principles of Thermal Collection and Storage/Sukhatme S.P. and J.K.Nayak/TMH

REFERENCE BOOKS:

R1. Non-Conventional Energy Resources- Khan B.H/ Tata McGraw Hill, New Delhi, 2006.

R2. Non-Conventional Energy - Ashok V Desai /New Age International (P) Ltd

R3. Non-conventional Energy Source- G S Sawhney- PHI, New Delhi, 2012

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: SOLAR RADIATION

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Course Outcomes	1	30-06-2025		TLM2	
2.	Role and potential of new and renewable sources	1	02-07-2025		TLM2	
3.	The solar energy option, Environmental impact of solar power	1	05-07-2025		TLM2	
4.	Structure of the Sun, The solar constant	1	07-07-2025		TLM2	
5.	Sun-earth relationships	1	09-07-2025		TLM2	
6.	Coordinate systems and coordinates of the sun	1	14-07-2025		TLM2	
7.	Extraterrestrial and terrestrial solar radiation	1	16-07-2025		TLM2	
8.	Solar radiation on tilted surface	1	19-07-2025		TLM2	
9.	Instruments for measuring solar radiation and sun shine, Solar radiation data	1	21-07-2025		TLM2	
No. of classes required to complete UNIT-I: 09				No. of classes taken:		

UNIT-II: SOLAR PV MODULES AND PV SYSTEMS

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	PV module Circuit Design, Module Structure, Packing Density	1	23-07-2025		TLM2	
2.	Interconnenctions, Mismatch and temperature effects	1	28-07-2025		TLM2	
3.	Electrical and Mechanical Insulation, Lifetime of PV modules, Degradation and failure	1	30-07-2025		TLM2	
4.	PV module parameters, Efficiency of PV Systems	1	02-08-2025		TLM2	
5.	Solar PV Systems	1	04-08-2025		TLM2	
6.	Battery Operation, Types of Batteries, Battery parameters, Applications, Selection of batteries for Solar PV System	1	06-08-2025		TLM2	
No. of classes required to complete UNIT-II: 06				No. of classes taken:		

UNIT-III: SOLAR ENERGY COLLECTION, SOLAR ENERGY STORAGE AND APPLICATIONS

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Solar Energy Collection: Flat plate and concentrating collectors	1	09-08-2025		TLM2	
2.	Classification of concentrating collectors	1	11-08-2025		TLM2	
3.	Solar Energy Storage and	1	13-08-2025		TLM2	

	Applications: Different methods					
4.	Sensible latent heat and stratified storage, Solar ponds	1	18-08-2025		TLM2	
5.	Solar Applications-solar heating cooling technique	1	20-08-2025		TLM2	
6.	Solar distillation and drying	1	23-08-2025		TLM2	
7.	Solar cookers	1	01-09-2025		TLM2	
8.	Central power tower concept	1	03-09-2025		TLM2	
9.	Solar chimney	1	06-09-2025		TLM2	
No. of classes required to complete UNIT-III: 09				No. of classes taken:		

UNIT-IV : WIND ENERGY, BIO-MASS

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Wind energy: Sources and potential	1	08-09-2025		TLM2	
2.	Horizontal and Vertical axis wind mill	1	10-09-2025		TLM2	
3.	Performance characteristics	1	13-09-2025		TLM2	
4.	Betz criteria	1	15-09-2025		TLM2	
5.	Types of winds	1	17-09-2025		TLM2	
6.	Wind data measurement	1	20-09-2025		TLM2	
7.	Bio-mass: Principles of bio-conversion	1	22-09-2025		TLM2	
8.	Anaerobic/aerobic digestion	1	24-09-2025		TLM2	
9.	Types of biogas digesters	1	27-09-2025		TLM2	
10.	Gas yield, Gasifiers	1	06-10-2025		TLM2	
11.	Applications	1	08-10-2025		TLM2	
No. of classes required to complete UNIT-IV:11				No. of classes taken:		

UNIT-V : GEOTHERMAL ENERGY, OCEAN ENERGY, FUEL CELLS

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Geothermal Energy: Origin, Applications	1	11-10-2025		TLM2	
2.	Types of Geothermal Resources	1	13-10-2025		TLM2	
3.	Geothermal power generation	1	15-10-2025		TLM2	
4.	Relative merits and demerits	1	18-10-2025		TLM2	
5.	Ocean Energy: Ocean Thermal energy	1	20-10-2025		TLM2	
6.	Open cycle and closed cycle OTEC plants, Environmental impacts	1	22-10-2025		TLM2	
7.	Challenges and applications, Fuel Cells: Introduction, Applications	1	25-10-2025		TLM2	

8.	Classification, Different types of Fuel Cells, Phosphoric Acid fuel cell	1	27-10-2025		TLM2	
9.	Alkaline fuel cell	1	29-10-2025		TLM2	
10.	PEM fuel cell	1	29-10-2025		TLM2	
11.	MC fuel cell	1	01-11-2025		TLM2	
No. of classes required to complete UNIT-V: 11				No. of classes taken:		

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/ MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

Academic Calendar

Description	From	To	Weeks
I Phase of Instructions	30-06-2025	23-08-2025	8
I MID Examinations	25-08-2025	30-08-2025	1
II Phase of Instructions	01-09-2025	01-11-2025	9
II MID Examinations	03-11-2025	08-11-2025	1
Preparation and Practicals	10-11-2025	15-11-2025	1
Semester End Examinations	17-11-2025	25-11-2025	2

PART-C

EVALUATION PROCESS (R23 Regulation):

Evaluation Task	**Marks**
Assignment-I (Units-I, II & UNIT-III (Half of the Syllabus))	A1=5
I-Descriptive Examination (Units-I, II & UNIT-III (Half of the Syllabus))	M1=15
I-Quiz Examination (Units-I, II & UNIT-III (Half of the Syllabus))	Q1=10
Assignment-II (Unit-III (Remaining Half of the Syllabus), IV & V)	A2=5
II-Descriptive Examination (UNIT-III (Remaining Half of the Syllabus), IV & V)	M2=15
II-Quiz Examination (UNIT-III (Remaining Half of the Syllabus),IV & V)	Q2=10
Mid Marks =80% of Max ((M1+Q1+A1),(M2+Q2+A2))+20% of Min((M1+Q1+A1),(M2+Q2+A2))	M=30
Cumulative Internal Examination (CIE):M	30
Semester End Examination (SEE)	70
Total Marks = CIE+SEE	100

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	To apply the principles of thermal sciences to design and develop various thermal systems.
PSO 2	To apply the principles of manufacturing technology, scientific management towards improvement of quality and optimization of engineering systems in the design, analysis and manufacturability of products.
PSO 3	To apply the basic principles of mechanical engineering design for evaluation of performance of various systems relating to transmission of motion and power, conservation of energy and other process equipment.

Course Instructor	Course Coordinator	Module Coordinator	HOD
Mallikarjuna Rao Dandu	Dr. P.Vijay Kumar	Dr. P.Vijay Kumar	Dr. M B S Sreekar Reddy

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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

COURSE HANDOUT

PART-A

Name of Course Instructor : Dr.Ch.Rajendra Babu,

Course Name & Code : Data Warehousing and Data Mining Lab (23AD53)

Regulation : R23

L-T-P Structure : 0-0-3 **Credits:** 1.5

Program/Sem/Sec : B.Tech – V Semester – A Section **A.Y.:** 2025-26

PRE-REQUISITE: WEKA Tool/Python/R-Tool/Rapid Tool/Oracle Data mining

Course Educational Objective:

The objective of this lab is to Practical exposure on implementation of well-known data mining algorithms and Learning performance evaluation of data mining algorithms in a supervised and an unsupervised setting.

Course Outcomes (CO): At the end of this course, the student will be able to:

CO 1: Inculcate Conceptual, Logical, and Physical design of Data Warehouses OLAP applications and OLAP deployment

CO 2: Design a data warehouse or data mart to present information needed by management in a form that is usable

CO 3: Emphasize hands-on experience working with all real data sets

CO 4: Test real data sets using popular data mining tools such as WEKA, Python Libraries.

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1		2							1	2	2	1
CO2	3	2		2	2								2	2	
CO3	2	3	2	2	2							2	2	2	1
CO4	2	2			2								2	2	

Note: Enter Correlation Levels **1** or **2** or **3.** If there is no correlation, **put '-'**

1- Slight (Low), **2 –** Moderate (Medium), **3 -** Substantial (High).

PART-B

COURSE DELIVERY PLAN (LESSON PLAN): DATA WAREHOUSING AND DATA MINING LAB SCHEDULE(23AD53)

Expt. No	Experiments to be conducted	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1	Creation of a Data Warehouse.	1	7/3/2025		TLM8	
2	Explore machine learning tool "WEKA"	1	7/10/2025		TLM8	
3	Perform data pre-processing tasks and Demonstrate performing association rule mining on data sets	1	7/10/2025		TLM8	
4	Demonstrate performing classification on data sets Weka/R	1	7/17/2025		TLM8	
5	Demonstrate performing clustering of data sets	1	7/24/2025		TLM8	
6	Demonstrate knowledge flow application on data sets into Weka/R	1	7/31/2025		TLM8	
7	Demonstrate ZeroR technique on Iris dataset (by using necessary preprocessing technique(s)) and share your observations	1	8/7/2025		TLM8	
8	Write a java program to prepare a simulated data set with unique instances.	1	8/14/2025		TLM8	
9	Write a Python program to generate frequent item sets / association rules using Apriori algorithm	1	8/21/2025		TLM8	
10	Write a program to calculate chi-square value using Python/R. Report your observation.	1	9/4/2025		TLM8	
11	Write a program of Naive Bayesian classification using Python/R programming language.	1	9/11/2025		TLM8	
12	Implement a Java/R program to perform Apriori algorithm	1	9/18/2025		TLM8	
13	Write a R program to cluster your choice of data using simple k-means algorithm using JDK	1	9/25/2025		TLM8	
14	Write a program of cluster analysis using simple k-means algorithm Python/R programming language.	1	10/9/2025		TLM8	

15	Write a program to compute / display dissimilarity matrix (for your own dataset containing at least four instances with two attributes) using Python.	1	10/16/2025		TLM8	
16	Visualize the datasets using matplotlib in python/R.(Histogram, Box plot, Bar chart, Pie chart etc.,)	1	10/23/2025		TLM8	
17	Internal Lab	1	10/30/2025			

Teaching Learning Methods					
TLM1	Chalk and Talk	**TLM4**	Problem Solving	**TLM7**	Seminars or GD
TLM2	PPT	**TLM5**	Programming	**TLM8**	Lab Demo
TLM3	Tutorial	**TLM6**	Assignment or Quiz	**TLM9**	Case Study

PART-C

EVALUATION PROCESS (R20 Regulations):

According to Academic Regulations of R20 Distribution and Weightage of Marks for Laboratory Courses is as follows

(a) Continuous Internal Evaluation (CIE): The Continuous Internal Evaluation (CIE) is based on the following parameters:

Parameter	Marks
Day to Day work	10
Record	10
Internal Test	10
Total	30

(b) Semester End Examinations (SEE) : The Semester End examinations (SEE) for laboratory courses shall be jointly conducted by internal and external examiners with 3 hours duration and evaluated for 35 marks. The performance of the student shall be evaluated as per the parameters indicated below:

Parameter	Marks
Procedure/Algorithm	20
Experimentation/Program execution	30
Observations/Calculations/Validation	
Result/Inference	
Viva voce	20
Total	70

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	To apply the fundamental engineering knowledge, computational principles, and methods for extracting knowledge from data to identify, formulate and solve real time problems.
PSO 2	To develop multidisciplinary projects with advanced technologies and tools to address social and environmental issues.
PSO 3	To provide a concrete foundation and enrich their abilities for Employment and Higher studies in Artificial Intelligence and Data science with ethical values.

Course Instructor	Course Coordinator	Module Coordinator	HOD
Dr Ch. Rajendra Babu	**Dr Ch. Rajendra Babu**	**Dr. V. Suryanarayana**	**Dr. P. Bhagath**

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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

COURSE HANDOUT
PART-A

Name of Course Instructor: Mr. S.V.V.D.JAGADEESH/Ms. P. MADHAVI/MS. G. DIVYA
Course Name & Code : DATA VISUALIZATION Lab (23AD54)
L-T-P Structure : 0-0-3 **Credits:** 1.5
Program/Sem/Sec : III B.Tech V Sem AI & DS - A **A.Y.:** 2025-26

PRE-REQUISITE: R Tool, Engineering Graphics

COURSE EDUCATIONAL OBJECTIVES (CEOs):

1. To visualize the different datasets using histograms, line charts.
2. To understand the use of bar charts and box plots.
3. To understand Scatter plots, mosaic plots
4. To understand different Map visualizations
5. To learn advanced graphs such as correlogram, heatmap and 3D graphs.

COURSE OUTCOMES (COs): After successful completion of the course the students are able to

CO 1	Apply different visualization techniques like plots and graphs in R on different datasets **(Apply-L3)**
CO 2	Apply different Map visualizations in R **(Apply-L3)**
CO 3	Develop advanced graphs such as correlogram, heatmap and 3D graphs in R **(Apply-L3)**
CO 4	Improve individual / teamwork skills, communication & report writing skills with ethical values.

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	2	-	3	-	-	-	-	-	-	-	-	2	-
CO2	-	2	2	-	3	-	-	-	-	-	-	-	2	2	-
CO3	-	2	2	-	3	-	-	-	-	-	-	-	2	2	-
CO4	-	-	-	-	-	-	-	2	2	-	-	-	-	-	2

Note: Enter Correlation Levels **1** or **2** or **3.** If there is no correlation, **put '-'**
1- Slight (Low), **2 –** Moderate (Medium), **3 -** Substantial (High).

PART-B

COURSE DELIVERY PLAN (LESSON PLAN): Section-A

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1	R Programming Basics	3	01-07-25		TLM4	
2	R Programming Basics	3	08-07-25		TLM4	
3	Week-1 a) Load VADeaths(Death Rates in Virginia) dataset in R and visualize the data using different histograms. 2 b) Load air quality dataset in R and visualize La Guardia Airport's daily maximum temperature using histogram.	3	15-07-25		TLM4	
4	Week-2 Load AirPassengers dataset in R and visualize the data using line chart that shows increase in air passengers over given time period.	3	22-07-25		TLM4	
5	Week-3 a) Load iris dataset in R, visualize the data using different Bar Charts and also demonstrate the use of stacked plots. b)Load air quality dataset in R and visualize ozone concentration in air.	3	29-07-25		TLM4	
6	Week-4 a) Load iris dataset in R, visualize the data using different Box plots including group by option and also use color palette to represent species. b) Load air quality dataset in R and visualize air quality parameters using box plots.	3	05-08-25		TLM4	
7	Week-5 Visualize iris dataset using simple scatter, multivariate scatter plot and also visualize scatter plot matrix to visualize multiple variables across each other.	3	12-08-25		TLM4	
8	Week-6 Load diamonds dataset in R and visualize the structure in datasets with large data points using hexagon binning and also add color palette	3	19-08-25		TLM4	
9	Week-7 Load HairEyeColor dataset in R and plot categorical data using mosaic plot.	3	02-09-25		TLM4	
10	Week-8 Load mtcars dataset in R and visualize data using heat map.	3	09-19-25		TLM4	
11	Week-9 Install leaflet library in R and perform different map visualizations. Week-12 Install maps library in R and draw different map visualizations.	3	16-09-25		TLM4	
12	Week-10 Visualize iris dataset using 3d graphs such as scatter3d, cloud, xyplot.	3	23-09-25		TLM4	

13	Week-11 Make use of correlogram to visualize data in correlation matrices for iris dataset.	3	14-10-25		TLM4	
14	Internal Exam	3	21-10-25		TLM4	

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS (R23 Regulation):

Evaluation Task	**Marks**
Day to Day Work:	15
Internal Test	15
Continuous Internal Assessment	30
Procedure	20
Execution & Results	30
Viva-voce	20
Semester End Examination (SEE)	70
Total Marks = CIE + SEE	100

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess

	societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	To apply the fundamental engineering knowledge, computational principles, and methods for extracting knowledge from data to identify, formulate and solve real time problems.
PSO 2	To develop multidisciplinary projects with advanced technologies and tools to address social and environmental issues.
PSO 3	To provide a concrete foundation and enrich their abilities for Employment and Higher studies in Artificial Intelligence and Data science with ethical values.

Title	**Course Instructor**	**Course Coordinator**	**Module Coordinator**	**Head of the Department**
Name of the Faculty	**Mr. S.V.V.D.Jagadeesh**	**Mrs. V. Sowjanya**	**Dr. V. Surya Narayana**	**Dr. P. Bhagath**
Signature				

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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

COURSE HANDOUT

PART-A

Name of Course Instructor: Mr. S. V. V. D. JAGADEESH
Course Name & Code : FULL STACK DEVELOPMENT-II (23CSS3)
L-T-P Structure : 3-0-0 **Credits:** 3
Program/Sem/Sec :III **B.Tech /V Sem /AI & DS - A** **A.Y.:** 2025-26

PREREQUISITE: Object oriented programming, Full stack development-I

COURSE EDUCATIONAL OBJECTIVES (CEOs):
The objective of this course is to equip students with hands-on skills in developing full stack web applications using Java, Node.js, and React. It focuses on building backend services using JDBC, Servlets, and Express.js, along with frontend development using React.js. Students will learn to integrate databases like MySQL and MongoDB for real-time data handling. The course emphasizes applying MVC architecture, REST APIs, and deployment practices for complete web solutions.

COURSE OUTCOMES (CO's): After successful completion of the course the students are able to

CO1	Apply JDBC and Servlet technologies to develop web applications that interact with relational databases. **(Apply-L3)**
CO2	Apply the MVC architecture using JSP, Servlets, and JavaBeans to design structured and maintainable web applications. **(Apply-L3)**
CO3	Apply Node.js and Express.js to create RESTful services and perform backend operations with MongoDB. **(Apply-L3)**
CO4	Apply React.js to develop dynamic user interfaces and integrate them with backend APIs for full-stack web solutions. **(Apply-L4)**

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	-	3	-	-	-	-	-	-	2	2	2	3
CO2	3	2	3	-	3	-	-	-	-	-	-	2	3	3	2
CO3	3	2	3	-	3	-	-	-	-	-	-	2	2	3	2
CO4	3	2	3	-	3	-	-	-	-	-	-	2	2	3	2
1 - Low					**2 –**Medium							**3 –** High			

TEXTBOOKS:

T1 "Head First Servlets and JSP" By: Bryan Basham, Kathy Sierra, Bert Bates Publisher: O'Reilly Media.
T2 "Learning Node.js Development" By: Andrew Mead Publisher: Packt Publishing.
T3 "MongoDB: The Definitive Guide" By: Kristina Chodorow Publisher: O'Reilly Media
T4 "Learning React: Modern Patterns for Developing React Apps" By: Alex Banks and Eve Porcello Publisher: O'Reilly Media

e-Resources:

1. OracleJavaDocumentation(JDBC&Servlets)
https://docs.oracle.com/javase/tutorial/jdbc/
https://docs.oracle.com/javaee/7/tutorial/servlets.htm
2. MozillaDeveloperNetwork(HTML,JS,HTTP)
https://developer.mozilla.org
3. Node.jsOfficialDocumentation
https://nodejs.org/en/docs
4. Express.jsGuide
https://expressjs.com
5. MongoDBDocumentation
https://www.mongodb.com/docs/
6. React Official Docs
https://reactjs.org
7. W3Schools Tutorials (JSP, JavaScript, Node.js)
https://www.w3schools.com
8. TutorialsPoint(FullStacktopics)
https://www.tutorialspoint.com

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	CYCLE-1 (SERVLETS)	3	02-07-2025		TLM 4	
2.	CYCLE-1 (SERVLETS)	3	09-07-2025		TLM 4	
3.	CYCLE-1 (JDBC)	3	16-07-2025		TLM 4	
4.	CYCLE-2 (JSP & Java Beans)	3	23-07-2025		TLM 4	
5.	CYCLE-2 (JSP and MVC)	3	30-07-2025		TLM 4	
6.	Start of Mini Project	3	06-08-2025		TLM 4	
7.	CYCLE-3 (Node.js)	3	13-08-2025		TLM 4	
8.	CYCLE-3 (Node.js and Express.js)	3	20-08-2025		TLM 4	
9.	CYCLE-4 (MongoDB)	3	03-09-2025		TLM 4	
10.	CYCLE-4 (MongoDB and Express.js)	3	10-09-2025		TLM 4	
11.	CYCLE-5 (Rect.js)	3	17-09-2025		TLM4	
12.	CYCLE-5 (Rect.js)	3	24-09-2025		TLM4	
13.	Mini Project Finalization	3	15-10-2025		TLM5/TLM6	
14.	Internal Assessment	3	29-10-2025		TLM4	

PART-C

EVALUATION PROCESS (R23 Regulation):

Evaluation Task	Marks
Day to Day Work:	15
Internal Test	15
Continuous Internal Assessment	30
Procedure	20
Execution & Results	30
Viva-voce	20
Semester End Examination (SEE)	70
Total Marks = CIE + SEE	100

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to
PO 11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	To apply the fundamental engineering knowledge, computational principles, and methods for extracting knowledge from data to identify, formulate and solve real time problems.
PSO 2	To develop multidisciplinary projects with advanced technologies and tools to address social and environmental issues.
PSO 3	To provide a concrete foundation and enrich their abilities for Employment and Higher studies in Artificial Intelligence and Data science with ethical values.

Title	**Course Instructor**	**Course Coordinator**	**Module Coordinator**	**Head of the Department**
Name of the Faculty	**Mr. S.V.V.D.Jagadeesh**		**Dr. D Srinivasa Rao**	**Dr. P. Bhagath**
Signature				

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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

COURSE HANDOUT
PART-A

Name of Course Instructor : **K SUDHAKAR**
Course Name & Code : **User Interface Design Using Flutter (23IT53)**
L-T-P Structure : 3-0-0 **Credits :**3
Program/Sem/Sec : **B.Tech /IV Sem /AI & DS - A** **A.Y.:** 2025-26

Course Objectives: -
- Learns to Implement Flutter Widgets and Layouts
- Understands Responsive UI Design and with Navigation in Flutter
- Knowledge on Widgets and customize widgets for specific UI elements, Themes
- Understand to include animation apart from fetching data

Course Educational Objectives (CEOs):
1. Introduce core programming concepts of Python programming language.
2. Demonstrate about Python data structures like Lists, Tuples, Sets and dictionaries
3. Implement Functions, Modules and Regular Expressions in Python Programming and to create practical and contemporary applications.

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

CO1: Apply Flutter and Dart fundamentals to design and develop interactive user interfaces. **(Apply-L3)**
CO2: Implement UI layouts, navigation, state management, and responsive design principles for mobile applications. **(Apply-L3)**
CO3: Integrate animations, API data fetching, form validation, and debugging techniques to enhance application performance and usability**. (Apply-L3)**
CO4: Improve individual / teamwork skills, communication & report writing skills with ethical Value **(Apply -L3)**

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

CO/PO/PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	**3**	**1**	**2**	**-**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**2**	**2**	**1**	**2**
CO2	**3**	**2**	**3**	**1**	**3**	**1**	**-**	**-**	**1**	**2**	**-**	**3**	**2**	**2**	**3**
CO3	**3**	**2**	**3**	**1**	**3**	**1**	**-**	**-**	**2**	**2**	**-**	**2**	**3**	**2**	**3**
CO4	**3**	**2**	**3**	**2**	**3**	**-**	**-**	**-**	**2**	**2**	**-**	**3**	**3**	**2**	**3**

Note: Enter Correlation Levels **1** or **2** or **3.** If there is no correlation, **put '-'**
1- Slight (Low), **2 –** Moderate (Medium), **3 -** Substantial (High).

PART-B

COURSE DELIVERY PLAN (LESSON PLAN): Section-A

S.No	Topic Name	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1	Flutter & Dart Basics: SDK Installation & Dart Language Fundamentals (Exp 1a, 1b)	1	30-06-2025 (Mon)		TLM2, TLM4, TLM5	
2	Core Widgets & Layouts: Explore Text, Image, Container; Implement Row, Column, Stack (Exp 2a, 2b)	1	07-07-2025 (Mon)		TLM2, TLM4	
3	Responsive UI Design: Adapting to screen sizes, Media Queries & Breakpoints (Exp 3a, 3b)	1	14-07-2025 (Mon)		TLM1, TLM2, TLM4	
4	App Navigation: Setting up navigation with Navigator & Named Routes (Exp 4a, 4b)	1	21-07-2025 (Mon)		TLM1, TLM2, TLM4	
5	Stateful vs. Stateless Widgets: Understanding their differences and use cases (Exp 5a)	1	28-07-2025 (Mon)		TLM1, TLM2, TLM5	
6	Local State Management: Implementing state using setState() (Exp 5b Part 1)	1	04-08-2025 (Mon)		TLM2, TLM4	

7	External State Management: Introduction to Provider (Exp 5b Part 2)	1	11-08-2025 (Mon)		TLM2, TLM4, TLM5	
8	Custom Widgets & Theming: Creating reusable custom widgets and applying themes/styles (Exp 6a, 6b)	1	18-08-2025 (Mon)		TLM2, TLM4	
9	Form Design & Validation: Designing forms with input fields, validation, and error handling (Exp 7a, 7b)	1	01-09-2025 (Mon)		TLM2, TLM4	
10	List Widgets & Interaction: Creating scrollable lists, adding items, displaying selections (Exp 8a, 8b)	1	08-09-2025 (Mon)		TLM2, TLM4	
11	UI Animations: Introduction to Flutter's animation framework, basic fade/slide animations (Exp 9a, 9b)	1	15-09-2025 (Mon)		TLM1, TLM2, TLM4	
12	API Integration - Part 1: Fetching data from a REST API (Exp 10a)	1	22-09-2025 (Mon)		TLM1, TLM2, TLM4	
13	API Integration - Part 2: Displaying fetched data in the UI (Exp 10b)	1	29-09-2025 (Mon)		TLM2, TLM4, TLM6	
14	Project Lab / Review Session 1: Hands-on practice, Q&A, and troubleshooting on combined topics	1	06-10-2025 (Mon)		TLM3, TLM4, TLM6	
15	Project Lab / Review Session 2: Consolidated practice, mini-project work, final Q&A	1	27-10-2025 (Mon)		TLM3, TLM4, TLM6	

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

Evaluation PROCESS(R23Regulation):

Evaluation Task	Marks
Day to Day Work, Record:	15
Internal Test	15
Continuous Internal Assessment	30
Procedure	20
Execution Results	30
Viva-voce	20
Semester End Examination (SEE)	70
Total Marks=CIE+SEE	100

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
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PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	To apply the fundamental engineering knowledge, computational principles, and methods for extracting knowledge from data to identify, formulate and solve real time problems.
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PSO 3	To provide a concrete foundation and enrich their abilities for Employment and Higher studies in Artificial Intelligence and Data science with ethical values.

Title	**Course Instructor**	**Course Coordinator**	**Module Coordinator**	**Head of the Department**
Name of the Faculty	**K. SUDHAKAR**	**Dr. B. Phani Krishna**	**Dr. D. Srinivasa Rao**	**Dr. P. Bhagath**
Signature				