SIPNA COLLEGE OF ENGINEERING & TECHNOLOGY, AMRAVATI

An Autonomous Institute Affiliated to

Sant Gadge Baba Amravati University, Amravati, Maharashtra (India)

(Approved by AICTE, New Delhi and Recognized by DTE, Maharashtra)

(Accredited With 'A+' Grade by NAAC)

Department of Artificial Intelligence (AI) and Data Science

Syllabus for Multidisciplinary Minors

Semester V & Semester VI

Effective from Academic Year 2026-27

Prepared by: Boards of Studies- Artificial Intelligence (AI) and Data Science

Approved by: Academic Council Sipna COET, Amravati

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Chairman Board of Studies	Dean Academics	Chairman Academic Council	Date of Release	Version

MDM Track 1: Artificial Intelligence

Program:	B. Tech. (Artificial Intelligence (AI) & Data Science)	Semester:	V
Course:	MDM-III: Statistical Analysis and Data Computing	Code:	BTALMD13AD5T

Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	--	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Test, Assignment, Quiz

Course Objectives: To develop understanding and application of data visualization, time series analysis, ANOVA, data sampling and processing, inferential statistics, and scaling techniques for effective machine learning analysis.

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

CO	Course Outcomes	BT Level
CO-1	Outline the plots and graphs and statistical indices in data distribution.	L2
CO-2	Perform analysis of time series for calculating least square, measurement of cyclic variations in performance of Machine Learning algorithms.	L4
CO-3	Learn analysis of variance (ANNOVA) models, its various types and apply on Machine Learning Models	L4
CO-4	Analyse data sampling methods and its types for dataset processing.	L2
CO-5	Apply estimation and inferential statistics for testing of hypothesis using Z test, t test, Chi-squared test.	L2
CO-6	Outline the scaling techniques for educational data with various scaling test.	L2

Unit I: Data Visualization **(6 Hrs.)**

Plots and Graphs: Scatter Plot, Line Chart, Pie-diagram for dataset visualization. Data Distribution Measures: Normal curves, Dispersion, Skewness, Kurtosis statistical indices.

Unit II: Analysis of Time Series **(6 Hrs.)**

Introduction, Components of Time Series Data, Time series analysis and decomposition techniques, Measurement of Tends: Principal of Least square, Measurement of Seasonal and Cyclic Variation, Auto-Regression Series.

Unit III: Analysis of Variance (ANOVA) **(6 Hrs.)**

Introduction, Assumptions and Correlations, Types of ANOVA: One way classification: ANOVA for Fixed Effect model and Random Effect model, Two way classification: ANOVA for Fixed Effect model and Random Effect model with m-observations per cell.

Unit IV: Theory of Sampling **(6 Hrs.)**

Introduction, Parameters and Statistics, Principles of sample survey, sampling errors, Sampling Types: Simple random sampling, Stratified Sampling, Systematic Sampling.

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Unit V: Inferential Statistics **(6 Hrs.)**

Introduction, Parameter Estimation and Probability distribution of data sampling. Design of Hypothesis, Types of Hypothesis, Testing of Hypothesis: z test, t test for difference of mean, paired t test, chi-squared test.

Unit VI: Scaling Techniques **(6 Hrs.)**

Introduction, Scaling Tests: z-score, Standard score, Normalized Score, T-score, Percentile Score; Scaling in terms of normal probability curve.

Total: 36 Hrs

Textbook:

1. Gupta S C, Kapoor V K. (2007). "Fundamentals of applied statistics". New Delhi: Sultan Chand & Sons Publication.
2. Gupta S C, Kapoor V K. "Fundamentals of mathematical statistics". New Delhi: Sultan Chand & Sons Publication.

Reference Books:

1. A. M. Gun, M. K. Gupta, B. Dasgupta, "Fundamentals of Statistics", World Press Publisher, 2008.
2. K.R.gupta, "Mathematical Statistics", Vol 1, Atlantic Publishers and Distributors, 2021.

MOOC Links and additional reading, learning, video material:

Coursera: Probability & Statistics for Machine Learning & Data Science | Coursera

Coursera: Mathematics for Machine Learning and Data Science | Coursera

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Program:	B. Tech. (Artificial Intelligence (AI) & Data Science)			Semester:			VI	
Course:	MDM IV: Artificial Intelligence in Practice			Code:			BTALMD14AD6T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Test, Assignment, Quiz

Course Objectives: To develop understanding of fundamental machine learning concepts, data preprocessing and feature selection, and to apply classification models, training and evaluation techniques, along with TensorFlow for implementing neural network models.

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

CO	Course Outcomes	BT Level
CO-1	Outline the types, uses, and challenges of Machine Learning.	L2
CO-2	Analyse the working of real dataset by framing the problem.	L6
CO-3	Apply data preparation techniques to select, train machine learning models, and perform feature extraction.	L4
CO-4	Implement Machine Learning Models based on Binary, Multiclass, Multioutput Classification.	L6
CO-5	Apply training to Machine Learning Models & evaluating model performance with regression type algorithms.	L3
CO-6	Describe TensorFlow and TensorBoard libraries for implementing neural network models.	L2

Unit I: Machine Learning Landscape **(6 Hrs.)**
Machine Learning: Definition, Types, Uses; Instance-Based Versus Model-Based Learning, Challenges of Machine Learning, Testing and Validating ML model.

Unit II: Working with Real Data **(6 Hrs.)**
Frame the Problem, Select a Performance Measure, Create the Workspace, Download the Data, Create a Test Set, Discover and Visualize the Data to Gain Insights.

Unit III: Prepare the Data for Machine Learning Models **(6 Hrs.)**
Data Cleaning, Handling Text and Categorical Attributes, Custom Transformers, Feature Scaling, Select and Train a Model: Training and Evaluating on the Training Set, Better Evaluation Using Cross-Validation; Ensemble Methods Overview.

Unit IV: Classification **(6 Hrs.)**
Training a Binary Classifier, Confusion Matrix, The ROC Curve, Multiclass Classification, Error Analysis, Multilabel Classification, Multioutput Classification.

Unit V: Training Machine Learning Models **(6 Hrs.)**
Linear Regression Algorithm, Gradient Descent Algorithm, Polynomial Regression, Learning Curves, Logistic Regression Algorithm.

Unit VI: Running with TensorFlow **(6 Hrs.)**
Managing Graphs, Linear Regression with TensorFlow , Feeding Data to the Training Algorithm, Saving and Restoring Models, Visualizing the Graph and Training Curves Using TensorBoard, Modularity, Sharing Variables

Total: 36 Hrs

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Textbook:

1. G Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow", Published by O'Reilly Media, First Edition, March 2017.

Reference Books:

1. G Aurélien Géron, "Hands-On Machine Learning With Scikit-Learn and Pytorch: Concepts, Tools, and Techniques to Build Intelligent Systems", Published by O'Reilly Media, First Edition, December 2025.
2. Ashwin Pajankar, Aditya Joshi, "Hands-on Machine Learning with Python", A-Press Publisher, March 2022.
3. Dhairya Parikh, "Machine Learning Essentials You Always Wanted to Know: A Hands-On Beginner's Guide to Mastering AI, Supervised, Unsupervised, and Deep Learning Algorithms, Vibrant Publishers, July 2025.

MOOC Links and additional reading, learning, video material:

Coursera: https://www.udemy.com/course/deep-reinforcement-learning-in-python

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MDM Track 2: Fundamentals of Artificial Intelligence &Data Science

Program:	**B. Tech. (Artificial Intelligence (AI) & Data Science)**	**Semester:**	**V**
Course:	**MDM III: Introduction to Artificial Intelligence**	**Code:**	**BTALMD23AD5T**

Teaching Scheme				Evaluation Scheme				
Lecture	**Tutorial**	**Hours**	**Credit**	**TA**	**MSE-I**	**MSE-II**	**ESE**	**Total**
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Test, Assignment, Quiz

Course Objectives: To develop understanding of Artificial Intelligence foundations, intelligent agents, problem formulation, search techniques, adversarial strategies, and knowledge-based systems for solving real-world problems.

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

CO	Course Outcomes	BT Level
CO1	Outline the fundamental concepts of Artificial Intelligence, its evolution, applications, and the architecture of intelligent agents.	L2
CO2	Formulate AI problems using state-space representation and production systems and classify different types of AI problems.	L3
CO3	Analyse and compare uninformed search strategies such as Breadth-First Search and Depth-First Search for problem-solving agents.	L4
CO4	Apply informed search strategies including heuristic search, Best-First Search, and A* algorithm to solve complex problems efficiently.	L3
CO5	Analyse adversarial search techniques and game-playing algorithms such as Minimax, including their limitations in partially observable environments.	L4
CO6	Analyse the role of knowledge in AI systems and compare different types of knowledge, representation methods, and knowledge engineering processes.	L4

Unit I: Introduction to AI **(6 Hrs.)**

Introduction: What is AI? The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of Art, Risks and Benefits of AI,

Intelligent Agents: Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

Unit II: Problem Solving Through AI **(6 Hrs.)**

Introduction, Representation the AI Problems, Production System, Algorithm of Problem Solving, Examples of AI Problems, Nature of AI Problems.

Unit III: Introduction to SQL **(6 Hrs.)**

Problem Solving Agents, Example Problems, Search Algorithms, Uninformed Search Strategies: Breadth-First Search, Depth First Search.

Unit IV: Informed Search Strategies **(6Hrs.)**

Basic Concept of Heuristic Search and Knowledge, Heuristic Search, Strategies: Best-First Search, A* Algorithm

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Unit V: Adversarial Search & Games **(6 Hrs.)**

Game Theory, Optimal Decisions in Games, Mini-Max Search, Additional Refinements, Partially Observable Games, Limitations of Game Search Algorithms.

Unit VI: Introduction to Knowledge **(6 Hrs.)**

Introduction, Types of Knowledge, Knowledge Representation, Knowledge Storage, Knowledge Acquisition, Knowledge Organization and Management, Basic Concepts of Knowledge Engineering.

Total: 36 Hrs

Textbook:

1. Artificial Intelligence by Ela Kumar (Wiley Publication)

2.Artificial Intelligence: A Modern Approach by Stuart Russell & Peter Norvig (Pearson -4th Ed.)

Reference Books:

1.Artificial Intelligence by Elaine Richand Kevin Knight (Tata McGraw Hill-3rdEd.)

2.A First Course in Artificial Intelligence by Deepak Khemani (Tata McGrawHill-1stEd.)

3.Artificial Intelligence and Expert Systems by Patterson (PHI)

MOOC Links and additional reading, learning, video material:

4. https://www.coursera.org/learn/introduction-to-ai#modules
5. https://onlinecourses.nptel.ac.in/noc22_cs56/preview
6. https://onlinecours.es.swayam2.ac.in/cec20_cs10/preview

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Program:	B. Tech. (Artificial Intelligence (AI) & Data Science)			Semester:			VI	
Course:	MDM IV: Basics of Machine Learning			Code:			BTALMD24AD6T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Test, Assignment, Quiz

Course Objectives: To understand fundamental machine learning concepts and neural networks, and to apply data preprocessing, model selection, training, evaluation, and analysis of classification, regression, and learning approaches for solving real-world problems

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

CO	Course Outcomes	BT Level
CO-1	Outline the fundamental concepts, types, applications, tools, and challenges of machine learning.	L2
CO-2	Apply data preprocessing techniques to improve data quality for machine learning models.	L3
CO-3	Analyse different machine learning models, evaluate their performance, and optimize them using feature engineering.	L4
CO-4	Implement classification and regression algorithms to solve supervised learning problems.	L3
CO-5	Differentiate between supervised and unsupervised learning and apply clustering and association rule techniques for pattern discovery.	L4
CO-6	Describe the fundamentals of neural networks, including artificial neurons, activation functions, and architectures	L2

Unit I: Introduction to Machine Learning **(6 Hrs.)**

Human Learning, what is Machine Learning? Types of Machine Learning, Applications of Machine Learning, Tools in Machine Learning, Issues in Machine Learning

Unit II: Preparing Machine Learning Model **(6 Hrs.)**

Machine Learning Activities, Basic Types of Data in Machine Learning, Exploring Structure of Data, Data Quality and Remediation, Data Pre-Processing

Unit III: Modelling and Evaluation **(6 Hrs.)**

Introduction, Selecting a Model, Training a Model (for Supervised Learning), Evaluating Performance of a Model, Improving Performance of a Model, Introduction of Feature Engineering, Feature Transformation.

Unit IV: Supervised Learning **(6Hrs.)**

Classification: Classification Model, Classification Learning Steps, Classification Algorithms: k-Nearest Neighbor (kNN), Decision Tree.

Regression: Introduction of Regression Algorithms, Regression Algorithms: Simple Linear Regression, Multiple Linear Regression.

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Unit V: Unsupervised Learning **(6 Hrs.)**

Introduction, Unsupervised vs Supervised Learning, Application of Unsupervised Learning, Clustering, Finding Pattern using Association Rule.

Unit VI: Basics of Neural Network **(6 Hrs.)**

Introduction, Understanding the Biological Neuron, Exploring the Artificial Neuron, Types of Activation Functions, Architectures of Neural Network.

Total: 36 Hrs

Textbook:

1. Saikat Dutt, Subramaniyam Chandramauli – Machine Learning, Pearson Publication.

Reference Books:

1. Chris Albon – Machine Learning with Python Cookbook: Practical Solutions from Preprocessing to Deep Learning.
2. Andreas C. Müller & Sarah Guido – Introduction to Machine Learning with Python: A Guide for Data Scientists.
3. Sebastian Raschka and Vahid Mirjalili – Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow.

MOOC Links and additional reading, learning, video material:

1. https://nptel.ac.in/courses/106/106/106106202/
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-036-introduction-to-machine-learning-fall-2020/

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