

Branch Name:	M.Sc. (Artificial Intelligence & Data Science)
Program Code:	ET214
Course Title:	Machine Learning
Course Code:	1ET2140103
Pre-requisite Course:	Mathematics for Machine Learning, Programming in Python

Course Objectives:

1. To understand fundamental machine learning paradigms including supervised and unsupervised learning.
2. To apply regression and classification algorithms for predictive data modeling.
3. To implement clustering and dimensionality reduction techniques for pattern discovery.
4. To evaluate machine learning models using validation techniques and performance metrics.
5. To develop end-to-end classical machine learning solutions using Python libraries.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	0	2	4	50	50	25	25	150

Course Contents:

Unit No	Topic	Total Hours	Weightage (%)
1	Introduction to Machine Learning and Data Pre-processing: Overview of Machine Learning paradigms (Supervised and Unsupervised Learning), Machine Learning workflow, data collection, data cleaning, feature engineering, feature scaling, training and testing datasets	10	20%
2	Regression Techniques: Simple Linear Regression, Multiple Linear Regression, Polynomial Regression, Model assumptions, Regularization methods (Ridge and Lasso Regression), evaluation of regression models	12	20%
3	Classification Algorithms: Logistic Regression, k-Nearest Neighbors (k-NN), Decision Trees, Naïve Bayes Classifier, Support Vector Machines (SVM), bias-variance tradeoff in classification	14	25%
4	Clustering Techniques: Unsupervised learning concepts, K-Means clustering, Hierarchical clustering, DBSCAN clustering, cluster validation techniques and visualization	12	20%
5	Model Evaluation and Validation: Confusion Matrix, Accuracy, Precision, Recall, F1-Score, ROC Curve and AUC, Cross-validation techniques, overfitting and underfitting, model selection and performance comparison	12	15%

Text Books:

1. Tom M. Mitchell – *Machine Learning*, McGraw-Hill.
2. Aurélien Géron – *Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow*, O'Reilly.
3. Kevin P. Murphy – *Machine Learning: A Probabilistic Perspective*, MIT Press.

Reference Books:

1. Christopher Bishop – Pattern Recognition and Machine Learning, Springer.
2. Gareth James et al. – An Introduction to Statistical Learning, Springer.
3. Alex Smola & S.V.N. Vishwanathan – Introduction to Machine Learning, Cambridge University Press.
4. Hastie, Tibshirani, Friedman – The Elements of Statistical Learning, Springer.

LIST OF EXPERIMENTS / PRACTICALS

1. Data Preprocessing and Exploratory Data Analysis using Pandas and NumPy.
2. Implementation of Simple and Multiple Linear Regression using Scikit-learn.
3. Polynomial Regression and Regularization Techniques (Ridge and Lasso).
4. Logistic Regression for Binary Classification Problems.
5. k-Nearest Neighbors (k-NN) Classification and Hyperparameter Tuning.
6. Decision Tree Classification and Visualization of Decision Boundaries.
7. Naïve Bayes Classification for Text or Numerical Dataset.
8. Support Vector Machine (SVM) Classification with Linear and RBF Kernels.
9. Implementation of K-Means Clustering for Customer Segmentation.
10. Hierarchical Clustering and Dendrogram Visualization.
11. DBSCAN Clustering for Density-Based Pattern Discovery.
12. Dimensionality Reduction using Principal Component Analysis (PCA).
13. Model Evaluation using Confusion Matrix, Precision, Recall, and F1-Score.
14. ROC Curve Analysis and AUC Calculation for Classification Models.
15. Cross-Validation and Bias–Variance Analysis for Model Selection.
16. Mini Case Study: End-to-End Machine Learning Pipeline on Real Dataset.

Course Learning Outcomes (CLO):

CO	Statement	Bloom's Level
CO1	Understand fundamental concepts and workflow of classical machine learning algorithms	L2 – Understand
CO2	Apply regression and classification algorithms to real-world datasets	L3 – Apply
CO3	Analyze clustering techniques and dimensionality reduction methods for pattern discovery	L4 – Analyze
CO4	Evaluate machine learning models using validation techniques and performance metrics	L5 – Evaluate
CO5	Develop complete machine learning solutions using Python libraries for real-world applications	L6 – Create

Mapping of CLO with PO and PSO

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CLO1	M	H	–	–	M	–	–	–	–	L	–	M	M	M	M	L
CLO2	M	H	H	M	H	–	–	–	L	M	–	M	H	H	M	M
CLO3	M	H	M	H	H	–	–	–	L	M	–	M	H	H	M	M
CLO4	M	M	H	H	H	–	–	–	M	H	M	M	H	H	M	M
CLO5	M	H	H	H	H	M	L	M	M	H	H	H	H	H	H	H

H:High, M:Medium, L:Low