Course Type	Course Code	Name of the Course	L	T	P	Credits
DP (Hons)	**NCSH304**	**INTRODUCTION TO MACHINE LEARNING LABORATORY**	0	0	3	1.5

Course Objective

This course aims to provide a comprehensive foundation in machine learning by covering both fundamental theories and hands-on applications. Students will develop the skills to handle diverse datasets, design appropriate learning models, and critically evaluate their performance. Additionally, they will explore emerging areas of deep learning, reinforcement learning, and model interpretability to prepare them for cutting-edge challenges in research and industry.

Learning Outcomes

Develop skills to identify and categorize supervised, unsupervised, and reinforcement learning problems, implement relevant algorithms, and rigorously evaluate model performance. Gain practical skills in data preprocessing, hyperparameter tuning, and model deployment, while also exploring advanced deep learning and reinforcement learning techniques, including model transparency and explainability.

Unit No.	Topics to be Covered	Practical Hours	Learning Outcome
1	**Environment Setup & Data Exploration** - Setting up Python/Anaconda environment - Basic Python, NumPy, Pandas - Exploratory Data Analysis (EDA)	3	Familiarize with the development environment, basic data handling, and exploration techniques
2	**Linear & Logistic Regression** - Simple linear regression (from scratch & via scikit-learn) - Logistic regression for classification	6	Understand how to implement regression models, interpret coefficients, and evaluate performance
3	**Decision Trees & Ensemble Methods** - Building decision trees - Random Forests - Gradient Boosting (e.g., XGBoost or LightGBM)	6	Practice tree-based model training, understand hyperparameters, and compare ensemble methods
4	**Support Vector Machines (SVM)** - Implementing SVM for classification/regression - Kernel selection and hyperparameter tuning	6	SVM internals, tune parameters, and explore different kernels for improved classification accuracy
5	**Model Evaluation & Hyperparameter Tuning** - Cross-validation (k-fold) - Metrics (accuracy, precision, recall, F1-score) - Grid/Random search	3	Conduct systematic model evaluation and hyperparameter tuning for performance optimization
6	**K-Means & Hierarchical Clustering** - Clustering on real datasets - Visualizing clusters - Interpreting cluster quality	6	Practice unsupervised clustering, compare algorithms, and interpret cluster structures
7	**Introduction to Neural Networks** - Building a simple feedforward network (e.g., with PyTorch or TensorFlow) - Forward/backpropagation	6	Understand the basics of neural network architectures, backpropagation, and training loops
8	**Transfer Learning & Model Interpretability** - Transfer learning for image or text tasks - Model explainability	6	Practice adapting pre-trained networks for new domains and interpreting models' predictions
			Total: 42

Text Books:

1. Christopher M. Bishop, "Pattern Recognition and Machine Learning", SPRINGER
2. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, "Deep Learning", MIT Press

Reference Books:

1. Ethem Alpaydin, "Introduction to Machine Learning", PHI Learning Pvt. Ltd, 2015.
2. Shai Shalev-Shwartz and Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2014.