NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	M.Tech. in Electronics & Instrumentation Engineering (Robotics and Artificial Intelligence)
Semester:	II
Course Code:	6CS401CC25
Course Title:	Machine and Deep Learning
Course Type:	Core
Year of Introduction:	2025 - 26

L	T	Practical Component				C
		LPW	PW	W	S	
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Course Learning Outcomes (CLO):

After successful completion of the course, student will be able to –

1. demonstrate the concepts of supervised and unsupervised learning, and their applications (BL2)
2. apply supervised and unsupervised learning techniques, including clustering and classification algorithms, to analyze datasets (BL3)
3. develop deep learning models such as ANNs, CNNs, and sequence models (RNNs, LSTMs, GRUs) for complex applications (BL3)
4. evaluate advanced techniques like transfer learning, GANs, and reinforcement learning for solving research challenges. (BL5)

Unit	Contents	Teaching Hours (Total 30)
Unit-I	**Introduction to ML and DL** Motivation and Applications, importance of Data Visualization, Basics of Supervised and Unsupervised Learning, Hierarchical Agglomerative Clustering, k-means Algorithm, Self-Organizing Maps	04
Unit-II	**Supervised Learning** Regression Techniques: Basic concepts and applications of Regression, Simple Linear Regression – Gradient Descent Method, Multiple Linear Regression, Non-Linear Regression, Linear Regression with Regularization, Hyper-parameters tuning, Loss Functions, Evaluation Measures for Regression Techniques Classification Techniques: Naïve Bayes Classification, Fitting Multivariate Bernoulli Distribution, Gaussian Distribution and Multinomial Distribution, K-Nearest Neighbours, Decision trees, Support Vector Machines	08

Unit-III	**Artificial Neural Networks** Perceptron Learning, Feed Forward Neural Networks, Back-propagation, Unstable and vanishing Gradient Problem Convolutional Neural Networks: Convolution & Pooling, Dropout, Batch Normalization, State-of-the-art CNNs	06
Unit-IV	**Transfer Learning & Domain Adaptation** Transfer Learning Scenarios, Applications of Transfer Learning, Transfer Learning Methods, Fine Tuning and Data Augmentation, Supervised, Semi Supervised and Unsupervised Deep Learning Advanced Concepts: Linear Discriminant Analysis, Auto encoders and Stacked Auto encoders, Generative Adversarial Networks, Deep Reinforcement Learning	09
Unit-V	**Sequence Models** Recurrent Neural Networks (RNN), Language Modelling, Long-Short Term Memory Network, Gated Recurrent Unit, Bi-directional RNN, Applications of Sequence Models	05

Self-Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents

Suggested Readings/References:

1. Tom Mitchell, Machine Learning, TMH
2. Bishop C., Pattern Recognition and Machine Learning, Springer
3. Kishan Mehrotra, Chilukuri Mohan, Sanjay Ranka, Elements of Artificial Neural Networks, Penram International
4. Athem Ealpaydin, Introduction to Machine Learning, PHI
5. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press
6. Charu C. Aggarwal, Neural Networks and Deep Learning – A Textbook, Springer
7. Adam Gibson, Josh Patterson, Deep Learning, O'Reilly Media, Inc.
8. Hastie T., Tibshirani R., Friedman J., The Elements of Statistical Learning, Springer

Suggested List of experiments:

Sr. No.	Title	Hours
1.	Introduction to Python, Numpy, Pandas, Matplotlib, Sklearn and Pytorch	04
2.	Simple and Multiple Linear Regression using Gradient Descent & Normal Equation Method (without using sklearn or equivalent library for both)	04
3.	Linear Regression with Regularization (without using sklearn or equivalent library) and Simple and Multiple Linear Regression with and without regularization using Sklearn	02
4.	Naïve-Bayes – Multivariate Bernoulli, Multinomial and Gaussian using sklearn	02

5.	Decision Trees – ID3, C4.5 using sklearn and Support Vector Classification and Regression with Grid Search for Hyper-parameter tuning using sklearn	02
6.	AND gate using Perceptron Learning (self-implementation) and Ex-OR Gate/any other problem using Backpropagation Neural Networks (self-implementation)	04
7.	Backpropagation Neural Network and K-means using sklearn	02
8.	Convolutional Neural Network on MNIST, Fashion MNIST and CIFAR10 datasets with and without transfer learning	04
9.	Language Modelling using RNN	04
10.	MNIST like image generation using GAN	02

L = Lecture, T = Tutorial, P = Practical, C = Credit

w.e.f. the academic year 2025 - 26 and onwards