NIRMA UNIVERSITY

Institute:	Institute of Technology, School of Technology
Name of Programme:	MTech CSE (Cyber Security)
Course Code:	6CS401CC22
Course Title:	Machine and Deep Learning
Course Type:	Department Elective-I
Year of Introduction:	2022-23

Credit Scheme

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

At the end of the course, students 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 45)
Unit-I	**Introduction to ML and DL:** Motivation and Applications, importance of Data Visualization, Basics of Supervised and Unsupervised Learning	02
Unit-II	**Unsupervised Learning:** Hierarchical Agglomerative Clustering, k-means Algorithm, Self-Organizing Maps	03
Unit-III	**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	12
Unit-IV	**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	10

Unit-V	**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	03
Unit-VI	**Sequence Models:** Recurrent Neural Networks (RNN), Language Modelling, Long-Short Term Memory Network, Gated Recurrent Unit, Bi-directional RNN, Applications of Sequence Models	09
Unit-VII	**Advanced Concepts:** Linear Discriminant Analysis, Auto encoders and Stacked Autoencoders, Generative Adversarial Networks, Deep Reinforcement Learning.	06

Self-Study:

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

Suggested Readings/ References:

1. Tom Mitchell, Machine Learning, McGraw Hill
2. C. Bishop, Pattern Recognition and Machine Learning, Springer
3. Kishan Mehrotra, Chilukuri Mohan, and Sanjay Ranka, Elements of Artificial Neural Networks, Penram International
4. Athem Ealpaydin, Introduction to Machine Learning, Prentice Hall
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
8. Hastie, T., Tibshirani, R. and Friedman, J. The Elements of Statistical Learning, Springer.

Suggested List of Experiments:

Sr. No.	Name of Experiments/Exercises	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