NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	MTech CSE (Cyber Security)
Course Code:	3CS5101
Course Title:	Machine and Deep Learning
Course Type:	(√ **Core**/ □ Value Added Course / □ Department Elective / □ Institute Elective/ □ University Elective/ □ Open Elective / □ Any other)
Year of Introduction:	2022-23

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		LPW	**PW**	**W**	**S**	
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Course Learning Outcomes (CLO):

At the end of the course, the student will be able to –

1. make use of machine learning and deep learning techniques to solve problems in applicable domains (BL3)
2. appraise the need of machine learning and deep learning (BL5)
3. evaluate variety of machine learning algorithms for appropriate applications (BL5)
4. adopt different deep learning algorithms appropriate to solve problems in various domains (BL6)

Syllabus: **Total Teaching hours: 45**

Unit	**Syllabus**	**Teaching hours**
Unit-I	**Introduction:** Motivation and Applications, importance of Data Visualization, Basics of Supervised and Unsupervised Learning	02
Unit-II	**Unsupervised Learning** **Clustering:** 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:** Hard Margin and Soft Margin, Kernels and Kernel Trick, Evaluation Measures for Classification Techniques	12
Unit-IV	**Artificial Neural Networks:** Perceptron Learning, Feed Forward Neural Networks, Back-propagation, Unstable and vanishing Gradient Problem	10

Unit-V	**Convolutional Neural Networks:** Convolution & Pooling, Dropout, Batch Normalization, State-of-the-art CNNs **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	**Miscellaneous:** Linear Discriminant Analysis, Auto encoders and Stacked Auto encoders, Generative Adversarial Networks, Deep Reinforcement Learning	06

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. 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, 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. and Friedman, J. The Elements of Statistical Learning, Springer

Suggested List of Experiments:

Sr. No.	Title	Hours
1	Introduction to Python, Numpy, Sklearn and Matplotlib.	02
2	Implementation of K-means and Hierarchical clustering algorithms.	02
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, Support Vector Classification and Regression with Grid Search for Hyper-parameter tuning using sklearn.	04
6	AND gate using Perceptron Learning (self-implementation). Ex-OR Gate/any other problem	04

	using Backpropagation Neural Networks (self-implementation) and Sklearn.	
7	Convolutional Neural Network on MNIST, Fashion MNIST and CIFAR10 datasets. Write code using (a) Sequential Class (b) Model Class API.	04
8	Use transfer learning for Image Segmentation & Detection using Deep Networks.	04
9	Unsupervised MNIST.	04
10	Build a language model using RNN. Write functions to sample novel sentences and find the probability of input sentence. Also, use Recurrent Neural Network for Sentiment Analysis.	02
11 *	Reinforcement learning for game development.	06

*Marked as additional definitions for practice