Year: M. Tech. I (Semester – I)

Subject Name: Machine Learning and Deep Learning: PEC **Subject Code:** MTCO14104
Type of course: Professional Elective - I
Prerequisite (if any): Python programming, Probability and Statistics

List of Courses where this course will be prerequisite: --

Rationale: Machine Learning and Deep Learning are the fastest-growing fields in the Computer Science industry. This course focuses on giving a detailed insight into various Machine learning and Deep learning paradigms and algorithms that will enable the students to build appropriate learning models and undertake predictive analytics on multitude of domains.

Teaching and Examination Scheme:

Teaching Scheme				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	
3	0	2	4	60	25	15	30	20	150

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests CA2: Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems TEE: Term End Examination TEP: Term End Practical Exam (Performance and viva on practical skills learned in course) CA3: Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr.No.	Content	Total Hrs
1	Fundamentals of Machine Learning: Introduction to Machine Learning,, Overview of Supervised Learning, Unsupervised Learning and Reinforcement Learning, Loss functions, Parametric vs Non-parametric methods, Elements of Computational Learning Theory	5
2	Data preparation: Data cleaning, Data transformation, Dimensionality Reduction: Feature Selection vs Feature Extraction, Feature selection methods: Filter, Wrapper, Embedded, Feature Extraction method: Principal Component Analysis and its interpretations, Canonical Correlation Analysis, Linear Discriminant Analysis, Independent Component Analysis,	7

3	Supervised and Unsupervised Learning Methods: Regression: Linear Regression, Polynomial Regression, Logistic Regression, Ridge Regression, Ensemble Learning: Bagging, Random Forest, Boosting, Kernel Methods for non-linear data, Support Vector Machines Clustering: k-means, Hierarchical; Recommendation Systems: Collaborative Filtering, Content Based	10
4	Introduction to Artificial Neural Network, Multilayer Perceptron's, Feedforward Neural Networks, Gradient Descent, Backpropagation, Deep Learning and its Architectures, Activation Functions and Hyper parameter Tuning	7
5	CNN and its Variants: Foundations of CNN- Convolution, Striding, Padding, Pooling, AlexNet, VGGNet, ResNet, Mobile Net, Overview of Transfer Learning Case Study: Image Classification	7
6	Improving Deep Neural Network: Bias vs Variance Tradeoff, Regularization: L1 regularization, L2 regularization, Batch Normalization, Early stopping, Dropout, Pruning, Optimization Techniques overview	5
7	Models for Sequence Analysis - RNN, LSTM, Generative Adversarial Models	4

Reference Books:

Sr.No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1	Machine Learning	Tom Mitchell	McGraw- Hill	1997	First Edition
2	Introduction to Machine Learning	Ethem Alpaydin	PHI Learning	2015	Second Edition
3	Fundamentals of Deep Learning	Nikhil Buduma	O-Reilly	2019	3rd Edition
4	Deep Learning Using Python	S Lovelyn Rose, L Ashok Kumar, D Karthika Renuka	Wiley	2020	1st edition
5	Hands–On Machine Learning with	Aurelin Geron	O-Reilly	2017	

	Scikit–Learn and TensorFlow				
6	Deep Learning	Goodfellow, I.,Bengio,Y., Courville, A.,	MIT Press,	2016	
7	Deep Learning with Python	Francois Chollet	Manning	2017	

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Compare and contrast supervised and unsupervised machine learning techniques.	25%
CO-2	Examine the important Dimensionality Reduction methods for machine learning	15%
CO-3	Integrate the basic building blocks of ANN and DNN to construct models	15%
CO-4	Construct convolutional neural network models for computer vision applications	15%
CO-5	Analysing various optimization techniques for improving deep neural networks	15%
CO-6	Implement sequence models for text analysis and examine deep generative model	15%

List of Open learning website:

- https://onlinecourses.nptel.ac.in/noc19_cs85
- https://onlinecourses.nptel.ac.in/noc19_cs52
- https://www.udemy.com/course/deeplearning/
- https://www.coursera.org/specializations/deep-learning
- https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-cs54/

List of Open Source Software:

- Python
- Tensorflow
- Keras
- OpenCV

- Pytorch

FOR LAB SESSIONS:

List of Experiments:

Sr. No.	Practical
1.	Implement Logistic Regression in Python using machine learning for the Social_Networks_Ads.csv dataset.
2.	Implement the following Ensemble algorithms on the Iris dataset or the labelled dataset of your choice. Prepare a comparison table of accuracy measures for different number of estimators for the given algorithms. 1. Random Forest 2. AdaBoost 3. Gradient Boost
3.	Calculate the Cost metrics and/or the Cost function for the following datasets after preprocessing if necessary. Further, use cross validation and record the results. 1. Linear Regression on Boston Housing dataset available at : https://www.kaggle.com/schirmerchad/bostonhoustingmlnd#housing.csv 2. Classification or Logistic Regression on following datasets: Coronavirus patients.csv at https://www.kaggle.com/kimjihoo/coronavirusdataset
4.	Implement a User – User Collaborative Filtering Recommendation System on the Movie data provided in the link: https://gist.github.com/rajarsheem/12cd9e7cd7c8f1b6ed81
5.	Implement and Compare PCA and LDA on the dataset of your choice.
6.	Design multilayer perceptron network for MNIST digits classification with Dropout.
7.	Implement image classification on the dataset of your choice using CNN and understand new best-practices for the deep learning era of how to set up train/validation/test sets and analyze bias/variance.
8.	Implement and apply a variety of optimization algorithms, such as Mini-batch Gradient Descent, Momentum, RMSprop, Adam, and hyper-parameter tuning and check for their convergence on MNIST Dataset
9.	Build a Generative Adversarial Network

10.	Learn features from Natural Language using sequence models.
11.	Detect and classify positive and negative reviews using a sequence model.