Year: B. Tech III (Semester V)

Subject Name: Machine Learning and Deep Learning **Subject Code:** BTEA19521
Type of course: Honor (Group: Data Science)
Prerequisite (if any): Statics and Data pre-processing

Rationale: Machine learning has potential to analyze and interpret complex patterns and structures in data to enable learning, reasoning, and data-driven decision making. It allows predictions that can guide better recommendations, decisions and smart actions in real-time without human intervention. Deep learning is a subset of machine learning having improved analyzing capabilities.

Teaching and Examination Scheme:

Teaching Scheme				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	
4	0	2	5	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.	Contents	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	06
2.	Dimensionality Reduction: Feature Selection vs Feature Extraction, Principal Component Analysis and its interpretations	07
3.	Supervised and Unsupervised Learning Methods: Regression - Linear Regression, Polynomial Regression, Logistic Regression Classifiers - Naive Bayes, Support Vector Machines Clustering - k-means, k-medoid, Nearest Neighbour Algorithm Recommendation Systems: Collaborative Filtering, Content Based	14
4.	Introduction to Perceptron, McCulloch-Pitts Neuron and Artificial Neural Network, Multilayer Perceptrons, Feedforward Neural Networks, Gradient Descent, Backpropagation, Heuristics to improve Backpropagation algorithms, Deep Learning and its Architectures, Activation Functions and Hyper parameter Tuning	10
5	CNN and its Variants: Foundations of CNN- Convolution, Striding, Padding, Pooling, Case Study - Image Classification	10
6.	Improving Deep Neural Network: Bias vs Variance Tradeoff, Discriminative Analysis, Batch Normalization, Early stopping, Dropout, Pruning	07

7.	Language Modeling and Sequence Generation: RNN, LSTM	06

Suggested Specification table with Marks (Theory): (For B.Tech only)

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
5	10	15	25	5	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

Sr No.	Title of book /article	Author(s)	Publisher and details like ISBN
1.	Machine Learning	Tom Mitchell	McGraw- Hill
2.	Introduction to Machine Learning	Ethem Alpaydin	PHI Learning
3.	Fundamentals of Deep Learning	Nikhil Buduma	O-Reilly
4.	Deep Learning Using Python	S Lovelyn Rose, L Ashok Kumar, D Karthika Renuka	Wiley
5.	Hands–On Machine Learning with Scikit–Learn and TensorFlow	Aurelin Geron	O-Reilly
6.	Deep Learning	Goodfellow, I.,Bengio,Y., Courville, A.	MIT Press
7.	Deep Learning with Python	Francois Chollet	Manning

Note: Students should refer to the latest editions of books

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Compare and contrast supervised and unsupervised machine learning techniques.	25%
CO-2	Illustrate the concepts of features extraction and feature selection.	15%
CO-3	Integrate the basic building blocks of ANN and DNN to construct models	20%
CO-4	Implement convolutional neural network model for computer vision applications	20%
CO-5	Practice sequence models for text analysis.	20%

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
- Scikit-Learn
- Tensorflow
- Keras
- OpenCV
- Pytorch

FOR LAB SESSIONS:

List of Experiments:

Sr. No	Practical
1.	Implement Logistic Regression in Python using machine learning for an appropriate dataset.
2.	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. Linear Regression on Boston Housing dataset available at : https://www.kaggle.com/schirmerchad/bostonhoustingmlnd#housing.csv
3.	Implement Naive Bayes and SVM classifier for the following dataset: 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 Principal Component Analysis method 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 how to set up train/validation/test sets and analyze bias/variance.
8.	Practice image classification using appropriate pre-trained CNN model and tune the hyper parameters.
9.	Explore NLTK library and implement its basic functionalities.
10.	Learn features from Natural Language using sequence models.
11.	Mini Project