BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI,
HYDERABAD CAMPUS
INSTRUCTION DIVISION, SECOND SEMESTER 2025-2026

Course Handout (Part-I)

Date: 20/12/2025

Course No. **: EEE G513**

Course Title **: Machine Learning for Electronic Engineers**

Instructor-in-charge: R. Venkateswaran

Course Description

This course provides a requisite conceptual foundation of ML and contextual application of ML techniques for improving the performance of electronic systems. The course introduces the major approaches to ML such as supervised, unsupervised, semi-supervised, and reinforcement learning. The course discusses the challenges in implementation of ML techniques, complexity analysis of the ML architectures for hardware implementation, efficient architectures, and various topologies used for implementation.

Scope of the Course:
The rise of machine learning (ML) has introduced many opportunities in the design of electronic systems. The course lays emphasis on various deep learning techniques and their application to various types of electronic systems/sub-systems (e.g. control-dominated systems, NLP systems, vision-based systems, communication systems, embedded systems, IoTs). Additionally, the course covers advance topics in ML such as multi-modal, multi-task learning as well as transfer learning.

Outcomes:
- Students should be able to apply ML techniques to model, design, validate, and optimize embedded electronic systems in their area of interest.
- Develop the skills and practical exposure in modeling, developing and debugging ML-based systems.
- Develop the foundation required to explore advanced topics of research in ML.

Text Book(s):

T1. I. Goodfellow, Y. Bengio, A. Courville, Deep Learning, MIT Press, 2016.
T2. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006

Reference Book(s):

R1: "An Introduction to Statistical Learning" by Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani.
R2: "Neural Network Design" by Martin T. Hagan, Howard B. Demuth, and Mark H. Beale.
R3: "Introduction to Artificial Neural Systems" by Jacek M. Zurada.
R4: Introduction to Data Mining, Pang-Ning Tan, Michael Steinbatch, Vipin Kumar

Lecture No.	Learning Objectives	Topics to Be Covered	Reference to the Text
1–2	Overview of the course and Introduction to different types of machine learning	Introduction to Machine Learning, Supervised Learning, Unsupervised Learning, semi-supervised learning, Reinforcement Learning	Chapter 2 (R1) and class lecture material on all the topics
3–10	Understand the difference between classification and regression problem	Classification and regression problems, Linear Regression, Logistic Regression, Decision Trees, Naïve Bayes	Chapter 3.1, 3.2, (R1), Chapter 4.2, 4.3 (R1), Chapter 8 (R1), Chapter 4 (R4) and class lecture material on all the topics
11–15	Curse of dimensionality and how to reduce dimensionality of high dimensional data,	Principal Component Analysis (PCA), Bias–Variance Trade off, Regularization	Chapter 6.3 (R1) , Chapter 10.2 (R1), Chapter 2.2 (R1), Chapter 6.2 (R1) and class lecture material on all the topics
16–21	How to select training and test instances for machine learning models, Various performance measures to evaluate the performance of the models	Selection of training and test instances for classifiers: hold-out validation, Five fold Cross Validation, Leave One Out Cross Validation, Performance measures for binary and multiclass classifiers, regression model performance metrics	Chapter 5 (R1), Chapter 6.1 (R1), Chapter 4.4.3 (R1), Chapter 4 (R4) and class lecture material on all the topics
22–29	Neural Networks - concept of perceptron and multiclass perceptron	Human Brain and Biological Neuron, Model of an Artificial Neuron, Learning Rules, Single Layer Perceptron, Multiclass Perceptron	Chapter 2 (R2), Chapter 2(R3), Chapter 3 (R2), Chapters 3 and 4 (R2) and class lecture material on all the topics
30–37	Neural networks - multilayer feed forward network and Deep learning	Multilayer Perceptron, Back propagation Algorithm, Gradient Descent, Regression MLPs, Classification MLPs, Convolutional Neural Networks, Residual Neural Networks, Unet Architecture	Chapter 4 (R3), Chapter 11 (R2), Chapter 5 (R3), Chapter 21 (R2) and class lecture material on all the topics
38–42	Unsupervised Learning	Clustering (k Means), Gaussian Mixture Models, Expectation Maximization Algorithm	Chapter 10 (R1), Chapter 9 (T2) and class lecture material on all the topics

2. Evaluation Scheme

Component	Duration	Weightage	Marks	Date & Time	Evaluation type
Mid sem	90 min	25%	50	-	Closed Book
2 Quizzes		20%	40	To be announced in the class	Open Book
Lab (Regular)		20%	40	-	Open Book
Compre. Exam.	3 hours	35%	70	-	Closed Book
Total			**200**		

3. NC Grade Criteria

A student should obtain 30% of the average of the top few performers in the class, or 25% of the median marks of the class, whichever is lower to clear the course.

4. Chamber Consultation Hour: To be announced in the class

Notices: LMS (In EEE Notice Board if LMS is not working)

5. Make-up Examination:

Make-up examination will be given only in extremely genuine cases for which prior permission of the instructor-in-charge is required. No makeup will be given for quizzes.

6. **Academic Honesty and Integrity Policy:** Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Instructor-in-charge
EEE G 513