Machine Learning (IE 406)

Course Placement: It is a technical elective course for B. Tech. 5th and 7th Semester students

Course format: Three hours' lecture and two-hours lab every week (3-0-2-4).

Course Content:

S. No.	Unit Title	Topics	Lectures
1	Introduction to ML	Introduction and Significance of Machine Learning, Supervised, Semi-supervised and Unsupervised learning, Introduction to Classification, Regression and Clustering problems.	2
2	Mathematical and Statistical Foundation	Quick revision of linear algebra for machine learning, Convex functions, Gradient, Steepest descent direction, Gradient Descent method, Stochastic Gradient Descent method, Sub gradients.	6
		Multivariate Analysis , Covariance matrix, Multivariate normal distribution and its properties,.	
3	Model Selection and Evaluation	Evaluation metric for regression and classification models, Training and Testing set, Resampling method, Cross Validation, K-fold cross validation, Leave-one Out method.	2
4	Regression Analysis	Least Squares methods, Least Squares multiple linear regression model, Non-linear multiple regression models through basis functions, Polynomial, Gaussian and Sigmoidal basis, Overfitting, Least Squares kernel regression model, Derivation of least square loss for normal noise using MLE, Need of Regularization, Bias-variance trade-off, Lasso Regression, L_1- norm loss regression model,	11
4.	Classification	Bayesian Classification, Gaussian Models, Naïve Bayes Classifier, Logistic Regression, Soft-max Regression, Neural Network and multilayer perceptron and Support Vector Machine.	14
6.	Unsupervised ML	Feature Selection methods, Dimensionality Reduction: PCA, Basic of clustering, K-mean clustering.	5

References:

Suggested books:

- Deisenroth, Marc Peter, A. Aldo Faisal, and Cheng Soon Ong. *Mathematics for machine learning*. Cambridge University Press, 2020.

- Chandra, Suresh, Jayadeva, and Aparna Mehra. *Numerical optimization with applications*. Alpha Science International, 2009.

- Bishop, Christopher M. *Pattern recognition and Machine learning* 128.9 (2008).

- Murphy, K. P. (2013). *Machine learning: a probabilistic perspective*. Cambridge, Mass: MIT Press. ISBN: 9780262018029 026201802.

- Friedman, Jerome, Trevor Hastie, and Robert Tibshirani. *The elements of statistical learning*. Vol. 1. No. 10. New York: Springer series in statistics, 2001.

- Deng, Naiyang, Yingjie Tian, and Chunhua Zhang. *Support vector machines: optimization based theory, algorithms, and extensions*. CRC press, 2012.

- Duda, Richard O., and Peter E. Hart. *Pattern classification*. John Wiley & Sons, 2006.

- Zaki, Mohammed J., and Wagner Meira Jr. *Data Mining and Machine Learning: Fundamental Concepts and Algorithms*. Cambridge University Press, 2020.

Evaluation Components: -   Surprise Quizzes, Assignments, Viva, Semester exams, Lab test.

Tentative marks distributions: -

- Surprise Quizzes:- 30 .

- End Semester Exam:- 30.

- Lab   Assignments + Viva + Lab test:- 40.

Course Outcomes: After completion of this course, students will

- develop the depth understanding of the fundamental mathematical and statistical concepts used in machine learning models.

- develop the systematic and deep understanding of the popular machine learning models.

- learn to implement the machine learning models from scratch.

- will be able to apply the variants of machine learning model to solve the real -time problems.

P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12
X			X	X							