



# Indian Institute of Technology

## Course Details Report

**Course No: OE5510**

**Course Name: Machine Learning for Ocean Engineers**

**Course Type:**

Theory

**Description:**

To introduce students to machine learning and its applications in ocean engineering

**Course Content:**

Mathematical Preliminaries: Review of Linear Algebra and Probability, Singular Value Decomposition (SVD), pseudo inverse, least squares, regression, Principal Component Analysis (PCA), Fourier transforms. Classification and Regression: Introduction to machine learning, feature vectors, linear classifier, perceptron, hinge loss, objective function, margin boundaries, linear classification, regularization and generalization, gradient descent and stochastic gradient descent methods, higher order feature vectors, kernel methods, kernel composition, support vector machines (SVMs), radial basis kernels. Term project I (Project areas mentioned below) Neural Networks: Feedforward neural networks - activation functions, hidden layers, weights, deep neural networks, hidden layer models, backpropagation, stochastic gradient descent. Recurrent Neural Networks (RNNs) - encoding and decoding with RNNs, gating and LSTMs. Term project II (Project areas mentioned below) Unsupervised Learning: Clustering, generative models, maximum likelihood estimation, mixture models, Expectation-Maximization (EM) algorithm. Term project III (Project areas mentioned below) Reinforcement Learning: Markov decision process, Utility function, Bellman equations, Q-value iteration. Term project IV (Project areas mentioned below) Term project areas: Fluid dynamics, Ships and offshore structure dynamics, System identification, Marine robotics and autonomy, Underwater acoustics, Marine control, Coastal Engineering. Four topics will be selected from the list.

**Text Books:**

Brunton, S. L., & Kutz, J. N. (2019). Data-driven science and engineering: Machine learning, dynamical systems, and control. Cambridge University Press. (Supplementary Material: <http://www.databookuw.com/>)

**Reference Books:**

Goodfellow, I., Bengio, Y., Courville, A., & Bengio, Y. (2016). Deep learning (Vol. 1, No. 2). Cambridge: MIT press. (Online Access: <https://www.deeplearningbook.org/>)