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| **Semester:** | 7 | | | | |
| **Course Code:** | EE5130 | | | | |
| **Course Name:** | Artificial Intelligence and Machine Learning | | | | |
| **Credit Value:** | 3 (Notional hours: 150) | | | | |
| **Pre-requisites:** | EE2070 or ME2050 | | | | |
| **Core/Optional** | Optional | | | | |
| **Hourly Breakdown** | **Lecture** | **Tutorial** | **Practical** | **Assignment** | **Independent Learning & Assessment** |
| | 30 | - | - | 30 | 90 |

**Course Aim:** To provide the students with the knowledge and skills on solving engineering problems with concepts in Artificial Intelligence (AI) and Machine Learning (ML).

**Intended Learning Outcomes:**
On successful completion of the course, the students should be able to:

- **explain** the fundamental concepts, issues and challenges of AIML.
- **formalize** a given task as an AIML problem.
- **apply** suitable algorithms to tackle different AIML problems and apply AIML frameworks to solve practical problems.

**Course Content:**

- **Fundamental concepts in AI and ML**

Introduction to AI and ML, Evolution of AI and ML, Types of Learning: Supervised, Unsupervised and Reinforcement Learning, Static and Dynamic Learning, Big Data and associated challenges, Trends and applications of AI and ML

- **Linear methods in ML**

Representation and Visualization of Feature spaces, Linear and Nonlinear mapping of feature spaces, Curse of dimensionality and dimensionality reduction, Regularized and Generalized Regression Models, k-Nearest Neighbour (kNN) Algorithm

- **Supervised Learning & Artificial Neural Networks (ANN)**

The challenge of mapping nonlinear feature spaces, The concept of perceptron, Multi Layer Perceptrons (MLP), Supervised Learning, and Feed Forward ANN, Overfitting and regularization, Radial Basis Function (RBF) ANNs, Echo-State ANN

- **Unspervised Learning**

Clustering, k-Means Algorithm, Component Analysis, Self Organizing Maps (SOM), Auto Encoding Neural Networks

- **Deep Learning**

Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN), Practical implementation of Deep Learning

- **Decision Trees**

Regression and Classification Tree, Decision metrics, Chi-Squared Automatic Interaction Detection (CHAID) Algorithm, Ensemble Decision Trees (EDT), Boosted EDT (BEDT): AdaBoost and Gradient Boosting, Random Forest Trees and Decision Jungles,

- **Support Vector Machines (SVM)**

Theory of SVM, Extension of SVM for Multi class and non-linea problems, Separability and Margins, Non-Linearity and use of Kernels, Risk Minimization

- **Probabilistic Models**

Discriminative Models: Maximum Likelihood Estimation (MLE) and Baysian Approach, Mixture Models, Generative Models: Mixture Models, Baysian Networks

- **Dynamic Programming and Reinforcement Learning**

Fundamentals of Dynamic programming and classes of problems, Characteristics and Frame work of Reinforcement learning

- **Evolutionary Algorithms**

Genetic Algorithms, Swarm Intelligence, Ant Colony Optimization, Simulated annealing

- **Time Series Models**

Stationarity, Auto Regressive (AR), Moving Avrage (MA), Auto Regressive Moving Avrage (ARMA) and Auto Regressive Integrated Moving Avrage (ARIMA) Models, Hidden Markov Models (HMM), Conditional Random Fields (CRF)

- **Emerging Trends in Machine Learning**

Transfer learning, Generative Adversarial Networks (GAN), Quantum Computation: Quantum theory, Entanglement and Superposition, Computation with quantum particles, Auto ML

- **Implementation platforms for AI & ML**

- **AIML Mini Project**

**Teaching /Learning Methods:**

Lectures and Assignments

**Assessment Strategy:**

| Continuous Assessment<br><br>50% | Final Assessment<br><br>50% | | |
|---|---|---|---|
| Details: | Theory (%) | Practical (%) | Other (%) |

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|---|---|---|---|
| Assignments 50% | 50 | | |

**Recommended Reading:**

- Simon Haykin. Neural Networks and Learning Machines, 3rd Edition, Prentice Hall, 2008
- Christoper M. Bishops, Pattern Recognition and Machine Learning, Springer 2006
- Trevor Hastie, Robert Tibshirani and Jerome Friedman, Elements of Statistical Learning, Springer 2009
- Shai Shalev-Shwartz, Shai Ben-David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014