Course Code:	**ECSE703L**	**Semester : 2** **Year : 1**	**Credit Hours:**	**3-0-2**
Course Title :	**MACHINE LEARNING**		**Pre-requisite:**	**NIL**

Course Objectives

Objectives of the course are:

CO1: To understand the basic principles, techniques, and applications of Machine Learning, Regressions tasks or Classification tasks.

CO2: To be able to assess and apply the use of supervised and unsupervised learning approaches in different scenarios

CO3: Understand and use decision tree learning, bayesian perspective on machine learning, Artificial neural networks, etc.

CO3: Assess learning algorithms modelled after biological evolution, including genetic algorithms and genetic programming.

CO4: Understand the 'curse of dimensionality' and apply feature reduction or subset selection for datasets with large number of attributes.

CO5: Assess explanation-based learning that uses prior knowledge to explain observed training examples, then generalizes based on these explanations and discuss approaches to combining approximate prior knowledge with available training data in order to improve the accuracy of learned hypotheses.

CO6: Demonstrate knowledge of the disciplinary foundation and of proven experience in the design and analysis of learning algorithms and systems. To demonstrate the ability to critically evaluate and compare different learning models and learning algorithms and be able to adapt or combine some of the key elements of existing machine learning algorithms to design new algorithms as needed.

Course Contents :

Topics	**L-T-P**
Introduction and Motivation: Well-Posed learning problems, Basic concepts, Designing a learning system, Issues in machine learning. Types of machine learning: Learning associations. Tools and software for machine learning	3-0-2
Overview: *Supervised learning* (Classification and Regression Trees, Support vector machines), *Unsupervised learning* (Clustering), *Instance-based learning* (K-nearest Neighbor, Locally weighted regression, Radial Basis Function), *Reinforcement learning* (Learning Task, Q-learning, Value function approximation, Temporal difference learning).	3-0-2
Regression: Linear Regression with single and multiple variables	3-0-2
Logistic Regression: Linear models for classification, Logistic sigmoid.	3-0-2
Decision Tree Learning: Decision tree representation, appropriate problems for decision tree learning, Univariate Trees, Multivariate Trees, Basic Decision Tree Learning algorithms, Hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning.	3-0-2

	Bayesian Learning: Bayes theorem and concept learning, Bayes optimal classifier, Gibbs algorithms, Naive Bayes Classifier, Bayesian belief networks, The EM algorithm.	3-0-2
	Artificial Neural Network: Neural network representation, Neural Networks as a paradigm for parallel processing, Linear discrimination, Pairwise separation, Gradient Descent, Logistic discrimination, Perceptron, Training a perceptron, Multilayer perceptron, Back propagation Algorithm. Recurrent Networks, Dynamically modifying network structure.	3-0-2
	Genetic Algorithms: Basic concepts, Hypothesis space search, Genetic programming, Models of evolution and learning, Parallelizing Genetic Algorithms.	3-0-2
	Inductive and Analytical Learning: Learning rule sets, Comparison between inductive and analytical learning, Analytical learning with perfect domain theories: Prolog-EBG. Inductive-Analytical approaches to learning, Using prior knowledge to initialize hypothesis (KBANN Algorithm), to alter search objective (TangentProp and EBNN Algorithm), to augment search operators (FOCL Algorithm).	3-0-2
	Clustering: Common distance measures, Hierarchical algorithms – agglomerative and divisive, partitioning algorithms – k-means and derivatives	3-0-2
	Dimensionality reduction: PCA, Feature subset selection, misc.	3-0-2
	Design and Analysis of Machine Learning Experiments: Guidelines for machine learning experiments, Factors, Response, and Strategy of experimentation, Cross-Validation and Resampling methods, measuring classifier performance, Hypothesis testing, Assessing a classification algorithm's performance, Comparing two classification algorithms, Comparing multiple algorithms: Analysis of variance, Comparison over multiple datasets.	5-0-4
	Current trends in Machine Learning	2-0-0
		40-0-26
References	1. Bishop C., Pattern Recognition and Machine Learning, Springer-Verlag (2006) 2nd ed. 2. Mitchell T.M., Machine Learning, McGraw Hill (1997) 2nd ed. 3. David E. Goldberg, Genetic Algorithm, Pearson education (2005), 3rd ed. 4. Alpaydin E., Introduction to Machine Learning, MIT Press (2010) 2nd ed. 5. Michie D., Spiegelhalter D. J., Taylor C. C., Machine Learning, Neural and Statistical Classification. Overseas Press (2009) 1st ed.	
Special Instructions (if any)		