FACULTY OF ENGINEERING & TECHNOLOGY

First Year Master of Engineering

Semester I

Course Code: 102430102

Course Title: Machine Learning

Type of Course:Core Course II

Course Objectives: To introduce students to the basic concepts and techniques of Machine Learning. To develop skills of using recent machine learning software for solving practical problems.To gain experience of doing independent study and research.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Internal		External		Total
Lecture	Tutorial	Practical		Theory	J/V/P*	Theory	J/V/P*	
3	0	2	4	30 / 15	20 / 10	70 / 35	30 / 15	150 / 75

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	Introduction: Motivation and applications of learning systems, Importance of Data Visualization, Classification of learning: supervised, unsupervised and reinforcement learning, Aspects of developing a learning system: training data, concept representation, function approximation.	5
2	Artificial Neural Networks: Biological Neurons and Biological Neural Networks, Perceptron Learning, Activation Functions, Multilayer Perceptron Network, Back-propagation Neural Networks, Competitive Neural Networks.	10
3	Unsupervised learning: Hierarchical Agglomerative Clustering, k-means Algorithm, Self-Organizing Maps.	5
4	Classification Techniques: Naïve Bayes Classification, Fitting Multivariate Bernoulli Distribution, Gaussian Distribution and Multinomial Distribution, KNearest Neighbours, Decision trees. Support Vector Machines: Hard Margin and Soft Margin, Kernels and Kernel Trick, Evaluation Measures for Classification Techniques	10
5	Regression Techniques: Basic concepts and applications of Regression, Simple Linear Regression – Gradient Descent and Normal Equation Method, Multiple Linear Regression, Non-Linear Regression, Linear Regression with Regularization, Hyper-parameters tuning, Loss Functions, Evaluation Measures for Regression Techniques.	10

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6	Advanced Concepts: Basics of Semi-Supervised and Reinforcement Learning,Q-learning. Value function approximation, Policy search, Linear Discriminant Analysis, Introduction to Deep Learning.	**5**

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks						**R**: Remembering; **U**: Understanding; **A**: Application, **N**: Analyze; **E**: Evaluate; **C**: Create
R	**U**	**A**	**N**	**E**	**C**	
10	20	20	20	20	10	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1	Tom M Mitchell, Machine Learning, McGraw-Hill Education.
2	Bishop, C., Pattern Recognition and Machine Learning, Springer-Verlag r.
3	Alpaydin, Ethem, Introduction to Machine Learning, MIT Press.
4	Duda, Richard, Peter Hart, and David Stork., Pattern Classification. 2nd ed. New York, NY: Wiley-Interscience.
5	Bishop, Christopher. Neural Networks for Pattern Recognition. New York, Oxford University Press
6	S.N.Sivanandam and S.N.Deepa, Principles of Soft Computing, Wiley India Pvt. Limited.

Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Recognize the characteristics of machine learning that make it useful to real-world problems.	**20**
CO-2	Characterize machine learning algorithms as supervised, semi-supervised, and unsupervised.	**20**
CO-3	Effectively use machine learning toolboxes.	**15**
CO-4	Understand the concept behind neural networks for learning non-linear functions.	**15**
CO-5	Understand and apply unsupervised algorithms for clustering.	**15**
CO-6	Understand reinforcement learning algorithms and its practical applications.	**15**

List of Practicals / Tutorials:

Laboratory work will be based on applications of the above syllabus with minimum 10 Experiments to be incorporated.

1	Introduction to MATLAB Toolbox for Machine Learning Applications.
2	Introduction to Python Tool for Machine Learning Applications.
3	Introduction: Neural Network (NN) Toolbox, NN Simulink Demos.
4	MATLAB simulation: Artificial Neural Network (ANN) implementation.
5	MATLAB simulation: NN Tool Artificial Neural Network (ANN) implementation.
6	MATLAB simulation: Various structure of NN algorithms implementation.

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7	Study and Implement the Naive Bayes learner using WEKA. (The datasets taken can be: Breast Cancer data file or data sets from UCI ML Repository).
8	Study and Implement the Decision Tree learners using WEKA. (The datasets taken can be: Breast Cancer data file or data sets from UCI ML Repository).
9	Select two datasets. Each dataset should contain examples from multiple classes. For training purposes assume that the class label of each example is unknown (if it is known, ignore it). Implement the K-means algorithm and apply it to the data you selected. Evaluate performance by measuring the sum of Euclidean distance of each example from its class center. Test the performance of the algorithm as a function of the parameter k.
10	MATLAB simulation: Support Vector Machine (SVM) implementation.
11	Implement various reinforcement learning models and develop one application using this model.

Supplementary learning Material:	
1	MATLAB: Signal Processing Toolbox, Image Processing Toolbox, Neural Network Toolbox.
2	Python for Signal & Image Processing.
3	Python for Machine Learning.
4	NPTEL courses on Machine Learning & its Applications domain.

Curriculum Revision:	
Version:	**1**
Drafted on (Month-Year):	Apr-20
Last Reviewed on (Month-Year):	Jul-20
Next Review on (Month-Year):	Apr-22

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