

## SEMESTER S5

### MACHINE LEARNING

(Common to CS/AD/CR/CA/CC/CD)

<b>Course Code</b>	<b>PCCST503</b>	<b>CIE Marks</b>	40
<b>Teaching Hours/Week (L: T:P: R)</b>	3:0:0:0	<b>ESE Marks</b>	60
<b>Credits</b>	3	<b>Exam Hours</b>	2 Hrs. 30 Min.
<b>Prerequisites (if any)</b>	None	<b>Course Type</b>	Theory

#### Course Objectives:

1. To impart the fundamentals principles of machine learning in computer and science.
2. To provide an understanding of the concepts and algorithms of supervised and unsupervised learning.

#### SYLLABUS

<b>Module No.</b>	<b>Syllabus Description</b>	<b>Contact Hours</b>
<b>1</b>	<b>Introduction to ML :-</b> Machine Learning vs. Traditional Programming, Machine learning paradigms - supervised, semi-supervised, unsupervised, reinforcement learning. Parameter Estimation - Maximum likelihood estimation (MLE) and maximum a posteriori estimation (MAP), Bayesian formulation. <b>Supervised Learning :-</b> Feature Representation and Problem Formulation, Role of loss functions and optimization Regression - Linear regression with one variable, Linear regression with multiple variables : solution using gradient descent algorithm and matrix method.	<b>9</b>
<b>2</b>	<b>Classification</b> - Logistic regression, Naïve Bayes, KNN, Decision Trees – ID3	<b>9</b>

	<p>Generalisation and Overfitting - Idea of overfitting, LASSO and RIDGE regularization, Idea of Training, Testing, Validation</p> <p>Evaluation measures – Classification - Precision, Recall, Accuracy, F-Measure, Receiver Operating Characteristic Curve(ROC), Area Under Curve (AUC).</p> <p>Regression - Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), R Squared/Coefficient of Determination.</p>	
<b>3</b>	<p>SVM – Linear SVM, Idea of Hyperplane, Maximum Margin Hyperplane, Non-linear SVM, Kernels for learning non-linear functions</p> <p>Neural Networks (NN) - Perceptron, Neural Network - Multilayer feed-forward network, Activation functions (Sigmoid, ReLU, Tanh), Back propagation algorithm.</p>	<b>9</b>
<b>4</b>	<p><b>Unsupervised Learning</b></p> <p>Clustering - Similarity measures, Hierarchical Clustering - Agglomerative Clustering, partitional clustering, K-means clustering</p> <p>Dimensionality reduction - Principal Component Analysis, Multidimensional scaling</p> <p>Ensemble methods - bagging, boosting; Resampling methods - Bootstrapping, Cross Validation. Practical aspects - Bias-Variance tradeoff.</p>	<b>9</b>

**Course Assessment Method**  
(CIE: 40 marks, ESE: 60 marks)

**Continuous Internal Evaluation Marks (CIE):**

<b>Attendance</b>	<b>Assignment/ Microproject</b>	<b>Internal Examination-1 (Written)</b>	<b>Internal Examination- 2 (Written )</b>	<b>Total</b>
<b>5</b>	<b>15</b>	<b>10</b>	<b>10</b>	<b>40</b>

**End Semester Examination Marks (ESE)**

*In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions*

<b>Part A</b>	<b>Part B</b>	<b>Total</b>
<ul style="list-style-type: none"> <li>• 2 Questions from each module.</li> <li>• Total of 8 Questions, each carrying 3 marks</li> </ul> <p style="text-align: center;"><b>(8x3 =24 marks)</b></p>	<ul style="list-style-type: none"> <li>• Each question carries 9 marks.</li> <li>• Two questions will be given from each module, out of which 1 question should be answered.</li> <li>• Each question can have a maximum of 3 subdivisions.</li> </ul> <p style="text-align: center;"><b>(4x9 = 36 marks)</b></p>	<b>60</b>

### Course Outcomes (COs)

At the end of the course students should be able to:

<b>Course Outcome</b>		<b>Bloom's Knowledge Level (KL)</b>
<b>CO1</b>	Illustrate Machine Learning concepts and basic parameter estimation methods.	<b>K2</b>
<b>CO2</b>	Demonstrate supervised learning concepts (regression, classification).	<b>K3</b>
<b>CO3</b>	Illustrate the concepts of Multilayer neural network and Decision trees	<b>K3</b>
<b>CO4</b>	Describe unsupervised learning concepts and dimensionality reduction techniques	<b>K3</b>
<b>CO5</b>	Use appropriate performance measures to evaluate machine learning models	<b>K3</b>

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

### CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>
<b>CO1</b>	3	3	3									3
<b>CO2</b>	3	3	3									3
<b>CO3</b>	3	3	3									3
<b>CO4</b>	3	3	3									3
<b>CO5</b>	3	3	3									3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

<b>Text Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
1	Introduction to Machine Learning	Ethem Alpaydin	MIT Press	4/e, 2020
2	Data Mining and Analysis: Fundamental Concepts and Algorithms	Mohammed J. Zaki   Wagner Meira	Cambridge University Press	1/e, 2016
3	Neural Networks for Pattern Recognition	Christopher Bishop	Oxford University Press	1/e, 1998

<b>Reference Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
1	Applied Machine Learning	M Gopal	McGraw Hill	2/e, 2018
2	Machine Learning using Python	Manaranjan Pradhan   U Dinesh Kumar	Wiley	1/e, 2019
3	Machine Learning: Theory and Practice	M.N. Murty, V.S. Ananthanarayana	Universities Press	1/e, 2024

<b>Video Links (NPTEL, SWAYAM...)</b>	
<b>No.</b>	<b>Link ID</b>
<b>1</b>	<a href="https://archive.nptel.ac.in/courses/106/105/106105152/">https://archive.nptel.ac.in/courses/106/105/106105152/</a>
<b>2</b>	<a href="https://archive.nptel.ac.in/courses/106/106/106106139/">https://archive.nptel.ac.in/courses/106/106/106106139/</a>
<b>3</b>	<a href="https://nptel.ac.in/courses/106106202/">https://nptel.ac.in/courses/106106202\</a>