| **Course Title** | **Machine Learning** | | | | **Course Type** | | **HC** | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Code** | **B20EF0503** | **Credits** | **3** | | **Class** | | **V Semester** | |
| **Course**  **Structure** | **TLP** | **Credits** | **Contact**  **Hours** | **Work**  **Load** | **Total Number of**  **Classes**  **Per Semester** | | **Assessment in**  **Weightage** | |
| **Theory** | 3 | 3 | 3 |
| **Practice** | - | - | - | **Theory** | **Practical** | **CIE** | **SEE** |
| **-** | - | - | - |
| **Total** | 3 | 3 | 3 | 39 | - | 50 | 50 |

**COURSE OVERVIEW:**

The course introduces the fundamental concepts of machine learning, data exploration, information-based learning, similarity-based learning, probability based learning, and error based learning. It also discusses the concepts of Artificial Neural networks and perform analysis on machine learning experiments.

**COURSE OBJECTIVE (S):**

The main objectives of this course are:

1. Understand different learning algorithms and the techniques of data exploration.
2. Illustrate supervised machine learning techniques that are suitable for applications.
3. Describe probability based machine learning algorithms and error optimization.
4. Discuss the concepts of ANN and perform evaluation on the trained models.

**COURSE OUTCOMES (COs)**

After the completion of the course, the student will be able to:

| **CO#** | **Course Outcomes** | **POs** | **PSOs** |
| --- | --- | --- | --- |
| CO1 | Understand the fundamental concepts of machine learning and data exploration. | 1,2,3,5,11,12 | 1,2,3 |
| CO2 | Implement the concepts of supervised machine learning algorithms to predict the output class labels. | 1,2,3,4,5,9,11,12 | 1,2,3 |
| CO3 | Demonstrate probability based learning techniques to predict the solutions for real world problems. | 1,2,3,4,5,6,9,11,12 | 1,2,3 |
| CO4 | Apply error minimization techniques to optimize the machine learning model. | 1,2,3,5,12 | 1,2,3 |
| CO5 | Compare biological neuron vs artificial neuron and develop applications using neural networks. | 1,2,3,4,5,9,11,12 | 1,2,3 |
| CO6 | Analyze and evaluate the performance of machine learning experiments. | 1,2,3,4,5,6,9,11,12 | 1,2,3 |

**BLOOM’S LEVEL OF THE COURSE OUTCOMES**

| **CO#** | **Bloom’s Level** | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| **Remember**  **(L1)** | **Understand**  **(L2)** | **Apply**  **(L3)** | **Analyze**  **(L4)** | **Evaluate**  **(L5)** | **Create**  **(L6)** |
| **CO1** |  |  |  |  |  |  |
| **CO2** |  |  |  |  |  |  |
| **CO3** |  |  |  |  |  |  |
| **CO4** |  |  |  |  |  |  |
| **CO5** |  |  |  |  |  |  |
| **CO6** |  |  |  |  |  |  |

**COURSE ARTICULATION MATRIX**

| **CO#/ POs** | **PO1** | **PO2** | | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CO1** | 3 | 3 | 2 | |  | 3 |  |  |  |  |  | 3 | 3 |  |  |  |
| **CO2** | 3 | 2 | 3 | | 3 | 3 |  |  |  | 3 |  | 3 | 3 |  |  |  |
| **CO3** | 3 | 2 | 3 | | 3 | 3 | 2 |  |  | 3 |  | 3 | 3 |  |  |  |
| **CO4** | 3 | 3 | 3 | |  | 3 |  |  |  |  |  |  | 3 |  |  |  |
| **CO5** | 3 | 2 | 3 | | 3 | 3 |  |  |  | 3 |  | 3 | 3 |  |  |  |
| **CO6** | 3 | 2 | 3 | | 3 | 3 | 2 |  |  | 3 |  | 3 | 3 |  |  |  |

**Note: 1-Low, 2-Medium, 3-High**

**COURSE CONTENT**

**UNIT – 1**

**Machine Learning:** What is Machine Learning? How does Machine Learning Work? What can go wrong with Machine Learning? What is Predictive Data Analytics? The Predictive Data Analytics Project Life Cycle: CRISP-DM and Predictive Data Analytics Tools, Designing & Implementing Features: Different types of data, different types of features.

Data Exploration- Getting to know the Data, Preprocessing: Identifying Data Quality Issues, Handling Data Quality Issues, Advanced Data Exploration, Data Preparation, Feature selection, Forward Sequential Selection, Backward Sequential Selection.

**UNIT – 2**

**Information-based Learning:** Decision Trees, Shannon’s Entropy Model, Information Gain, Standard Approach: The ID3 Algorithm, A Worked Example: Predicting Vegetation Distributions, Alternative Feature Selection & Impurity Metrics, Handling Continuous Descriptive Features, Predicting Continuous Targets, Tree Pruning and Model Ensembles, Case studies.

**Similarity-based Learning:** Feature Space, Measuring Similarity Using Distance Metrics, Standard Approach: The Nearest Neighbor Algorithm, Handling Noisy Data, Efficient Memory Search Data Normalization, Predicting Continuous Targets, Other Measures of Similarity, Case studies.

**UNIT – 3**

**Probability-based Learning:** Baye’s Theorem, Bayesian Prediction, Conditional Independence &Factorization, Standard Approach: The Naive Bayes Model, A Worked Example.

**Error-based Learning:** Simple Linear Regression, Measuring Error, Error Surfaces, Standard Approach: Multivariable Linear Regression with Gradient Descent, Multivariable Linear Regression, Gradient Descent, Choosing Learning Rates & Initial Weights, A Worked Example.

**Unit 4**

Artificial Neural Networks: Introduction, Neural Network Representation, Appropriate problems for Neural Network Learning, Perceptrons, Multilayer Networks and Back Propagation Algorithm.

Analysis of Machine Learning Experiments: Introduction, Factors, Response, and Strategy of Experimentation, Randomization, Replication, and Blocking, Guidelines for Machine Learning Experiments, Cross-Validation and Resampling Methods, Measuring Classifier Performance, Interval Estimation, Hypothesis Testing.

**TEXT BOOKS:**

1. John D Kelleher, Brian Mac Namee, Aoife D’Arcy, “Fundamentals of Machine Learning for Predictive Data Analytics- Algorithms, Worked Examples and case studies”, MIT Press, 2015.
2. Tom M. Mitchell, “Machine Learning”, McGraw-Hill Education (INDIAN EDITION), 2013.
3. Ethem Alpaydin, - Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series), Third Edition, MIT Press, 2014.

**REFERENCE BOOKS:**

1. T. Hastie, R. Tibshirani, J. H. Friedman, “The Elements of Statistical Learning”, Springer; 1stedition, 2001.
2. Stephen Marsland, - Machine Learning – An Algorithmic Perspective‖, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.

**JOURNALS/MAGAZINES:**

1. Springer Journal of Machine Learning.
2. International Journal of Machine Learning and Computing.

**SWAYAM/NPTEL/MOOCs:**

## Coursera – Machine Learning

## Coursera – Deep Learning

## <https://onlinecourses.nptel.ac.in/noc19_cs53/preview>

## <https://www.edx.org/learn/machine-learning>

**SELF-LEARNING EXERCISES:**

1. Data Visualization
2. Bar Plots
3. Histograms
4. Box Plots