| SUBJECT: COMPUTER SCIENCE | | | | | | | |
|---|---|---|---|---|---|---|---|
| **DSE** | **BCS-E803** | **Machine Learning** | **L** | **T** | **P** | **C** | **Time for ESE** |
| | | | **4** | **-** | **-** | **4** | **3 Hrs.** |

**Pre- requisite:** Computer programming (python); Calculus; Linear Algebra.

**Course Objectives:** This course provides an advanced level of understanding to machine learning and statistical pattern recognition. It offers some of the most cost-effective approaches to automated knowledge acquisition in emerging data-rich disciplines and focuses on the theoretical understanding of these methods, as well as their computational implications.

**Course Outcomes:**

| | |
|---|---|
| CO1 | Demonstrate in-depth knowledge of methods and theories in the field of machine learning. To introduce the basic principles, techniques, and applications of Machine Learning, Classification Tasks, Decision tree learning |
| CO2 | Understand and use Bayesian perspective on machine learning, Artificial neural networks, back propagation algorithm |
| CO3 | Assess learning algorithms modelled after biological evolution, including Genetic Algorithm |
| CO4 | Demonstrate knowledge of the disciplinary foundation and of proven experience in the design and analysis of learning algorithms and systems. |

## Course Contents

| UNIT | Contents | Lectures Required |
|---|---|---|
| 1. | **Introduction:** Well-Posed learning problems, Basic concepts, Designing a learning system, Issues in machine learning. Types of machine learning: Learning associations, Supervised learning, Unsupervised learning, Reinforcement learning. | 10 |
| 2. | **Decision Tree Learning:** Decision tree representation, appropriate problems for decision tree learning, Univariate Trees (Classification and Regression), 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. | 10 |
| 3. | **Bayesian Learning:** Bayes theorem and concept learning, Bayes optimal classifier, Gibbs algorithms, Naive Bayes Classifier, Bayesian belief networks, The EM algorithm.<br>**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. | 10 |
| 4. | **Genetic Algorithms:** Basic concepts, Hypothesis space search, Genetic programming, Models of evolution and learning, Parallelizing Genetic Algorithms. | 8 |

| | | |
|---|---|---|
| 5. | **Data Mining Techniques for Analysis:** Classification: Decision tree induction, Bayes classification, Rule-based classification, Support Vector Machines, Classification Using Frequent Patterns, k-Nearest-Neighbor, Fuzzy-set approach Classifier, Clustering: K-Means, k-Medoids, Agglomerative versus Divisive Hierarchical Clustering Distance Measures in Algorithmic Methods, Mean-shift Clustering. | 10 |
| | Total Lectures | 48 |

**Suggested Text Book(s):**

| | |
|---|---|
| 1. | Mitchell T.M., Machine Learning, McGraw Hill. |
| 2. | Bishop C., Pattern Recognition and Machine Learning, Springer-Verlag. |

**Suggested Reference Book(s):**

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|---|---|
| 1. | Stephen Marsland, Machine Learning: An Algorithmic Perspective, CRC Press. |
| 2. | David Barber, Bayesian Reasoning and Machine Learning, Cambridge University Press. |

**Other Useful Resource(s)**

| | |
|---|---|
| 1. | https://nptel.ac.in/courses/106106139 |
| 2. | https://nptel.ac.in/courses/106105152 |
| 3. | https://ocw.mit.edu/courses/6-867-machine-learning-fall-2006/pages/lecture-notes/ |

## Course Outcomes Contributed to Programme Outcomes

| PO→ CO↓ | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | AVERAGE |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 1 | 3 | 2 | 1 | 1 | **2.1** |
| **CO2** | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 2 | **2.4** |
| **CO3** | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | **2.5** |
| **CO4** | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | **2.8** |
| **AVG.** | **2.8** | **2.5** | **2.3** | **2.5** | **2.8** | **2.5** | **2.3** | **2.0** | **2.4** |

## Course Outcomes Contributed to Programme Specific Outcomes

| PSO→ CO↓ | PSO1 | PSO2 | PSO3 | AVERAGE |
|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | **2.7** |
| **CO2** | 2 | 1 | 3 | **2.0** |
| **CO3** | 3 | 3 | 2 | **2.7** |
| **CO4** | 3 | 3 | 3 | **3.0** |
| **AVG.** | **2.8** | **2.5** | **2.5** | **2.4** |