

## INT254:FUNDAMENTALS OF MACHINE LEARNING

L:2 T:0 P:2 Credits:3

**Course Outcomes:** Through this course students should be able to

- CO1 :: define the concepts of linear algebra and multivariate calculus
- CO2 :: demonstrate the usage of various python libraries for data handling and visualization
- CO3 :: explain the concepts of dimensionality reduction using PCA
- CO4 :: make use of fuzzy logic to handle uncertainty in data
- CO5 :: solve the optimization problems using genetic algorithms
- CO6 :: examine various swarm optimization techniques to solve optimization problems

### Unit I

**Linear algebra** : Introduction to linear algebra, operations with vectors, modulus and inner product, cosine and dot product, projection, changing basis, matrices, solving simultaneous equation problems, types of matrix transformation, determinants and inverses, matrices changing basis, orthogonal matrices, eigen values and eigen vectors

**Multivariate calculus** : Introduction to multivariate calculus, definition of a derivative, differentiation examples & special cases,, product rule, chain rule, differentiate with respect to anything, The Jacobian, The Hessian, multivariate chain rule, building approximate functions, power series, linearisation, multivariate taylor

### Unit II

**Data handling and visualization using python** : types of data, reading the data, math operations for data analysis, handling missing values, Converting data into numerical format, correlation matrix, data visualization using different graphs

### Unit III

**Dimensionality Reduction** : statistics of dataset, orthogonal projections, problem setting and PCA objective, finding the coordinates of the projected data, steps of PCA, linear discriminant analysis, kernel PCA

### Unit IV

**Fuzzy logic** : basic definition and terminology, set-theoretic fuzzy operations, fuzzy sets and operations on fuzzy sets, fuzzy relations, fuzzy rules and fuzzy reasoning, fuzzy inference system, fuzzification and defuzzification methods, fuzzy based expert system

### Unit V

**Genetic algorithms** : introduction to genetic algorithms, genetic operators, working of genetic algorithm, applications of genetic algorithm, genetic programming

### Unit VI

**Swarm optimization techniques** : swarm intelligence, ant colony optimization, swarm intelligence in bees, cuckoo search, Firefly Algorithm, Crow Search Algorithm, Hybrid Wolf-Bat Algorithm, Whale Search Algorithm, grasshopper optimization

### List of Practicals / Experiments:

#### Practicals

- Write a python program to work with scalars.
- Write a python program to work with matrices.
- Write a python program to compute eigen values and eigen vectors.
- Write a python program to read data using pandas.
- Write a python program to deal with missing values.
- Write a python program to convert data into numerical format.
- Write a program to reduce dimensionality using PCA.
- Write a program to reduce dimensionality using LDA.

- Write a program to reduce the dimensionality using KPCA.
- Write a program to implement fuzzy operators.
- Write a python program to implement fuzzy inference system.
- Write a program to implement genetic algorithms.
- Write a program to implement ant colony optimization.
- Write a program to implement bee colony optimization.
- Write a python program to implement Cuckoo search optimization technique.

**Text Books:** 1. NEURAL NETWORKS, FUZZY SYSTEMS AND EVOLUTIONARY ALGORITHMS : SYNTHESIS AND APPLICATIONS by RAJASEKARAN, S. PAI, G. A. VIJAYALAKSHMI, PHI Learning

**References:** 1. PRINCIPLES OF SOFT COMPUTING by PRINCIPLES OF SOFT COMPUTING, WILEY