GAI01SG187	Introduction to AI&ML	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Basic knowledge of mathematics and statistics				
Co-requisites	--				

Course Objectives

1. Understand the fundamental concepts, usage and impact of artificial intelligence & machine learning algorithms in various domain.
2. Discuss various artificial intelligence & machine-learning algorithms to solve real life problems.

Course Outcomes

On completion of this course, the students will be able to

CO1. To know the range of artificial intelligence & machine learning algorithms along with their strengths and weaknesses.
CO2. Discuss the artificial intelligence & machine learning concepts corresponding to different applications.
CO3. Comprehend the contemporary techniques in artificial intelligence & machine learning.
CO4. Analyse the concept of evolutionary intelligence, neural networks, natural language and its usage.
CO5. Discuss learning deterministic models.

Catalog Description

This course provides a broad introduction to artificial intelligence & machine learning. This course enables the concepts like evolutionary intelligence, neural networks, natural language, learning deterministic models for designing systems. Fundamental concepts of machine learning is included.

Course Content

Unit 1. Introduction to Artificial Intelligence **06 Lecture Hours**

History of artificial intelligence, The birth of artificial intelligence, AI Winters, Todays' AI, Historical milestones in the development of AI, Great contributors, People who have influenced AI, Differences between strong AI and weak AI, Artificial Intelligence definitions, Emergence of AI – Technological advances, Machine Learning ---> Deep Learning --->AI, Functions of AI, Characteristics of artificial intelligence, Applications of AI, AI in health care, Industry 4.0, AI in manufacturing, AI in education sector, AI in business, AI in Finance Sector, AI in Law, AI in society, Cognitive science and AI, Cognition and process of Cognition, Disciplines in Cognitive science, Multidisciplinary subject, Linguistics, Artificial intelligence as Cognitive science, Methods in Cognitive science, Watson.

Unit 2. Logical approach to AI and knowledge-based system **06 Lecture Hours**

Introduction to knowledge representation systems, Knowledge representation using logic, Propositional logic, Semantics of propositional logic, Properties of propositional logic statements, Tautologies and logical implication, Resolution, Conjunctive normal form, Resolution is valid, Resolution algorithm,

Knowledgebase systems, Structure of a knowledge based system, Recap of artificial intelligence, Components of expert systems, Expert systems development, Wumpus world, Logic, A simple knowledge base, Exploring the Wumpus world, Semantic net, Inference in semantic networks, Semantic networks: Types and components, Types of relationships in semantic network, Frames, Frames: Some examples, Non-monotonic logic, Circumscription, Default logic.

Unit 3. Probabilistic approach to AI **08 Lecture Hours**

Probability, Basic concepts, Probability of an event, Example on Sample Space, counting rules, Event relations, Conditional Probabilities, Defining Independence, The Law of Total Probability, Bayes' Rule, Examples. Random Variables, Discrete Random Variable, Probability Distributions, Probability Mass Function, Probability Density Function, Expectations of Random Variables, Medians of Random Variables, The variance of a Random Variable, Chebyshev's Inequality, Quantiles of Random Variables, Jointly Distributed Random Variables, Marginal Probability Distributions, Independence and Covariance, Bayesian Networks, Merits of Bayesian Networks, Construction of a Bayesian Network, Representation in Bayesian Networks, Benefits of Bayesian Networks, Why learn Bayesian networks? Constructing Bayesian networks, Example from medical diagnostics, Software for Bayesian networks, Gaussian Bayesian Networks, Linear Gaussian BN to joint Gaussian, Theorem: From Gaussian to Bayesian networks, Noisy OR-Gate model, Promedas: A clinical diagnostic decision support system, Organization of PROMEDAS development.

Unit 4. Evolutionary Intelligence **07 Lecture Hours**

Biological background - The cell, Chromosome, genes and genomes, Reproduction, Natural selection, Inspiration - Evolution, Classes of search techniques, Introduction - Genetic algorithm, Vocabulary, Pseudo code - Genetic Algorithm, Roulette Wheel's Selection Pseudo Code, Population/Representation, Representation example, Crossover, Mutation, Evaluation and deletion, The traveling salesman problem, Representation, cross over and mutation, TSP Example - 30 cities, Ant colony and artificial ants for TSP, Pheromone trails, Ant colony optimization algorithms, Particle swarm optimization – Introduction, Kennedy and Eberhart's (1995) refined algorithm, A (partial) example in two dimensions, Algorithm termination, Financial applications, An automatic stock trading system using Particle Swarm Optimization, PSO based methodology, Trading decision, Considering the GA technology, Some GA application types.

Unit 5. Neural networks, Natural language understanding **06 Lecture Hours**

Introduction, Artificial Neural Network, Appropriate problems for neural network learning, Characteristics of the problems, Basic understanding of neural networks, A single neuron, Activation Functions, Architectures of neural networks, Feedforward neural network, Single-Layer feedforward architecture, Multiple-Layer feedforward architecture, Types of feedforward networks, Multi-layer perceptron, Training MLP: The back-propagation algorithm, Step 1: Forward propagation, Step 2: Back

propagation and weight updation, Process of learning in neural network, Recurrent or feedback architecture, Mesh Architectures, GRADIENT-DESCENT (training examples, η), Stochastic GRADIENTDESCENT(training examples, η), Multilayer networks and Backpropagation algorithm, The Backpropagation algorithm, Natural language processing, Classical NLP, Feed-forward networks, Recurrent neural networks and recursive networks, Features for NLP problems, Framenet Vs. Wordnet, Features for text, Features for word relations, NGRAM features, Some terminologies.

Unit 6. Introduction to Machine Learning **06 Lecture Hours**

Motivation for Machine Learning, Applications, Machine Learning, Learning associations, Classification, Regression, The Origin of machine learning, Uses and abuses of machine learning, Success cases, How do machines learn, Abstraction and knowledge representation, Generalization, Factors to be considered, Assessing the success of learning, Metrics for evaluation of classification method, Steps to apply machine learning to data, Machine learning process, Input data and ML algorithm, Classification of machine learning algorithms, General ML architecture, Group of algorithms, Reinforcement learning, Supervised learning, Unsupervised learning, Semi-Supervised learning, Algorithms, Ensemble learning, Matching data to an appropriate algorithm.

Unit 7. Learning deterministic models **06 Lecture Hours**

Supervised Learning, Regression, Linear regression, Multiple linear regression, A multiple regression analysis, The analysis of variance for multiple regression, Examples for multiple regression, Overfitting, Detecting overfit models: Cross validation, Cross validation: The ideal procedure, Parameter estimation, Logistic regression, Decision trees: Background, Decision trees, Decision trees for credit card promotion, An algorithm for building decision trees, Attribute selection measure: Information gain, Entropy, Decision Tree: Weekend example, Occam's Razor, Converting a tree to rules, Unsupervised learning, Semi-Supervised learning, Clustering, K – means clustering, Automated discovery, Reinforcement learning, Multi-Armed Bandit algorithms, Influence diagrams, Risk modelling, Sensitivity analysis, Casual learning.

Text Book - Introduction to Artificial Intelligence & Machine Learning (IBM ICE Publication).

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	MSE	Quiz/Assignment/ etc.	ESE
Weightage (%)	20%	30%	50%

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs):

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	1	1										1		3
CO2	1	1	1										1		3
CO3	1	1	1										1		3
CO4	1	1	1										2		3
CO5	1	1	1										2		3
Average	1	1	1										1.4		3

1=Weak 2=Moderate 3=Strong