IX. List of Practicals

S.No.	Topic	No. of Practicals
1.	Prolog language, syntax and meaning of Prolog programs, Lists, operators, arithmetic.	4
2.	Using structures: Example programs, controlling backtracking, input and output. more built-in procedures, programming, style and technique, operations on data structures.	5
3.	Advanced tree representations, basic problem-solving strategies, depth-first search strategy, breadth-first search strategy.	5
	Total	**14**

X. Suggested Reading

- GNU PROLOG *A Native Prolog Compiler with Constraint Solving over Finite Domains* Edition 1.44, for GNU Prolog version 1.4.5 July 14, 2018.
- Ivan Bratko, *Prolog Programming for Artificial Intelligence.*
- Warwick K. 2012. *Artificial Intelligence: The Basics* ISBN: 978-0-415-56482-3 (hbk).

I. Course Title : Neuro-Fuzzy Application in Engineering

II. Course Code : CSE 503

III. Credit Hours : 2+1

IV. Aim of the course

To learn the basic concept of neural network models and fuzzy logic based models and apply fuzzy reasoning and fuzzy inference to solve various agricultural engineering problems

V. Theory

Unit I

Basic concepts of neural networks and fuzzy logic, differences between conventional computing and neuro-fuzzy computing, characteristics of neuro-fuzzy computing.

Unit II

Fuzzy set theory: Basic definitions, terminology, formulation and parameters of membership functions. Basic operations of fuzzy sets: Complement, intersection, vision, T-norm and T- conorm. Fuzzy reasoning and fuzzy Inference: Relations, rules, reasoning, Inference systems, and modeling. Applications of fuzzy reasoning and modelling in engineering problems.

Unit III

Fundamental concepts of artificial neural networks: Model of a neuron, activation functions, neural processing. Network architectures, learning methods. Neural network models: Feed forward neural networks, back propagation algorithm, applications of feed forward networks, recurrent networks, hopfield networks, hebbian learning, self organizing networks, unsupervised learning, competitive learning.

Unit IV

Neuro–fuzzy modelling: Neuro-fuzzy inference systems, neuro-fuzzy control.

Unit V

Applications of neuro-fuzzy computing: Time series analysis and modelling, remote sensing, environmental modelling.

VI. Practical

Training algorithms of artificial neural networks: Basic models, learning rules, single layer and multi-layer feed-forward and feedback networks, supervised and unsupervised methods of training, recurrent networks, modular networks. Fuzzy systems: Fuzzy sets, operations on fuzzy sets, fuzzy relations, measures, fuzzy logic, fuzzy logic controller, integrated hybrid systems. Adaptive neuro-fuzzy inference systems, coactive neuro-fuzzy modelling, classification and regression trees, data clustering algorithms like k-means, fuzzy c-means, mountain and subtractive clustering, rule based structure identification, neuro-fuzzy control, case studies. Use of available software for fuzzy logic and neural networks.

VII. Learning outcome

The students will be able to have the basic concept of neural network models and fuzzy logic-based models and will be in a position to apply fuzzy reasoning and fuzzy inference for various problems of agricultural engineering. They will also learn to develop different types of neural network models.

VIII. Lecture Schedule

S.No.	Topic	No. of Lectures
1.	Basic concepts of neural networks and fuzzy logic, differences between conventional computing and neuro-fuzzy computing, characteristics of neuro-fuzzy computing.	3
2.	Fuzzy set theory: Basic definitions, terminology, formulation and parameters of membership functions.	3
3.	Basic operations of fuzzy sets: Complement, intersection, vision, T-norm and T- conorm. Fuzzy reasoning and fuzzy Inference: Relations, rules, reasoning, Inference systems, and modeling.	4
4.	Applications of fuzzy reasoning and modelling in engineering problems.	3
5.	Fundamental concepts of artificial neural networks: Model of a neuron, activation functions, neural processing. Network architectures, learning methods.	3
6.	Neural network models: Feed forward neural networks, back propagation algorithm, applications of feed forward networks	3
7.	recurrent networks, hopfield networks, hebbian learning, self-organizing networks, unsupervised learning, competitive learning.	4
8.	Neuro–fuzzy modelling: Neuro-fuzzy inference systems, neuro-fuzzy control.	3
9.	Applications of neuro-fuzzy computing: Time series analysis and modelling, remote sensing, environmental modelling.	4
	Total	**30**

IX. List of Practicals

S.No.	Topic	No. of Practicals
1.	Training algorithms of artificial neural networks: Basic models, learning rules, single layer and multi-layer feed-forward and feedback networks, supervised and unsupervised methods of training, recurrent networks, modular networks	5
2	Fuzzy systems: Fuzzy sets, operations on fuzzy sets, fuzzy relations, measures, fuzzy logic, fuzzy logic controller, integrated hybrid systems. Adaptive neuro-fuzzy inference systems, coactive neuro-fuzzy modelling, classification and regression trees,	5

S.No.	Topic	No. of Lectures
3	data clustering algorithms like k-means, fuzzy c-means, mountain and subtractive clustering, rule based structure identification, neuro-fuzzy control, case studies. Use of available software for fuzzy logic and neural networks	6
	Total	**16**

X. Suggested Reading

- Jang, JS R, Sun C Tand Mizutan E 1997. *Neuro-Fuzzy and Soft Computing.* Prentice Hall
- Simon Haykin NJ. 1994. *Neural Networks. A Comprehensive Foundation.* McMillan College Publishing Company.
- Klir George J and Forger TA. 1995. *Fuzzy Sets, Uncertainty and Information.* Prentice Hall of India, Pvt. Ltd, New Delhi.
- Kosko B. 1997. *Neural Networks and Fuzzy Systems.* Prentice Hall of India Pvt. Ltd, New Delhi.
- Rao V and Rao H. 1996. *C++ Neural Networks and Fuzzy Logic.* BPB Publications, New Delhi.

I. Course Title : Soft Computing Techniques in Engineering

II. Course Code : CSE 504

III. Credit Hours : 2+1

IV. Aim of the course

To learn the basic concepts of soft computing techniques like neural networks, genetic algorithms and fuzzy systems and apply these techniques for real time problem solving.

V. Theory

Unit I

Introduction to control techniques, need of intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule based systems, the artificial intelligence approach. Knowledge representation and expert systems. Data pre-processing: Scaling, Fourier transformation, principle component analysis and wavelet transformations.

Unit II

Concept of artificial neural networks (ANN) and basic mathematical model, network structures, activation function, back propagation, network size and pruning McCulloch-Pitts neuron model, simple perceptron, adaline and madaline neural networks, feed-forward multi-layer perceptron. Learning and training the neural network. Networks: Hopfield network, self-organizing network and recurrent network. Neural network based controller. Case studies: Identification and control of linear and nonlinear dynamic systems.

Unit III

Genetic algorithm (GA): Basic concept and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using GA. Concept of other search techniques like tabu search and ant-colony search for solving optimization problems.