Course Code: 22UPCSC1E11 / 22UPCSC2E11 **Credits: 4**

Soft Computing

COURSE OBJECTIVES:

- Develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory.
- To understand supervised and unsupervised learning algorithms
- To enable the students to gain a basic understanding of neural networks.
- To know about fuzzy logic, fuzzy inference systems, and their functions.
- To impart basic knowledge on Genetic algorithms and their applications.

UNIT-I

INTRODUCTION TO SOFT COMPUTING: Artificial Neural Networks-Biological Neurons- Basic Models of Artificial Neural Networks-Connections-Learning-Activation Functions- Important Terminologies of ANNs- Muculloch and Pitts Neuron-Linear Separability- Hebb Network-Flowchart of Training Process-Training Algorithm.

UNIT - II

SUPERVISED LEARNING NETWORK : Perceptron Networks–Perceptron Learning Rule-Architecture-Flowchart for Training Process-Perceptron Training Algorithms for Single Output Classes-Perceptron Training Algorithm for Multiple Output Classes-Perceptron Network Testing Algorithm - Adaptive Linear Neuron-Delta Rule for Single Output Unit-Flowchart for training algorithm-Training Algorithm – Testing Algorithm - Multiple Adaptive Linear Neurons-Architecture-Flowchart of Training Process-Training Algorithm-Back Propagation Network-Architecture-Flowchart for Training Process-Training Algorithm-Learning Factors of Back-Propagation Network-Radial Basis Function Network- Architecture-Flowchart for Training Process-Training Algorithm.

UNIT-III

UNSUPERVISED LEARNING NETWORK: Associative Memory Networks - Auto Associative Memory Network**-**Architecture-Flowchart for Training Process-Training Algorithm-Testing Algorithm- Bidirectional Associative Memory- Architecture-Discrete Bidirectional Associative Memory-Iterative

Auto Associative Memory Networks - Linear AutoAssociative Memory-Kohonen Self-Organizing Feature Map- Architecture-Flowchart for Training Process-Training Algorithm.

UNIT-IV

INTRODUCTION TO FUZZY LOGIC: Classical Sets –Operations on Classical Sets-Fuzzy sets - Fuzzy Sets- Properties of Fuzzy Sets- Fuzzy Relations – Membership Functions: Fuzzification- Methods of Membership Value Assignments – Defuzzification – Lambda-Cuts for Fuzzy sets and Fuzzy Relations – Defuzzification Methods–Max-Membership Principle-Centroid Method-Weighted Average Method-Mean Max Membership-Center of Sums-Center of Largest Area-First of Maxima - Fuzzy Set Theory - Fuzzy Arithmetic And Fuzzy Measures: Fuzzy Measures – Belief and Plausibility Measures-Probability Measures-Possibility and Necessity Measures- Formation of Rules –Fuzzy Inference Systems (FIS) – Fuzzy Decision Making – Fuzzy Logic Control Systems.

UNIT-V

GENETIC ALGORITHM: Introduction - Biological Background - Traditional Optimization and Search Techniques -Gradient Based Local Optimization Method-Random Search-Stochastic Hill Climbing-Simulated Annealing-Symbolic Artificial Intelligence-Operators in Genetic Algorithm -Encoding-Selection-Crossover-Mutation - Stopping Conditions for Genetic Algorithm Flow-Genetic Programming-Working of Genetic Programming-Characteristics of Genetic Programming-Data Representation.

TEXT BOOKS

1. Principles of Soft Computing, S.N. Sivanandam, S.N.Deepa, Wiley, Third Edition, 2019.

   UNIT I: Chapter 1: 2.1,2.3,2.4,2.5,2.6,2.7
   UNIT II: Chapter 2: 3.2,3.3,3.4,3.5,3.6
   UNIT III: Chapter 3: 4.3,4.4,4.7,5.3
   UNIT IV: Chapter 4: 7.2,7.3,8.4,9.3,9.4,10,10.2,10.3,10.4,11.4,12.8,14
   UNIT V: Chapter 5: 15,15.2,15.3,15.4,15.9,15.10

REFERENCE BOOKS

1. Das, A. (2018). Artificial Intelligence and Soft Computing for Beginners.
2. Amit, K. (2018). Artificial intelligence and soft computing: behavioral and cognitive modeling of the human brain. CRC press.
3. Rajasekaran, S., &Pai, G. V. (2011). Neural networks, fuzzy logic and genetic algorithm: synthesis and applications (with cd). PHI Learning Pvt. Ltd.

4. Jang, J. S. R., Sun, C. T., &Mizutani, E. (2004). Neuro-fuzzy and soft computing-a computational approach to learning and machine intelligence [Book Review]. IEEE Transactions on automatic control, 42(10), 1482-1484.
5. Gupta, M. M. (2004). Soft computing and intelligent systems: theory and applications. Elsevier.
6. Jang, J. S. R., Sun, C. T., &Mizutani, E. (1997). Neuro-fuzzy and soft computing-a computational approach to learning and machine intelligence [Book Review]. IEEE Transactions on automatic control, 42(10), 1482-1484.

COURSE OUTCOMES:

- On the successful completion of the course, students will be able to

CO1	To provide an introduction to the basic principles, techniques, and applications of soft computing	K- 1 K2	L O
CO2	To get familiar with Neural network architectures and supervised learning algorithms	K3	IO
CO3	To understand the architectures and algorithms of Unsupervised Learning techniques	K3-K4	H O
CO4	Develop the skills to gain a basic understanding of fuzzy logic theory and fuzzy inference systems	K4	IO
CO5	Ability to learn traditional optimization and search techniques and genetic programming	K5	H O

MAPPING WITH PROGRAMME OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	S	M	S	M	S	S	S	M	S	M	S	S
CO2	M	S	M	S	M	M	M	S	M	S	S	M
CO3	M	M	S	S	S	M	M	S	S	S	S	S
CO4	S	S	M	M	M	S	S	S	S	M	M	M
CO5	S	S	S	S	S	M	S	M	M	S	S	M

S- STRONG; M-MEDIUM; L-LOW

Course Code: 22UPCSC1E12 / 22UPCSC2E12 **Credits: 4**

Soft Computing Lab

COURSE OBJECTIVES:

- To implement various Supervised Neural Network-based approaches
- To apply the fuzzy-based logical operations and arithmetic operations
- To implement unsupervised neural network approaches
- To solve a problem using a simple genetic algorithm
- To implement logic gates.

Program List

1. Implementation of Logic gates using Artificial Neural Network.
2. Implementation of Perception Algorithm.
3. Implementation of Back Propagation Algorithm.
4. Implementation of Self Organizing Maps.
5. Implementation of Radial Basis Function Network.
6. Implementation of De-Morgan's Law.
7. Implementation of McCulloch Pits Artificial Neuron model
8. Implementation of Simple genetic algorithm
9. Implementation of fuzzy based Logical operations
10. Implementation of fuzzy based arithmetic operations

COURSE OUTCOMES:

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

CO1	To apply supervised learning algorithms for real datasets	K- 1K2	LO
CO2	To implement Unsupervised Learning techniques	K3	IO
CO3	To apply fuzzy based arithmetic and logical operations	K3- K4	HO
CO4	To find solutions for problems using Genetic algorithm	K4	IO
CO5	To implement DeMorgan's Law	K5	HO

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	S	M	S	S	S	M	S	M	S	S
CO2	M	S	M	M	M	M	M	S	M	S	M	M
CO3	M	M	S	S	S	M	M	S	S	S	S	S
CO4	S	S	S	M	M	S	S	M	S	S	S	M
CO5	S	S	S	S	S	M	M	M	M	S	M	M

S- STRONG; M-MEDIUM; L-LOW