GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Internet of Things

Subject Code : ME02062071

Subject Name : Fuzzy Logic and Neural Network

w. e. f. Academic Year:	2024-25
Semester:	2
Category of the Course:	Professional Elective Course

Prerequisite:	Probability Theory, Discrete Mathematics
Rationale:	This course covers concepts of fuzzy sets, fuzzy logics, and neural networks with help of some numerical examples. Fundamentals of neural networks and various learning methods will then be discussed. The principles of multi-layer feed forward neural network, radial basis function network, self-organizing map, counter-propagation neural network, recurrent neural network, and deep learning neural network will be explained with appropriate numerical examples. The method of evolving optimized fuzzy reasoning tools, neural networks will be discussed with the help of some numerical examples. Two popular neuro-fuzzy systems will be explained and numerical examples will be solved. A summary of the course will be given at the end.

Course Outcome:

After completion of the Course, Students will be able to:

No	Course Outcomes	RBT Level*
01	Understanding of fuzzy logic and neural networks	UN
02	Apply fuzzy logic and neural networks on IoT applications	AP
03	Analysis of examples and use cases of neural networks	AN
04	Analysis of the Generic algorithms using fuzzy logic and neural networks	AN
05	Evaluate the combined neural networks and fuzzy logics using various approaches	EL

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

Course Scheme:

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
				Theory		Practical		
L	T	PR	C	ESE (E)	PA(M)	ESE (V)	PA (I)	
03	00	02	04	70	30	30	20	150

Course Content:

Sr No	Course Content	No of Hours	% of Weightage
1	**Unit 1: Introduction to Fuzzy Sets:** Crisp sets – notations, operations, properties, Fuzzy Set – Representation, difference between crisp set and fuzzy sets, definitions in fuzzy sets, operations and properties, Fuzzy Reasoning and Clustering: Introduction, fuzzy logic controller – two major forms, hierarchical, sensitivity analysis, advantages and disadvantages. fuzzy clustering – fuzzy C-means clustering, entropy based fuzzy clustering	6	15
2	**Unit 2: Fundamentals of Neural Networks:** Introduction – biological neuron, artificial neuron, a layer of neurons, multiple layers of neurons, Static Vs dynamic neural networks, training of neural networks – supervised learning, unsupervised learning, incremental training, batch training	4	05
3	**Unit 3: Some Examples of Neural Networks:** Introduction, Multi-layer feed-forward neural network, Radial basis function network, Self-organizing map, recurrent neural networks	8	20
4	**Unit 4: Combined Generic Algorithm – Fuzzy Logic:** Introduction, Fuzzy-Genetic Algorithm, Genetic-Fuzzy System – A brief literature review, working principle of Genetic-Fuzzy Systems.	9	20
5	**Unit 5: Combined Genetic Algorithms – Neural Networks:** Introduction, Working Principle of a Genetic-Neural system – forward calculation, A Hand Calculation	9	20
6	**Unit 6: Combined Neural Networks: Fuzzy Logic:** Introduction, Neuro-Fuzzy Working based on Mamdani Approach – Tuning of the Neuro-Fuzzy system using a back-propagation algorithm, tuning of the Neuro-Fuzzy system using a Genetic algorithm, A numerical example, Neuro-Fuzzy system based on Takagi and Sugeno's Approach – tuning of the ANFIS using a Generic Algorithm, A numerical example.	9	20
	TOTAL	**45**	**100**

Reference Book:

- Dipak. K. Pratihar, Soft Computing Fundamentals and Applications, Alpha Science International Ltd., Oxford, 2013
- Fuzzy Sets and Fuzzy Logic: Theory and Applications byGeorge J. Klir, Bo Yuan, Prentice Hall, 1995
- Neural Networks: A Comprehensive Foundation by S. Haykin,Prentice Hall PTR Upper Saddle River, NJ, USA, 1994

Suggested Course Practical List:

- The practical work will be carried out based on the content covered during the academic session.

List of Laboratory/Learning Resources Required:

- List of Hardware: NIL
- List of Software:
- List of Open Source Tools/Simulator:
- List of Useful websites/MOOCs:
  https://nptel.ac.in/courses/108104157
  https://nptel.ac.in/courses/127105006

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