



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Computer Engineering (Artificial Intelligence And Data Science)

Course / Subject Code : ME01095041

Subject Name: Soft Computing

WEF Academic Year :	2024-25
Semester :	1 st Semester
Category of the Course :	Advanced

Prerequisite :	Basic knowledge of Mathematics
Rationale :	The course curriculum helps to understand the concepts of soft computing domains such as fuzzy sets, fuzzy rule, crisp rule, crisp data, fuzzy relation, implication, and elaborates the concepts of particle intelligence, swarm intelligence, evolutionary computing, optimization theory, different kind of neural network, learning theory by neural network, algorithm based computing, probabilistic computing, hybrid system concepts, etc..

Course Scheme :

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Practical		
				ESE (E)	PA(M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Course Content:

Sr. No.	Course Content	No. of Hours	% of Weightage
1	Soft Computing Basics: Conventional AI to Computational Intelligence; Soft Computing Constituents and Applications. Soft Computing vs. Hard Computing Data Clustering Algorithms: K-Means, Fuzzy C-Means, Mountain Clustering, Subtractive Clustering.	7	15
2	Neural Networks: Taxonomy of neural net, characteristics and applications of ANN, McCulloch Pitt model, different activation functions Supervised Learning algorithms- Perceptron (Single Layer, Multi layer), Linear separability, ADALINE, MADALINE, RBF networks , Widrow Hoff, learning rule, Delta learning rule, Back Propagation algorithm	10	25



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	Un-Supervised Learning algorithms- Hebbian Learning, Winner take all, Self Organizing Maps Adaptive Resonance Theory: Architecture, classifications, Implementation and training. Associative Memory, Convolutional neural Networks (CNN), Recurrent neural Networks (RNN)		
3	Fuzzy Logic: Fuzzy set theory, Introduction & features of membership functions, Fuzzy rule base system : fuzzy propositions, formation, decomposition & aggregation of fuzzy rules, fuzzy reasoning, fuzzy quantifier, fuzzy inference systems, Mamdani Fuzzy Models – Sugeno Fuzzy Models, Adaptive Neuro-Fuzzy Inference Systems Architecture, Application using fuzzy system - Air Conditioner Controller	8	20
4	Introduction to Non-traditional Metaheuristic Optimization Techniques: Random Optimization, Simulated Annealing, Tabu Search, Ant Colony Optimization, Particle Swarm Optimization, Harmony Search, Memetic Algorithms, Other Evolutionary Algorithms such as Firefly Algorithm, Bee Algorithm, Shuffled Frog Leap algorithm, Bat algorithm etc.	7	10
5	Genetic algorithm: Fundamentals, Encoding styles – Binary, Octal, Hexadecimal, Permutation, Value, tree, fitness function, reproduction Genetic modeling - Inheritance operator, cross over, mutation operator, Generational Cycle, Convergence of GA, Genetic Modelling, Applications & advances in GA, Differences & similarities between GA & other traditional methods	9	20
6	Hybrid Systems Hybrid systems, GA based BPNN (Weight determination, Application); Neuro Fuzzy Systems—Fuzzy BPNN--fuzzy Neuron, architecture, learning, application; Fuzzy Logic controlled G.A, Fuzzy Associative Memories;	4	10
	Total	45	100

Reference Book:

1. Neural Networks, Fuzzy Logic & Genetic Algorithms – Synthesis & applications, T.S. Rajasekaran & G.A. Vijayalakshmi Pai, PHI.
2. S.N. Sivanandam & S.N. Deepa, “Principles of Soft Computing”, Wiley Publications.
3. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, “Neuro-Fuzzy and Soft Computing”, Prentice-Hall of India.
4. Sandries P Engelbrecht, Computational Intelligence: An Introduction, Wiley Publications.
5. Timothy J. Ross, Fuzzy Logic with Engineering Applications, McGraw-Hill.

Course Outcome:

After Completion of the Course, Student will able to:



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No	Course Outcomes	RBT Level*
01	To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario.	RM
02	To know about the concepts of the neural network, Single Layer, Multilayer, classifications, Implementation, and training.	UN
03	To give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, genetic algorithms.	AP
04	To implement soft computing based solutions for real-world problems.	CR
05	To provide student hand-on experience on MATLAB to implement various strategies.	EL

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

Suggested Course Practical List:

1. Create a perceptron with appropriate no. of inputs and outputs. Train it using fixed increment learning algorithm until no change in weights is required. Output the final weights.
2. Create a simple ADALINE network with appropriate no. of input and output nodes. Train it using delta learning rule until no change in weights is required. Output the final weights.
3. Implement Union, Intersection, Complement and Difference operations on fuzzy sets. Also create fuzzy relation by Cartesian product of any two fuzzy sets and perform maxmin composition on any two fuzzy relations
4. Solve Greg Viot's fuzzy cruise controller using MATLAB Fuzzy logic toolbox.
5. Solve Air Conditioner Controller using MATLAB Fuzzy logic toolbox
6. Implement TSP using GA.
7. Introduction to MATLAB: Neural Network (NN) Toolbox, NN Simulink Demos
8. MATLAB simulation: Artificial Neural Network (ANN) implementation
9. MATLAB simulation: NN Tool Artificial Neural Network (ANN) implementation
10. MATLAB simulation: Various structure of NN algorithms implementation
11. MATLAB simulation: Training Algorithms of ANN.

List of Laboratory/Learning Resources Required:

- <http://www.iitk.ac.in/kangal/codes.shtml>
- <http://lancet.mit.edu/ga/dist/galibdoc.pdf>



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- https://books.google.co.in/books?hl=en&lr=&id=W5SAhUqBVYoC&oi=fnd&pg=PR11&dq=SOft+computing+course+&ots=et_2Nvjy_4&sig=jDXLrGleD3zc4QUxvcEvC5FrFY#v=onepage&q=SOft%20computing%20course&f=false

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