Name of the Programme: M.Sc. in Artificial Intelligence
Course Code: CSI-527
Title of the Course: Soft Computing
Number of Credits: 4 (2L+2T+0P)
Effective from AY: 2023-24

Prerequisites for the course	Machine Learning, Statistics	
Objectives	The objective of this course is to introduce methods for handling imprecise and uncertain data using Rough sets, Neuro Fuzzy Systems and foster their abilities in designing and implementing optimal solutions for real-world and engineering problems using derivative free optimization techniques.	
Content	**Introduction to Soft Computing** Soft Computing Overview – Uncertainty in data, Hard vs Soft Computing **Neural Networks** Introduction, RBF Networks, Self-Organizing Map, Boltzmann Machines, Convolutional Neural Networks. **Fuzzy Systems** Fuzzy Sets, Fuzzy Relations, and Membership functions, Properties of Membership functions, Fuzzification and Defuzzification. **Fuzzy logic** Fuzzy Rule based systems, Fuzzy Decision making, Fuzzy Classification, Fuzzy CMeans Clustering. **Rough Sets** Rough Sets – Definition, Upper and Lower Approximations, Boundary Region, Decision Tables and Decision Algorithms. Properties of Rough Sets. Rough K-means clustering, Rough **Optimization Techniques** Introduction, Genetic Algorithm, Memetic Algorithms, Particle Swarm Optimization, Ant Colony Optimization, Frog-Leaping. **Hybrid Systems** GA Based Back Propagation Networks, Fuzzy Back Propagation Networks, Evolutionary Ensembles	3 hours 2 hours 5 hours 5 hours 5 hours 5 hours 5 hours
Assignments and Mini Project Discussions during the Tutorial Slots:	**List of Assignments:** 1. To demonstrate the working of Hebbian learning rule 2. To demonstrate the working of perceptron learning rule 3. To demonstrate the working of Delta learning rule 4. To demonstrate the working of Widrow-Hoff learning rule 5. To demonstrate the working of Radial basis function network 6. To demonstrate the working of Learning vector quantization 7. To demonstrate the working of Self-Organizing maps 8. To demonstrate the working of Recurrent neural networks 9. To demonstrate the working of Fuzzy inference system 10. To demonstrate the working of Genetic algorithm 11. To demonstrate the working of Particle Swarm Optimization 12. To demonstrate the working of Ant Colony Optimizations and TSP	12 * 2 = 24 hours + 6 hours for a Mini Project

Pedagogy	Lectures / Assignments / Quiz / Mini Project / Seminar Presentations	
References/ Readings	**Main Readings** 1. S.N. Sivanandham and S.N.Deepa, “Principles of Soft Computing”, 2nd Edition, Wiley Publications. 2. Andries P. Engelbrecht, "Computational Intelligence: An Introduction", John Wiley & Sons, 2007. 3. Laurene V. Fausett “Fundamentals of Neural Networks: Architectures, Algorithms And Applications”, Pearson, 1993. 4. Simon Haykin "Neural Networks and Learning Machines" Prentice Hall, 2008. Timothy Ross, “Fuzzy Logic with Engineering Applications”, Third Edition,Wiley.	
Course Outcomes	1. Have a general understanding of soft computing methodologies, to deal with imprecise and uncertain data 2. Develop computational neural network models for some simple biological systems; 3. Develop fuzzy models for engineering systems, particularly for control systems; 4. Apply derivative free optimization methods to solve real world problems 5. Demonstrate some applications of computational intelligence.	

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