

Year: M. Tech. I (Semester – II)

Subject Name: Soft Computing
Type of course: Professional Core Course
Prerequisite (if any): Artificial Intelligence

Subject Code: MTCO13202

List of Courses where this course will be prerequisite: --

Rationale: The rationale behind this course is to provide precise approximation and quick solutions for complex real-life problems. Soft computing is an important branch of computational intelligence, where fuzzy logic, probability theory, neural networks, and genetic algorithms are synergistically used to mimic the reasoning and decision making of a human.

Teaching and Examination Scheme:

Teaching Scheme				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	
3	0	2	4	60	25	15	30	20	150

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests. CA2: Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems TEE: Term End Examination TEP: Term End Practical Exam (Performance and viva on practical skills learned in course) CA3: Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. No.	Content	Total Hrs
1	Introduction to Soft Computing and Fuzzy Logic: Soft Computing definition, soft computing Vs hard computing, Applications of soft computing Techniques, Fuzzy set. Operation on Fuzzy set, fuzzy membership function, Fuzzification, Defuzzification, fuzzy proposition, Fuzzy relations. Fuzzy Inference System	7
2	Evolutionary Computing: Basic Concepts of Genetic Algorithms (GA), Working Principle, Encoding methods, Fitness function, GA Operators- Reproduction; Crossover; Mutation, Convergence of GA, Multi-level Optimization, Real Life Problems using GA	8





3	New trends in Evolutionary Algorithms: Ant Colony Optimization: Ant system, MM-AS, Ant Miner, Snake-Ant Algorithm. Particle Swarm Optimization. Artificial Bee Colony, Cuckoo Search Algorithm. Co-evolution, Plasticity and life-time learning, Lamarckian learning, the "No free lunch" theorem. RL using evolutionary algorithm	8
4	ANN and hybrid system: Hopfield network, self-organizing map, Introduction to Artificial Neural Network, Weight setting, activation function, learning rules, back propagation. Extreme Learning Machine, Modification (structure) and application of ANN	8
5	Hybrid System : GA based Back propagation Networks: GA based Weight determination, K - factor determination in Columns , Fuzzy Backpropagation Networks, ANFIS	8
6	Applications based on GA/Fuzzy/ANN/PSO/ACO	6

Reference Books:

Sr.No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1	Principles of Soft Computing	S.N.Sivanandan and S.N.Deepa	Wiley	2011	
2	Genetic algorithm in search, optimization and machine learning	Goldberg, D. E	Addison-Wesley, Reading Mass		
3	Fuzzy Logic with Engineering Applications	Timothy J.Ross			McGraw-Hill
4	Introduction to Evolutionary Computing	Eiben A. E. and Smith J. E	Second Edition, Springer	2007.	Natural Computing Series



5	Fundamentals of Computational Swarm Intelligence	Engelbrecht A. P	John Wiley & Sons,	2006	
6	Neural Networks, Fuzzy Logic, and Genetic Algorithms synthesis and application	S. Rajasekaran & GA Vijayalakshmi Pai			PHI

Course Outcomes:

Sr.No.	CO statement	Marks % weightage
CO-1	Identify and describe soft computing techniques and their roles in building intelligent machines.	20%
CO-2	Apply evolutionary algorithms to combinatorial optimization problems	25%
CO-3	Evaluate and compare solutions by various soft computing approaches for a given problem.	30%
CO-4	Develop application on different soft computing techniques like Fuzzy, GA and Neural network	25%

List of Open learning website:

List of Open Source Software: Linux, CentOS

SCI-KIT:<https://pypi.org/project/scikit-fuzzy/>



FOR LAB SESSIONS:

List of Experiments:

Sr. No.	Practical
1	Create a perceptron with appropriate no. of inputs and outputs for a) AND b) OR c) X-OR gates. Train the model until no significance change is observed in the weights.

2	Implement Genetic algorithm for Travelling Salesman Problem.
3	Implement Genetic algorithm for any minimization/maximization/optimization problem.
4	Implement Image Classification using Multilayer Perceptron on the following datasets <ul style="list-style-type: none"> • MNIST Digit Dataset • Iris flowers Dataset
5	Consider fuzzy set A of tall men and fuzzy set B of short men. Given $A = \{0/175, 0/150, 0/140, 0.5/185, 1/190\}$ Given $B = \{1/155, 1/150, 0/190, 0.5/170, 0.8/160\}$ Apply the appropriate fuzzy set operations to derive fuzzy set containing <ul style="list-style-type: none"> • Not very tall men and not very short men • Not very very tall and not very very short men
6	Design fuzzy inference system for the following case studies <ul style="list-style-type: none"> • Calculating the washing time of washing machine based on the weight and type of clothes • Inferring the immunity of person based on the age, lifestyle (fitness routine, diet) • Inference of student academic record based on the marks of the student, co-curricular activities (sports, cultural etc)

Major Equipment Needed:

