

25UCST414	SOFT COMPUTING	Category	L	T	P	R	Credit	Year of Introduction
		PEC	3	0	0	0	3	2025

Preamble: This course aims to apply Artificial Neural Network (ANN) models to design and implement intelligent systems for real-world problem solving and also apply soft computing techniques to handle uncertainty, imprecision, and non-linear problems in practical domains.

Prerequisite: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO	Course Outcomes	Knowledge Level
CO1	Explain the techniques employed in soft computing and present the fundamental models of artificial neural networks.	K2 Understand
CO2	Apply the principles of fuzzy sets, membership functions, and linguistic variables to model uncertain and imprecise data.	K3 Apply
CO3	Apply the fundamental concepts of Genetic Algorithms to solve engineering, scheduling, routing, and function optimization problems.	K3 Apply
CO4	Describe the principles underlying multi-objective optimization models and collective systems.	K2 Understand

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	1	2	1
CO2	3	3	2	2	-	-	-	-	-	-	1	3	3
CO3	3	2	2	-	-	-	-	-	-	-	1	2	2
CO4	3	2	2	-	-	-	-	-	-	-	1	2	2
Avg	3	2.5	2	2	-	-	-	-	-	-	1	2.3	2

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*				*	
CO2	*	*	*	*	*			*	
CO3	*	*	*	*	*			*	
CO4	*	*	*	*	*			*	

Wks Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*			*	

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 hrs

Continuous Internal Evaluation Pattern:

Attendance	: 5 marks
Continuous Assessment Test	: 20 marks
Continuous Assessment Assignment	: 15 marks

SYLLABUS

Module 1 (10 hrs)

Introduction to Soft Computing. Difference between Hard Computing & Soft Computing. Applications of Soft Computing. Artificial Neurons Vs Biological Neurons. Basic models of artificial neural networks – Connections, Learning, Activation Function, McCulloch-Pitts neuron - linear separability - hebb network - supervised learning network: perceptron networks - adaptive linear neuron, BPN.

Module 2 (12 hrs)

Fuzzy logic, Fuzzy sets – Properties, Fuzzy membership functions, Features of Fuzzy membership functions. Operations on a fuzzy set. Linguistic variables, Linguistic hedges, Fuzzy Relations, Fuzzy If-Then Rules, Fuzzification, Defuzzification– Lambda cuts, Defuzzification methods. Fuzzy Inference systems - Mamdani and Sugeno type, Applications of Fuzzy logic.

Module 3 (10hrs)

Genetic algorithm- Introduction - biological background - traditional optimization and search techniques - Genetic basic concepts - operators – Encoding scheme – Fitness evaluation – crossover - mutation - genetic programming – multilevel optimization – real life problem- advances in GA.

Module 4 (10 hrs)

Multi-objective optimization problem. Principles of Multi- objective optimization, Dominance and pareto-optimality. Optimality conditions. Collective Systems, Biological Self-Organization, Particle Swarm Optimization, Ant Colony Optimization, Swarm Robotics.

Text Books:

1. Hemalatha, M., Jhansi, I., & Rathinapriya, V. (2024). *Soft Computing*.
2. Keller, J. M., Liu, D., & Fogel, D. B. (2016). *Fundamentals of Computational Intelligence: Neural Networks, Fuzzy Systems and Evolutionary Computation*.
3. Ghosh, D., et al. (2016). *Soft Computing*.

Reference Books:

1. Goldberg, D. E. (2013). *Genetic Algorithms in Search, Optimization and Machine Learning*. Pearson Education India.
2. Sivanandam, S. N., & Deepa, S. N. (2011). *Principles of Soft Computing*. Wiley India Pvt. Ltd.
3. Deb, K. (2009). *Multi-Objective Optimization Using Evolutionary Algorithms* (1st ed.). John Wiley & Sons.

END SEMESTER EXAMINATION -MODEL QUESTION PAPER

Course Code	25UCST414
Course Name	SOFT COMPUTING
Max. Marks: 60	Duration: 2.5 Hours

Part A (Answer all questions. Each question carries 3 marks)				
Qn No.	Question	Marks	CO	BL
1	Explain the concept of supervised learning in neural networks and describe its role in model training.	3	1	L2
2	Compare and contrast biological neuron and artificial neuron.	3	1	L2
3	Using your own intuition, plot the Fuzzy membership function for the "Age of people".	3	2	L3
4	Let $A = \{(x1,0.5), (x2,0.1), (x3,0.9)\}$ and $B = \{(x1,0.4), (x2,0.4), (x3,0.5)\}$ Compute intersection, union and complement of both the fuzzy sets .	3	2	L3
5	Given a binary encoded chromosome, demonstrate how single-point crossover is performed between two parent chromosomes.	3	3	L3
6	Select an appropriate encoding scheme for a travelling salesman problem and justify your choice .	3	3	L3
7	Explain the significance of a Pareto-optimal solution in decision making.	3	4	L2

8	Describe the characteristics of collective systems.	3	4	L2
Part B <i>(Answer any one full question from each Module. Each carry 9 marks)</i>				
Module I				
Qn No.	Question	Marks	CO	BL
9.a	Illustrate how a McCulloch–Pitts neuron can be used to implement the AND-NOT logical operation.” .”	5	1	L2
9.b	Describe the concept of linear separability and explain its importance in neural networks.	4	1	L2
OR				
10.a	Explain how a perceptron can be trained using binary inputs and bipolar targets to realize a logical operation such as OR.”	5	1	L2
10.b	Describe how an ADALINE model can be trained to implement the OR function using bipolar inputs and targets, and explain the training steps for two iterations.”	4	1	L2
Module II				
Qn No.	Question	Marks	CO	BL
11.a	Universe $X = \{x_1, x_2, x_3, x_4, x_5\}$: $Y = \{y_1, y_2, y_3, y_4, y_5\}$: $V = \{v_1, v_2, v_3\}$ Given Fuzzy Sets A on X: $A = \{1/x_1, 0.8/x_2, 0.6/x_3, 0.4/x_4, 0.2/x_5\}$ B on Y: $B = \{0.2/y_1, 0.6/y_2, 1/y_3, 0.9/y_4, 0.7/y_5\}$ C on V: $C = \{0.4/v_1, 1/v_2, 0.8/v_3\}$ Calculate (i) $R = A \times B$ (ii) Max–Min Composition $R \circ P$	5	2	L3
11.b	Consider the discrete fuzzy set defined on the universe X: $\{a, b, c, d, e\}$ as $A = \left\{ \frac{1}{a} + \frac{0.9}{b} + \frac{0.6}{c} + \frac{0.3}{d} + \frac{0}{e} \right\},$ Using Zadeh's notation, calculate the alpha- cut sets for $\alpha = 1, 0.9, 0.6, 0+$ and 0.	4	2	L3
OR				L2
12.a	Compute the algebraic sum. algebraic product, bounded sum. and bounded difference for the given sets.	5	2	L3

	$\underline{A} = \left\{ \frac{1}{2} + \frac{0.5}{3} + \frac{0.3}{4} + \frac{0.2}{5} \right\}$ $\underline{B} = \left\{ \frac{0.5}{2} + \frac{0.7}{3} + \frac{0.2}{4} + \frac{0.4}{5} \right\}$			
12.b	Illustrate Mamdani FIS with an example .	4	2	L3
Module III				
Qn No.	Question	Marks	CO	BL
13.a	A population contains the chromosomes 101010, 110011, 100111, and 111000 with fitness values 10, 20, 30, and 40 respectively. Apply the roulette-wheel selection method and determine the selection probability of each chromosome .	5	3	L3
13.b	Given a search problem, choose a suitable encoding scheme and justify its application.	4	3	L3
OR				
14.a	.Apply one complete generation of a Genetic Algorithm, including selection, crossover, and mutation, for a given population of four chromosomes .	5	3	L3
14.b	Apply two-point crossover to the chromosomes 11110000 and 00001111 with crossover points at positions 2 and 6.	4	3	L3
Module IV				
Qn No.	Question	Marks	CO	BL
15.a	Describe the principles of multi-objective optimization and explain how trade-offs are handled between conflicting objectives.	5	4	L2
15.b	Explain biological self-organization with suitable real-world examples.	4	4	L2
OR				
16.a	Explain how cooperation and communication among agents improve system performance in swarm intelligence.	5	4	L2
16.b	Discuss the importance of optimality conditions in multi-objective optimization.	4	4	L2

