CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
ITT332	SOFT COMPUTING	PEC	2	1	0	3

Preamble: The objective of the course is to introduce the basic concepts of soft computing techniques such as Artificial Neural Networks, Fuzzy Logic, Genetic Algorithm and Hybrid Systems.

Prerequisite: Nil

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

CO No.	Course Outcome (CO)	Bloom's Category Level
CO 1	Explain various soft computing techniques and their roles in building intelligent machines	Level 2: Understand
CO 2	Discuss Artificial Neural Network Architectures and different Learning Methods	Level 2: Understand
CO 3	Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems	Level 3: Apply
CO 4	Apply genetic algorithm to solve optimization problems	Level 3: Apply
CO 5	Explain the concepts of hybrid systems	Level 2: Understand

Mapping of course outcomes with program outcomes

POs / COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1	-	-	-	-	-	-	-	-	-	2
CO 2	3	3	-	1	-	-	-	-	-	-	-	2
CO 3	3	3	3	3	-	-	-	-	-	-	-	2
CO 4	3	3	3	3	-	-	-	-	-	-	-	2
CO 5	2	1	-	1	-	-	-	-	-	-	-	2

3/2/1: high/medium/low

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test1 (Marks)	Test1 (Marks)	
Remember	20	10	30
Understand	20	20	40
Apply	10	20	30
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Describe various soft computing techniques.
2. List applications of Neural Networks.
3. Soft computing techniques give best solution to complex problems. Justify.

Course Outcome 2 (CO2):

1. What is unsupervised learning and how is it different from reinforced learning.

2. How does learning takes place in supervised learning.
3. Draw the architecture of back propagation algorithm.

Course Outcome 3(CO3):

1. With suitable example, explain how membership assignment is performed using intuition.
2. Design computer software to perform image processing to locate objects within a scene. The two fuzzy sets representing a plane and a train image are

Plane : $\left\{ \frac{0.2}{train} + \frac{0.5}{bike} + \frac{0.3}{boat} + \frac{0.8}{plane} + \frac{0.1}{house} \right\}$

Train : $\left\{ \frac{1}{train} + \frac{0.2}{bike} + \frac{0.4}{boat} + \frac{0.5}{plane} + \frac{0.2}{house} \right\}$

Find the following

(a) Plane □ Train (b) Plain □ Train

(C) $\overline{Plane}$ (d) $\overline{Train}$

(e) Plane□ Train (f) $\overline{\text{Plane} \cup \text{Train}}$

(g) $\overline{\text{Plane} \cap \text{Train}}$ (h) $\overline{\text{Plane} \cup \overline{\text{Plane}}}$

(i) Plain □ $\overline{Plane}$ (j) Train □ $\overline{Train}$

Course Outcome 4 (CO4):

1. Determine the maximum of a function $f(x)= x^2$ using genetic algorithm.
2. With a neat flowchart, explain the operation of a simple genetic algorithm.

Course Outcome 5 (CO5):

1. Describe Neuro Genetic hybrid systems.
2. Mention the characteristics and properties of Neuro-Fuzzy hybrid systems

Model Question paper

Course Code: ITT 332
Course Name: Soft Computing

Max.Marks:100 **Duration: 3 Hour**

Part A

Answer all questions. Each question carries 3 marks.

1. Discuss the back propagation process in a neural network.
2. How is fuzzy relation converted into a crisp relation using lamda-cut process?
3. Differentiate convex and nonconvex fuzzy set
4. What is ANFIS?
5. Differentiate hard computing and soft computing
6. What is the significance of weight in an Artificial Neural Network?
7. Define Fuzzy Equivalence Relation.
8. Compare Tuning and learning problems
9. What are the advantages and limitations of Genetic Algorithm?
10. List various encoding techniques used in genetic algorithm.

Part B

Answer all questions. Each question carries 14 marks. (5 * 14 = 70 Marks)

11. (a) State the basic components of soft computing (6 marks)

    (b) What are the different applications of Soft Computing? (8 marks)

OR

12. (a) What are the characteristics of hard computing and soft computing? (6 marks)

    (b) Describe various soft computing techniques (8 marks)

13. (a)Explain Exclusive OR problem. How it is solved with two layer perceptrons (8 marks)

    (b) Calculate the output y of a three-input neuron with bias. The input feature vector is (x1, x2,x3)= (0.3,0.5,0.6) and weight values are [w1,w2,w3, b] = [0.1, 0.3, -0.2, 0.35]. Use (i) binary sigmoidal and (ii) bipolar sigmoidal activation functions (6 marks)

OR

14. (a) (i) Construct a feed forward network with five input nodes, three hidden nodes and four output nodes.

(ii) Construct a recurrent network with four input nodes, three hidden nodes and two output nodes that has feedback links from the hidden layer to the input layer. (8 marks)

(b) Compare Supervised and Unsupervised Learning Methods. (6 marks)

15. (a) Using the inference approach, find the membership values for the fuzzy triangular shapes(i) isosceles triangle,(ii) equilateral triangle,(iii) right angle triangle,(iv) isosceles and right angle triangle (v) other triangles for a triangle with angles 45^0,55^0,80^0 (10 marks)

(b) What are the different features of membership functions? (4 marks)

OR

16. (a) Explain different Defuzzification methods (8 marks)

(b) Describe Max-min composition and Max-product composition of Classical Relations (6 marks)

17. (a) Define the following Aggregation of Fuzzy Rules

(i) Conjunctive system of rules (ii) Disjunctive system of rules (6 marks)

(b) Explain four modes of Fuzzy Approximate Reasoning (8 marks)

OR

18. (a) Compare Mamdani Fuzzy Interface System and Takagi-Sugeno Fuzzy Model (8 marks)

(b) What is meant by compound rule? List the different methods used for decomposition of compound linguistic rules into simple canonical rules. (6 marks)

19. (a) Briefly explain the selection operation in genetic algorithm. (5 marks)

(b) Compare and contrast cooperative Neuro- fuzzy systems and hybrid Neuro-fuzzy systems. (9 marks)

OR

20. (a) Explain Two-Point Crossover. In a Genetic algorithm, suppose that two potential parents are given by

1	1	0	0	1	1	0	1	1	1
0	0	1	1	1	0	1	0	0	1

Assuming the numbering goes from left to right and that $\square_1$=4 and $\square_2$=8, show result of two point crossover

(6 marks)

(b) Describe Neuro Genetic Hybrid Systems (8 marks)

Syllabus

Module 1: Introduction to Soft Computing (5 Hours)
Evolution of Computing-From Conventional Artificial Intelligence to Computational Intelligence, Characteristics of Hard Computing and Soft Computing, Soft Computing Constituents, Applications of Soft Computing
Module 2: Artificial Neural Networks (7 Hours)
Biological Neuron, Artificial Neural Network Architectures: Single-Layer Feed Forward Network, Multi-Layer Feed Forward Network and Recurrent Network, Learning Methods: Supervised, Unsupervised and Reinforced Learning
Module 3: Fuzzy Logic (8 Hours)
Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Operations on Fuzzy Relations, Fuzzy Membership Functions, Fuzzification, Methods of Membership Value Assignments, Defuzzification Methods
Module 4: Fuzzy System (6 Hours)
Fuzzy Rules: Formation, Decomposition and Aggregation, Fuzzy Reasoning, Fuzzy Inference System: Mamdani Fuzzy System and Sugeno Fuzzy System
Module 5: Genetic Algorithm and Hybrid Systems (9 Hours)
Genetic Algorithm: Basic Version of Genetic Algorithm, Encoding Methods, Operators in Genetic Algorithm: Selection, Crossover and Mutation Hybrid Systems: Basic Concept, Neuro-Fuzzy Hybrid System, Neuro-Genetic Hybrid System and Fuzzy-Genetic Hybrid System

Text Books

1. S.N.Sivanandam , S.N.Deepa, Principles of Soft Computing, Wiley India Pvt. Ltd., 2nd Edition, 2011.
2. S.Rajasekaran, G.A.Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications , PHI Learning Pvt. Ltd., 2017.

Reference Books

1. James A. Freeman and David M. Skapura, —Neural Networks Algorithms, Applications, and Programming Techniques, Addison Wesley, 2003.
2. Jacek M. Zurada, Introduction to Artificial Neural Systems, PWS Publishers, 1992.
3. George J. Klir and Bo Yuan, —Fuzzy Sets and Fuzzy Logic-Theory and Applications, Prentice Hall, 1996.
4. Mitchell Melanie, An Introduction to Genetic Algorithm, Prentice Hall, 1998.
5. David E. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison Wesley,1997.
6. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, —Neuro-Fuzzy and Soft Computing, Prentice-Hall of India, 2002.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Introduction to Soft Computing**	**5 Hours**
1.1	Evolution of Computing-From Conventional Artificial Intelligence to Computational Intelligence	2 Hours
1.2	Characteristics of Hard Computing and Soft Computing,	1 Hour
1.3	Soft Computing Constituents	1 Hour
1.4	Applications of Soft Computing	1 Hour
2	**Artificial Neural Networks**	**7 Hours**
2.1	Biological Neuron and Artificial Neural Network Concepts	1 Hour
2.2	Single-Layer and Multi-Layer Feed Forward Networks	2 Hours
2.3	Recurrent Network	1 Hour
2.4	Supervised Learning	1 Hour
2.5	Unsupervised Learning	1 Hour
2.6	Reinforced Learning	1 Hour
3	**Fuzzy Logic**	**8 Hours**
3.1	Fuzzy Sets and Operations on Fuzzy Sets	2 Hours
3.2	Fuzzy Relations and Operations on Fuzzy Relations	2 Hours
3.3	Fuzzy Membership Functions	2 Hours
3.4	Fuzzification and Methods of Membership Value Assignments	1 Hour
3.5	Defuzzification Methods	1 Hour
4	**Fuzzy System**	**6 Hours**
4.1	Fuzzy Rules: Formation, Decomposition and Aggregation	2 Hours
4.2	Fuzzy Reasoning	2 Hours
4.3	Fuzzy Inference System: Mamdani and Sugeno Fuzzy Systems	2 Hours
5	**Genetic Algorithm and Hybrid Systems**	**9 Hours**
5.1	Basic Version of Genetic Algorithm	1 Hour

5.2	Encoding Methods	1 Hour
5.3	Operators in Genetic Algorithm: Selection, Crossover and Mutation	3 Hours
5.4	Basic Concept of Hybrid Systems	1 Hour
5.5	Neuro-Fuzzy Hybrid System	1 Hour
5.6	Neuro-Genetic Hybrid System	1 Hour
5.7	Fuzzy-Genetic Hybrid System	1 Hour