School:		**School of Engineering and Technology**		
Department		**Department of Computer Science and Engineering**		
Program:		**B. Tech**		
Branch:		**CSE with Specialization in AI & ML**		
1	**Course Code**	**CSA301**		
2	**Course Title**	**SOFT COMPUTING**		
3	Credits	3		
4	Contact Hours (L-T-P)	3	0	0
	Course Status	Core		
5	Course Objective	The primary objective of this course is to provide an introduction to the basic principles, techniques, and applications of soft computing. ● Upon successful completion of the course, students will have an understanding of the basic areas of Soft Computing including Artificial Neural Networks, Fuzzy Logic and Genetic Algorithms. ● Provide the mathematical background for carrying out the optimization associated with neural network learning. ● Aim of this course is to develop some familiarity with current research problems and research methods in Soft Computing by working on a research or design project. To give students knowledge of **soft computing theories fundamentals,** i.e. of fundamentals of **non-traditional technologies** and approaches to solving hard real-world problems, namely of fundamentals of artificial neural networks, fuzzy sets and fuzzy logic and genetic algorithms.		
6	Course Outcomes	The Completion of this Course will Enable the Students to be able to Learn **CO1:** Define the basic concepts of soft computing. **CO2:** Explain applications & operations of Fuzzy Logic in real life problems. **CO3:** Apply different FIS models to solve optimization problems. **CO4:** Analyse and examine Evolutionary and swarm algorithms in solving real world Multi-Objective optimization problems **CO5:** Choose of different optimization algorithms to solve real-life multi objective problems. **CO6:** Discuss applications of Soft Computing and solve Problems in Varieties of Application Domains.		
7	Course Description	This course will cover fundamental concepts used in Soft computing. The concepts of Fuzzy logic (FL) will be covered first, followed by Artificial Neural Networks (ANNs) and optimization techniques using Genetic Algorithm (GA). Applications of Soft Computing techniques to solve a number of real life problems will be covered to have hands on practices. Soft computing covers non-traditional technologies or approaches for solving hard real-world problems. Tolerance of imprecision and uncertainty as the main attributes of soft computing theories. Ex: Neural networks. Fuzzy logic. Genetic algorithms.		

8					CO Mapping
	Unit 1	**Introduction to Soft Computing**			
	A	Concept of computing systems. What is Soft Computing?			CO1
	B	"Soft" Computing versus "Hard" computing			CO1
	C	Characteristics of Soft computing, Some applications of Soft computing techniques			CO1, CO6
	Unit 2	**FUZZY LOGIC**			
	A	Introduction to Fuzzy logic, Fuzzy sets and membership functions			CO2
	B	Operations on Fuzzy sets. Fuzzy relations, rules, propositions, implications and inferences.			CO2
	C	Defuzzification techniques, Fuzzy logic controller design, Some real life societal applications of Fuzzy logic.			CO2
	Unit 3	**Fuzzy inference System**			
	A	Fuzzy Inference Systems, Different Fuzzy Models: Mamdani Fuzzy Models, Sugeno Fuzzy Models			CO3
	B	Tsukamoto Fuzzy Models, Input Space Partitioning and Fuzzy Modeling.			CO3
	C	Neuro Fuzzy Modelling: Adaptive Neuro-Fuzzy Inference Systems, Architecture, Hybrid Learning Algorithm, Learning Method that Cross- fertilize ANFIS and RBFN			CO3
	Unit 4	**Swarm and Evolutionary Algorithms**			
	A	Concept of "Genetics" and "Evolution" and its application to probabilistic search techniques			CO4
	B	Basic GA framework and different GA architectures, GA operators: Encoding, Crossover, Selection, Mutation, Solving single-objective optimization problems			CO4
	C	Swarm Optimization: Introduction to Ant Colony Optimization, Particle Swarm Optimization etc.			CO4
	Unit 5	**Multi-objective Optimization Problem Solving**			
	A	Concept of multi-objective optimization problems (MOOPs) and issues of solving them.			CO5,CO6
	B	Multi-Objective Evolutionary Algorithm (MOEA) Non-Pareto approaches to solve MOOPs,			CO5,CO6
	C	Pareto-based approaches to solve MOOPs , Some applications with MOEAs			CO5,CO6
	Mode of examination	Theory and Practical			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. George J. Klir and Bo Yuan, "Fuzzy sets and Fuzzy Logic", Prentice Hall, USA. 2. Goldberg D.E., Genetic Algorithms in Search, Optimization, and Machine Learning Addison Wesley. 3. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill			
	Other References	**1. Jang J.S.R., Sun C.T. and Mizutani E, "Neuro-Fuzzy and Soft computing", Prentice Hall.**			

		2. An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press, 2000. 3. Genetic Algorithms In Search, Optimization And Machine Learning, David E. Goldberg, Pearson Education, 2002. 4. Practical Genetic Algorithms, Randy L. Haupt and sue Ellen Haupt, John Willey & Sons, 2002	

CO and PO Mapping

S. No.	Course Outcome	Program Outcomes (PO) & Program Specific Outcomes (PSO)
1.	**CO1:** Define the basic concepts of soft computing.	PO1,PO2,PO3,PO4, PO5,PO6,PO7,PO8, PO9,PO10, PSO1,PSO2,PSO3
2.	**CO2:** Explain applications & operations of Fuzzy Logic in real life problems.	PO1,PO2,PO3,PO4, PO5,PO6,PO7,PO8, PO9,PO10, PSO1,PSO2,PSO3
3.	**CO3:** Apply different FIS models to solve optimization problems.	PO1,PO2,PO3,PO4, PO5,PO6,PO7,PO8, PO9,PO10, PSO1,PSO2,PSO3
4.	**CO4:** Analyse and examine Evolutionary and swarm algorithms in solving real world Multi-Objective optimization problems	PO1,PO2,PO3,PO4, PO5,PO6,PO7,PO8, PO9,PO10, PSO1,PSO2,PSO3
5.	**CO5:** Choose of different optimization algorithms to solve real-life multi objective problems.	PO1,PO2,PO3,PO4, PO5,PO6,PO7,PO8, PO9,PO10, PSO1,PSO2,PSO3
6.	**CO6:** Discuss applications of Soft Computing and solve Problems in Varieties of Application Domains.	PO1,PO2,PO3,PO4, PO5,PO6,PO7,PO8, PO9,PO10, PSO1,PSO2,PSO3

PO and PSO mapping with level of strength for Course Name SOFT COMPUTING **(Course Code** CSA-202**)**

Subject	**PO's / PSO's**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
SOFT COMPUTING CSA301	CO1	3	3	1	1	1	1	1	1	2	1	1	3	1	3	1
	CO2	3	3	3	3	2	3	2	2	2	2	3	3	3	3	3
	CO3	3	3	3	3	3	3	1	2	2	2	3	3	3	3	3
	CO4	3	3	3	3	3	3	3	2	2	2	3	3	3	3	3
	CO5	3	3	3	3	3	3	3	2	3	2	3	3	3	3	3
	CO6	3	3	3	3	3	1	3	2	3	2	3	3	3	3	3

Average of non-zeros entry in following table (should be auto calculated).

Course Code	**Course Name**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CSA 301	**SOFT COMPUTING**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**2.83**	**2.00**	**2.00**	**3.00**	**2.67**	**3.00**	**2.83**	**2.83**	**2.67**

Strength of Correlation

1. Addressed to **Slight (Low=1) extent** **2.** Addressed to **Moderate (Medium=2) extent**
3. Addressed to **Substantial (High=3) extent**