Course Code	Course Name		Course Category		L	T	P	C
21CSE415T	FUZZY LOGIC AND ITS APPLICATIONS		E	PROFESSIONAL ELECTIVE	3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department		School of Computing	Data Book / Codes / Standards	Nil	

Course Learning Rationale (CLR): The purpose of learning this course is to:

CLR-1:	Outline the ideas of fuzzy sets, fuzzification and defuzzification.
CLR-2:	Explain fuzzy logic and fuzzy systems with examples
CLR-3:	Introduce decision making with fuzzy information
CLR-4:	Gain knowledge on fuzzy classification and pattern recognition
CLR-5:	Design and implement fuzzy control systems and industrial applications

Course Outcomes (CO): At the end of this course, learners will be able to:

		Program Outcomes (PO)												Program Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	PSO-1	PSO-2	PSO-3
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning			
CO-1:	Gain knowledge on Fuzzy sets to recognize the appropriateness of computational task	3	2	2	-	-	-	-	-	-	-	-	-	1	-	3
CO-2:	Learn the foundations of fuzzy logic and methods for fuzzy systems	3	2	3	-	-	-	-	-	-	-	-	-	1	-	-
CO-3:	Understand rule-based inference and decision making with fuzzy information	3	2	3	-	-	-	-	-	-	-	-	-	-	2	-
CO-4:	Acquire and apply fuzzy classification and recognition methods	3	2	3	-	-	-	-	-	-	-	-	-	-	2	-
CO-5:	Apply and Design fuzzy control systems with example applications	3	2	3	-	-	-	-	-	-	-	-	-	-	2	3

Unit-1 - Introduction 9 Hour

The Case for Imprecision, The Utility of Fuzzy Systems, Limitations of Fuzzy Systems, Uncertainty and Information, Fuzzy Sets and Membership, Chance versus Fuzziness - Fuzzy Sets: Fuzzy Set Operations, Properties of Fuzzy Sets, Noninteractive Fuzzy Sets, Alternative Fuzzy Set Operations - Fuzzy Relations: Crisp Relations, Fuzzy Relations, Fuzzy Tolerance and Equivalence Relations, Value Assignments, Problems on fuzzy relation - Membership function – various forms –fuzzification – defuzzification to crisp sets.

Unit-2 - Logic and Fuzzy Systems 9 Hour

classical logic, fuzzy logic, fuzzy systems – Development of Membership functions: membership value assignments, intuition, Inference, rank ordering – Automated Methods for Fuzzy Systems: Definitions, Batch Least Squares Algorithm, Recursive Least Squares Algorithm, Gradient Method, Learning From Example, Modified Learning From Example, Problems on logic and fuzzy systems

Unit-3 - Rule-Base Reduction Methods 9 Hour

: Fuzzy Systems Theory and Rule Reduction, Singular Value Decomposition, Combs Method, SVD and Combs Method Examples, problems on SVD and Combs method for rapid inference - Decision Making with Fuzzy Information: Fuzzy Synthetic Evaluation, Fuzzy Ordering, Nontransitive Ranking, Preference and Consensus, Multiobjective Decision Making, Decision Making under Fuzzy States and Fuzzy Actions, problems on decision making with fuzzy information.

Unit-4 - Fuzzy Classification and Pattern Recognition 9 Hour

Classification by Equivalence Relations, Cluster Analysis, Cluster Validity, c-Means Clustering, Fuzzy c-Means, Classification Metric, Similarity Relations from Clustering - Pattern Recognition: Feature Analysis, Partitions of the Feature Space, Single-Sample Identification, Multifeature Pattern Recognition, problems on fuzzy classification and pattern recognition, Case Study: Hand written character recognition using fuzzy logic.

Unit-5 - Fuzzy Control Systems 9 Hour

Control System Design Problem, Control (Decision) Surface, Assumptions in a Fuzzy Control System Design, Simple Fuzzy Logic Controllers, Examples of Fuzzy Control System Design, Aircraft Landing Control Problem - Fuzzy Optimization - Fuzzy Linear Regression – problems on fuzzy optimization and regression, Case study: Robot Navigation using fuzzy logic.

Learning Resources	1. Ross, T. J., "Fuzzy logic with engineering applications," John Wiley & Sons, Second Edition, 2017 2. H.-J. Zimmermann, "Fuzzy Set Theory and Its Applications", 4th edition, Springer Science+Business Media, LLC, 2001 3. J.-S. R. Jang, C.-T. Sun, and E. Mizutani, "Neuro-Fuzzy and Soft Computing" Prentice Hall. 1997.	4. Klir.G, Yuan B.B. Fuzzy sets and Fuzzy Logic Prentice Hall of India private limited, 1997 5. https://ieeexplore.ieee.org/document/519069/ 6. https://www.academia.edu/2073261/A_case_study_of_fuzzy_logic_based_robot_navigation

Learning Assessment

Bloom's Level of Thinking		Continuous Learning Assessment (CLA)						Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)			Life-Long Learning CLA-2 (10%)				
		Theory	Practice		Theory	Practice		Theory	Practice
Level 1	Remember	20%	-		20%	-		20%	-
Level 2	Understand	30%	-		20%	-		20%	-
Level 3	Apply	50%	-		50%	-		50%	-
Level 4	Analyze	-	-		10%	-		10%	-
Level 5	Evaluate	-	-		-	-		-	-
Level 6	Create	-	-		-	-		-	-
	Total	100 %			100 %			100 %	

Course Designers

Experts from Industry

1. Dr.A.Vasanthi, Senior Consultant, Slalom - Sydney, New South Wales, Australia

Experts from Higher Technical Institutions

1. Dr.A.Punitha, Associate Professor, Annamalai University

Internal Experts

1. Mr.S.Joseph James, SRMIST