

Course Code	21CSE415T	Course Name	FUZZY LOGIC AND ITS APPLICATIONS	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							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:		Program Outcomes (PO)												Program Specific outcomes			
CLR-1:	CLR-2:	CLR-3:	CLR-4:	CLR-5:	1	2	3	4	5	6	7	8	9	10	11	12	PSO-1	PSO-2	PSO-3
Outline the ideas of fuzzy sets, fuzzification and defuzzification.	Explain fuzzy logic and fuzzy systems with examples	Introduce decision making with fuzzy information	Gain knowledge on fuzzy classification and pattern recognition	Design and implement fuzzy control systems and industrial applications	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:	CO-2:	CO-3:	CO-4:	CO-5:	3	2	2	-	-	-	-	-	-	-	-	-	1	-	-
Gain knowledge on Fuzzy sets to recognize the appropriateness of computational task	Learn the foundations of fuzzy logic and methods for fuzzy systems	Understand rule-based inference and decision making with fuzzy information	Acquire and apply fuzzy classification and recognition methods	Apply and Design fuzzy control systems with example applications	3	2	3	-	-	-	-	-	-	-	-	-	1	-	-
					3	2	3	-	-	-	-	-	-	-	-	-	-	2	-
					3	2	3	-	-	-	-	-	-	-	-	-	-	2	-
					3	2	3	-	-	-	-	-	-	-	-	-	-	2	3

<b>Unit-1 - Introduction</b>	<b>9 Hour</b>
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.	
<b>Unit-2 - Logic and Fuzzy Systems</b>	<b>9 Hour</b>
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	
<b>Unit-3 - Rule-Base Reduction Methods</b>	<b>9 Hour</b>
: 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.	
<b>Unit-4 - Fuzzy Classification and Pattern Recognition</b>	<b>9 Hour</b>
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.	
<b>Unit-5 - Fuzzy Control Systems</b>	<b>9 Hour</b>
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.	

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

<b>Learning Assessment</b>							
	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	-	-	-	-	-	-
	<i>Total</i>	100 %		100 %		100 %	

<b>Course Designers</b>		
<b>Experts from Industry</b>	<b>Experts from Higher Technical Institutions</b>	<b>Internal Experts</b>
1. Dr.A.Vasanthi, Senior Consultant, Slalom · Sydney, New South Wales, Australia	1. Dr.A.Punitha, Associate Professor, Annamalai University	1. Mr.S.Joseph James, SRMIST