

Course code	Course Name	L-T-P - Credits	Year of Introduction
CS462	FUZZY SET THEORY AND APPLICATIONS	3-0-0-3	2016
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>To introduce the theory of fuzzy sets.</li> <li>To discuss theoretical differences between fuzzy sets and classical sets.</li> <li>To discuss fuzzy logic inference</li> <li>To introduce fuzzy arithmetic concepts.</li> <li>To discuss fuzzy inference applications in the area of control.</li> </ul>			
<b>Syllabus:</b> Theory of Fuzzy Sets: Classical Sets vs Fuzzy Sets, Types of Fuzzy Sets, Operations on Fuzzy Sets, Zadeh's Extension Principle, Fuzzy Relations, Fuzzy Relational Equations, Possibility Theory and Fuzzy Measures. Applications of Fuzzy Sets: Approximate Reasoning, Fuzzy Relational Inference, Fuzzy Controllers, Efficiency and Effectiveness of inference schemes, Functional Approximation capabilities.			
<b>Expected Outcome:</b> The Student will be able to : <ol style="list-style-type: none"> <li>interpret fuzzy set theory and uncertainty concepts</li> <li>identify the similarities and differences between probability theory and fuzzy set theory and their application conditions</li> <li>apply fuzzy set theory in modeling and analyzing uncertainty in a decision problem</li> <li>apply fuzzy control by examining simple control problem examples</li> </ol>			
<b>Text Books:</b> <ol style="list-style-type: none"> <li>George J Klir and Bo Yuan, "<i>Fuzzy Sets and Fuzzy Logic : Theory and Applications</i>", Prentice Hall NJ,1995.</li> <li>Timothy J. Ross, "Fuzzy Logic with Engineering Applications", 3rd Edition, Willey, 2010.</li> </ol>			
<b>References:</b> <ol style="list-style-type: none"> <li>E P Klement, R Mesiar and E. Pap, Triangular norms, Kluwer Academic Press, Dordrecht, 2000.</li> <li>H.J. Zimmermann, <i>Fuzzy Set Theory and its Applications</i>, Allied Publishers, New Delhi, 1991.</li> <li>Kevin M Passino and Stephen Yurkovich, <i>Fuzzy Control</i>, Addison Wesley Longman, 1998.</li> <li>M Grabisch et al., <i>Aggregation Functions</i>, Series - Encyclopedia Of Mathematics And Its Applications, Cambridge University Press, 2009</li> <li>Michal Baczynski and Balasubramaniam Jayaram, <i>Fuzzy Implications</i>, Springer Verlag, Heidelberg, 2008.</li> </ol>			
Course Plan			
Module	Contents	Hours	End Sem. Exam Marks
I	Classical sets vs Fuzzy Sets - Need for fuzzy sets - Definition and Mathematical representations - Level Sets - Fuzzy functions - Zadeh's Extension Principle.	06	15%
II	Operations on [0,1] - Fuzzy negation, triangular norms, t-	06	15%

	conorms, fuzzy implications, Aggregation Operations, Fuzzy Functional Equations		
<b>FIRST INTERNAL EXAMINATION</b>			
<b>III</b>	Fuzzy Binary and n-ary relations - composition of fuzzy relations - Fuzzy Equivalence Relations - Fuzzy Compatibility Relations - Fuzzy Relational Equations	07	15%
<b>IV</b>	Fuzzy Measures - Evidence Theory - Necessity and Belief Measures - Probability Measures vs Possibility Measures	07	15%
<b>SECOND INTERNAL EXAMINATION</b>			
<b>V</b>	Fuzzy Decision Making - Fuzzy Relational Inference - Compositional Rule of Inference - Efficiency of Inference - Hierarchical	08	20%
<b>VI</b>	Fuzzy If-Then Rule Base - Inference Engine - Takagi-Sugeno Fuzzy Systems - Function Approximation Applications <i>Advanced topics: Adaptive fuzzy inference systems: Adaptive networks - Architectures - Learning rules.</i> <i>Adaptive neuro-fuzzy inference systems (ANFIS) - Architectures - Hybrid learning rules.</i>	08	20%
<b>END SEMESTER EXAM</b>			

#### Question Paper Pattern

- There will be **FOUR** parts in the question paper – A, B, C, D
- Part A**
  - Total marks : 40**
  - TEN** questions, each have **4 marks**, covering **all the SIX modules** (**THREE** questions from **modules I & II**; **THREE** questions from **modules III & IV**; **FOUR** questions from **modules V & VI**). **All** questions have to be answered.
- Part B**
  - Total marks : 18**
  - THREE** questions, each having **9 marks**. One question is from **module I**; one question is from **module II**; one question **uniformly** covers **modules I & II**.
  - Any TWO** questions have to be answered.
  - Each question can have **maximum THREE** subparts.
- Part C**
  - Total marks : 18**
  - THREE** questions, each having **9 marks**. One question is from **module III**; one question is from **module IV**; one question **uniformly** covers **modules III & IV**.
  - Any TWO** questions have to be answered.
  - Each question can have **maximum THREE** subparts.
- Part D**
  - Total marks : 24**
  - THREE** questions, each having **12 marks**. One question is from **module V**; one question is from **module VI**; one question **uniformly** covers **modules V & VI**.
  - Any TWO** questions have to be answered.
  - Each question can have **maximum THREE** subparts.
- There will be **AT LEAST 60%** analytical/numerical questions in all possible combinations of question choices.