Course code	Course Name	L-T-P - Credits	Year of Introduction
CS462	FUZZY SET THEORY AND APPLICATIONS	3-0-0-3	2016

Course Objectives:

- To introduce the theory of fuzzy sets.
- To discuss theoretical differences between fuzzy sets and classical sets.
- To discuss fuzzy logic inference
- To introduce fuzzy arithmetic concepts.
- To discuss fuzzy inference applications in the area of control.

Syllabus:

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.

Expected Outcome:

The Student will be able to :

i. interpret fuzzy set theory and uncertainty concepts
ii. identify the similarities and differences between probability theory and fuzzy set theory and their application conditions
iii. apply fuzzy set theory in modeling and analyzing uncertainty in a decision problem
iv. apply fuzzy control by examining simple control problem examples

Text Books:

1. George J Klir and Bo Yuan, "*Fuzzy Sets and Fuzzy Logic : Theory and Applications*", Prentice Hall NJ,1995.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", 3rd Edition, Willey, 2010.

References:

1. E P Klement, R Mesiar and E. Pap, Triangular norms, Kluwer Academic Press, Dordrecht, 2000.
2. H.J. Zimmermann, *Fuzzy Set Theory and its Applications*, Allied Publishers, New Delhi, 1991.
3. Kevin M Passino and Stephen Yurkovich, *Fuzzy Control*, Addison Wesley Longman, 1998.
4. M Grabisch et al., *Aggregation Functions*, Series - Encyclopedia Of Mathematics And Its Applications, Cambridge University Press, 2009
5. Michal Baczynski and Balasubramaniam Jayaram, *Fuzzy Implications*, Springer Verlag, Heidelberg, 2008.

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

Question Paper Pattern

1. There will be ***FOUR*** parts in the question paper – **A, B, C, D**
2. **Part A**
   a. **Total marks : 40**
   b. ***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.
3. **Part B**
   a. **Total marks : 18**
   b. ***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**.
   c. ***Any TWO*** questions have to be answered.
   d. Each question can have ***maximum THREE*** subparts.
4. **Part C**
   a. **Total marks : 18**
   b. ***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**.
   c. ***Any TWO*** questions have to be answered.
   d. Each question can have ***maximum THREE*** subparts.
5. **Part D**
   a. **Total marks : 24**
   b. ***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**.
   c. ***Any TWO*** questions have to be answered.
   d. Each question can have ***maximum THREE*** subparts.
6. There will be ***AT LEAST* 60%** analytical/numerical questions in all possible combinations of question choices.