

NIRMA UNIVERSITY

Institute:	Institute of Technology, School of Technology
Name of Programme:	BTech in Electronics and Instrumentation Engineering
Semester:	VII
Course Code:	4EI102ME25
Course Title:	Fuzzy Control Theory
Course Type:	Department Elective-III
Year of Introduction:	2024-25

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Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to –

1. interpret basics of fuzzy set theory (BL3)
2. analyze fuzzy inference system (BL4)
3. execute fuzzy based control system (BL5)
4. design fuzzy logic controller for various applications. (BL6)

Unit	Contents	Teaching hours (Total 45)
Unit - I	Introduction Fuzzy control from an industrial perspective, benefits of fuzzy control, limits of fuzzy control, use of fuzzy control, applications, Knowledge based system for process control: process monitoring, fault diagnosis, planning & scheduling, supervisory control	03
Unit - II	Theory of Fuzzy logic Introduction: fuzzy sets: fuzzy set theory vs. probability theory, classical set theory. fuzzy set theory, properties of fuzzy sets, operations of fuzzy sets, Fuzzy relations: classical relations, fuzzy relations, operations on fuzzy relations, the extension principle, approximate reasoning: introduction, linguistic variables, fuzzy propositions, fuzzy if then statements, inference rules, the compositional rule of inference, Representing a set of rules: properties of rules, completeness of a set of rules, consistency of a set of rules, continuity of a set of rules, interaction of a set of rules.	15
Unit - III	Fuzzy Knowledge Based Controller design (FKBC) Structure of FKBC: fuzzification, knowledge base, inference engine, defuzzification, Rule base: choice of variables and content of rules, choice of term set, derivation of rules, Data base: choice of membership functions, choice of scaling function, inference engine, choice of fuzzification procedure, choice of defuzzification procedure.	15
Unit - IV	Applications of Fuzzy Control Controller tuning using fuzzy logic, fuzzy logic based controller design for inverted pendulum and robots, design of fuzzy decision making systems	12

Self Study:

The self -study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:

This shall consist of at least 10 practicals based on the above syllabus.

Suggested Reading:

1. Jang, T. Sun and E. Mizutani, *Neuro-Fuzzy and Soft computing. A computational Approach to learning and machine intelligence*, Prentice Hall Publication.
2. Kevin Passino, *Fuzzy control*, Addison Wesley Publication.
3. D.Driankov, H. Hellendoorn and M. Reinfrank, *An Introduction to Fuzzy Control*, Springer Publication.

Suggested List of Experiments:

Sr. No	Name of Experiments/Exercises	Hours
1	Familiarization with fuzzy logic toolbox	02
2	Verification of crisp set properties using fuzzy sets	02
3	Verification of membership function related operation	02
4	Verification of various fuzzy complement operations	02
5	Verification of T-norm and S-norm operations using fuzzy membership functions	02
6	Design of FAMM [Fuzzy Associative Memory Map] to develop fuzzy rules	02
7	Tuning of fuzzy rules	02
8	Analyze various defuzzification methods	02
9	Design of fuzzy logic system	02
10	Design of fuzzy logic based control system with fuzzy logic toolbox	02
11	Case study 1: Fuzzy controller design	02
12	Case study 2: Fuzzy controller design	02