NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B. Tech in Electronics and Instrumentation Engineering
Course Code:	2EIDE65
Course Title:	Fuzzy Control Theory
Course Type:	([] Core/[] Value Added Course/[√] **Departmental Elective/** [] Institute Elective/[]University Elective/[]Any other)
Year of introduction:	2023-2024

Credit Scheme

L	T	Practical component				C
		LPW	PW	W	S	
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Course Learning Outcomes (CLO):

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

1. interpret basics of fuzzy set theory
2. develop fuzzy inference system
3. design fuzzy based control system
4. apply fuzzy logic controller for various applications

Syllabus: **Total Teaching hours: 30**

Unit	Syllabus	Teaching hours
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	04
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.	10

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.	10
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	06

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: Laboratory work will consist of minimum 10 experiments based on the above syllabus.

Suggested List of Experiments:

1. Familiarization with fuzzy logic toolbox
2. Verification of crisp set properties using fuzzy sets
3. Verification of membership function related operations
4. Verification of various fuzzy complement operations
5. Verification of T-norm and S-norm operations using fuzzy membership functions
6. Design of FAMM [Fuzzy Associative Memory Map] to develop fuzzy rules
7. Tuning of fuzzy rules
8. Analyze various defuzzification methods
9. Design of fuzzy logic system
10. Design of fuzzy logic based control system with fuzzy logic toolbox
11. Case study 1: Fuzzy controller design
12. Case study 2: Fuzzy controller design

Suggested Readings/ References:

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 Case List: --

L= Lecture, T=Tutorial, P= Practical, C= Credit

w.e.f. academic year 2023-24 and onwards.