MNE8125: INTELLIGENT CONTROL OF COMPLEX NONLINEAR SYSTEMS

Effective Term
Semester A 2026/27

Part I Course Overview

Course Title
Intelligent Control of Complex Nonlinear Systems

Subject Code
MNE - Mechanical Engineering
Course Number
8125

Academic Unit
Mechanical Engineering (MNE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
R8 - Research Degree

Medium of Instruction
English

Medium of Assessment
English

Precursors
MNE3049

Part II Course Details

Abstract
This course covers several advanced topics in intelligent control of complex nonlinear systems at a level for research degree students in mechanical engineering, electrical engineering, and related areas. The course aims to present systematic and fundamental design methodologies for intelligent control of complex nonlinear systems which exist in many practical applications. The topics include, but not limited to, fuzzy sets and fuzzy systems, fuzzy dynamic system modeling, stability analysis of fuzzy dynamic systems, control/ robust control/adaptive control of fuzzy dynamic systems. Furthermore, this course also aims to equip students with design skills of various controllers, and thus enable students to develop skills in solving practical intelligent control problems of complex nonlinear systems.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe fuzzy sets, fuzzy logic, fuzzy systems, and fuzzy dynamic systems		x	x	
2	Apply fuzzy dynamic system modeling to complex nonlinear systems		x	x	x
3	Design intelligent controllers for various fuzzy dynamic systems		x	x	
4	Apply various control design methods to typical complex nonlinear systems		x	x	x

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures/Discussions/ Project Presentations	Students will develop the understanding of key concepts and control design methodologies. They will also present their project findings.	1, 2, 3, 4	3 hours/week
2	Projects	Students will carry out projects to solve intelligent control problems of some typical complex nonlinear systems. They will also present their findings in the form of technical reports.	1, 2, 3, 4	6 weeks

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks	Allow Use of GenAI?
1	Projects including presentations	1, 2, 3, 4	50	One report to be submitted	Yes

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)
2

Additional Information for ATs
For a student to pass the course, at least 30% of the maximum mark for both coursework and examination should be obtained.

Assessment Rubrics (AR)

Assessment Task
Project reports (for students admitted in Semester A 2024/25 & thereafter)

Criterion
Ability to solve the problems of intelligent control for some typical practical complex nonlinear systems

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching the marginal level

Assessment Task
Examination (for students admitted in Semester A 2024/25 & thereafter)

Criterion
Ability to analyze and design controllers for various fuzzy dynamic systems.

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal level

Assessment Task
Project Report (for students admitted in Semester A 2022/23 to summer term 2024)

Criterion
Ability to solve the problems of intelligent control for some typical practical complex nonlinear systems

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Marginal (D)
Basic

Failure (F)
Not even reaching marginal level

Assessment Task
Examination (for students admitted in Semester A 2022/23 to summer term 2024)

Criterion
Ability to analyse and design controllers for various fuzzy dynamic systems

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Marginal (D)
Basic

Failure (F)
Not even reaching marginal level

Part III Other Information

Keyword Syllabus
Intelligent control, complex systems, nonlinear systems, fuzzy sets, fuzzy systems, fuzzy dynamic systems, Lyapunov stability, stabilization, robust control, H_∞ control, adaptive control, system modeling, observers, filtering

Reading List

Compulsory Readings

	Title
1	G. Feng, Analysis and Synthesis of Fuzzy Control Systems: A Model-Based Approach, CRC Press, 2010. ISBN: 978-1420092646.

Additional Readings

	Title
1	G. Chen and T.T. Pham, Introduction to Fuzzy Sets, Fuzzy Logic, and Fuzzy Control Systems, CRC Press, ISBN: 0849316588.
2	M. Kristic, I. Kanellakopoulos, and P. Kokotovic, Nonlinear and Adaptive Control, John Wiley &Sons, 1995, ISBN: 0471127329.