ELK 7132 FUZZY LOGIC CONTROL IN ENERGY SYSTEMS 3(3 0 0)

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Objectives of the Course

The students are subject to learn basic concepts in fuzzy logic control and fuzzy decision making processes applied to power systems, renewable energy systems such as solar and wind, energy management systems and micro grids. The students will also be able to develop and design fuzzy subsystems, partition the universes, developing fuzzy decision makers and controllers and simulating those models in Matlab/ Simulink.

Contents

The course covers the basic concepts of fuzzy set theory. Partitioning the universes of power and energy systems. Problem definitions in power and energy systems using fuzzy terms. Fuzzy logic based solution approaches to load-frequency and excitation control of power systems. Fuzzy logic control for damping oscillations in power systems. Application of fuzzy logic control to wind and solar PV systems such as in utility integration and MPPT operation. Fuzzy logic in micro grids and energy management systems.

Learning Outcomes

Upon successfully completion of the course, the students will be able to :
LO - 1 : Have sufficient knowledge on fuzzy logic control and decision making
LO - 2 : Have sufficient information on fuzzy logic control of load-frequency systems
LO - 3 : Have sufficient knowledge on fuzzy logic control of excitation systems
LO - 4 : Develop fuzzy logic controller and decision maker to damp oscillations in power systems
LO - 5 : Model fuzzy logic controllers and decision makers for wind energy control and operation
LO - 6 : Model fuzzy logic controllers and decision makers for PV solar energy control and operation
LO - 7 : Using fuzzy logic in micro
LO - 8 : Using fuzzy logic in energy management systems

Teaching Plan

Week 1 Basics of Fuzzy Sets, Fuzzy operations, Fuzzy Partition, Fuzzy sets for Representing Uncertain data
Week 2 Fuzzy sets for Representing Uncertain data
Week 3 Uncertain data in PV solar, wind and wave energy systems
Week 4 Uncertain data in Power Systems
Week 5 Fuzzy relations and fuzzy inference systems
Week 6 Fuzzy implication and fuzzy decision-making
Week 7 Decision making in energy systems
Week 8 Intelligent decision making in energy systems
Week 9 Midterm exam
Week 10 FLC of Single Machine Connected to Infinite Bus
Week 11 FLC of Exciter Systems
Week 12 FLC in Wind Energy Systems
Week 13 FLC in PV Energy Systems
Week 14 FLC for oscillation in power systems
Week 15 FLC for micro grids and energy management
Week 16 Final exam

Text book / Course materyals

1. Ismail H. Altas, unpublished lecture notes
2. Ismail H. Altas, "Fuzzy Logic Control in Energy Systems with design applications in MATLAB/Simulink", The Institution of Engineering and Technology (The IET) Books, 2017.

Evaluation Method

Method	Week	Date	Duration (Hour)	Contribution (%)
Midterm	9		2	30
Project 1	5 - 11		12	20
Project 2 (Final)	10 - 15		12	50
Total			26	100

Student Work Load and its Distribution

Type of work	Duration (hours pw)	Number of weeks
Lectures (face to face teaching)	3	14
Extracurricular work	2	10
Preparation for the Midterm Exam	2	8
Midterm	2	1
Homework	0	0
Project	2	6
End of term exam	2	6
Other 1	2	1
Total Work Load	**15**	