



Course Syllabus

1. Course Title:

Fuzzy Modeling in Matlab

2. Academic Level:

Master

3. ECTS Credits:

5 ECTS

4. Semester:

2, spring semester

5. School/Department:

Institute of Radio Engineering Systems and Control/ Department of Automatic Control Systems

6. Location:

Taganrog Campus, 44 Nekrasovsky Lane, Taganrog

7. Instructor:

Assoc. Prof. Elena Shestova, email: eashestova@sfedu.ru

8. Language of Instruction:

English

9. Course Description:

In discipline Fuzzy modeling in Matlab, the basics of fuzzy set theory and fuzzy logic as well as the basics of fuzzy modeling in Matlab are considered. The lecture part of the course and laboratory work are supported by many examples that allow students to study in more detail the process of modeling control systems using fuzzy logic.

10. Course Aims:

Course aims: teaching students the methods of mathematical modeling of complex dynamic objects and control systems using fuzzy logic; training in types of mathematical models of objects and control processes based on fuzzy logic; training in the field of construction and research of mathematical models based on fuzzy logic for the optimization and control of technical, economic and social objects.

11. Specific entry requirements (if any):

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12. Course Content:

Module 1. Formalization of uncertainties.

1. Fuzzy sets. Basic terms and definitions.
2. Formalization of the parameters of control objects using linguistic forms.
3. Application of fuzzy operations.
4. Fuzzy logical inference.

Module 2. Decision making models.

5. Basic algorithms of fuzzy inference.
6. Exploring the possibilities of fuzzy modeling in Matlab. Development of Mamdani type fuzzy system in Matlab Fuzzy Logic Toolbox.
7. Situational model of decision making, the basic features. Development of Sugeno fuzzy system in Matlab Fuzzy Logic Toolbox.
8. Fuzzification and defuzzification operations. Exploring Simulink simulation features.
9. Control models in the form of a fuzzy controller.

13. Intended Learning Outcomes:

After studying this course, the student will receive the following knowledge, skills and abilities.

Knowledge: fundamental and advanced knowledge and scientific principles underlying the fuzzy modeling in the formulation and solution of engineering tasks; methods of constructing mathematical models of objects and control systems with the use of fuzzy logic; methods of formalizing the parameters of technical, economic and social systems in the context of incomplete source data, at the verbal level using the knowledge of experts; modern methods of constructing algorithms and their implementation using application programs in the field of fuzzy modeling.

Skills: to create fuzzy models: of objects and control processes, of economic models, models of technological processes, tools and systems for automation, control, diagnostics at all stages of its life cycle; to apply mathematical, architectural and software framework for modeling control systems based on fuzzy logic; the use of the tools of the Fuzzy Logic Toolbox in Matlab to simulate a fuzzy system.

Abilities: the principles and methods for constructing systems based on fuzzy logic; development of programs for the study of mathematical models of the objects and processes under study using fuzzy logic; application Programming in Matlab environment based on the study of control systems with the use of fuzzy logic.

14. Learning and Teaching Methods:

Lecture - visualization using presentation material.

Laboratory classes - students use the Matlab Fuzzy Logic software package with a variety of examples of constructing mathematical models to explore the possibilities of fuzzy modeling in Matlab.

Self-study - use of different reference books and Internet resources.

15. Methods of Assessment/Final assessment information:

Current assessment: Performing laboratory work, a written survey on the topics of lectures, an essay.

Frontier assessment: control of theoretical knowledge (in the form of a written test).

Final assessment: offset.

16. Reading List:

Main reading list.

1. Soloviev V.V., Shadrina V.V., Shestova E.A. The Basics of the fuzzy modelling in Matlab: tutorial. - Taganrog: SFU Publishing House, 2015. — 99 p. ISBN 978-5-9275-1683-4. URL: <https://biblioclub.ru/index.php?page=book&id=462029>.
2. Soloviev V.V., Shadrina V.V., Shestova E.A. Investigation of the fuzzy control systems in Matlab: tutorial. - Taganrog: SFU Publishing House, 2015. — 54 p. ISBN 978-5-9275-1686-5. URL: <https://biblioclub.ru/index.php?page=book&id=462028>.

Additional reading list.

1. Intelligent information systems and technologies / Yu.Yu. Gromov - Tambov: Publishing house of FGBOU VPO "TSTU", 2013. - 244 p. <http://biblioclub.ru/index.php?page=book&id=277713>
2. Finaev V.I. Modeling in the design of information and control systems. Taganrog, TRTU, 2002. http://ntb.tti.sfedu.ru/UML/UML_3320.pdf
3. Sakharova, L. V. Mathematical modeling under uncertainty: textbook: / L. V. Sakharova; Rostov State Economic University (RINH). - Rostov-on-Don: Publishing and printing complex RGEU (RINH), 2017. — <https://biblioclub.ru/index.php?page=book&id=567423>.