# Syllabus

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|---|---|---|---|---|---|
| **Term:** | 2022/23/1 | **Subject name:** | Intelligent Controll Systems | **Subject code:** | IVM194ANMI |

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|---|---|
| **Unit (Unit code)** | (MIK-IV) |
| **Lecturer responsible for the course:** | JANCSKÁRNÉ DR. Anweiler Ildikó |
| **Requirement:** | Exam |
| **Classes per week :** | 2/2/0/0 |
| **Classes per term:** | 14/14/0/0 |

**Purpose of education:**

**Introduction, Learning Outcomes**

This course presents some fundamental knowledge of classic and modern control systems, focusing on intelligent control algorithms.

Upon completion of this course the student should be :

- able to understand basic knowledge of control systems
- able to apply basic knowledge of fuzzy information representation and processing
- able to apply basic fuzzy inference and approximate reasoning
- able to understand the basic notion of fuzzy rule base
- able to apply basic fuzzy PID control systems.

**Contents:**

**General Course Description and Main Content:**

Introduction to control engineering.Basics of classical control theory, PID control. Control performance testing examples. Introduction to fuzzy sets: The uncertain and inexact nature of the real world: ideas and examples; fuzzy membership functions. Introduction to fuzzy logic: Basic concept and properties of fuzzy logic versus classical two-valued logic. Introduction to fuzzy inference: Fuzzy inference principles; fuzzy decision making; approximate reasoning. Introduction to fuzzy rule base: If-Then rules; general format of fuzzy rule base; establishment of fuzzy rule base. Introduction to fuzzy control systems: Basic fuzzy control principle: example of set-point tracking; open-loop and closed-loop fuzzy control systems; fuzzy PID controllers design methods.

**Methodology:**

Lecturing using NI ELVIS QUANSER models. Practice in LabVIEW with PID and fuzzy logic toolkit development module.

**Dokuments: in Neptun Meetstreet.**

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**Contents:**

**Assigments: in Moodle LMS.**

**Lectures and consultations: in class room or MS Teams.**

| Ref. Nr. | **Lecture topics** | **Lecture ppt in pdf: Intelligent Control Systems_Jancskárné_2020.pdf slides page-to-page** |
|---|---|---|
| **1.** | Introduction to control principles,<br>Control examples | 1…22 |
| **2.** | Open loop, closed loop control examples;<br>elements of the control loops;<br>Graphical representation of control loops: P&ID diagrams , Block diagrams | 22…30<br>34…42<br>30…34 |
| **3.** | Stedady-state & transient responses;<br>first order second order systems;<br>model reduction to FOPTD t | 43…52<br>53…62 |
| **4.** | Closed loop control : on/off controller and control performance | 146…150 |
| **5.** | Closed loop control II: continous control;<br>control performance meters;<br>PID controller;<br>Saturation of the final control element | 155…160<br>173…180<br>181…185 |

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**Contents:**

| Lab ref. Nr. | Topics of Seminar, lab | Assignment or Report required |
|---|---|---|
| 1. | Drawing P&ID diagrams and block diagrams | Quiz |
| 2. | Approximation FOPDT model parameters of three tank step response. | Report |
| 3. | Drawing a Control Loop demo program in LabVIEW: 1. simulation a FOPDT controlled process . | |
| 4. | Drawing a Control Loop demo program in LabVIEW: 1. writing on/off control algorithm. Testing the contol loop. (Step reference change.) | Program and Report |
| 5. | Modell system PID control: writing PID control algorithm. | |
| 6. | Testing the contol loop. (Step reference change.) Performance comparison. | Program and Report |
| 7. | Fuzzy set manipulation | |
| 8. | Fuzzy controller design | Quiz |
| 9. | Fuzzy controller design in LabVIEW and performance testing. | .fs Fuzzy file and program , |
| 10. | Presentation of a scientific paper | pptx upload and taking a presentation |
| 11. | Presentation of a Labview control demo program | Report and taking a presentation using the program |

**Schedule**

**Syllabus**

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**Contents:**

| **Week of semester** | **Lecture topic** Nr. | **Seminar, lab** Nr. |
|---|---|---|
| **2** | 1,2 | 1 |
| **3** | 3 | 2 |
| **4** | 4 | 3 |
| **5** | 5,6 | 4,5 |
| **6** | 6,7 | 4,5 |
| **7** | 8 | 6 |
| **8** | 9 | 7 |
| **9** | Autumn break | |
| **10** | 10,11 | 8 |
| **11** | 12 | 8,9 |
| **12** | 13,14 | 8,9 |
| **13** | Consultation & Student's presentations of task1 | 10 |
| **14** | Student's presentations of task2 | 11 |

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**Contents:**

| | | |
|---|---|---|
| **15** | Final Grade | |

**System of examing and valuation:**

Each student is expected to do quizzes, homework assignments and submit the final project with a written report on the topic as agreed upon by the student and the instructor.

Projects and homework

1. Paper Review: A journal paper dealing with fuzzy systems will be assigned by the instructor. The student will write a detailed report on the paper, showing his/her mastery and understanding of the contents of the paper. All relevant mathematical derivations and computer simulations (if any) will be included in the report.

2.Explain a LabVIEW fuzzy demo program..

3. Design a fuzzy controller for a model system. Students will prepare a written report on their project, explaining in detail the theoretical development, experimental work, and analysis of the results obtained.

**Attendance:**

Attending is required all classes. Unexcused absences will adversely affect the grade, and in case of absence from more than 30% of the total number of lesson will be grounds for failing the class. To be in class at the beginning time and stay until the scheduled end of the lesson is required, tardiness of more than 20 minutes will be counted as an absence. In the case of an illness or family emergency, the student must present a valid excuse, such as a doctor's note.

**Evaluation + Grading**

Evaluation criteria will be able with the Report descriptions.

Offered exam grade can be obtained, calculated from the results of the study period.

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**System of examing and valuation:**

**Grading scale**

| Numeric Grade: | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|
| Evaluation in % | 85%-100% | 70%-84% | 55%-69% | 40% - 54% | 0-39% |

**Bibliography:**


1. Intelligent Control Systems_Jancskarne_2020.pdf (Neptun MS)
2. R. C. Dorf, R. H. Bishop, Modern control systems, 12.ed. Prentice Hall, 2011.
3. Process Control Fundamentals P ID.pdf
4. Jan Jantzen: Tutorial On Fuzzy Logic: Jantsen - Tutorial On Fuzzy Logic.pdf
5. LabVIEWfuzy toolbook.pdf
6. Nise: Control system engineering. Wiley, 2011
7. Timothy J. Ross: *Fuzzy Logic with Engineering Applications*, Wiley, 2010. ISBN-13: 978-0470743768
8. Kevin M. Passino and Stephen Yurkovich, *Fuzzy Control*, Addison Wesley Longman, Menlo Park, CA, 1998 (later published by Prentice-Hall). http://eewww.eng.ohio-state.edu/~passino/FCbook.pdf
9. Standard Isa - Instrumentation Symbols And Identification.pdf
10. L. A. Bryan, E. A. Bryan, *PROGRAMMABLE CONTROLLERS, THEORY AND IMPLEMENTATION*, An Industrial Text Company Publication, Atlanta • Georgia • USA, 1997, ISBN 0-944107-32-X
11. Kevin M. Passino and Stephen Yurkovich, *Fuzzy Control*, Addison Wesley Longman, Menlo Park, CA, 1998 (later published by Prentice-Hall).
12. PC WORX 6 IEC 61131-Programming
13. E.A. Parr, *Programmable Controllers, An engineer's guide*, Newnes, 2003, ISBN 0 7506 5757 X


Additional papers for reading will be uploaded into Neptun MS by the instructor.