General Information:

Name of Course: # INTELLIGENT CONTROL SYSTEMS

Course Code: IVM194ANMI
Semester: 1st
Number of Credits: 6
Allotment of Hours per Week: 2 lectures, 2 practices
Evaluation: Exam (with grade)
Prerequisites: -
Instructors: **Dr Ildikó JANCSKÁRNÉ ANWEILER, associate professor**
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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 understand basic knowledge of open and closed loop control systems
- able to solve control problems with SFC
- able to understand classical PID control algorithms
- 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.

General Course Description and Main Content:
Introduction to control engineering. PLC programing with SFC. 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 fuzzy control development module.

Intelligent control systems **Course Syllabus**
Course Code: IVM194ANMI Time: L Wednesday 15:00-16:30
Semester: Autumn 2019/2020 1. P Wednesday 16:45-18:15
Location: PTE MIK, B-0006

Schedule:

Week	Lecture	Seminar, lab	Related books or papers	Recommended reading for the next lab
2	Introduction , control principles, P&ID diagrams Control examples	Drawing P&ID diagrams and block diagrams	Process Control Fundamentals P ID.pdf Standard Isa - Instrumentation Symbols And Identification.pdf	
			E.A. Parr, Programmable Controllers, An engineer's guide, Newnes, 2003, ISBN 0 7506 5757 X	Chapter 1: Computers and industrial control Chapter 2.2 The program scan 2.4 Programming methods 2.6 Timers 2.7 Counters
3	Open loop control: PLC programing, presentation using Phoenix PLC and PC WORX software	PLC programming: 1. PCWORX program and PHOEXIX ILC PLC: create a project; Declare variable; write and download timer test program.	PC_WORX_6_IEC_61131_Programming.pdf	Chapter 11: Programming in PC WORX Program Organization Units 11-5 Standard Functions 11-9 Standard Function Blocks 11-13
4	PLC programming: 2. write and download timer and counters test program. Writing function block.	Program & function block . Online testing.	GMPRG040SFC.pdf	We will use: SEQUENTIAL FUNCTION CHARTS (SFC)
5	PLC programming: writing SFC program together.	PLC programming: writing SFC program together. On-line test	PC_WORX_6_IEC_61131_Programming.pdf	Chapter 16: SFC Sequential Function Chart Basic Structure of the SFC 16-5 Basic Elements 16-9

6	OPC server. LabVIEW as SCADA system. PLC programming: writing SFC program together.	PLC programming: writing SFC program together. Testing program with LabVIEW.		
7	PLC programming: writing own SFC program. Project 1.	PLC programming: writing own SFC program. Report!!	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	14-3 PROCESS DYNAMICS 15-1 INTRODUCTION 15-3 DISCRETE-MODE CONTROLLERS
8	break, national holiday			
9	Autumn Break			
10	closed loop control : on/off controller and control performanceclosed loop control II: PID controller and tuning	Modell system PID control: Testing the contol loop. (Step reference change.) Controller parameters by 1.Lambda-tuning method 2. Z-N method 3. loopshaping method. Performance comparison. **Report!!**	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	Chapter 15 Process Controllers and Loop Tuning Chapter 15-11 Advanced Control Sytems
11	closed loop control III: Cascade control example: AR drone control system fuzzy sets and fuzzy logic	Fuzzy set manipulations.	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	Chapter 17 Fuzzy Logic
12	fuzzy control	Fuzzy controller design.		

13	project work 2.	Fuzzy controller programming and performance testing. Report!!	
14	Consultation		
15	Students presentations.		

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. 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.
3. Create and test SFC program.

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
Grading will follow the course structure with the following weight:
1. Homeworks 10 %.
2. Tests 80 %
3. Offered exam grade: over 65 % during the study and correction period.
4. Written exam in the exam period. A minimum of 50% is required to pass the exam.

Grading scale

Numeric Grade:	5	4	3	2	1
Evaluation in points:	85%-100%	75%-84%	65%-74%	50%-64%	0-49%

Students with special needs:
Students with special physical needs and requiring special assistance must first register with the Dean of the Students Office. All reasonable requests to provide an equal learning environment for all students is to be assured.

Required Reading and other Materials will be equivalent to:
- 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
- PC WORX 6 IEC 61131-Programming
- E.A. Parr, *Programmable Controllers, An engineer's guide*, Newnes, 2003, ISBN 0 7506 5757 X

- 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

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