Syllabus

1. Data about the program of study

1.1 Institution	Technical University of Cluj-Napoca
1.2 Faculty	Automation and Computer Science
1.3 Department	Automation
1.4 Field of study	Systems Engineering
1.5 Cycle of study	Bachelor of Science
1.6 Program of study/Qualification	Automation and Applied Informatics (English)
1.7 Form of education	Full time
1.8 Course code	53

2. Data about the subject

2.1 Subject name	***Industrial plant control***				
2.2 Course responsible/lecturer	Prof. dr. ing. Vlad Mureşan – Vlad.Muresan@aut.utcluj.ro				
2.3 Teachers in charge of applications	Prof. dr. ing. Vlad Mureşan – Vlad.Muresan@aut.utcluj.ro, Conf. dr. ing. Iulia Clitan – Iulia.Clitan@aut.utcluj.ro				
2.4 Year of study	4	2.5 Semester	2	2.6 Assessment *(E/C/V)*	E
2.7 Type of subject	*DF – fundamental, DD – in the field, DS – specialty, DC – complementary*				DS
	DI – compulsory, DO – elective, Dfac – optional				DOB (DI)

3. Estimated total time

3.1 Number of hours per week	4	of which:	Course	2	Seminar	0	Laboratory	1	Project	1
3.2 Number of hours per semester	56	of which:	course	28	Seminar	0	Laboratory	14	Project	14
3.3 Individual study										
(a) Manual, lecture material and notes, bibliography										34
(b) Supplementary study in the library, online and in the field										12
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays										14
(d) Tutoring										5
(e) Exams and tests										4
(f) Other activities:										0

3.4 Total hours of individual study (sum of (3.3(a)…3.3(f)))	69
3.5 Total hours per semester (3.2+3.4)	125
3.6 Number of credit points	5

4. Pre-requisites (where appropriate)

4.1 Curriculum	• The automatic control engineering, systems theory, mathematics, physics, chemistry, power electronics in automatics, the automation equipment, control systems of the continuous processes, reliability and diagnosis, processes identification
4.2 Competence	• Differential equations, Numerical methods

5. Requirements (where appropriate)

5.1. For the course	• N/A
5.2. For the applications	• The attendance of laboratory/project is compulsory

6. Specific competences

6.1 Professional competences	C3 Using the basic elements of the automatics, of the modeling methods, simulation, of the identification and the processes analysis, of the computer-aided designing technics. C5 Elaboration of applications and implementation of automatic control algorithms and structures, using project management concepts, programming

	languages and technologies based on microcontrollers, signal processors, programmable automatons, embedded systems.
6.2 Cross competences	• N/A

7. Course objectives

7.1 General objective	Acquiring knowledge about the concurrent control of the industrial processes, showing gradually the stages that have to be passed through in the designing and in the running of these systems.
7.2 Specific objectives	• Acquiring knowledge about: analysis and synthesis of the automatic system, verifying the stability of the system, control structures, controllers tuning, the determination of system's parameters and performances. • Acquiring abilities in control loops designing and knowledge about transducers, actuators, analogical and numerical controllers.

8. Contents

8.1 Lecture	No.hours	Teaching methods	Notes
Features of the continuous technological processes - Technological structures in the chemical industry (Azomureş) - Technological structures in the energy industry (C. T. Luduş)	2	Blackboard presentation/ Online Presentation (Zoom)	
Features of the continuous technological processes - Technological structures in the nuclear industry (Drobeta Turnu Severin, Cernavodă) - Unified electronic and pneumatic systems	2		
Modeling and Simulation of the thermal and chemical processes - The equations of the mathematical physics with applications in thermal and chemical processes (calorific transfer, material and energy balance, motion, impulse, etc.) - Analogical and numerical modeling - Numerical simulation (linear and non-linear differential equations, partial differential equations in MATLAB, SIMULINK, etc.)	2		
Structures of fluids flows control	2		
Structures of pressure control	2		
Structures of fluids level control	2		
Structures of concentration control	2		
Structures of temperature control	2		
Control of the processes with mass transfer - Designing of the conventional control systems of the chemical reactors 1. Modeling of the isothermal reactors with continuous action and of the non-isothermal reactors with periodically action 2. The stationary regime of the chemical reactors and their stability 3. Control of the reacting substances flows, of the temperature, of the pressure, of the level and concentration, of the reaction composition	2		
Control of the processes with heat transfer 1. Temperature control in the blending devices of two fluids having the same phase or different phases 2. Temperature control in autoclaves with bonnets and shell-and-coil heat exchangers 3. Temperature control in tubular heat exchangers in uniflow or in counter-flow.	2		
Control structures for neutralization processes	2		

Control of the processes with mass transfer - Designing of the control systems of the separation processes 1. Control systems of the distillation processes, dynamic and stationary behavior, the structure of the conventional control system 2. Control systems of the separation towers in counter-flow and of the fractional towers	2		
Control of the heating systems and heat installations - Systems and central heating installations for interior	2		
- Electrical heating systems - Unconventional heating systems (geothermal, solar, heating pumps, etc.) - Heating systems with hot air and through radiation - Local heating systems	2		

Bibliography

1. V. Mureşan, M. Abrudean, „Industrial Plant Control – Didactic Course", Galaxia Gutenberg Publishing House, Cluj-Napoca 2017, 181 pag., ISBN 978-973-141-699-1.
2. M. Abrudean, "Sytems theory and automatic control", Mediamira Publishing House, 1998, ISBN: 973 – 2398 – 11- x.
3. Tiberiu Coloşi, Mihail Abrudean, Mihaela-Ligia Ungureşan, Vlad Mureşan, Numerical Simulation Method for Distributed Parameters Processes using the Matrix with Partial Derivatives of the State Vector, Ed. Springer, ISBN: 978-3-319-00013-8(Print); 978-3-319-00014-5 (Online), 2013, pg. 343. http://link.springer.com/book/10.1007/978-3-319-00014-5/page/1
4. C. Feştilă, M. Abrudean, E. Dulf, " Power electronics in automatics", Mediamira Publishing House, 2004, 325 pag.
5. M. Vânătoru, "Automatic control of the industrial processes", Universitaria Publishing House, 2001, 305 pag.
6. P. S. Agachi, "Chemical processes automation", Casa Cărţii de Ştiinţă Publishing House, 1994.

8.2 Applications (seminar/laboratory/project)	No.hours	Teaching methods	Notes
Automatic control structures	2	Blackboard presentation/ Online Presentation (Zoom) + simulation on computer	
Practical criteria of controllers tuning for processes with delay and working systems	2		
Approximation of the superior order processes through simplified transfer functions	2		
Automation of the thermo-energetic plants. Simulation of the frequency control loop	2		
Automation of the thermo-energetic plants. Simulation of the voltage control loop at the generator's terminals	2		
Methods for designing the numerical controllers	2		
Methods for designing the predictive controllers	2		
Project: Designing of the main control loops for a boiler-turbine-generator-energetic system. Designing data: -the nominal power of the plant (100-450) MW -the thermo-electric specific consumption (2400-2250) Mcal/MWh -the pressure of the process steam (100-170) bars -the enthalpy of the process steam (800-835) Mcal/t Chapter I. Controllers tuning for the process steam pressure and for process steam flow Chapter II. Real power and frequency control Chapter III. Voltage and reactive power control Chapter IV. Analytical and numerical solving (on the computer) - - frequency and real power responses to the disturbances. The project includes constructional and functional principled details for a diversity of elements and equipment: -unified signal generators; -hydraulic servomotor with valve and negative feedback; -operational amplifiers;	14	Blackboard presentation/ Online Presentation (Zoom) + simulation on computer	

-negative offset characteristic correction feedbacks ; -positive feedbacks of load currents compundation; -semi-graphical logarithmic scale representation; -logic diagrams of numerical integration and computer run.			

Bibliography
1. Vlad Mureşan, "Industrial plant control Laboratory tutorial", U.T. PRESS Publishing House, Cluj-Napoca 2011, ISBN 978-973-662-663-0, 134 pag.
2. Vlad Mureşan, Mihail Abrudean, Tiberiu Coloşi, "Industrial plant control - Project tutorial", Galaxia Gutenberg Publishing House, 2018, ISBN 978-973-141-759-2.

9. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field

• Collaborations with: C.T. Ludus, Tenaris Silcotub Zalău, INCDTIM Cluj, IPA Cluj.

10. Evaluation

Activity type	Assessment criteria	Assessment methods	Weight in the final grade
Course	Acquired theoretical knowledge about the modeling-control of the industrial processes	Written exam / On-line exam using Zoom	50%
Seminar	-	-	-
Laboratory	Knowledge about the tuning of the controllers associated to the control loops from a steam power plant Abilities related to the simulation of the control loops for industrial processes (MATLAB-SIMULINK)	Laboratory test / On-line laboratory test using Zoom	25%
Project	Knowledge about the work of the main control loops from a steam power plants	Oral presentation of the project/ On-line presentation of the project using Zoom	25%

Minimum standard of performance:
Grade at exam ≥ 5
Grade at laboratory ≥ 5
Grade at project ≥ 5

Date of filling in:		**Title Firstname NAME**	**Signature**
30.06.2022	Course	Prof. dr. ing. Vlad MUREȘAN	
	Applications	Prof. dr. ing. Vlad MUREȘAN	
		Conf. dr. ing. Iulia CLITAN	

Date of approval by the Department Board	Head of Departament Automation Prof.dr.ing. Honoriu VĂLEAN
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Date of approval by the Faculty Council ……	Dean Prof.dr.ing. Liviu Cristian MICLEA
_____	