(*faculty stamp*)

COURSE DESCRIPTION

1. Course title: INDUSTRIAL CONTROL SYSTEMS DESIGN	**2. Course code**
3. Validity of course description: 2012/2013	
4. Level of studies: 1st cycle of higher education	
5. Mode of studies: intramural studies	
6. Field of study: : MACROCOURSE CONTROL, ELECTRONIC AND INFORMATION ENGINEERING	RAU
7. Profile of studies:	
8. Programme: Automatic Control	
9. Semester: 7	
10. Faculty teaching the course: Automatic Control, Electronics and Computer Science	
11. Course instructor: dr inż. Zbigniew Ogonowski	
12. Course classification: common courses	
13. Course status: elective	
14. Language of instruction: English	
15. Pre-requisite qualifications: Course attendants are supposed to have general knowledge concerning control fundamentals and system dynamics. Students should be also familiar with fundamentals of signal processing, measurement systems, numerical methods and optimization and decision making. They are supposed to possess practical skills concerning computers programming in the basic level.	
16. Course objectives: The course is related to advanced control design methods for industrial systems. It is aimed to extend control engineering knowledge of the students onto structuralized multi-level control system design. It is then assumed that students understand control fundamentals, dynamic modeling, signals measurement and processing as well as numerical methods and optimization problems. The course gathers these aspects and assumes to use them as a tool in the control system design for industrial processes. The main aim is to teach design principles according to hierarchical structure of the industrial processes. Students should acquire skills to create realistic and practical solutions of the industrial control problems.	

17. Description of learning outcomes:

Nr	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
1.	Knows rules for industrial process analyzing and modeling in the context of control system functional structure which includes direct, upper, optimizing and managing layers.		lecture	
2.	Knows rules for industrial control system designing in hierarchical structure of the control algorithms and models.		lecture	
3.	Knows rules for constructing optimization problems for upper layers of the industrial control systems using data acquisition system.		lecture	
4.	Can analyze and model industrial process according to the tasks formulated for control system.	laboratory excercise	laboratory	
5.	Can design functional structure of the direct control layer; apply and tune standard and nonstandard control algorithms.	laboratory excercise	laboratory	
6.	Can formulate and solve optimization problem of the operating point choice for industrial processes.	laboratory excercise	laboratory	

18. Teaching modes and hours

Lecture – 15 h / BA /MA Seminar / Class / Project / Laboratory - 15 h

19. Syllabus description:

Lecture:

The course consists of three parts covering the most important aspects of Industrial Control System Design. Beginning with the general hierarchical structure of control system (part one) the course proceeds with the direct control layer (part two). The most important in this part are the principles of structure choice of the

control system. In part three, functionality of the upper control layer is presented including acquisition and data processing together with process optimization.

Part I

1. Basic notions: Analysis of the process, Functional structure, Equipment, Control System and its purpose, Process state, Process model, Horizon of control, Functional structure and equipment structure of the control system.
2. Hierarchy of control algorithms: Properties of algorithms connected hierarchically, Necessity of using hierarchical structures, Hierarchy of the models.
3. Functional structure of control systems: General scheme of industrial process, Direct control layer, Upper control layer, Operating (optimization) control layer, managing layer.

Part II

1. Direct control layer: Tasks, Structure of direct control layer, Leading streams, Constructive postulates for direct control layer.
2. Structure choice – general aspects: Control tractability, Multivariable processes and input/output assignment problem, Analysis of degree of freedom, relative gain array method, Special structures (recycling process with losses complement).
3. Structure choice – certain problems: Flow, pressure and level control, Quality control of material streams, Thermal processes control, Mass diffusion control.

Part III

1. Data acquisition and processing: Periodical data acquisition, Acquisition methods, AD/DA conversion, Acquisition file, Basic data processing, Special processing of process variables.
2. Signaling, supervision and documenting the process: Purpose, Signaling, Supervision, Documenting, Alarm system, Supervision.
3. Optimization of the process: Elements of the process optimization, Principles of quality index creation, Principles of mathematical models creation, Standard optimization problem, Basic optimization method, Decomposition of optimization problems.
   Standardization of project description: ISO norm, Topology of the project, Graphical signs, Abbreviation system.

Laboratory:

1. Simple industrial process analysis and control design.
2. Continuous stirred tank reactor - Three-level hierarchical control system.
3. Sodium bicarbonate technology - Leading steam choice.
4. Evaporation process – DoF analysis and input-output assignment.
5. Drying spray-both system – recycling process with losses complement.
6. Oil refiner – optimizing control layer.

20. Examination: no

21. Primary sources:

Smith C.A., A.B. Corripio: „Principles and practice of automatic control" Wiley, 1997. ISBN 0-471-57588-7.

Grimble M.J.: „Industrial Control System Design" Willey, 2001. ISBN 0-471-49225-6.

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22. Secondary sources:

Maciejowski J.: „Multivariable feedback design" Addison-Wesley, 1991. ISBN 0-201-182-43-2.

Astrom K.J, B. Wittenmark: „Computer Controlled Systems. Theory and Design". Prentice Hall, 1997. ISBN 0-13-314899-8.

23. Total workload required to achieve learning outcomes

Lp.	Teaching mode :	Contact hours / Student workload hours
1	Lecture	15/5
2	Classes	/
3	Laboratory	15/20
4	Project	/
5	BA/ MA Seminar	/
6	Other	10/15
	Total number of hours	40/40

24. Total hours: 80

25. Number of ECTS credits:

26. Number of ECTS credits allocated for contact hours:

27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects):

26. Comments:

Approved:

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(date, Instructor's signature)

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(*date , the Director of the Faculty Unit signature)*